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Effect of Mean Arterial Pressure (MAP)-Based Preeclampsia Screening Training on Midwives' Knowledge

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ABSTRACT

Introduction: Preeclampsia remains a major cause of maternal morbidity and mortality worldwide, making early risk identification an important component of antenatal care. Mean Arterial Pressure (MAP) has been recommended as a simple and cost-effective screening method for predicting the risk of preeclampsia. However, its application in primary healthcare settings remains limited. This study aimed to evaluate the effect of MAP-based preeclampsia screening training on midwives' knowledge of early preeclampsia detection.

Methods: A one-group pretest–posttest study was conducted among midwives participating in a MAP-based preeclampsia screening training program. Forty-two midwives attended the training, and 37 who completed both assessments were included in the analysis. The training covered the concept of MAP, accurate blood pressure measurement procedures, MAP calculation, and interpretation of MAP values for identifying women at risk of preeclampsia. Knowledge was assessed using a structured 20-item questionnaire administered before and after the training. Data normality was tested using the Kolmogorov–Smirnov test, and differences between pretest and posttest scores were analyzed using the Wilcoxon Signed Rank Test.

Results: Knowledge scores improved following the training, with a mean increase of 3.35 points. Statistical analysis showed a significant difference between pretest and posttest scores ($p = 0.018$), indicating that the training effectively enhanced participants' understanding of MAP-based preeclampsia screening. The findings suggest that a short structured educational intervention can improve knowledge related to early preeclampsia detection.

Conclusion: MAP-based preeclampsia screening training significantly improved midwives' knowledge regarding early detection of preeclampsia. Incorporating similar training into continuing professional development programs may strengthen early risk identification in maternal healthcare. Further studies with larger samples, control groups, and longer follow-up periods are needed to assess knowledge retention and clinical implementation.

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INTRODUCTION

Preeclampsia remains a persistent public health concern and continues to place a substantial burden on maternal health outcomes worldwide. Hypertensive disorders of pregnancy, particularly preeclampsia, contribute significantly to preventable maternal morbidity and mortality in both high-income and low- and middle-income countries. Recent global estimates indicate that preeclampsia affects approximately 2% to 8% of pregnancies, and it remains among the top five causes of maternal deaths globally (1). In Indonesia, hypertensive disorders of pregnancy consistently rank as one of the leading causes of maternal mortality, reinforcing the need for strategic measures to mitigate preventable deaths associated with this condition. According to the Ministry of Health, efforts to lower the maternal mortality ratio (MMR) are aligned with the Sustainable Development Goals (SDGs), which aim to reduce the MMR from 183 to below 70 per 100,000 live births by 2030 (2). Achieving this target requires sustainable and effective interventions in antenatal care (ANC), especially those geared towards early identification and management of preeclampsia.

Early detection of preeclampsia is essential to ensuring timely surveillance, referral, and management during pregnancy. Despite various programmatic efforts, cases of maternal deaths linked to preeclampsia in Indonesia have shown concerning trends in recent years (3)(4). At the global level, the International Federation of Gynecology and Obstetrics (FIGO) recommends universal screening for preeclampsia within ANC services, emphasizing the importance of identifying women at risk as early as possible to prevent severe complications for both mother and fetus (5). Similar recommendations have also been highlighted by the World Health Organization (WHO), which stresses strengthening routine ANC screenings as an essential strategy in reducing adverse pregnancy outcomes (1). Yet, the implementation of comprehensive preeclampsia screening remains inconsistent across healthcare systems, particularly in lower-resource settings.

Traditionally, screening for preeclampsia has relied on maternal demographic factors and clinical history, such as age, parity, chronic hypertension, and previous obstetric complications. Although valuable, this approach alone detects only around one-third of women who may go on to develop preeclampsia, indicating limited predictive performance (6)(7). As a result, there has been growing interest in incorporating additional clinical parameters that could improve the sensitivity of screening. In Indonesia, the Pudji Rochayati Score (KSPR) remains the most commonly used tool in primary care, yet it has not fully integrated physiological indicators with stronger predictive value (8). Several studies highlight the potential benefit of including simple clinical measures such as Body Mass Index (BMI) and Mean Arterial Pressure (MAP) to strengthen risk assessment for preeclampsia (9)(10).

