JOURNAL MIDWIFERY (JM)
Jurnal Jurusan Kebidanan, Poltekkes Kemenkes Gorontalo
P-ISSN (2407-8506), E-ISSN (2808-523X)
http://jurnal.poltekkesgorontalo.ac.id/index.php/JM/index
DOI: http://dx.doi.org/10.52365/jm.v12i1.1671

THE RELATIONSHIP BETWEEN AGE AND BMI OF PREGNANT WOMEN AND THE INCIDENCE OF PREECLAMPSIA

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ABSTRACT

Preeclampsia is a hypertensive disorder during pregnancy that is a significant cause of maternal and neonatal morbidity and mortality. This condition is characterized by the appearance of high blood pressure after ≥20 weeks of gestation accompanied by proteinuria or other organ dysfunction, and often leads to serious complications if not detected early. Preeclampsia is also closely related to maternal conditions such as obesity, extremes of age, and other metabolic factors. These factors are important to understand because they provide direction for early prevention efforts and effective risk control. The purpose of this study was to determine the relationship between maternal age and BMI with the incidence of preeclampsia in Boyolali in 2026. This study uses quantitative research with an analytical observational study design with a cross-control approach.. The study population was all pregnant women in the working area of Klego I, II, and Karanggede Health Centers. Sampling in this study used total sampling, namely 202 respondents. The research instrument was a summary sheet. The results of this study found a relationship between maternal age with the incidence of preeclampsia (p value = 0.001) and BMI (p value = 0.000) The age variable has a probability of approximately 2.3 times greater of experiencing preeclampsia compared to BMI.s The conclusion is that there is a significant relationship between age and BMI with the occurrence of preeclampsia.

Keywords: Preeclampsia, Age, BMI

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INTRODUCTION

Preeclampsia is a hypertensive disorder during pregnancy that is a significant cause of maternal and neonatal morbidity and mortality. This condition is characterized by the appearance of high blood pressure after 20 weeks of gestation, accompanied by proteinuria or other organ dysfunction, and often leads to serious complications if not detected early. Preeclampsia is also closely associated with maternal conditions such as obesity, extremes of age, and other metabolic factors. Understanding these factors is important because it guides early prevention efforts and effective risk management.

Maternal age is one of the biological determinants frequently cited in various studies of preeclampsia risk. A normal reproductive age (20–35 years) is often considered ideal, while age under 20 or over 35 is thought to increase the risk of preeclampsia. Observational studies and literature reviews suggest that women with advanced maternal age have a higher risk of developing preeclampsia than women of middle reproductive age, due to the physiological and vascular changes that occur with aging, which can complicate the body's adaptation to pregnancy. However, several local studies have shown that the association between age and preeclampsia is not always statistically significant, so other factors such as comorbidities should also be considered in the analysis of this association. (Sun, 2023)

In addition to age, Body Mass Index (BMI) before and during pregnancy is now recognized as another important risk factor. Obesity and overweight before pregnancy are associated with a higher risk of preeclampsia, as obesity increases insulin resistance, systemic inflammation, and endothelial dysfunction—mechanisms that contribute to the development of hypertension in pregnancy. Recent research also shows a strong positive association between high pre-pregnancy BMI and the incidence of preeclampsia, with increasing BMI categories significantly increasing the risk of preeclampsia, including in primigravida women. (Sun, 2023)

Furthermore, there is evidence of an interaction between age and BMI on the risk of preeclampsia. One large study showed that advanced age and high BMI not only individually increase the risk of preeclampsia but also interact with each other, increasing the potential for preeclampsia in women with both risk factors. The mediation analysis also found

that pre-pregnancy BMI mediates the relationship between maternal age and the risk of preeclampsia, further emphasizing the role of nutrition and pre-pregnancy weight status as important prevention targets.

In Indonesia, the prevalence of obesity continues to increase and has become a significant public health problem. Changes in consumption patterns and modern lifestyles have increased the risk of obesity in women of reproductive age. The combination of high BMI and extreme age at pregnancy increases the complexity of pregnancy management, especially in primary healthcare facilities. Therefore, understanding the relationship between age and BMI and the incidence of preeclampsia can assist healthcare workers, particularly midwives and obstetricians, in planning comprehensive risk control strategies through prenatal screening, nutrition education, and routine blood pressure monitoring.

Based on the above description, further studies on the relationship between age and BMI and the incidence of preeclampsia are deemed essential to provide up-to-date scientific evidence and effective recommendations for preeclampsia prevention in maternal healthcare.

