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THE CORRELATION BETWEEN MEAN ARTERIAL PRESSURE (MAP) EXAMINATION AND THE INCIDENCE OF PREECLAMPSIA

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ABSTRACT

Background: Preeclampsia is the second contributor to death after bleeding. Effort are made to detect the incidence of preeclampsia early, one of which uses the mean arterial pressure examination.
Objective: To determine the correlation of mean arterial pressure (MAP) examination with the incidence of preeclampsia, determine the characteristics of pregnant women based on parity, age and MAP examination results for case and control group, analyze the correlation between MAP examination with the incidence of preeclampsia at PKU Muhammadiyah Delanggu Hospital.
Methods: The type of research used was quantitative case control design and data collection using retrospective. The sampling technique was purposive sampling. The number of sampels in this study were 66 respondents with a ratio of 1:1 between cases and controls, for cases 33 respondents and for controls 33 respondents from medical record data at PKU Muhammadiyah Delanggu Hospital in 2022. Data analysis technique used non-parametric statistics chi square with a significance level of 0,05.
Results: According to the results of statistical tests with the Fisher Exact Chi Square test with a confidence level of 95% (σ = 5) and result of Exact. Sig. (2-Sided) is 0,000 (Exact. Sig (2-Sided) < 0,05).
Conclusion: There is a statistically significant correlation between MAP examination and the occurrence of preeclampsia at PKU Muhammadiyah Delanggu Hospital.

Key word: *Mean Arterial Pressure Examination, Preeclampsia*

INTRODUCTION

The second cause of death after bleeding is preeclampsia with a percentage of 24%. Rapat Kerja Nasional Kesehatan in 2019 stated that the main cause of maternal death was hypertension (including preeclampsia/eclampsia), amounting to 33.07%[1]. Klaten Regency Health Profile shows the number of maternal deaths was 11 cases. The causes of death include severe preeclampsia/hypertension in 3 cases in 2022 [2].

Although the exact cause of gestational preeclampsia is not yet known, there are several factors associated with the condition. Based on research that occupation, age and parity of pregnant women are related to the incidence of preeclampsia[3]. But different from else research that age and parity are not related to preeclampsia, but a history of hypertension and gestational age are related to hypertension[4].

During pregnancy, preeclampsia is very dangerous for the mother and the fetus she is carrying. Patients that diagnosed with preeclampsia manifest high levels of hypertension and proteinuria. Prematurity, severe hypotrophy and infant death are the main complications of preeclampsia[5].

Preeclampsia is a serious complication and appears in the second or third trimester and is characterized by symptoms such as edema, hypertension, proteinuria, seizures, and even coma after a pregnancy of more than 20 weeks[6]. The consequences of preeclampsia in pregnant women are placental abruption, hypofibrinogenemia, hemolysis, brain hemorrhage, eye vessel damage which causes visual impairment or blindness, pulmonary edema, liver necrosis, heart damage, HELLP syndrome, and kidney disorders[7].

Preeclampsia during pregnancy can also have an impact on the fetus, namely low birth weight due to decidual spiral arteriole spasm reducing blood flow to the placenta, resulting in impaired placental function. A damaged placenta can cause fetal hypoxia, intrauterine growth restriction (IUGR). If the damage gets worse it will result in the fetus being premature, dysmaturity and IUFD or fetal death in the womb[7.]

That efforts that can be made to overcome preeclampsia include diagnostic tests, early detection, appropriate referrals, regular measurements of blood pressure and urine protein. Meanwhile, low-dose aspirin and calcium are given to mothers who already have a history of preeclampsia or gestational hypertension[8]. Preeclampsia can be prevented through primary and secondary prevention. Primary prevention is carried out by providing access to quality maternal health services such as screening, especially at <20 weeks' gestation[9].

Primary prevention of preeclampsia is carried out through routine Antenatal Care (ANC) examinations to identify risk factors early, then secondary prevention of preeclampsia, namely adding calcium supplements, foods containing antioxidants and a balanced diet rich in protein[10].

As mentioned, preventing preeclampsia can include regular blood pressure checks. One way to measure blood pressure is to measure mean arterial pressure (MAP). The MAP examination is carried out by calculating the average diastolic and systolic arterial blood pressure. MAP has advantages as a screening method, including: it is simple, easy to use, can be carried out by all health workers, does not involve too many procedures for patients, and does not require special training[11].

