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Correlation between Mean Arterial Pressure Examination Values and the Incidence of Pre-eclampsia in Pregnant Women at Sultan Suriansyah Hospital, Banjarmasin

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ABSTRACT/ ABSTRAK

ABSTRACT. *Pre-eclampsia is one of the pregnancy complications that contributes to maternal and fetal morbidity and mortality. Early detection of this condition is crucial to prevent more severe complications. Mean Arterial Pressure (MAP) is one of the screening methods that can be used to assess the risk of pre-eclampsia in pregnant women. This study aimed to analyze the correlation between MAP examination values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin. This research employed a correlational study design with a cross-sectional approach. The study sample consisted of 187 pregnant women selected through purposive sampling. Data were collected from medical records and observation sheets. Data analysis was performed using the Chi-Square statistical test. The results showed that among the 187 respondents, 131 pregnant women (70.1%) had MAP values >90 mmHg, categorized as being at risk of developing pre-eclampsia, and 56 pregnant women (29.9%) were diagnosed with pre-eclampsia. The statistical analysis revealed a significant correlation between MAP values and the incidence of pre-eclampsia (p-value = 0.000; p < 0.05). The study concludes that there is a significant correlation between MAP examination values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin. Therefore, MAP can be utilized as a screening method for early detection of pre-eclampsia risk. Health workers are expected to enhance MAP monitoring in pregnant women to reduce the incidence of pre-eclampsia and its related complications.*

Kata kunci:

Mean Arterial Pressure (MAP), Ibu Hamil, Pre-eklamsia, Skrining, RSUD Sultan Suriansyah

ABSTRAK. Pre-eklamsia merupakan salah satu komplikasi kehamilan yang berkontribusi terhadap morbiditas dan mortalitas ibu serta janin. Deteksi dini kondisi ini penting untuk mencegah komplikasi yang lebih serius. Mean Arterial Pressure (MAP) merupakan salah satu metode skrining yang dapat digunakan untuk menilai risiko pre-eklamsia pada ibu hamil. Penelitian ini bertujuan untuk menganalisis hubungan antara nilai pemeriksaan MAP dengan kejadian pre-eklamsia pada ibu hamil di RSUD Sultan Suriansyah Banjarmasin. Penelitian ini menggunakan desain studi korelasional dengan pendekatan cross-sectional. Sampel penelitian terdiri dari 187 ibu hamil yang dipilih menggunakan metode purposive sampling. Data dikumpulkan melalui rekam medis dan lembar observasi. Analisis data dilakukan dengan uji statistik Chi-Square. Hasil penelitian menunjukkan bahwa dari 187 responden, sebanyak 131 ibu hamil (70,1%) memiliki nilai MAP >90 mmHg yang dikategorikan berisiko mengalami pre-eklamsia, dan 56 ibu hamil (29,9%) mengalami pre-eklamsia. Hasil uji statistik menunjukkan adanya hubungan yang signifikan antara nilai MAP dengan kejadian pre-eklamsia (p- value = 0,000; p < 0,05). Kesimpulan dari penelitian ini adalah terdapat hubungan yang signifikan antara nilai pemeriksaan MAP dengan kejadian pre-eklamsia pada ibu hamil di RSUD Sultan Suriansyah Banjarmasin. Oleh karena itu, MAP dapat digunakan sebagai metode skrining untuk mendeteksi risiko pre-eklamsia lebih dini. Diharapkan tenaga kesehatan dapat meningkatkan pemantauan MAP pada ibu hamil guna menurunkan angka kejadian pre-eklamsia dan komplikasi terkait.

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INTRODUCTION

Pre-eclampsia (PE) affects approximately 2% of pregnancies worldwide and is a leading cause of maternal death, as well as perinatal morbidity and mortality, particularly when delivery occurs before 34 weeks of gestation (1,2). Pre-eclampsia, a multisystem disorder unique to human pregnancy, is characterized by endothelial dysfunction leading to hypertension due to vasoconstriction, proteinuria associated with glomerular damage, and secondary edema caused by increased vascular permeability (Zainiyah et al., 2024).