The maternal mortality rate in Indonesia remains high due to direct and indirect causes occurring during pregnancy and childbirth. The overall Maternal Mortality Rate (MMR) in Indonesia according to the 2024 Survey and Census data was 4,151, with the cause of death being non-obstetric complications in pregnancy totaling 1,351 cases, followed by hypertension in pregnancy, childbirth, and postpartum totaling 988 cases. Meanwhile, according to the 2024 health profile of the Boyolali Regency Health Office, there were 2,323 cases of pregnant women with complications, of which 619 cases were caused by preeclampsia/eclampsia. However, Indonesia remains one of the countries with the highest MMR among other ASEAN countries. The RPJMN set a MMR target of 194 per 100,000 live births in 2023 and 183 per 100,000 live births in 2024. This achievement is still far from the SDGs target of reducing MMR by 2030 to less than 70 per 100,000 live births. Innovation and acceleration strategies are needed to achieve the target of reducing maternal mortality.

According to the International Classification of Disease Mortality (ICD-MM), causes of maternal death are divided into direct causes, indirect causes, unspecified causes, and other causes. Direct causes include miscarriage, pregnancy-related hypertensive disorders, obstetric hemorrhage, pregnancy-related infections, other obstetric complications,

and management of unanticipated complications. Indirect causes include non-obstetric complications, unspecified causes such as unknown problems, and other causes.

METHOD

This study is a descriptive quantitative study with a retrospective, case-control approach. The population in this study were all pregnant women at risk of developing preeclampsia in the Boyolali Regency working area. The sample taken was a portion of pregnant women in three Community Health Centers (Puskesmas) in Boyolali Regency with the highest incidence of preeclampsia, namely Klego I, Klego II, and Karanggede. The sampling technique used was proportional cluster sampling. The statistical test used was Chi-Square.

RESULTS AND DISCUSSIONS

Result

Table 1. Distribution of Respondents Based on Preeclampsia, Maternal Age, and Excessive BMI

Preeclampsia	Frequency	%
Yes	101	50
No	101	50
Mother's Age		
Risk	42	20,8
No Risk	160	79,2
BMI		
Overweight	105	51,9
Not overweight	97	48,1
Sum	202	100

Based on the table above, of the 202 respondents, 101 (50%) experienced preeclampsia, This is a case control with 1:1. There were 42 (20.8%) mothers at risk and 105 (51.9%) mothers with an overweight BMI.

Table 2. The Relationship Between Maternal Age and the Incidence of Preeclampsia

Mother's Age	Preeclampsia events						Pvalue
	Yes		No		Total		
	n	%	n	%	N	%	
Risk	30	71,4	12	28,6	42	100	0,003
No Risk	71	44,4	89	55,6	160	100	
Sum	101	50	101	50	202	100	

In this study, preeclampsia was divided into two categories, namely Yes (If the mother was diagnosed with preeclampsia) and No (If the mother was not diagnosed with preeclampsia) and the mother's age was divided into two categories, namely risk (If the mother's age was ≤20 years or ≥35 years) and no risk (If the mother's age was 20-35 years). The results of the univariate study showed that from the

results of the Chi-square statistical test, a p-value of 0.003 was obtained, meaning that there was a significant relationship between the mother's age and the incidence of preeclampsia, so that the hypothesis stating that there was a significant relationship between the mother's age and the incidence of preeclampsia was statistically proven.

Table 3. The relationship between BMI and the incidence of preeclampsia

BMI	Preeclampsia events						Pvalue
	Yes		No		Jumlah		
	n	%	n	%	N	%	
Overweight	68	64,8	37	35,2	105	51,9	0,000
Not overweight	33	34	64	66	97	48,1	
Sum	101	100	101	100	202	100	

In this study, preeclampsia is divided into two categories, namely overweight (if the mother's BMI ≥25) and not excess weight if the BMI <25. The results of univariate data show that out of 202 respondents, 105 (51.9%) have excess weight. The results of the Chi-square statistical test obtained a p-value = 0.000, meaning that maternal BMI with the incidence of preeclampsia has a significant relationship, so the hypothesis that states there is a significant relationship between maternal BMI and the incidence of preeclampsia is statistically proven.

Discussion

1. Maternal Age

Maternal age is a crucial factor in determining pregnancy risks, including the risk of preeclampsia. A study conducted on 202 respondents in the Klego I, Klego II, and Karanggede Community Health Centers (Puskesmas) revealed that some mothers were in the at-risk age group (<20 years or >35 years). Bivariate analysis using the Chi-Square test showed a p-value of 0.001, indicating a significant association between maternal age and the incidence of preeclampsia.

