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The relationship between blood albumin and the incidence of preeclampsia in pregnant women

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Abstract

Maternal Mortality Rate (MMR) is one of the important indicators of public health status. Maternal Mortality Rate (MMR) in West Kalimantan Province was 131 cases. The cause of this maternal mortality rate (22.61%) is hypertension in pregnancy. If pregnant women experience a lack of albumin levels (Hypoalbuminemia) then fetal development will be hampered, it can even cause babies to be born malnourished. Pregnant women who have low albumin levels will have a higher risk of preeclampsia. The purpose of this study was to determine the relationship between blood albumin and the incidence of preeclampsia in pregnant women and examine blood albumin as a risk factor for the incidence of preeclampsia in pregnant women. This research method is descriptive analytic with a cross-sectional approach, The population of this study were pregnant women who performed pregnancy checks at the Tanjungpura University Pratama Clinic. The sampling technique used was Incidental Sampling with a sample size of 43 respondents. The results of the analysis using the Chi-Square test obtained a p-value on Fisher's Exact Test of 0.001 with a sig limit (<0.05). And obtained the odd risk value in the risk estimate table of 20.3. The conclusion of this study shows that there is an association between blood albumin and the incidence of preeclampsia. And blood albumin can be used as a risk factor for the occurrence of preeclampsia in pregnant women.

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INTRODUCTION

Pregnancy is a normal, natural process for a woman, as long as there are only physical, mental and social changes. High-risk pregnancies are pregnancies that must be detected early because they can cause risks or problems for the mother and fetus. Problems can occur during pregnancy, or the postpartum period. This condition can occur due to pregnancy complications and even the mother's condition before pregnancy (Alvionita, et. al, 2023). Maternal mortality rate (MMR) is an important metric for assessing public health conditions. Based on Maternal Perinatal Death Notification (MPDN) data dated September 21, 2021, the top three causes of maternal deaths are Eclampsia (37.1%), Hemorrhage (27.3%), and Infection (10.4%). In 2020, the Maternal Mortality Rate (MMR) in West Kalimantan Province was 131 cases. The causes of maternal mortality cases include bleeding (34.78%), followed by other causes or indirect factors / comorbidities (26.96%), hypertension in pregnancy (22.61%), metabolic disorders (6.96%), circulatory system disorders (4.35%) and infections (4.35%) (Dinas Kesehatan Provinnsi Kalimantan Barat, 2020).

The risk of complications during pregnancy is experienced by women with high pregnancy risk factors. Preeclampsia and eclampsia are one of the complications of pregnancy caused by pregnancy itself, but the cause of preeclampsia is still unclear. The incidence of preeclampsia in pregnant women should receive special attention, in order to achieve success indicators in the health sector by reducing the incidence of morbidity and mortality due to preeclampsia (Apriyani, et. al., 2022). Preeclampsia or hypertension in pregnancy is often referred to as gestational hypertension which is characterized by an increase in blood pressure during pregnancy ≥140/90 mmHg, and sometimes accompanied by the presence of protein in the urine (proteinuria) after 20 weeks of gestation. It was found that maternal age 15-20 years, pregnancy from a new partner, diabetes before pregnancy, family history of hypertension, history of hypertension in previous pregnancies, husband's age more than 45 years, and multi-fetal pregnancy were significantly associated with the incidence of severe preeclampsia. One strategy to reduce maternal mortality is prevent or reduce the possibility of pregnant women experiencing complications in pregnancy and childbirth. Early detection and prevention of complications in pregnancy can be done by paying attention to factors that can lead to complications in pregnancy. Factors that can be seen include blood pressure, and urine protein (Ismawati, et. al., 2023).

Pregnancy hypertension causes hypoperfusion of vital organs such as the placenta and kidneys. Endothelial damage is characterized by morphological lesions typical of preeclampsia, such as glomerular endotheliosis and ultrastructural changes in the placental lining and uterine blood vessels (Pramatirta & Krisnadi, 2023). Obstetric complications are known as pregnancy-induced hypertension. There are significant negative impacts on the mother, some of which cause serious illness or death in the mother. Both pharmacologically and nonpharmacologically, efforts are made to keep blood pressure normal in order to avoid these complications (Alatas, 2019) . In addition to hypertension, one of the signs of preeclampsia is proteinuria. Proteinuria can be caused by an increase in the amount of protein filtered by the glomerulus and a decrease in the capacity of the renal tubules to absorb the filtered protein. As a result, the tubules are unable to absorb all the protein. However, tubular cells continue to remove protein from the lumen fluid, which is excreted with urine (Savithri & Ananda, 2020). The presence of protein in the urine before hypertension is usually a sign of kidney disease, so it is likely a complication of pregnancy. Proteinuria is the last symptom experienced by preeclampsia patients (Arum, et. al., 2021). Massive proteinuria causes hypoalbuminemia. Hypoalbuminemia is a condition where blood albumin levels are below normal levels. Increased reabsorption and catabolism of albumin in the proximal tubules causes low albumin levels. Serum albumin will decrease with