Globally, the number of pre-eclampsia cases is projected to increase in 2025, with an estimated 1.15 billion cases, representing around 29% of the total world population. With 1,066 cases of hypertension in pregnancy, this condition is the second leading cause of maternal death after hemorrhage. Indonesia's Sustainable Development Goals (SDGs) target of reducing the maternal mortality rate to 70 per 100,000 live births by 2030 remains far from being achieved. This highlights the need for further efforts to prevent and manage hypertensive complications in pregnancy, including strengthening early detection and improving antenatal care. In Indonesia, maternal deaths due to pre-eclampsia reached 801 cases in 2022, with the highest maternal mortality recorded in West Java Province (146 cases) and Central Java Province (100 cases) (Berliana, 2024). In South Kalimantan Province, maternal deaths due to pre-eclampsia totaled 28 cases.

Pre-eclampsia is a pregnancy specific condition affecting 3–5% of all pregnancies. Its hallmark features include high blood pressure (hypertension) and endothelial dysfunction, which cause widespread end-organ damage, including to the liver, blood, kidneys, brain, and placenta. Pre-eclampsia significantly contributes to maternal morbidity, such as severe outcomes like hepatic rupture, renal failure, seizures (eclampsia), stroke, and maternal mortality worldwide. Since delivery is currently the only definitive cure, pre-eclampsia also significantly contributes to prematurity, neonatal morbidity, and perinatal death (Zainiyah et al., 2024).

One pregnancy complication is pre-eclampsia, characterized by high blood pressure and the presence of protein in urine, typically occurring at ≥20 weeks of gestation. Pre-eclampsia can cause maternal death during pregnancy, childbirth, or the postpartum period, while fetal complications include intrauterine growth restriction, placental disorders, prematurity, respiratory distress syndrome, intrauterine fetal death, and neonatal death (Mandani & Sugijati, 2024).

Screening for pre-eclampsia risk factors can be conducted through the measurement of Mean Arterial Pressure (MAP). MAP is the average arterial pressure during a single cardiac cycle, calculated from systolic and diastolic blood pressure readings. MAP measurement is a simple screening method for detecting pre-eclampsia risk in pregnant women, particularly those with risk factors. The procedure involves measuring systolic and diastolic blood pressure, followed by calculating the average arterial pressure using a standard formula. A pregnant woman is classified as having a positive MAP if the value is >90 mmHg and a negative MAP if <90 mmHg (Nyoman et al., 2024).

A study by Haq et al. (2024) reported that the optimal gestational age for early detection of pre-eclampsia is during the first trimester, with continuous monitoring in the second and third trimesters. Ten studies demonstrated a sensitivity above 0.5, indicating that MAP is a fairly effective tool for early detection of pre-eclampsia, as early detection can

significantly influence prognosis. This suggests that MAP measurement can help detect pre-eclampsia risk in pregnant women.

A preliminary study conducted on March 18, 2024, showed that in 2023, there were 59 cases of pre-eclampsia at Sultan Suriansyah Hospital, Banjarmasin, with the highest incidence in January and August (11 and 13 cases, respectively) (Sultan Suriansyah Hospital, 2024). Based on the above background, pre-eclampsia is one of the leading causes of high maternal mortality worldwide, emphasizing the importance of early detection in pregnant women. One such method is MAP screening, which is simple to perform and can be carried out by all healthcare providers. The results of MAP screening can serve as a reference for providing better care to pregnant women. Therefore, the authors were interested in investigating the relationship between MAP screening results and the incidence of pre-eclampsia in pregnant women.