The results showed that 42 respondents (20.8%) in the at-risk age group experienced preeclampsia, while 71 respondents (44.4%) in the non-risk age group (20–35 years) experienced preeclampsia. These findings indicate that mothers in the at-risk age group have a higher incidence of preeclampsia than mothers of healthy reproductive age.

Biologically, maternal age significantly influences the readiness of the reproductive organs and the body's ability to adapt to9 physiological changes during pregnancy. (Lean 2022) In mothers under 20 years of age, the reproductive

organs and hormonal system are not yet optimally developed, resulting in incomplete adaptation to pregnancy. This condition can increase the risk of pregnancy-related complications, including preeclampsia. Furthermore, at a young age, psychological factors such as unpreparedness for pregnancy and the role of mother are often present, which can increase stress during pregnancy. (Kartini, K., & Bagenda, 2025)

Meanwhile, in mothers over 35 years of age, degenerative processes occur in the blood vessels, which can lead to decreased blood vessel elasticity and increased peripheral resistance. This condition can trigger hypertension during pregnancy, which then progresses to preeclampsia. Furthermore, in older mothers, comorbidities such as chronic hypertension, diabetes, or metabolic disorders are more common, which can worsen pregnancy outcomes.

Pathophysiologically, in older mothers, structural changes in the blood vessels, including atherosclerosis in the uteroplacental arteries, can lead to impaired placental perfusion. Disrupted blood flow to the placenta can trigger endothelial dysfunction, vasospasm, and increased blood pressure, which are the main characteristics of preeclampsia. (Mustary, M., Ansariadi, A., Syam, A., Riskiyani, S., Erika, K. A., Moedjiono, A. I., & Lubis, 2024)

The results of this study align with Eka's (2023) study, which showed a significant association between maternal age and the incidence of preeclampsia, with a p-value of 0.000. The study stated that pregnancies under 20 years of age and over 35 years of age carry a higher risk of preeclampsia than those of healthy reproductive age. (Juniarty et al., 2023) Therefore, maternal age can be used as an important indicator in pregnancy risk screening. Health workers, particularly midwives and primary care providers, need to conduct more intensive monitoring of pregnant women at risk through routine antenatal checkups, health education, and early detection of signs and symptoms of preeclampsia so that pregnancy complications can be prevented as early as possible.

2. Body Mass Index (BMI) of Pregnant Women

Body Mass Index (BMI) is an indicator of nutritional status often used to assess maternal health before and during pregnancy (Yilmas, 2025). Abnormal nutritional status, whether underweight or overweight, can affect

the body's physiological adaptation to pregnancy and increase the risk of various complications, one of which is preeclampsia.

Based on the results of a study conducted on 202 respondents in the Klego I, Klego II, and Karanggede Community Health Centers (Puskesmas), it was found that the majority of respondents were overweight (105 respondents (51.9%), while 97 respondents (48.1%) had a BMI that was not overweight. Bivariate analysis using the Chi-Square test showed a p-value of 0.000, indicating a significant association between maternal BMI and the incidence of preeclampsia.

The results showed that in the group of mothers with an overweight BMI, 68 respondents (64.8%) experienced preeclampsia, while in the group with a not overweight BMI, 64 respondents (66%) did not experience preeclampsia. This indicates that mothers with an overweight BMI have a higher incidence of preeclampsia than mothers with a moderate BMI.

Physiologically, being overweight or obese can increase the risk of preeclampsia through several mechanisms. In mothers with a high BMI, there is an increase in adipose tissue, which triggers increased levels of leptin and pro-inflammatory cytokines in the body. This condition can lead to endothelial dysfunction, insulin resistance, and increased sympathetic nervous system activity, ultimately contributing to increased blood pressure during pregnancy. Furthermore, obesity is also associated with increased oxidative stress and chronic inflammation, which can disrupt placental function and exacerbate hypertension in pregnancy. (McCance, D. R., & Maresh, 2022)

Conversely, a BMI that is too low can also affect the health of pregnant women because it is associated with a lack of nutrients needed to support fetal growth and the mother's physiological functions. This imbalance in nutritional status can affect metabolic function, the hormonal system, and blood circulation during pregnancy, ultimately increasing the risk of pregnancy complications.

