

## The most influencing factors of the incidence of Preeclampsia at Public Health Center Sidosermo Surabaya

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### Abstract

Maternal Mortality Rate in Indonesia is the highest in Southeast Asian countries. The main reason of maternal mortality in Indonesia is preeclampsia, which is the prevalence up to 5,3%. Aims : to analyze the risk factors of preeclampsia at Public Health Center Sidosermo Surabaya in 2023. Methods: This research method is analytic observational with case control design. The number of samples is 93 by using simple random sampling, which are 31 samples cases and 62 samples control. Independent variables in this research are age, BMI, frequency of ANC, hemoglobin levels in first trimester, high glucose levels in first trimester. Dependent variable is incident of preeclampsia. Data was analyzed by using chi square, Fisher exact and regression tests logistics. Data was taken from medical records of Public Health Center Sidosermo Surabaya in 2023. Research results: Bivariate test results: There is significant correlation between age and preeclampsia, There is significant correlation between BMI and preeclampsia, There is significant correlation between frequency of ANC and preeclampsia, There is significant correlation between hemoglobin levels in first trimester and preeclampsia, There is significant correlation between glucose levels in first trimester and preeclampsia. Multivariate test results: Mother's age, BMI, ANC frequency, hemoglobin levels in first trimester, and glucose levels in first trimester had simultaneous effect to incident of preeclampsia amount to 63,5%. Conclusion: BMI is the most influencing factors of incident of preeclampsia at Public Health Center Sidosermo Surabaya in 2023.

**Keywords:** Preeclampsia; Risk factor; BMI; Frequency of ANC; Hemoglobin levels; Glucose levels

### 1 Introduction

The high maternal mortality rate (MMR) is still a health problem in Indonesia and also reflects the quality of health services during pregnancy and puerperium. The Maternal Mortality Rate (MMR) in Indonesia is the highest in Southeast Asian countries [1]. Based on the results of Litbangkes Sample Registration System (SRS) in 2016, the three main causes of maternal death were hypertensive disorders (33.07%), obstetric bleeding (27.03%) and non-obstetric complications (15.7%). Preeclampsia is a multi-systemic disorder that occurs in pregnancy which is characterized by hypertension and edema, and can be accompanied by proteinuria, usually occurring at  $\geq 20$  weeks of pregnancy or in the third trimester of pregnancy, or can occur immediately after delivery [5]. The causes of hypertension in pregnancy are not yet clearly known, so preeclampsia is currently referred to as a "disease of theory" [4]. Preeclampsia initially does not give symptoms and signs, but at some point it can get worse quickly. It has been proven that there are quite a few patients who, during a pregnancy check-up, have test results within normal limits, but when approaching delivery suddenly experience symptoms of preeclampsia [4], even if they do not receive good treatment, it will result in the death of both mother and baby. Preeclampsia also contributes to a large number of infant morbidity and mortality rates. How could it not be, the systemic disorders that occur in cases of preeclampsia greatly influence the incidence of IUGR (Intra Uterine Growth Restriction), in fact quite a few babies have to be born prematurely to save the mother's life because the mother's condition worsens with preeclampsia. Not only that, women with a history of preeclampsia have a risk of

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cardiovascular disease, 4x the increase in hypertension and 2x the risk of systemic heart disease, stroke and DVT (Deep Vein Thrombosis) in the future [1]. Primary prevention to reduce the incidence of preeclampsia in the city of Surabaya has also been carried out optimally, however the number of preeclampsia incidents in the city of Surabaya is still large, which in 2023 there are 1,663 cases while the number of preeclampsia incidents in Public Health Center Sidosermo Surabaya in 2023 is 71 cases, so it contributes 4.27% of the number of cases. In fact, this number has increased, where in 2022 it will only reach 42 cases. The prevalence of preeclampsia at Public Health Center Sidosermo Surabaya in 2022 is 6.2%, while in 2023 it is 10.49%

## 2 Material and methods

This research method is analytic observational with case control design. Data was taken from medical records of Public Health Center Sidosermo Surabaya from January to december 2023. The number of samples is 93 by using simple random sampling, which are 31 samples cases (pregnant women who experienced preeclampsia) and 62 samples control (pregnant women who did not experience preeclampsia). Independent variables in this research are age, parity, BMI, frequency of ANC, hemoglobin levels in first trimester, high glucose levels in first trimester. Dependent variable is incident of preeclampsia. Data was analyzed by using chi square, Fisher exact and regression tests logistics.