RESEARCH METHOD

This study employed a correlational design with a cross-sectional approach to examine the relationship between Mean Arterial Pressure (MAP) values as the independent variable and the incidence of pre-eclampsia as the dependent variable in pregnant women. The study was conducted at Sultan Suriansyah Hospital, Banjarmasin, from January to July 2023. The study population comprised all pregnant women who underwent antenatal care (ANC) examinations at Sultan Suriansyah Hospital, Banjarmasin, during this period, totaling 355 individuals. The research sample consisted of 187 participants selected using purposive sampling based on the inclusion criteria, namely pregnant women who attended ANC examinations during the study period, had complete medical records regarding systolic and diastolic blood pressure, and were willing to participate as respondents. The exclusion criteria included pregnant women with a history of chronic diseases other than hypertension, such as kidney disease, diabetes mellitus, or heart disease, as well as those with incomplete medical records.

The independent variable in this study was the MAP value, while the dependent variable was the incidence of pre-eclampsia in pregnant women. MAP was defined as the average arterial pressure calculated from systolic and diastolic blood pressure using the formula $MAP = (SBP + 2\times DBP) \div 3$. The incidence of pre-eclampsia was defined as hypertension during pregnancy, with blood pressure ≥140/90 mmHg after 20 weeks of gestation accompanied by proteinuria ≥300 mg/24 hours. Data were collected using an observation sheet containing respondent identity, blood pressure measurements, MAP calculations, and pre-eclampsia diagnoses based on medical records. The data collection procedure began with obtaining research approval from the hospital, followed by identifying pregnant women who met the inclusion criteria, recording blood pressure from medical records, calculating MAP values, and documenting the incidence of pre-eclampsia.

Data analysis was performed using SPSS software. Univariate analysis was conducted to describe the frequency distribution of research variables, while bivariate analysis was carried out using the Chi-Square test to determine the relationship between MAP values and the incidence of pre-eclampsia, with a significance level of $p < 0.05$. This study obtained ethical approval from the Health Research Ethics Committee of Universitas Muhammadiyah Banjarmasin. The confidentiality of respondents' identities was maintained, and the data were used solely for research purposes.

RESULTS

Respondent Characteristics

Table 1. Respondent Characteristics

Characteristics	Description	Frequency (f)	Percentage (%)
Age	16–25 years	52	27.8
	26–35 years	115	61.5
	36–45 years	15	8.0
	46–55 years	5	2.7
Total		**187**	**100**
Gestational Age	Less than 20 weeks	71	38.0
	More than 20 weeks	116	62.0
Total		**187**	**100**
Mean Arterial Pressure Score	<70–90 mmHg	50	26.7
	>90 mmHg	81	43.3
	107–119 mmHg	48	25.7
	>120 mmHg	8	4.3
Total		**187**	**100**

Based on Table 1, the majority of respondents were aged 26–35 years, totaling 115 individuals (61.5%), while the smallest proportion was aged 46–55 years, with 5 respondents (2.7%). Most respondents had a gestational age of more than 20 weeks (116 individuals, 62%), while 71 respondents (38%) had a gestational age of less than 20 weeks. In terms of MAP score, the majority had values >90 mmHg (81 respondents, 43.3%), and the smallest proportion had MAP scores >120 mmHg (8 respondents, 4.3%).

Univariate Analysis

Mean Arterial Pressure (MAP) Values

Table 2. Mean Arterial Pressure (MAP) Results in Pregnant Women

No	Mean Arterial Pressure	Frequency (f)	Percentage (%)
1	At risk (>90 mmHg)	131	70.1
2	Not at risk (<90 mmHg)	56	29.9
	Total	**187**	**100**

Based on Table 2, most respondents had MAP values >90 mmHg, classified as "at risk," totaling 131 individuals (70.1%).

Incidence of Pre-eclampsia

Table 3. Incidence of Pre-eclampsia in Pregnant Women

No	Pre-eclampsia Status	Frequency (f)	Percentage (%)
1	Pre-eclampsia	56	29.9
2	No pre-eclampsia	131	70.1
	Total	**187**	**100**

Based on Table 3, most respondents did not experience pre-eclampsia (131 individuals, 70.1%).