The MAP examination was effective in early detection of preeclampsia[12]. A preliminary study conducted by researchers at the Klaten District Health Service found data for 2023 from January to July, showing 248 cases of pregnant women with

preeclampsia. With the number of pregnant women as many as 8,818. Based on a preliminary study conducted at RSU PKU Muhammadiyah Delanggu in the 2022 period, 99 cases of preeclampsia were found from a total of 508 pregnant women.

METHODS

The type of research used was quantitative case control design and data collection using retrospective. The sampling technique was purposive sampling. The number of sampels in this study were 66 respondents who were divided into 2 groups, namely case group and the control group. The case group is a sample of pregnant women with preeclampsia, while the control group is pregnant women not with preeclampsia (normal pregnant woman). With a ratio of 1:1 between cases and controls, for cases 33 respondents and for controls 33 respondents from medical record data at PKU Muhammadiyah Delanggu Hospital in 2022. Data analysis technique used non-parametric statistics chi square with a significance level of 0,05.

RESULT

The following are the results of research is.

Table 1. Frequency Distribution of Pregnant Women's Characteristics Based on Parity, Age and Education Level for the Period January – December 2023

Parity	Preeclampsia	Not Preeclampsia
Primigravida	25 (75,8%)	24 (72,7%)
Multigravida	7 (21,2%)	8 (24,2%)
GrandeMultiparous	1 (3,0%)	1 (3,0%)
Total	33 (100,0%)	33 (100,0)
Age		
High Risk	8 (24,2%)	4 (12,1%)
No Risk	25 (75,8%)	29 (87,9%)
Total	33 (100,0%)	33 (100,0)
Education		
Junior High School	4 (12,1%)	1 (3,0%)
Senior High School	29 (87,9%)	22 (66,7%)
College	0 (0%)	10 (30,3%)
Total	33 (100,0%)	33 (100,0)

Based on table 1, it showed that frequency distribution of characteristics of pregnant women based on parity resulted in the percentage of parity in the case group, with the largest percentage in Primigravida being 25 people or 75.8%. Meanwhile, in the control group, the largest percentage was the same as the case group, namely in the Primigravida group, there were 24 people or 72.7%.

The frequency distribution of characteristics of pregnant women based on age was obtained from the percentage of pregnant women's age in the case group, with the largest percentage in the 20-35 year age group (not at risk) of 25 people or 75.8%. Meanwhile, in the control group, the largest percentage was the same as the case group, namely in the 20-35 year age group (not at risk) as many as 29 people or 87.9%.

The frequency distribution of characteristics of pregnant women based on education resulted in the case group being 29 (87.9%), namely high school education. Meanwhile, for the control group, the percentage was 22 (66.7%), namely high school education.

Table 2. Frequency Distribution of MAP Examination Results in Preeclamptic and Non-Preeclamptic Pregnant Women

MAP Check Results	Preeclampsia	Not Preeclampsia
≥90 (MAP+)	33 (100,0%)	29 (87,9%)
<90(MAP -)	0 (0%)	4 (12,1%)
Total	33 (100,0%)	33 (100,0%)

Based on the table 2, it showed that the frequency distribution of MAP examination results obtained in the case group of examination results showed that all 33 people had MAP (+) results or 100%. Meanwhile, in the control group, the largest percentage of MAP examination results was 29 people or 87.9%.

Table 3. Relationship between Mean Arterial Pressure (MAP) Examination and the Occurrence of Preeclampsia.

MAP check	**Pregnant Mother**				p value
	Preeclampsia		Not Preeclampsia		
	f	%	*f*	%	*ρ*
MAP + (≥90)	33	100.0	29	87.9	0,000
MAP – (<90)	0	0	4	12.1	
Total	33	100.0	33	100.0	

Based on the table 3, it showed the results of statistical tests with the Fisher Exact test with a confidence level of 95% (σ= 5) Exact value results are obtained. Sig. (2-Sided) is 0.000 (Exact. Sig (2-Sided) < 0.05). From the results of the Fisher Exact test, it can be explained that there is a statistically significant relationship between MAP examination and the incidence of preeclampsia at RSU PKU Muhammadiyah Delanggu.