MAP has gained increasing recognition due to its ability to provide a more accurate reflection of hemodynamic status compared to systolic or diastolic blood pressure alone. Research suggests that MAP in early and mid-pregnancy can be a useful predictor of preeclampsia risk and may support earlier intervention if used routinely in ANC screenings (11)(12). However, despite its simplicity and practicality, MAP measurement is still not consistently performed in primary healthcare settings in Indonesia. Studies suggest that one of the key barriers lies in the limited knowledge and clinical skills of midwives regarding accurate blood pressure assessment techniques, including MAP calculation (13)(14). A study reported that gaps in midwives' understanding of preeclampsia categories and blood pressure measurement methods remain a challenge in several maternal health services (15). Similarly, another research noted that many countries still lack structured training to reinforce preeclampsia screening practices in primary maternal care (13)(16).

Evidence from national studies has also demonstrated the need to improve midwives' competence in antenatal screening. A study conducted in Java found that the majority of midwives had insufficient knowledge regarding preeclampsia screening components and risk assessment, indicating the need for continuing professional development in this area (13). Another Indonesian study emphasized that strengthening midwives' skills in clinical assessment during ANC, including correct BP measurement techniques, contributes to improved pregnancy outcomes (14)(17). These findings underline the importance of targeted training to enhance midwives' capability to perform MAP-based screening accurately and consistently.

Given these gaps, efforts to assess and strengthen midwives' knowledge on MAP as part of preeclampsia screening may help improve early detection at the primary healthcare level. Enhancing midwives' capacity through appropriate training could support better decision-making and timely referral, potentially reducing complications associated with hypertensive disorders of pregnancy. While previous studies have examined midwives' knowledge

of preeclampsia in general, limited research has focused specifically on MAP-based screening practices as an approach to improve early risk identification. Understanding current knowledge levels serves as an initial step toward developing more effective capacity-building interventions and ANC improvements. This study aims to assess midwives' knowledge of MAP-based preeclampsia screening. The findings are expected to inform strategies to support ANC services and contribute to long-term maternal health improvements without overstating the scope of the present study. Although several studies have investigated preeclampsia screening and midwives' knowledge in general, evidence evaluating educational interventions specifically focused on MAP-based screening among Indonesian midwives remains limited. To our knowledge, few studies have examined whether structured MAP training can improve knowledge acquisition among independent-practice midwives. Therefore, this study aimed to evaluate changes in midwives' knowledge following MAP-based preeclampsia screening training.

METHOD

Research Design

This study applied a quantitative approach using a one-group pre-test and post-test design. The design was selected to assess changes in midwives' knowledge before and after receiving training on the use of Mean Arterial Pressure (MAP) for preeclampsia screening. No control group was included, as the focus was on measuring the direct effect of the training provided.

Population and Sample

The study population consisted of midwives practicing in the city of Surabaya. The sample was drawn using purposive sampling, with the inclusion criteria being midwives working in independent midwifery practices (*Praktik Mandiri Bidan*), willing to participate, and able to complete both the pre- and post-test assessments. A total of 42 midwives initially took part in the training, and 37 were included in the final analysis due to complete data availability. Midwives who did not complete either the pre-test or post-test were excluded from the analysis.

Research Location

The study was conducted in Surabaya, East Java, Indonesia. Training and data collection activities were carried out in a designated meeting facility coordinated by the local midwives' association, ensuring accessibility for participants from different practice areas within the city.

Instrumentation

A structured questionnaire was used as the assessment tool to measure midwives' knowledge related to MAP-based screening for preeclampsia. The questionnaire consisted of 20 multiple-choice items with one correct answer for each item. Scores ranged from 0 to 20, with higher scores indicating better knowledge of MAP-based preeclampsia screening. The questionnaire was developed based on current preeclampsia screening guidelines and reviewed by three maternal health experts for content validity. Prior to data collection, the instrument was pilot tested among ten midwives outside the study setting to ensure clarity and readability.

Data Collection Procedures

The training intervention was conducted in a single 120-minute session and designed according to current national and international recommendations for preeclampsia screening. The program consisted of interactive lectures, group discussions, demonstrations of accurate blood pressure measurement techniques, and hands-on practice in calculating and interpreting Mean Arterial Pressure (MAP). Data collection was carried out in two stages. Prior to the intervention, participants completed a pre-test to assess baseline knowledge regarding MAP measurement and its role in the early detection of preeclampsia. The training was subsequently delivered by qualified facilitators, emphasizing both the theoretical principles and practical procedures of MAP assessment. Immediately after the session, participants completed a post-test using the same questionnaire to evaluate changes in knowledge following the intervention. All participant responses were coded to ensure confidentiality and minimize potential bias during data analysis.

Data Analysis

Data were processed and analyzed using statistical software. Normality of the pre-test and post-test scores was examined through the Kolmogorov–Smirnov test. As the data were not normally distributed, the Wilcoxon Signed Rank Test was used to compare pre-test and post-test scores. A significance level of $p < 0.05$ was considered statistically meaningful.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Negeri Surabaya, with approval number 00003/EA/2025/0256243578**.** All participants received information regarding the study purpose and procedures and provided informed consent prior to participation. Confidentiality and anonymity were maintained throughout the study.