## 3 Results and discussion

### 3.1 Univariate analysis

**Table 1** Frequency distribution of factors that influence the incidence of preeclampsia at Public Health Center Sidosermo Surabaya

Category	Case		Control		Total	
	(F)	(%)	(F)	(%)	(F)	(%)
<b>Age</b>						
> 35th	9	29	5	8.1	14	15.1
< 20 th	1	3.2	4	6.5	5	5.4
20-35 th	21	67.7	53	85.5	74	79.6
<b>BMI</b>						
Obesity (>30)	16	51.6	9	14.5	25	26.9
Overweight (25-29,9)	11	35.5	9	14.5	20	21.5
Thin (18,5-24,9)	0	0	6	9.7	6	6.5
Normal (<18,5)	4	12.9	38	63.3	42	45.2
<b>Frequency of ANC (antenatal care)</b>						
< 6x	24	77.4	19	30.6	43	46.2
≥ 6x	7	22.6	43	69.4	50	53.8
<b>Hemoglobin levels in 1<sup>st</sup> trimester</b>						
High Levels ( ≥13,2 gr%)	19	61.3	18	29.0	37	39.8
Anemia (11-13,1 gr%)	3	9.7	14	22.6	17	18.3
Normal (<11 gr%)	9	29.0	30	48.4	39	41.9
<b>Glucose levels in 1<sup>st</sup> trimester</b>						
High Glucose ( >200mg/dl)	5	16.1	0	0	5	5.4
Normal Glucose ( <200mg/dl)	26	83.9	62	100	88	94.6
<b>Total</b>	<b>31</b>	<b>100</b>	<b>62</b>	<b>100</b>	<b>93</b>	<b>100</b>

### 3.2 Bivariate analysis

#### 3.2.1 The correlation between mother's age and the incidence of preeclampsia at Public Health Sidosermo Surabaya

**Table 2** Cross Tabulation of the Relationship between age and incidence of preeclampsia at Public Health Sidosermo Surabaya

Age	Case		Control		Total		Fisher Exact test	
	F	(%)	F	%	N	%	<i>p</i>	<i>c</i>
>35th	9	29	5	8.1	14	15.1	0.021	0.269
< 20th	1	3.2	4	6.5	5	5.4		
20-35th	21	67.7	53	85.5	74	79.6		
Total	31	100	62	100	93	100		

Based on table 2, it is known that the calculation results using Fisher exact test obtained  $p$  value = 0.021. The significance of  $p \leq \alpha$  (0.05), then the results of the analysis show that there is a significant correlation between mother's age and the incidence of preeclampsia at Public Health Sidosermo Surabaya, where the contingency coefficient value is 0.269. This value shows that the relationship between maternal age and the incidence of preeclampsia is classified as a weak correlation. The results of this research are in accordance with existing theory. Age is an important part of reproductive status. Age is related to increasing or decreasing body work, which affects a person's health status. The best pregnancy is when the woman's age is in the range of 20-35 years. One of the factors causing preeclampsia is pregnant women aged < 20 years and > 35 years [2]. A mother who is too young (<20 years) has a big risk of developing preeclampsia, this is because from a biological perspective the development of her reproductive organs is not optimal. Meanwhile, when the mother is >35 years old, a degenerative process occurs which results in structural and functional changes occurring in the peripheral blood vessels which results in changes in blood pressure. The high number of cases of hypertension is in line with increasing age, this is caused by changes in the structure of large blood vessels, so that the lumen becomes narrow and the blood vessel walls become stiffer, as a result of which systolic blood pressure increases [8]. This is in line with the results of this research which show that the number of respondents aged 35 years in the case group was 29% while in the control group it was only 8.1%.

The results of this research also show that in both the case and control groups, most of the respondents were in the 20-35 year age range. This is normal because the majority of Indonesian people get pregnant at reproductive age (20-35 th ). This should be of concern to midwives that it is true that those aged > 35 years are more at risk of developing preeclampsia, but cases of preeclampsia also often occur at the age of 20-35 years while still paying attention to other possible risk factors, so it is important for midwives to have screening for risk factors for preeclampsia in pregnant women in the 1<sup>st</sup> trimester properly and correctly.