DISCUSSION

Based on The New England Journal of Medicine, data shows that the risk of preeclampsia in the first pregnancy is 3.9%, in the second pregnancy it is 1.7%, and in the third pregnancy it is 1.8%. Other studies reveal findings that are in line with the uterine artery The incidence of preeclampsia at RSU PKU Muhammadiyah Delanggu was 99 pregnant women diagnosed with preeclampsia or 19.0%. Based on these incidence numbers, samples can be taken according to the Lemeshow sample calculation formula, resulting in 33 samples of pregnant women with preeclampsia and 33 pregnant women without preeclampsia.pulsatility index, where there is a significant increase in mean arterial pressure at 11-13 weeks of gestation in women who experience preeclampsia. Apart from that, a significant negative linear relationship was also found between mean arterial pressure and gestational age at delivery[13.]

At the gestational age range of 14-16 weeks, the second stage of trophoblast cell invasion occurs, where these cells enter the second layer more deeply, penetrating the spiral arteries until they reach the myometrium. This process involves endothelial replacement, damage to musculo-elastic tissue, and changes to the fibrinoid material in the arterial wall, similar to the first stage. The end of this process involves adjusting the blood vessels to meet the increased blood flow demands of pregnancy. At approximately 20 weeks of gestation, when there is no trophoblast invasion, a condition known as "uteroplacental ischemia" occurs, which is triggered by decreased blood flow to the placenta and is associated with large areas of infarction in the placenta[7].

Increased sensitivity, which is a precursor to gestational hypertension, begins to occur at 14-16 weeks of gestation. This can be considered an effort to detect preeclampsia early. It is

important to note that as gestational age increases, the risk of developing preeclampsia increases, supporting the concept of placental ischemia[11].On the other hand, in pregnancies without preeclampsia, blood pressure tends to decrease in the second trimester and return to normal in the third trimester. Detecting preeclampsia early in the first trimester and continuing to monitor it in subsequent trimesters can play a role in reducing morbidity rates and preventing preeclampsia from becoming more severe.

Based on data from Table 1 regarding the characteristics of pregnant women based on age, it can be concluded that the majority of pregnant women, both those included in the preeclampsia case group and the control group without preeclampsia, are in the age range of 20-35 years, which can be considered as a group that does not have preeclampsia. significant risk. The percentage of pregnant women in this age range reached 77.3%. There was no significant difference in the age range of pregnant women, whether they had preeclampsia or not. As many as 82% of pregnant women with preeclampsia and 84.4% of pregnant women without preeclampsia were in the age range 20-35 years[14].

Fertility well-being is closely related to age factors. Changes in body function that occur with age can affect a person's health. The age range considered to be the safest and optimal for pregnancy and childbirth is between 20 and 35 years. On the other hand, adolescent girls with their first pregnancy and pregnant women over the age of 35 years have a higher risk of developing preeclampsia[15].

Respondents who experienced preeclampsia at risk were 15 people (25.0%), while those who were not at risk were 45 people (75.0%). On the other hand, respondents who did not experience preeclampsia at risk were 2 people (3.3%) and 58 people who were not at risk (96.7%). The results of statistical tests to assess the correlation between age and preeclampsia show a value of ρ (p-value) = 0.001 ($\rho < 0.05$), indicating that there is a significant correlation between age at risk and the incidence of preeclampsia. From this analysis, an Odds Ratio (OR) was found to be 9.667, which means that mothers at risk age have a 10 times greater chance of experiencing preeclampsia[16].

The age of 20-35 years is considered optimal for pregnancy and childbirth. In this age range, the reproductive organs have reached maturity and are ready to accept pregnancy, with a lower chance of problems occurring during the pregnancy process. On the other hand, women under the age of 20 are at risk of experiencing preeclampsia during pregnancy because the reproductive organs are not yet fully mature. On the other hand, pregnant women after the age of 35 years are more susceptible to preeclampsia due to changes in body tissue elasticity that occur with age[17].

The frequency distribution of characteristics of pregnant women based on education showed that in the group of cases of pregnant women with preeclampsia, 29 (87.9%) had a high school education. Meanwhile, for the control group, the percentage of pregnant women without preeclampsia was 22 (66.7%), namely high school education.