Bivariate Analysis

Table 4. Relationship between MAP Values and the Incidence of Pre-eclampsia in Pregnant Women at Sultan Suriansyah Hospital, Banjarmasin

No	MAP Category	Pre-eclampsia		No Pre-eclampsia		Total	
		f	%	f	%	Σ	%
1	At risk (>90 mmHg)	56	30	73	39	129	69
2	Not at risk (<90 mmHg)	0	0	58	31	58	31
	Total	56	30	131	70	187	100

Chi-Square Test p-value = 0.000

Based on Table 4, the majority of respondents with MAP values <90 mmHg were categorized as not at risk for pre-eclampsia (58 individuals, 31%), and none in this group were at risk. Meanwhile, 56 respondents had MAP values >90 mmHg and were classified as at risk, and 73 respondents had MAP values >90 mmHg but did not experience pre-eclampsia. The Chi-Square correlation test yielded a p-value of 0.000 ($p < 0.05$), indicating a statistically significant relationship between MAP values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin.

DISCUSSION

MAP Values in Pregnant Women at Sultan Suriansyah Hospital, Banjarmasin

Based on Table 2, most respondents had MAP values >90 mmHg or were classified as at risk, totaling 131 individuals (70.1%), while 56 individuals (29.9%) were not at risk. These findings are consistent with a study by Kurniati (2020) on the relationship between Mean Arterial Pressure (MAP) and pre-eclampsia in pregnant women at Bontobangun Public Health Center, Bulukumba Regency, which reported a significant relationship between MAP and pre-eclampsia (p-value = 0.037 < 0.05). Similarly, a study by Latifa (2020) on the effectiveness of MAP as a method for early detection of pre-eclampsia in pregnant women found that MAP measurement was effective in detecting pre-eclampsia early (p-value = 0.000 < 0.05).

MAP represents the average arterial pressure required for blood circulation to reach the brain. During pregnancy, renal blood flow and glomerular filtration rate increase compared to the non-pregnant state. In pregnancies complicated by hypertension, renal perfusion and glomerular filtration rate decrease to varying degrees, allowing large molecular weight proteins to pass through the glomeruli and appear in the urine (proteinuria). If pre-eclampsia is not promptly managed, it can adversely affect the fetus, leading to asphyxia, low birth weight, perinatal death, and preterm delivery (Mandani & Sugijati, 2024).

Pregnancy induces physiological changes in the body, one of which involves the cardiovascular system. In pregnant women, cardiac output increases by the 8th week of gestation due to peripheral vasodilation caused by endothelial cells. This vasodilation reduces vascular resistance by 25–30%, and to compensate, cardiac output rises by approximately 40% during pregnancy. The peak cardiac output is observed between 20–28 weeks of gestation (Zainiyah, Susanti, & Harahap, 2024).

Early blood pressure measurement is essential for detecting pre-eclampsia, enabling preventive measures to be taken as soon as possible. Determining MAP before 20 weeks of gestation is one of the initial steps in screening for pre-eclampsia. MAP measurement can be used to detect risk factors for pre-eclampsia in pregnant women, as even small changes in blood pressure can signal the risk of developing the condition. Women who develop pre-eclampsia tend to have higher systolic blood pressure and positive MAP readings before the onset of clinical symptoms. MAP is more predictive of pre-eclampsia in the first and second trimesters compared to systolic or diastolic readings alone, making it a reliable tool for detection (Juwita et al., 2022; Marwang, 2021).

Based on these findings, the authors assume that MAP, as the average value of blood pressure, can determine whether a pregnant woman is at risk for pre-eclampsia. The higher the MAP value, the greater the risk of pre-eclampsia. Elevated MAP values may be influenced by poor dietary habits and stress, both of which can contribute to increased blood pressure.