#### 3.2.2 The correlation between BMI and the incidence of preeclampsia at Public Health Sidosermo Surabaya

**Table 3** Cross Tabulation of the Relationship between BMI and incidence of preeclampsia at Public Health Sidosermo Surabaya

BMI	Case		Control		Total		Uji Fisher Exact	
	(F)	(%)	(F)	(%)	(F)	(%)	<i>p</i>	<i>c</i>
Obesity (>30)	16	51.6	9	14.5	25	26.9		
Overweight (25-29,9)	11	35.5	9	14.5	20	21.5	< 0.001	0.484
Thin (18,5-24,9)	0	0	6	9.7	6	6.5		
Normal (<18,5)	4	12.9	38	63.3	42	45.2		
Total	31	100	62	100	93	100		

Based on table 3, it is known that the calculation results using the Fisher exact test obtained  $p$  value  $<0.001$ . The significance of  $p \leq \alpha$  (0.05), then the results of the analysis show that there is a significant correlation between BMI and the incidence of preeclampsia at Public Health Sidosermo Surabaya, where the contingency coefficient value is 0.484. This value shows that the correlation between BMI and the incidence of preeclampsia is classified as a correlation in the moderate category. This is in line with the theory put forward by the Ministry of Health [1] that obesity is a risk factor for preeclampsia and the risk increases with increasing BMI. Obesity is strongly associated with insulin resistance, which is also a risk factor for preeclampsia. Obesity increases the risk of preeclampsia by 2.47 times (95% CI, 1.66 – 3.67)

In theory, it is explained that obesity is related to oxidative stress and inflammatory responses. The inflammatory response was found to be increased in women with obesity and contributes to vascular targeting and vascular changes associated with preeclampsia [6]. Oxidative stress is characterized by the presence of reactive oxygen and free radicals which will cause the formation of lipid peroxide. The next event is the release of free radical toxins which will damage endothelial cells, produce NO products, and disrupt the balance of prostaglandins. Other events resulting from oxidative stress are the formation of bubble cells in atherosclerosis, activation of intravascular coagulation (this is what causes the appearance of thrombocytopenia in preeclampsia patients), and increased cell membrane permeability which then manifests in edema and proteinuria in preeclampsia patients. Fat peroxide as a very toxic oxidant will circulate throughout the body in the bloodstream and will damage the endothelial cell membrane. Endothelial cell membranes are more easily damaged by fat peroxide because they are directly connected to the bloodstream and contain many unsaturated fatty acids. Unsaturated fatty acids are very susceptible to hydroxyl radicals, which will turn into fat peroxide [5]. Meanwhile, in nutritional deficiency theory, it is said that consuming foods that contain lots of unsaturated fatty acids can inhibit thromboxane production, inhibit platelet activation and prevent vasoconstriction of blood vessels, thereby reducing the risk of preeclampsia [9].

This research shows the results that in the case group, most had a BMI in the obesity category, whereas in the control group, on the contrary, most had a BMI in the normal category. This real difference between the case group and the control group shows that the results of this research are in accordance with existing theory. We hoped that the results of this research will be a motivation for midwives in providing future bride reproductive services, especially if there is a future bride who has a BMI in the overweight or obese categories to adopt a healthy lifestyle so that their weight drops to a normal BMI before planning a pregnancy.

### 3.2.3 The correlation between Frequency of ANC (antenatal care) and the incidence of preeclampsia at Public Health Sidosermo Surabaya

**Table 4** Cross Tabulation of the Relationship between frequency of ANC and incidence of preeclampsia at Public Health Sidosermo Surabaya

Frequency of ANC	Case		Control		Total		Chi square test	
	(F)	(%)	(F)	(%)	(F)	%	$p$	$c$
< 6x	24	77.4	19	30.6	43	46.2	< 0.001	0.404
$\geq$ 6x	7	22.6	43	69.4	50	53.8		
Total	31	100	62	100	93	100		

Based on table 4, it is known that the results of calculations using the chi square test obtained a  $p$  value  $<0.001$ . The significance of  $p \leq \alpha$  (0.05), then the results of the analysis show that there is a significant relationship between the frequency of ANC and the incidence of preeclampsia at the Sidosermo Community Health Center, Surabaya, where the contingency coefficient value is 0.404. This value shows that the relationship between ANC frequency and the incidence of preeclampsia is classified as a correlation in the moderate category. This is in line with the theory put forward by the Ministry of Health [1] that frequency of ANC is related to incidence of Preeclampsia, through antenatal examinations can prevent the development of preeclampsia, because the purpose of antenatal examinations is to early recognize any complications that occur during pregnancy. Based on guidelines, ANC is carried out at least 6x during pregnancy, which are minimum visit of 1x in the first trimester, minimum visit of 2x in the second trimester and minimum visit of 3x in the third trimester, whereas according to the results of this research, most of the respondents in the case group either in control group have antenatal examinations on second trimester, some even had their first visit in the third trimester. Most respondents in the case group did not make an ANC visit in the first trimester. This make it clear that the frequency

of ANC affects the incidence of preeclampsia because if it is detected early, especially during the first trimester, early prevention can be carried out such as giving aspirin and 1000 mg calcium to prevent preeclampsia.