increased intake due to increased protein passing through the urine and increased glomerular pressure (Pahlevi et al., 2014).

When compared to non-pregnant people, renal blood flow and glomerular filtration rate increase during pregnancy. From the first to the third trimester, albumin levels decrease during pregnancy, with the greatest decrease occurring in the third trimester. The increased fetal need for protein and its use can also contribute to the decline (Yahnun, 2021). Fetal development will be hampered and the baby can even be born malnourished if the pregnant mother experiences hypoalbuminemia. Low albumin levels in the blood can also have an impact on fetal development and cause problems during pregnancy. Preeclampsia is more likely to occur in pregnant women with albumin levels below normal. Seizures, high blood pressure, and tissue fluid edema are some of the symptoms (Deshmukh et al., 2021; Mathews et al., 2021; Zoccarato et al., 2021; Suarez-Meade et al., 2022; Nickson 2023; Świercz et al., 2024). In Turrahmi's research (2023), 13 of 82 (15.9%) respondents with albumin <4 mg/dL experienced preeclampsia, while only 1 of 85 (1.2%) experienced preeclampsia in respondents with albumin ≥4 mg/dL. Statistical analysis found a significant relationship between albumin levels and preeclampsia. Respondents with albumin < 4mg/dL significantly had a risk of 13.48 times suffering from preeclampsia compared to respondents with albumin ≥4. Research conducted by Yahnun (2021) obtained results from three journals that there is a similarity in reduced albumin levels in third trimester pregnant women. Albumin levels below normal values occur because during pregnancy there is a lack of protein intake in pregnant women and invasive placental implantation.

METHOD

This research is descriptive analytic with Cross-sectional approach. The population used in this study were pregnant women who performed pregnancy checks at the Tanjungpura University Pratama Clinic. Based on the initial research of researchers in 2023 pregnant women who made visits were 442 pregnant women with an average per month in 2023 there were 37 visits by pregnant women. The sample used in this study was based on the inclusion and exclusion criteria determined by the researcher. The sample size was determined using the Slovin formula and obtained a sample size of 34 samples. The sampling method used was incidental sampling. The type of data used in this study is primary data obtained directly from examinations of pregnant women who conduct examinations at Tanjungpura University Clinic. The data was then analyzed by unibvariate and bivariate analysis.

RESULTS AND DISCUSSION

Table 1. Blood pressure distribution of pregnant women.

Blood Pressure	Frequency	Percentage (%)
Hypertension	9	20.9
No Hypertension	34	79.1
Total	43	100.0

Table 1 describes the distribution of blood pressure of pregnant women with a total of 43 respondents, where the blood pressure of pregnant women who are hypertensive is 9 people (20.9%) and the blood pressure of pregnant women who are not hypertensive is 34 people (79.1%). And what is meant by Hypertension blood pressure here is blood pressure ≥140/90 mmHg.

Table 2. Urine protein distribution of pregnant women.

Urine Protein	Frequency	Percentage (%)
Positive	9	20.9
Negative	34	79.1
Total	43	100.0

Table 2 describes the distribution of urine protein of pregnant women with a total of 43 respondents, where the positive urine protein of pregnant women is 9 people (20.9%), and the negative urine protein of pregnant women is 34 people (79.1%).

Table 3. Distribution of Preeclampsia in Pregnant Women

Incidence of Preeclampsia	Frequency	Percentage (%)
Yes	9	20.9
No	34	79.1
Total	43	100.0

Table 3 describes the distribution of the incidence of preeclampsia in pregnant women with a total of 43 respondents, where pregnant women who experienced preeclampsia were 9 people (20.9%), and pregnant women who did not experience preeclampsia were 34 people (79.1%).