Incidence of Pre-eclampsia in Pregnant Women at Sultan Suriansyah Hospital, Banjarmasin

Based on Table 3, most respondents did not experience pre-eclampsia (131 individuals, 70.1%), while 56 respondents (29.9%) were diagnosed with pre-eclampsia. Pre-eclampsia in pregnant women can progress to seizures, known as eclampsia, which commonly occurs during labor, may develop up to 10 days postpartum, and can also arise during pregnancy.

In terms of disease progression, pre-eclampsia is classified into two stages. The first stage is asymptomatic, characterized by abnormal placental development in the first trimester. This condition results in placental insufficiency and the release of damaged trophoblastic cell products or substrates (interleukins, prostaglandins, histamines, and others) into the maternal circulation. The release of these placental substrates triggers the clinical manifestations of the second stage, which is symptomatic. In this stage, vasospasm occurs, progressing to hypertension, renal impairment, and proteinuria, with the potential for HELLP syndrome, eclampsia, and other organ damage (Karlina, Aliansy, & Yunengsih, 2023).

Pre-eclampsia is a multisystem disorder of unknown cause that occurs exclusively in human pregnancy. It is characterized by an abnormal vascular response to placentation, associated with increased systemic vascular resistance, enhanced platelet aggregation, activation of the coagulation system, and endothelial cell dysfunction. Clinical manifestations of pre-eclampsia may present as a maternal syndrome (hypertension and proteinuria with or without other multisystem abnormalities) or as a fetal syndrome (intrauterine growth restriction, reduced amniotic fluid, and abnormal oxygenation) (Juwita, Yani, & Yudianti, 2022).

The effects of pre-eclampsia can lead to preterm birth, perinatal death, and intrauterine growth restriction. Contributing factors include reproductive status (age, parity, twin pregnancy, and genetic predisposition), health status (history of pre-eclampsia, hypertension, diabetes, nutritional status, stress/anxiety), health behaviors (fetal care, contraceptive use), education level, socioeconomic status, and occupation. All these factors can contribute to increased blood pressure, which may lead to pre-eclampsia (Myatt, 2022).

Based on these explanations, the authors assume that pre-eclampsia may occur due to dietary habits, maternal age, level of knowledge, hereditary factors, history of hypertension, and stress during pregnancy. If left unmanaged, pre-eclampsia poses significant risks to both the mother and the fetus, potentially leading to maternal complications, fetal death, or preterm birth.

Analysis of the Relationship between MAP Values and the Incidence of Pre-eclampsia in Pregnant Women at Sultan Suriansyah Hospital, Banjarmasin

Based on Table 4, it can be seen that the majority of respondents with MAP values <90 mmHg were categorized as not at risk for pre-eclampsia (58 individuals, 31%), and none in this group were at risk. Meanwhile, 56 respondents (30%) had MAP values >90 mmHg and were classified as at risk, and there were no respondents with MAP >90 mmHg who were not at risk for pre-eclampsia. Additionally, 73 respondents (39%) did not have pre-eclampsia but were still considered at risk. The Chi-Square correlation test yielded a p-value of 0.000 ($p < 0.05$), indicating a significant relationship between MAP values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin.

An increase in blood pressure against the arterial wall can result from the heightened demand for oxygen supply to body tissues and the increased blood volume in circulation, which is often triggered by excessive weight gain during pregnancy. Rapid weight gain over a short period in pregnancy can lead to fluid retention and increased blood volume, resulting in edema of the face and extremities. This edema is considered an early sign of pre-eclampsia if it occurs alongside excessive weight gain (Ambad et al., 2021).