The cadre empowerment program to reduce the Maternal Mortality Rate (MMR) and Infant Mortality Rate (IMR) by Government of Surabaya City has also been carried out through the Village Assistance Team (TPK) where in each citizens association there is 1 health worker and 2 cadres who are responsible for the area. This program is very effective, it was proven that 2 of 31 respondents in the case group in this research were detected through home visits by the TPK. Therefore, it is important for Public Health Center to routinely empower cadres and monitor and evaluate the performance of each Village Assistance Team (TPK). It is also important for midwives to remind every pregnant woman who is examined to do routine ANC at least 6 times during pregnancy.

### 3.2.4 The correlation between Hemoglobin levels in 1<sup>st</sup> trimester and the incidence of preeclampsia at Public Health Sidoserma Surabaya

**Table 5** Cross Tabulation of the Relationship between hemoglobin levels in 1<sup>s</sup> and incidence of preeclamsia at Public Health Sidoserma Surabaya

Hemoglobin levels in 1 <sup>st</sup> trimester	Case		Control		Total		Fisher Exact Test	
	(F)	(%)	(F)	(%)	(F)	(%)	<i>p</i>	<i>c</i>
High Levels ( ≥13.2 gr%)	19	61.3	18	29.0	37	39.8		
Anemia (11-13.1 gr%)	3	9.7	14	22.6	17	18.3	0.011	0.299
Normal (<11 gr%)	9	29.0	30	48.4	39	41.9		
Total	31	100	62	100	93	100		

Based on table 5, it is known that the calculation results using the Fisher exact test obtained a *p* value = 0.011. The significance of  $p \leq \alpha$  (0.05), then the results of the analysis show that there is a significant relationship between Hb levels during K1 and the incidence of preeclampsia at Public Health Sidoserma Surabaya, where the contingency coefficient value is 0.299. This value shows that the relationship between Hb levels in 1<sup>st</sup> trimester and the incidence of preeclampsia is classified as a correlation in the weak category. This research is in line with research by Fitriana F. and Palloti P. [3] which states that high Hb levels meaning  $\geq 13.2$  gr/dl during the first, second and third trimesters is correlated with the incidence of preeclampsia. Aghamohammadi, et al [10] also stated that women with high hemoglobin concentrations in the first trimester have an increased risk of hypertension in pregnancy. Likewise, Tiaranissa, et al [13] stated that there was a significant difference in hemoglobin levels between women with severe preeclampsia and normal pregnant women. The average hemoglobin level in pregnant women with severe preeclampsia is  $13.26 \pm 0.95$  and the average hemoglobin level in normal pregnant women is  $10.74 \pm 1.07$ . This shows an increase in hemoglobin levels in women with severe preeclampsia. This is thought to be caused by hematological abnormalities and impaired heme degradation. Endothelial damage causes hematological abnormalities through leakage between the gaps in the endothelial cells, then results in a decrease in intravascular plasma volume which causes hemoconcentration. Hemoconcentration will cause thrombocytopenia and increased erythrocyte production, so that hemoglobin levels are also high.

Different things were explained in the research of Khoigani et al [11] where low hemoglobin levels during the first half of pregnancy were associated with preeclampsia, while low hemoglobin levels during the second half of pregnancy were associated with the risk of premature rupture of membranes. This is not in accordance with the results of this research where in the case group only 9.68% were anemic, even in the control group the anemia of pregnant women was actually greater, namely 22.58%. The results of this research are in accordance with the research results of Nanda & Alit [12] that no relationship was identified between anemia and preeclampsia. The same thing was also expressed by Aghamohammadi [10] that anemia is not a big risk factor for the occurrence of preeclampsia in pregnant women. Anemia is associated with micronutrient deficiencies, whereas in this research the majority of the case group had a BMI in the obese category.