The results of the study showed that pregnant women with basic education levels (SD-SMP) had a 4.1 times higher risk of experiencing preeclampsia during pregnancy, and this relationship was significant (p=0.004). The educational level of pregnant women plays an important role in determining maternal knowledge, especially regarding diet. The diet of pregnant women in turn influences the possibility of preeclampsia during pregnancy. There was a significant correlation between diet and the incidence of hypertension in pregnant women in the Kamonji Community Health Center area, West Palu District, with a ρ value of 0.012[18].

Based on table 2, the results of the examination of the group of cases or mothers with preeclampsia showed that the entire sample, namely 33 (100%) pregnant women who underwent examination, had a MAP (+) value, namely≥90. That MAP can be positive if the result is≥90 mmHg, and can be negative if the result is <90mmHg[19].

Hypertension in pregnancy arises due to receptor responses to changes in blood pressure, especially through the baroreceptor reflex located in the carotid sinus and aortic arch. In the case of hypertension, genetic disorders and environmental factors cause neurohormonal disorders, involving the central nervous system and the renin-angiotensin-aldosterone (RAA) system. This process also involves inflammation and insulin resistance. Insulin resistance and neurohormonal disturbances result in systemic vasoconstriction and increased peripheral resistance. Inflammatory processes also contribute to impaired renal function which, along with abnormalities in the RAA system, results in salt and water retention in the kidneys, which in turn increases blood volume. The combination of increased peripheral resistance and blood volume are the two main factors that trigger hypertension[20].

Based on *American College of Obstetricians and Gynecologists*, 2013 (ACOG) that preeclampsia can be seen from an increase in blood pressure measurements, a person can be said to be preeclamptic if they have blood pressure≥140 /90 mmHg. That pregnant women who experience hypertension have a higher risk of experiencing various complications, including preeclampsia, eclampsia, HELLP syndrome, placental detachment, liver failure, kidney failure, and difficulty breathing[21].

Patients with preeclampsia (95.6%) had MAP screening results.≥90 mmHg compared to patients without preeclampsia, namely (40%). Another research conducted by Lushinta (2021) showed results from 50 respondents, there were 40 mothers (80%) who were MAP positive and 10 mothers (20%) who were MAP negative[14].

Based on various research results, it can be concluded that pregnant women with preeclampsia tend to have positive MAP values, this is related to blood pressure which is also related to preeclampsia. Because increased blood pressure is one of the signs of preeclampsia.

On the other hand, the results of examinations in the control group or pregnant women who did not suffer from preeclampsia showed that 29 (87.9%) pregnant women had positive MAP values or≥90 and as many as 4 (12.1%) pregnant women had negative MAP values. If you look at it, the control group of pregnant women who were researched were pregnant women with a gestational age of <20 weeks. Based on theory it can be seen that Pregnant women who experience physiological conditions experience an increase in blood volume of around 50% until they reach 34 weeks of gestation, which is followed by an increase in cardiac output of around 40%. This increase aims to prevent systemic vascular resistance, which may be caused by an increase in peripheral vasodilation of around 25–30% [22].

Not all pregnant women are able to adapt to the physiological changes that occur in their bodies. This causes physiological changes to become pathological. Pregnant women who cannot accommodate physiological changes in their cardiovascular system can cause an imbalance between blood volume and cardiac output resulting in peripheral vasodilation[23]. As a result, the force of blood against the walls of blood vessels is disturbed, and as a result, the MAP (Mean Arterial Pressure) value increases, which is followed by an increase in blood pressure.

Apart from other things such as blood pressure, according to the results of

the Obstetric and Gynecology Survey conducted by Raymond and Peterson in 2011, preeclampsia was found before 34 weeks of pregnancy or Early Onset Preeclampsia caused by invasion of the baby's placenta such as IUGR, fetal distress, complications in the mother such as multiple disorders. organ and utero-placental disorders.

There was a significant relationship between monitoring average blood pressure (MAP) at a gestational age of less than 20 weeks and the incidence of preeclampsia, with the valueρ= 0.001 (ρ < 0.05). In line with research by Poon, et al (2014) conducted on 5,590 mothers who underwent routine pregnancy checks, it was found that early detection of preeclampsia at 11-13 weeks of gestation could identify 95% of preeclampsia cases with a false positive rate of 10% [24].