Most respondents had a gestational age of more than 20 weeks (34 individuals or 57.6%). This finding is in line with Sembiring's (2018) study on MAP measurement at 27 weeks of gestation, which showed that among pregnant women with pre-eclampsia, 70.4% had a positive MAP, while 29.6% of women without pre-eclampsia also had a positive MAP. MAP is considered an effective predictor of pre-eclampsia when measured in the second trimester, as physiological increases in blood pressure during the first trimester may produce less accurate results. Sembiring also found that pre-eclampsia was most prevalent in the third trimester compared to the second trimester. This is likely due to increased vascular reactivity beginning around 20 weeks of gestation, which is typically detected during the second trimester. Therefore, urine protein testing is essential from the first trimester. More frequent monitoring in the second trimester is recommended due to rapid fetal growth, while in the third trimester, close monitoring is needed to prepare the mother and fetus for delivery (Zainiyah, Susanti, & Harahap, 2024).

Pregnancy is a natural process, and the physiological changes that occur are not pathological. Therefore, care during pregnancy should aim to minimize unnecessary interventions. Midwives play a role in facilitating the natural process of pregnancy while avoiding unnecessary medical procedures. Professional healthcare providers should closely monitor maternal conditions throughout pregnancy. While most pregnancies proceed physiologically, complications such as pre-eclampsia may still occur, even with preventive measures (Rukiah et al., 2021).

Pre-eclampsia remains a complication with an unknown definitive cause. Although many theories have been proposed, none have provided a fully satisfactory explanation. Tampubolon (2021) reported a significant association between a positive MAP result and the incidence of pre-eclampsia in Indonesia, with women having a positive MAP being 32 times more likely to develop pre-eclampsia. This study concluded that MAP could be used as a screening tool for pre-eclampsia.

If elevated MAP levels are detected early, the onset of pre-eclampsia can be managed more effectively over time. Undetected increases in MAP can lead to complications during pregnancy, such as long-term organ or system damage, including pre-eclampsia, eclampsia, gestational hypertension, and chronic hypertension. Hypertension in pregnancy is a major contributor to severe acute morbidity, long-term disability, and maternal and neonatal mortality (Zhu et al., 2021).

Therefore, early prevention is essential, especially in high-risk groups, by identifying women at risk from the beginning of pregnancy. Preventive measures may include specific medications, strict monitoring, earlier diagnosis, and timely interventions. The authors assume that, given the severe complications associated with pre-eclampsia, particularly during labor, early detection based on MAP is crucial. Screening MAP values can help identify risk factors for pre-eclampsia, allowing preventive measures and continuous support to be provided to high-risk pregnant women. Based on these findings, the authors conclude that there is a relationship between MAP values and the incidence of pre-eclampsia, with higher MAP values indicating a greater risk. Elevated MAP may be influenced by poor dietary habits and stress, both of which can increase blood pressure.

CONCLUSION

The results of this study showed that most respondents had MAP values >90 mmHg or were classified as at risk, totaling 131 individuals (70.1%), while the same number of respondents (131 individuals, 70.1%) did not experience pre-eclampsia. The majority of respondents with MAP values <90 mmHg were categorized as not at risk for pre-eclampsia (58 individuals, 31%), and none were found to be at risk in this group. A total of 56 respondents (30%) had MAP values >90 mmHg and experienced pre-eclampsia, while 73 respondents (39%) had MAP values >90 mmHg but did not experience pre-eclampsia. The Chi-Square test yielded a p-value of 0.000 ($p < 0.05$), indicating a significant relationship between MAP values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin.

The findings of this study are expected to serve as a scientific basis for healthcare providers in enhancing early detection and implementing precise and measurable management of pre-eclampsia. With the evidence of a significant relationship between Mean Arterial Pressure (MAP) values and the incidence of pre-eclampsia in pregnant women at Sultan Suriansyah Hospital, Banjarmasin, interventions can be focused on routine MAP screening during antenatal care. This step is essential for identifying high-risk pregnant women as early as possible, enabling close monitoring, health education, and necessary medical interventions to prevent the progression of pre-eclampsia to more severe stages. This evidence-based approach is expected not only to improve the quality of maternal healthcare services but also to contribute to reducing maternal and fetal morbidity and mortality caused by pre-eclampsia.

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