RESULTS

A total of 42 midwives participated in the training, and 37 of them completed both assessments and were included in the final analysis. Table 1 presents the demographic characteristics of the participants. Most of the midwives completed a Diploma in Midwifery (54.1%), while 29.7% held a professional midwifery degree. Only a small proportion reported bachelor's or master's degree qualifications. In terms of age, more than half of the midwives were in the 30–39 year age group (59.5%), followed by those younger than 30 years (27.0%). Nearly one in seven participants were aged 40 years or older. Regarding years of practice, 43.2% had worked for less than five years, while 37.8% had more than ten years of experience.

Table 1. Characteristics of Participants (n = 37)

Characteristics	Category	n	%
Education	Diploma (D3)	20	54.1
	Professional Midwife	11	29.7
	Bachelor (S1)	3	8.1
	Master (S2)	3	8.1
Age	<30 years	10	27.0
	30–39 years	22	59.5
	≥40 years	5	13.5
Years of Practice	<5 years	16	43.2
	5–10 years	7	18.9
	>10 years	14	37.8

Before the session, the mean pre-test score was 85.68. After the training, the post-test average increased to 89.03, indicating a gain in knowledge. The comparison of scores is displayed in Figure 1, which shows a noticeable rise from the pre-test to post-test measurement. To determine whether this improvement was statistically meaningful, the Wilcoxon Signed Rank Test was applied. As presented in Table 2, the difference in scores was statistically significant ($p = 0.018$), suggesting that the training contributed positively to enhancing midwives' understanding of MAP-based screening for preeclampsia.

Table 2. Comparison of Pre-Test and Post-Test Scores (n = 37)

Variable	Median (IQR)	Z	p-value
Pre-test	88 (62-98)	**-2,362**	**0.018***
Post-test	92 (50 -100)		

*Wilcoxon Signed Rank Test; significant at $p < 0.05$

The Wilcoxon Signed-Rank Test revealed a statistically significant difference between the pre-test and post-test scores ($Z = -2.362$, $p = 0.018$, $r = 0.388$). The negative Z value indicates the direction of the change, showing that post-test scores tended to be higher than pre-test scores. The p-value of 0.018 indicates that the observed difference is statistically significant at the 5% significance level. The effect size ($r = 0.388$) represents a medium

effect according to Cohen's criteria, suggesting that the intervention had a moderate practical impact on participants' scores.

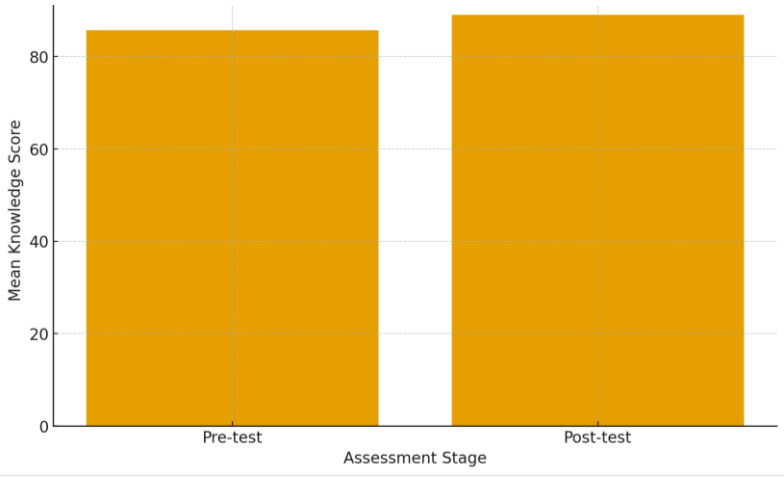

Figure 1. Comparison of Mean Knowledge Scores Before and After Training

Overall, the results show a consistent pattern of improvement among participants following the training activity. Although the increase in scores may appear modest, the combination of statistical significance and a moderate effect size suggests that the training session contributed to strengthening the core concepts related to MAP and its role in the early detection of preeclampsia. The upward shift shown in Figure 1, from a mean pre-test score of 85.68 to 89.03 in the post-test, indicates that most participants experienced a measurable gain in knowledge. Only a small number of midwives showed minimal change, while the majority demonstrated score improvements, reinforcing that the training was generally effective in enhancing their understanding of the material.