We hope the results of this research will become a basis for midwives in providing multivitamins to pregnant women. Since the end of 2022, the Public Health Sidoserma Surabaya has been providing Multi Micronutrient Supplements to pregnant women, which in 1 capsule contains 30 mg of iron, 400 mcg of folic acid and other multivitamins. All pregnant women who visit the Public Health Sidoserma Surabaya in 2023 will receive Multi Micronutrient Supplements, including pregnant women with high levels of hemoglobin. We hope the results of this research will serve as an

evaluation for all Public Health Centers to budget spending on pure folic acid medication as a solution for pregnant women with high Hb levels, so that Public Health Centers do not only rely on medication from the Government program but also budget pure folic acid medication in the Public Health's budget.

### 3.2.5 The correlation between Glucose levels in 1<sup>st</sup> trimester and the incidence of preeclampsia at Public Health Sidosermo Surabaya

**Table 6** Cross Tabulation of the Relationship between glucose levels and incidence of preeclampsia at Public Health Sidosermo Surabaya

Glucose Levels in 1 <sup>st</sup> trimester	Case		Control		Total		chi square test	
	(F)	(%)	(F)	(%)	(F)	(%)	<i>p</i>	<i>c</i>
High Glucose (>200mg/dl)	5	16.1	0	0	5	5.4		
Normal Glucose (<200mg/dl)	26	83.9	62	100	88	94.6	0.003	0.319
Total	31	100	62	100	93	100		

Based on table 6, it is known that the calculation results using the chi square test obtained  $p$  value = 0.003. The significance of  $p \leq \alpha$  (0.05), then the results of the analysis show that there is a significant relationship between glucose levels and the incidence of preeclampsia at Public Health Sidosermo Surabaya, where the correlation value is 0.319. This value shows that the relationship between glucose levels and the incidence of preeclampsia is classified as a correlation in the weak category. This research is in line with the results of research by Sugianto, et al [14] which states that the incidence of preeclampsia will increase due to an increase in HbA1c levels  $\geq 6.5$  in pregnant women suffering from diabetes mellitus. Diabetes mellitus can cause microvascular and macrovascular damage. One of the main risks of microvascular damage is preeclampsia in pregnant women. The Ministry of Health [1] also stated the same thing that the possibility of preeclampsia increases almost 4 times if diabetes occurs before pregnancy.

There are five theories underlying the occurrence of preeclampsia, one of which is placental ischemia, free radicals and endothelial dysfunction. Placental ischemia can cause oxidative stress which is one of the pathogenesis of preeclampsia. Insulin resistance syndrome (obesity and insulin resistance) has an important role in the pathogenesis of preeclampsia because fat that undergoes direct or induced oxidation will trigger oxidative stress. Lipids found in the blood in high enough quantities will cause oxidative stress which is one of the pathogenesis of preeclampsia. One of the products of lipid oxidation is unsaturated Alpha-Betha Alkenal Hydroxy (HNE). HNE found in people who are obese and preeclamptic can cause increased oxidative stress and can also cause diabetes mellitus. Diabetes that occurs before pregnancy is at risk of triggering preeclampsia in pregnancy compared to those who do not have a history of diabetes mellitus. Women who experience insulin resistance before pregnancy may experience vascular damage mechanisms characterized by chronic levels of inflammation, atherogenic activity, and prothrombotic processes which will affect normal vascularization and normal placentation [7].

This explanation is in line with the results of this research which showed that 16.1% of respondents in the case group had high glucose levels, while none in the control group had high glucose levels. In this research, it was found that the number of pregnant women with high glucose levels at the Public Health Center Sidosermo in 2023 was 6 people and only 1 person was excluded because his blood pressure was <140/90 but the MAP reached 90. So almost all pregnant women with high GDA experienced preeclampsia. This is because pregnant women with high glucose levels have insulin resistance. Therefore, it is important for midwives to carry out a glucose levels examination when pregnant women visit for the first time so that the risk of preeclampsia can be prevented early on.

### 3.3 Multivariate analysis

Multivariate analysis was carried out to determine the independent variable that had the most influence on the dependent variable of all the independent variables studied. Based on table 7, it is known that all variables influenced the incidence of preeclampsia simultaneously by 63.5%. Pregnant women aged > 35 years have a 6.638 times greater chance of developing preeclampsia than pregnant women aged  $\leq 35$  years. Pregnant women with BMI in the obesity category have a 16.012 times greater chance of developing preeclampsia than pregnant women with BMI in the normal category, while pregnant women with BMI in the overweight category have a 13.370 times greater chance of developing preeclampsia than pregnant women with BMI in the normal category. Pregnant women with frequency of ANC < 6x

have a 9.513 times greater chance of developing preeclampsia than pregnant women with frequency of ANC > 6x. The conclusion from the results of this multivariate test is that the BMI factor has the most influence on the incidence of preeclampsia at Public Health Sidoseremo Surabaya.