Table 4. Distribution of Pregnant Women's Blood Albumin

Blood Albumin	Frequency	Percentage (%)
Not Normal	12	27.9
Normal	31	72.1
Total	43	100.0

Table 4 describes the distribution of blood albumin in pregnant women with a total of 43 respondents, where the blood albumin of pregnant women who are not normal is 12 people (27.9%), and the blood albumin of normal pregnant women is 31 people (72.1%).

Table 5. Crosstab Results of Blood Albumin with Preeclampsia Incidence

Status		Preeclampsia					
		Preeclampsia		Non Preeclampsia		Total	
		N	%	N	%	N	%
Blood Albumin	Not Normal	7	77.8	5	14.7	12	28
	Normal	2	22.2	29	85.3	31	72
	Total	9	100	34	100	43	100

Table 5 shows that there are 12 pregnant women who have abnormal blood albumin values, 7 people (77.8%) are pregnant women with preeclampsia status, while 5 people (14.7%) with non preeclampsia status. In contrast, of the 31 pregnant women who had normal blood albumin values, only 2 (22.2%) pregnant women experienced preeclampsia, while 29 (85.3%) were pregnant women with non preeclampsia status. This data shows that pregnant women with preeclampsia status tend to have abnormal blood albumin compared to pregnant women with non preeclampsia status, where this abnormal blood albumin is below the normal range of values or can be said to be *hypoalbuminemia.*

Table 6. Chi-Square Analysis of the Relationship between Blood Albumin and the Incidence of Preeclampsia in Pregnant Women

Chi-Square Test					
	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.071[a]	1	0.000		
Continuity Correction[b]	11.110	1	0.001		
Likelihood Ratio	12.989	1	0.000		
Fisher's Exact				0.001	0.001

Test			
Linear-by-Linear Association	13.744	1	0.000
N of Valid Cases	43		

a. *1 cell (25%) has an expected count less than 5. The minimum expected count is 2.51.*
b. *b. Computed only for a 2x2 table*

Based on this table, the analysis of blood albumin and the incidence of preeclampsia uses a 2 x 2 table, but table 5. shows 1 cell with an expected value <5, meaning that there is an expected value smaller than 5 with a minimum expected value of 2.51. Then the Chi-square test requirements are not met, so what is read is the sig value on the *Fisher's Exact Test.* The results of the analysis using the *Chi-Square test,* on the *Fisher's Exact Test*, obtained a p-value or sig. of 0.001, using an alpha of 0.05, the p-value ≤ 0.05. Thus there is a significant relationship between blood albumin and the incidence of preeclampsia in pregnant women. The results of the analysis using the *Chi-Square test,* the *Fisher's Exact Test* obtained a p-value or sig. of 0.001, using an alpha of 0.05, the p-value ≤ 0.05. Thus there is a significant relationship between blood albumin and the incidence of preeclampsia in pregnant women .

Table 7. Risk Estimate of Blood Albumin Risk Factor for Preeclampsia

		95% Confidence Interval	
		Lower	Upper
Odds Ratio for Blood Albumin (Not normal/ Normal)	20.300	3.237	127.288
N of Valid Cases	43		

Based on table 7, the Odds ratio value is 20.3, where pregnant women with abnormal albumin will be at risk of preeclampsia by 20.3 times compared to pregnant women with normal blood albumin. Where in this study abnormal blood albumin is blood albumin below the normal range of values or can be said to be *hypoalbuminemia.*

DISCUSSION

Based on research conducted on 43 pregnant women respondents, 9 people (20.9%) experienced preeclampsia and 34 people (79.1%) who did not experience preeclampsia. Because in this study not all pregnant women fall into the category of preeclampsia, which is categorized as preeclampsia if pregnant women have high blood pressure and proteinuria. Of the 9 people who experienced preeclampsia, there was a decrease in blood albumin value in 7 pregnant women. Which in this study preeclampsia occurs in pregnant women with second trimester and third trimester gestational age. Preeclampsia is associated with excessive inflammation and albumin can play a role in reducing inflammation. When albumin levels are low, fluid tends to escape from the blood vessels into the tissues, including the placenta. This can disrupt the function of the placenta and lead to stunted fetal growth. Placental damage can also interfere with protein production, including albumin. Therefore, low albumin levels can worsen inflammatory conditions in pregnant women with preeclampsia.

