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Diagnostic Accuracy of the Roll Over Test (ROT) and Mean Arterial Pressure (MAP) for Early Detection of Preeclampsia in Pregnant Women

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ABSTRACT

Background: Preeclampsia remains a leading cause of maternal mortality. Early identification of pregnant women at risk is essential to prevent severe maternal and fetal complications. While Mean Arterial Pressure (MAP) and the Roll Over Test (ROT) are used for early detection, there is a need to compare their diagnostic performance in low-resource clinical settings to optimize screening protocols.

Purpose: This study aimed to determine the sensitivity and specificity of ROT and MAP in screening for preeclampsia among pregnant women.

Methods: This diagnostic observational study used a prospective approach involving 46 pregnant women (gestational age >30 weeks at the Puhjarak Community Health Center, Kediri District. Participants were selected using simple random sampling from a population of 52 eligible pregnant women. Screening was conducted using MAP and ROT, and the occurrence of preeclampsia was evaluated at ≥36 weeks of gestation based on clinical diagnosis. Data were analyzed to calculate sensitivity, specificity, and predictive values.

Results: The prevalence of preeclampsia in this study was 17.3%. Both MAP and ROT showed a sensitivity of 75%. However, ROT showed higher specificity (94%) compared to MAP (63%). The PPV for ROT (75%) was also higher than for MAP (30%),

Conclusion: There The findings suggest that the ROT may have higher specificity than MAP in screening for preeclampsia. However, further studies with larger samples are needed to confirm these findings.

Keywords: mean arterial pressure (map), preeclampsia, roll over test (rot)

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BACKGROUND

Hypertension or high blood pressure is a condition of increasing systolic blood pressure >140 mmHg and diastolic blood pressure >90 mmHg (Alatas, 2019). During pregnancy, hypertension can be caused by several non-modifiable risk factors that can affect the incidence of hypertension in pregnancy, including age, multiple pregnancies, a history of previous hypertension in pregnancy, gestational diabetes mellitus, chronic hypertension, pre-existing diabetes mellitus, and a family history of hypertension, type 2 diabetes mellitus, and preeclampsia (Laksono & Masrie, 2022). In Indonesia in 2022, hypertension is the number 1 cause of maternal death with a total of 801 cases. In East Java in 2022, it is known that the maternal mortality rate was 499 cases, of which 122 (24.45%) were caused by hypertension in pregnancy. This made East Java in the 3rd position with the highest number of maternal deaths due to hypertension in pregnancy (Profil Kesehatan Indonesia, 2023). The number of maternal deaths in Kediri District was 11 cases and in Kediri City area was 1 case (Profil Kesehatan Jawa Timur, 2023).

The high prevalence of hypertension in pregnancy is certainly a challenge for health workers, especially midwives. According to Beech & Mangos (2021), the adverse effect that may occur in pregnant women with hypertension is preeclampsia (25%) which can increase the risk of pregnancy complications such as damage to other systems or organs with long-term effects (Sulastri et al., 2023). Preeclampsia is characterized by hypertension and edema, and can be accompanied by proteinuria. Preeclampsia is mostly found at >20 weeks of gestation or in the third trimester of pregnancy (Lalenoh, 2018). According to Kediri District Health Office in 2023, preeclampsia was the highest complication of pregnancy with the highest case (52 pregnant women) found at Puhjarak Health Center (Profil Kesehatan Kabupaten Kediri, 2023).

Early screening is vital for preventing the progression of preeclampsia, yet current diagnostic methods often face implementation barriers. For instance, while Maternal and Child Health (KIA) books include screening charts, their utilization by health workers remains inconsistent; data shows that only 50% of these evaluation charts are properly filled. Many advanced screening techniques require expensive equipment or specialized training, which are often unavailable in community health settings.

Mean Arterial Pressure (MAP) and the Roll Over Test (ROT) are two techniques that offer accessible alternatives for early detection (Karlina et al., 2023). MAP examination is a method of measuring blood pressure carried out by calculating the average arterial blood pressure of systole and diastole. MAP is one of the screening methods that has various advantages including: simple, easy to reach, can be done by all health workers, does not give too much intervention to patients, and does not require special training (Susanti et al., 2022). In the Maternal and Child Health Book (KIA) published in 2023, on screening preeclampsia GA <20 weeks done by a doctor, it is stated that if the MAP value is > 90 mmHg then the pregnant woman is said to be at moderate risk. In fact, filling in the pregnancy evaluation chart is not maximally implemented as evidenced by the fact that out of 10 pregnant women who have a MCH book, only 5 (50%) of the pregnancy evaluation chart sheets are filled in by midwives.