**Table 7** Results of Logistic Regression Analysis Between Independent Variables and Dependent Variables

Variable	B.	Sig.	Exp (B)	95% C.I. for EXP(B)	
				Lower	Upper
Age	1.893	0.035	6.638	1.140	38.648
BMI (1)	2.773	0.001	16.012	2.902	88.355
BMI (2)	2.593	0.004	13.370	2.317	77.147
Glucose levels	20.287	0.999	646619015.2	0.000	-
Frequency of ANC	2.253	0.001	9.513	2.397	37.755
Hemoglobin levels	1.257	0.080	3.514	0.861	14.335
Constant	-4.683	0.000	0.009	-	-

The age factor simultaneously influences the incidence of preeclampsia. As increasing of age, the performance of blood vessels decreases, where the remodeling process of the spiral arteries occurs. In hypertension pregnancy, there is no invasion of trophoblast cells in the muscle layer of the spiral arteries and the surrounding matrix tissue. The muscle layer of the spiral arteries remains stiff and hard so that the lumen of the spiral arteries does not allow it to distension and vasodilate. As a result, the spiral arteries experience relative vasoconstriction, and subsequent failure of spiral artery remodeling occurs, resulting in decreased uteroplacental blood flow, and placental hypoxia and ischemia occur. This will then cause changes in hypertension in pregnancy. Endothelial dysfunction is characterized by increased levels of fibronectin, Von Willebrand factor, Tissue Plasminogen Activator (t-PA) and Plasminogen Activator Inhibitor (PAI-1) which are markers of endothelial cells. In preeclampsia, there is failure of the spiral artery remodeling process, which is related to the change in the spiral arteries becoming stiff and hard, unable to distension any longer, and unable to undergo vasodilation [5]. This is the basis that age > 35 years (Advanced Maternal Age) has a greater risk of preeclampsia, as evidenced by the results of the multivariate test in this research showing that maternal age > 35 years has a 6,638 greater risk of preeclampsia compared to age ≤ 35 years. . Previous multivariate results showed that age < 20 years was not proven to significantly ( $p = 0.078$ ) influence the incidence of preeclampsia. This is in accordance with the theory expressed by the Ministry of Health [1] which states that young age does not significantly increase the risk of preeclampsia.

This is because at a young age the performance of blood vessels has not yet decreased. Because it was not proven to be significant, the number of pregnant women respondents aged <20 years was combined with the number of respondents aged 20-30 years, to obtain the results of the multivariate analysis as in table 2.

The factor that also experienced a combination of the number of respondents in the multivariate analysis was the Hb levels. The number of anemic respondents was combined with the number of normal Hb respondents because previous multivariate test results did not prove that there was a significant relationship between anemia and the incidence of preeclampsia. High Hb also did not significantly influence the incidence of preeclampsia in the results of this multivariate test, however high Hb was proven to have a simultaneous effect with other factors in the occurrence of preeclampsia. This may be due to the small number of high Hb respondents, where the majority of respondents in the case group had Hb in the normal category.

The same thing also happens with high glucose levels factors. According to the results of the multivariate test, high glucose was not proven to significantly influence the incidence of preeclampsia, but high glucose levels simultaneously influenced other factors to cause preeclampsia. This may be because the number of respondents from pregnant women with high glucose levels is too small.

#### 4 Conclusion

Mother's age, BMI, ANC frequency, hemoglobin levels in first trimester, and glucose levels in first trimester had simultaned effect to incident of preeclamsia amount to 63,5%. BMI is the most influencing factors of incident of

preeclampsia at Public Health Center Sidoserma Surabaya in 2023. We hoped that the results of this research will be a motivation for midwives in providing reproductive services for future bride, especially if there is a woman who has a BMI in the overweight or obese categories to adopt a healthy lifestyle so that their weight drops to a normal BMI before planning a pregnancy. We also hope midwife Able to improve the quality of integrated antenatal care services, especially in carry out preeclampsia screening on every pregnant woman during first trimester.

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## Compliance with ethical standards

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### *Disclosure of Conflict of interest*

There is no conflict of interest in this research.

### *Statement of ethical approval*

This research has received ethical clearance approval from the Ethics Committee of the Faculty of Medicine, Universitas Airlangga.

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