DISCUSSION

Interpretation of key findings

Our findings revealed that a single training session on MAP-based preeclampsia screening resulted in a modest yet consistent improvement in midwives' knowledge. The mean score increased from 85.68 to 89.03, with a statistically significant difference ($p = 0.018$) and a moderate effect size ($r \approx 0.40$). This suggests that even a brief and focused training can strengthen understanding of MAP measurement and its importance for early detection of hypertensive disorders during pregnancy. The characteristics of the participants also help explain the pattern of improvement. Most midwives were 30–39 years old (59.5%) and had less than five years of experience (43.2%), a demographic generally receptive to capacity-building efforts and refining their clinical practice. Meanwhile, 37.8% had more than ten years of experience and may already have established routines, which could explain why the overall increase in scores, while positive, was not substantial. The dominance of diploma-trained midwives (54.1%) also reflects the need for regular upskilling, as this group often benefits from theoretical refreshers to complement their extensive hands-on exposure.

Comparison with previous studies

The findings of this study are consistent with earlier research that emphasizes the value of MAP in enhancing the accuracy of preeclampsia screening and the importance of training health providers to ensure proper implementation. Previous studies have reported that integrating MAP into routine antenatal care improves early identification of women at risk of developing preeclampsia (18)(19). Evidence from Asian populations reinforces the practicality and predictive value of MAP when applied in primary care settings (20)(21). Screening models that combine maternal risk factors with MAP and other biomarkers have also been shown to outperform traditional history-based methods. Furthermore, training and capacity-building interventions have been found to improve midwives' competence, adherence to screening standards, and decision-making in maternal health care (17)(22)(23).

National studies in Indonesia similarly highlight variability in antenatal practice quality and point to the need for continuous professional development to strengthen screening, counselling, and clinical judgment among midwives (24)(25). These findings collectively support the conclusion that structured training can improve midwives' knowledge regarding MAP-based preeclampsia screening. and may support future implementation of early detection strategies.

Limitations and Cautions

While this study provides meaningful contributions to understanding the effect of MAP-focused training on midwives' knowledge, several limitations should be acknowledged. First, the one-group pre–post study design without a comparison group limits attribution of the observed improvement solely to the intervention. Second, the sample size was small (n = 37) and drawn from a single area, restricting generalizability. Third, the assessment measured only immediate knowledge gain and did not include follow-up to evaluate long-term retention or translation into clinical practice. Fourth, knowledge was measured through a questionnaire rather than direct observation of MAP skills, which limits insight into actual competency. These limitations should be taken into consideration when interpreting the results. Furthermore, improvements observed immediately after training may partly reflect testing effects or short-term recall, which are common limitations of one-group pretest–posttest designs.

Recommendations for future research

Future studies should focus on addressing the identified limitations. For instance, adopting a quasi-experimental or randomized controlled design with larger and more diverse samples would provide stronger evidence of training effectiveness. Longitudinal follow-up over 3–6 months is recommended to assess knowledge retention and behavioural change in routine antenatal care. Future research should also incorporate objective skill assessments, such as direct observation using standardized checklists, to determine whether improved knowledge translates into correct MAP measurement and proper clinical decision-making. Exploring organisational and contextual factors such as workload, resource availability, documentation systems, and supervisory support would help identify barriers and facilitators of MAP implementation in primary care. Additionally, cost-effectiveness analyses could provide policymakers with valuable insights for scaling up MAP training initiatives within maternal health programs.

CONCLUSION

This study provides preliminary evidence that MAP-based preeclampsia screening training was associated with improved knowledge among midwives. Although knowledge scores increased significantly following the intervention, the findings should be interpreted cautiously because of the one-group pretest–posttest design and the absence of long-term follow-up. Further controlled studies are required to determine whether knowledge gains are sustained and translated into clinical practice.

AUTHOR CONTRIBUTION STATEMENT

All authors took part in the work that led to this manuscript and approved the final version prior to submission. The research idea and study design were discussed and agreed upon together. The first author handled most of the data work, including collecting the information and conducting the analysis, and prepared the first draft of the manuscript. The co-authors reviewed the draft, suggested revisions, and helped improve the clarity, flow, and academic quality of the paper. Senior authors provided guidance throughout the research, checked the interpretation of the findings, and ensured that the study met ethical and scientific standards. Each author contributed in a meaningful way and accepts responsibility for the content of this article.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest related to this study.

DECLARATION OF GENERATIVE AI AND AI-ASSISTED TECHNOLOGIES IN THE WRITING PROCESS

The authors state that the preparation of this manuscript was carried out through their own work and writing. No generative AI or AI-assisted tools were used to produce, edit, or structure the content of this paper. All analysis, interpretation, and writing reflect the authors' independent effort and responsibility.

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