ROT is a method of measuring blood pressure at two different positions, namely lateral and supine position. It is another cost-effective method used to assess cardiovascular reactivity MAP and ROT are especially relevant in rural or low-resource settings where midwives are the primary line of defense against maternal complications (Walia et al., 2015).

Recent studies have yielded conflicting results regarding the accuracy of these tests. While some research shows that MAP has high success in detecting preeclampsia among positive respondents, other studies on the ROT have reported significant variations in

identifying risk. Tampubolon et al. (2021) stated that almost all respondents in the study who had a MAP score (+) experienced preeclampsia. Another study by Sumarni (2021) reported that from 10 respondents with a MAP score (+), 9 of them experienced preeclampsia and from 20 respondents with a MAP score (-) only 1 who experienced preeclampsia. A study on ROT screening conducted by Tampubolon et al. (2021) showed that 60% of pregnant women experienced preeclampsia with ROT (-) results. Research conducted by Karlina et al. (2023), found that of all respondents (54 pregnant women) there were 21 mothers with ROT (+) scores in which 47.6% of them had preeclampsia, while 33 mothers with ROT (-) scores, 77.8% were not diagnosed with preeclampsia.

Such discrepancy highlights a research gap that there is a lack of direct, comparative data on the diagnostic performance of MAP and ROT within specific high-prevalence populations in Indonesia. Given these inconsistencies, there is a clear need to evaluate which screening method provides the most reliable diagnostic accuracy. This study aims to determine and compare the sensitivity and specificity of MAP and ROT screening in pregnant women to optimize early detection protocols in primary healthcare facilities.

METHODS

This study used an observational diagnostic accuracy design with a prospective approach. The index tests were MAP and ROT, conducted at >30 weeks gestation, while the reference standard was the clinical diagnosis of preeclampsia confirmed at > 36 weeks gestation. The population in this study were pregnant women in Puhjarak Health Center working area with the criteria of gestational age> 30 weeks and single pregnancy. Of the 52 respondents who were then sampled using simple random sampling technique with the Slovin formula, a sample size of 46 respondents was obtained. Respondents were randomly divided into 2 screening groups (23 per group), namely the ROT group and the MAP group via a lottery system. The screening procedures are as follow:

MAP Calculation : (Systolic + 2 x Diastolic) / 3. Positive result: > 90 mmHg.
ROT Procedur e : BP was measured in the left lateral position, then in the supine position. Positive result: Diastolic increase ≥20 mmHg.

ROT and MAP screening were conducted when pregnant women reached a gestational age of >30 weeks during antenatal care visits. All participants were then followed prospectively and re-evaluated at ≥36 weeks of gestation to determine the occurrence of preeclampsia based on clinical diagnosis. This follow-up period allowed sufficient time to observe the development of preeclampsia after the initial screening. These two time points were used to evaluate whether MAP and ROT could predict preeclampsia before the onset of clinical symptoms, by comparing the results from the initial screening with the results obtained at follow-up. Data analysis performance was measured using Sensitivity, Specificity, Positive Predictive Value (PPV), and Negative Predictive Value (NPV). This research was approved by the Ethics Committee of Poltekkes Kemenkes Malang (No. DP.04.03/F.XXI.31/01132/2024).

RESULTS

Table 1. Respondents' Characteristics

Characteristic	Frequency (n)	Percentage (%)
Age		
< 20 y/o	2	4.3
20-35 y/o	38	82.6
>35 y/o	6	13.1

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Parity		
Primigravida	19	41.3
Multigravida	27	58.7

Source: Processed Data, 2024

Table 1 showed that almost all respondents were between 20-35 years old (82.6%) and most of the respondents had multigravida parity (58.7%).

Table 2. Overview of Preeclampsia in Pregnant Women in Puhjarak Community Health Center Working Area

Incidence of Preeclampsia	Frequency (n)	Percentage (%)
Preeclampsia	8	17.3
Not preeclampsia	38	82.7
Total	46	100

Source: Processed Data, 2024

Table 2 showed that almost all of the respondents (82.7%) did not experience preeclampsia after screening and evaluation. While those who experienced preeclampsia were only a small proportion of respondents (17.3%).

Table 3. MAP and ROT Screening Results in Pregnant Women in Puhjarak Health Center Working Area

Screening Method	Result				Total	
	Positive		Negative			
	n	%	n	%	n	%
MAP	10	43.4	13	56.6	23	100
ROT	4	17.3	19	82.7	23	100

Source: Processed Data, 2024

Table 3 showed that almost half of the respondents (43.4%) had positive MAP screening results and a small proportion of respondents had positive ROT screening results (17.3%).