According to a book written by Akbar, Tjokroprawiro, and Hendarto, (2020) protein leakage that occurs in preeclampsia is caused by renal vasopasm. So that the proteinuria that occurs can reduce serum albumin levels and result in a decrease in oncotic pressure as one of the causes of the release of intravascular fluid to the extravascular. According to (Veronika et al., 2015) due to renal artery spasm, there is a decrease in the glomerular filtration rate in the kidney, causing protein absorption to decrease, resulting in proteinuria.

There is also a decrease in serum albumin (hypoalbuminemia), which results in a decrease in intravascular hypovolemic pressure. According to the book written by Trisnawati (2023) the decrease in glomerular filtration rate in pregnant women is due to typical lesions in the kidneys, especially in glomerulo endotheliosis, namely swelling of the glomerular endothelial capillaries. Proteinuria, a renal disorder in preeclampsia, is caused by salt and water retention. Due to spasm of the renal arterioles, the rate of sodium filtration in the glomerulus slows down, resulting in salt and water retention. Due to increased reabsorption in the tubules, preeclamptic patients have decreased urinary excretion of calcium.

In addition to pregnant women who experience preeclampsia, this study also found a decrease in blood albumin experienced by 5 pregnant women with gestational age in the third trimester and not experiencing preeclampsia. Thus, a decrease in blood albumin does not only occur in pregnant women who experience preeclampsia, but can also occur in pregnant women in normal conditions. Based on a book written by Afriyanti et al. (2022) during pregnancy there is an increase in the volume of body fluids in pregnant women. The body fluid that has increased is greater in the fetus (60%) which is distributed in the placenta, amniotic fluid and fetal tissue. The remaining increased fluid volume (40%) occurs in the mother's body tissues. effect of the increase in body fluids is the occurrence of *hypoalbuminemia* in pregnant women. According to Savithri and Ananda, (2020) albumin levels in pregnant women decrease in the first to third trimester, with the greatest decrease occurring in the third trimester. Before the second trimester ends, cytotrophoblasts line the uterine spiral artery and endothelial cells are no longer present in the endometrium or superficial part of the myometrium. Remodeling of the uterine spiral artery creates a system of arterioles with low resistance and a significant increase in blood supply for fetal needs.

Based on the results of research conducted using the *Chi Square* statistical test and obtained a significant value between blood albumin and the incidence of preeclampsia in pregnant women is 0.001< 0.05. It can be concluded that the Alternative Hypothesis (Ha) is accepted, which means that there is a significant relationship between blood albumin and the incidence of preeclampsia in pregnant women. In the *Risk Estimate* test of blood albumin as a risk factor for preeclampsia, it was found that the Odds of pregnant women with abnormal albumin values were 20.3 times greater than the Odds of pregnant women with normal albumin values. Then it was concluded that pregnant women with abnormal albumin had a 20.3 times risk of preeclampsia compared to pregnant women with normal blood albumin. In this study, what is meant by abnormal blood albumin is blood albumin below normal values or called *hypoalbuminemia.* So that blood albumin can be used as a risk factor for preeclampsia in pregnant women.

The pregnant women with albumin < 4mg/dL significantly have a risk of 13.48 times suffering from preeclampsia compared to respondents with albumin ≥ 4. Serum albumin is inversely related to oxidative stress but positively related to endothelial function in pregnant women. Serum albumin levels can be used as an important determinant of vascular oxidative stress in several diseases, one of which is preeclampsia. In another study conducted by Yahnun (2021), showed that the decrease in albumin levels experienced by pregnant women in the third trimester is a significant similarity between the research findings of the three references. Low intake of nutrients, especially protein consumed during pregnancy, can cause a decrease in albumin. The blood albumin levels of pregnant women can reveal the root causes of nutritional disorders.

CONCLUSION

Of the 43 pregnant women respondents, 9 people (20.9%) experienced preeclampsia and 34 people (79.1%) who did not experience preeclampsia. Chi Square statistical test results obtained a significant value of 0.001 <0.05. Which means there is a significant

relationship between blood albumin and the incidence of preeclampsia in pregnant women. The risk estimate test results obtained an Odds ratio value of 20.3, which means that pregnant women with abnormal albumin have a risk of 20.3 times experiencing preeclampsia compared to pregnant women with normal blood albumin. So that blood albumin can be used as a risk factor for preeclampsia in pregnant women.

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