Based on table 3, regarding the relationship between MAP examination and the incidence of preeclampsia, statistical test results were obtained using the Chi Square Fisher Exact test with a confidence level of 95% (α= 5) Exact value results are obtained. Sig. (2-Sided) is 0.000 (Exact. Sig (2-Sided) < 0.05),so this shows that there is a significant relationshipstatistically between MAP examination and the incidence of preeclampsia at RSU PKU Muhammadiyah Delangguin the period January – December 2022.

That from the chi-square test analysis regarding the relationship between Mean Arterial Pressure (MAP) and preeclampsia in pregnant women, a ρ (p-value) value of 0.002 (<0.05) was found. This shows the rejection of the null hypothesis (Ho) and acceptance of the alternative hypothesis (Ha), which means there is a relationship between Mean Arterial Pressure (MAP) and preeclampsia in pregnant women. A higher MAP value correlates with an increased risk of preeclampsia in pregnant women[25].

Pregnant women who received screening results for Mean Arterial Pressure (MAP) ≥ 90 mmHg had a higher proportion, namely 62%, of preeclampsia patients compared to patients who 28% did not experience preeclampsia. Through analysis using the chi-square test, it was found that there was a significant relationship between MAP screening at gestational age <20 weeks and the incidence of preeclampsia (ρ value = 0.001, OR = 4.195). These results conclude that pregnant women at <20 weeks' gestation who have MAP screening results ≥ 90 mmHg have a four times higher risk of experiencing preeclampsia compared to those who do not experience preeclampsia[24].

The optimal threshold value for predicting the possibility of preeclampsia, which occurs at various gestational ages, in a simple model in the Indonesian population is 63%. With a sensitivity value of 71.8% and specificity of 71.2%. Meanwhile, for the reference model, the sensitivity reached 70.4%, and the specificity was 74.9%, using a threshold value of 58%.The area under the curve for the simple model was 0.7651 (95% CI: 0.7023-0.8279)) and the reference model was 0.7911 (95% CI: 0.7312-0.8511) in predicting preeclampsia[26].

Based on the calculations carried out in this study, the odds ratio for preeclamptic pregnant women who have positive Mean Arterial Pressure (MAP) results for the incidence of preeclampsia cannot be calculated. This condition occurs because the value of C in the equation is zero. The presence of this zero value causes the denominator in the equation to also be zero. In this context, when the denominator of a fraction has a value of zero, the fraction becomes undefined. This condition arises due to a lack of variation in the sample, where the number of preeclamptic pregnant women who have negative MAP results is zero.$\frac{AxD}{BxC}$

Based on the explanation above, research on the relationship between mean arterial pressure examination and the

incidence of preeclampsia at RSU PKU Muhammadiyah Delanggu, found that MAP is related to the incidence of preeclampsia, namely to detect the presence of blood pressure which is one of the basics for diagnosing preeclampsia.

CONCLUSION

Preeclampsia is a medical condition that can be identified at an early stage, allowing for preventive measures to be taken to prevent complications. Preeclampsia can harm pregnant women and also harm the condition of the fetus through the placenta. Based on research regarding the effectiveness of mean arterial pressure (MAP) examinations on the incidence of preeclampsia carried out at RSU PKU Muhammadiyah Delanggu Klaten, the following conclusions can be drawn: The incidence of preeclampsia at RSU PKU Muhammadiyah Delanggu was 99 people (19.0%) pregnant women. Characteristics of pregnant women include parity, age and education level. In pregnant women with preeclampsia, the dominant parity was primigravida, namely 25 (75.8%), the majority were aged 20-35 years or age not at risk, 25 (75.8%), and the majority had a high school education, namely 29 (87, 9%). Meanwhile, the characteristics of preeclampsia are not the same in pregnant women. At parity, the majority were primigravidas, namely 29 (87.9%), the dominant age was 20-35 years or non-risk age, namely 24 (72.7%) and the majority had a high school education, namely 22 (66.7%). The results of MAP examination in pregnant women with preeclampsia and pregnant women without preeclampsia with the majority results being MAP (+) were 33 (100.0%) and 29 (87.9%) respectively. *Mean Arterial Pressure*(MAP) is related to the incidence of preeclampsia, especially to detect the presence of blood pressure which is one of the basics for diagnosing preeclampsia, shown by the value ($p < 0.05$).

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