Table 4. Diagnostic Performance of Mean Arterial Pressure (MAP) in Detecting Preeclampsia.

Screening test results	Clinical diagnosis results		
	Positive	Negative	Total
Positive	3	7	10
Negative	1	12	13
Total	4	19	23

Source: Processed Data, 2024

The sensitivity value (a/(a+c)) for MAP screening was 75% and for MAP specificity value (d/(b+d)) was 63%. The Positive Predictive Value (PPV) value (a/(a+b)) was 30% and the Negative Predictive Value (PPV) value (d/(c+d)) was 92%.

Table 5. Diagnostic Performance of Roll Over Test (ROT) Screening

Screening test results	Clinical diagnosis results		
	Positive	Negative	Total

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Positive	3	1	4
Negative	1	18	19
Total	4	19	23

Source: Processed Data, 2024

The sensitivity value for ROT screening was 75% and for ROT specificity value was 94%. The Positive Predictive Value (PPV) value was 75% and the Negative Predictive Value (PPV) value was 94%.

DISCUSSION

The results of the study in table 2. showed that most of the respondents (82.7%) did not experience preeclampsia. However, a small proportion of respondents (17.3%) were found to have preeclampsia. In this study, there were 8 pregnant women who experienced preeclampsia, 5 of whom were multigravida mothers. Of the 8 pregnant women with preeclampsia, 3 of them were in the risk group because they were pregnant at the age of >35 years. This is in line with what was conveyed by Kurniawati et al., (2020) that there are several risk factors for preeclampsia in pregnant women including age and parity. Pregnant at the age of >35 years is included in the risky pregnancy group and increases the risk of preeclampsia to 3-4 times (Primayanti et al., 2022).

The results of ROT and MAP screening in pregnant women in Puhjarak Health Center working area showed the same sensitivity value of 75%. Sensitivity means the ability of a test to classify someone correctly as a person who is really sick. Another definition states that sensitivity is the probability of a positive laboratory test result if the patient has the mentioned disease (McKay et al., 2021). This means that in this study, of all pregnant women who actually experienced preeclampsia, 75% of them were successfully detected through the MAP and ROT screening methods. This study was in line with that conducted by Waks et al., (2024) that MAP screening had a fairly good sensitivity value of 74.7%. Likewise, in a study conducted by Susanti et al., (2022) regarding several MAP screening studies in detecting the incidence of preeclampsia, the sensitivity value ranged from 71-90% and this screening proved to be effective in pregnant women. Research conducted by Torres-Coronado et al., (2022) on the sensitivity value of ROT screening in detecting preeclampsia in pregnant women was 60%. In each of these studies, differences in sensitivity values could be caused by the location of data collection and also respondents in the study (McKay et al., 2021).

Specificity is the probability of a negative laboratory test result if the patient does not have the disease in question (McKay et al., 2021). The specificity value for MAP was found to be 63%, indicating that MAP screening had limitations in identifying pregnant women who were not really at risk of preeclampsia. Meanwhile, the specificity value for ROT was 94%, which means that the ROT method had a good ability to identify individuals who were not at risk of preeclampsia. This is in line with research conducted by Torres-Coronado et al., (2022) that the ROT method had a fairly high specificity value of 96%. The higher specificity of ROT may be attributed to its focus on vascular sensitivity and the body's physiological response to position changes, whereas MAP is a static measurement that can be influenced by temporary external factors.

This study has several limitations that should be considered when interpreting the findings. First, the sample size (n=46) is relatively small for a diagnostic accuracy study, which may affects the reliability of the findings. Second, it was conducted in a single primary health center, which may limit the applicability of the findings to other settings. Third, potential measurement bias may occur during manual blood pressure assessment and ROT procedures.

Therefore, further studies with larger samples and multicenter design involving several health center facilities are needed to improve the generalizability of the findings.

CONCLUSION

This study found that both MAP and ROT had similar sensitivity in detecting preeclampsia, while ROT demonstrated higher specificity. These findings suggest that ROT may be useful as a complementary screening method in primary health care setting. However, larger studies are required to validate its clinical usefulness. Based on these findings, it is recommended that ROT be considered as a complementary screening method in antenatal care services, particularly in primary health care facilities with simple and low-cost screening tools. The use of ROT alongside Mean Arterial Pressure (MAP) may support the early identification of pregnant women at risk of preeclampsia. Future studies are recommended to involve larger sample sizes and multicenter designs to improve the reliability and generalizability of the findings. Further research could also explore the integration of MAP and ROT with additional maternal risk factors to develop a more comprehensive screening approach for preeclampsia

CONFLICTS OF INTEREST

The author declare no conflict of interest on this study.

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