The results of this study align with research by Nur Isra (2026), which showed a significant relationship between Body Mass Index and the incidence of preeclampsia. The results showed that most pregnant women with preeclampsia were in the normal to high BMI category, with a greater proportion of high BMI (overweight

and obesity) than low BMI. Statistical analysis showed a significant relationship between BMI and the incidence of preeclampsia ($p < 0.05$). Therefore, nutritional status, as measured by BMI, is an important factor that needs to be considered in efforts to prevent preeclampsia. Health workers need to monitor maternal nutritional status both before pregnancy and during antenatal care (ANC). In addition, education regarding balanced diet, ideal weight management, and monitoring weight gain during pregnancy needs to be carried out routinely to reduce the risk of pregnancy complications, including preeclampsia. (Nur Isra Awaliyah Suhardin1*, Masita Fujiko2, 2026)

Preeclampsia

Preeclampsia is a pregnancy complication characterized by elevated blood pressure after 20 weeks of gestation, accompanied by proteinuria or other organ disorders. This condition is a leading cause of maternal and neonatal morbidity and mortality, especially in developing countries. Therefore, early detection and understanding of the risk factors for preeclampsia are crucial in preventing more severe complications during pregnancy.

Based on the results of a study conducted on 202 respondents, 101 (50%) had preeclampsia. This data indicates that preeclampsia is still found in some pregnant women in the study area, requiring special attention in maternal health services.

Preeclampsia can occur due to disruptions in the formation and function of the placenta, resulting in suboptimal uteroplacental blood flow. These disruptions can trigger endothelial dysfunction, blood vessel vasoconstriction, and increased vascular resistance, ultimately leading to increased blood pressure in pregnant women. This condition can also cause disorders in various organs, such as the kidneys, liver, and nervous system. If left untreated, it can develop into more severe complications such as eclampsia, HELLP syndrome, and maternal and fetal death. (Mustary, M., Ansariadi, A., Syam, A., Riskiyani, S., Erika, K. A., Moedjiono, A. I., & Lubis, 2024)

Several risk factors are known to play a role in increasing the incidence of preeclampsia, including maternal age, nutritional status, history of hypertension, first pregnancy (primigravida), and the presence of comorbidities such as diabetes mellitus and kidney disease. In this study, the

factors examined were maternal age and Body Mass Index (BMI), both of which have been shown to have a significant association with the incidence of preeclampsia. This suggests that the biological condition and nutritional status of pregnant women significantly influence the risk of developing hypertensive disorders during pregnancy.

The high incidence of preeclampsia is also related to delayed early detection during pregnancy. Irregular antenatal care (ANC) checkups can lead to early signs of preeclampsia, such as increased blood pressure and edema, going undetected. Therefore, regular prenatal checkups are crucial for monitoring the condition of the mother and fetus and identifying risk factors that can trigger preeclampsia.

Therefore, preeclampsia is a health problem that requires serious attention from healthcare professionals. Preventive measures can be implemented through improving the quality of antenatal care, screening for risk factors early in pregnancy, educating pregnant women about pregnancy warning signs, and regularly monitoring blood pressure and nutritional status. These measures are expected to reduce the incidence of preeclampsia and prevent more serious complications for both mother and baby.

The Relationship between Maternal Age and the Incidence of Preeclampsia

Maternal age is a significant risk factor that can influence health during pregnancy, including the risk of preeclampsia. The safest reproductive age for pregnancy is considered to be between 20 and 35 years, while pregnancies under 20 and over 35 are considered high-risk due to their association with various pregnancy complications.

Based on the results of a study conducted on 202 respondents, it was found that in the at-risk age group (≤20 years or ≥35 years), 30 respondents (71.4%) experienced preeclampsia and 12 respondents (28.6%) did not. Meanwhile, in the non-risk age group (20–35 years), 71 respondents (44.4%) experienced preeclampsia and 89 respondents (55.6%) did not. The results of the Chi-Square statistical test yielded a p-value of 0.003, indicating a significant association between maternal age and the incidence of preeclampsia. Thus, the hypothesis stating a relationship between maternal age and the incidence of preeclampsia is statistically acceptable.

The results of this study indicate that pregnant women at risk have a higher

chance of developing preeclampsia compared to women of healthy reproductive age. This can be explained physiologically and psychologically. In mothers under 20 years of age, the reproductive organs and hormonal system are not yet optimally developed, so the body is not fully prepared for pregnancy. This condition can disrupt the body's physiological adaptation to pregnancy and increase the risk of complications, including preeclampsia.

Meanwhile, in mothers over 35 years of age, degenerative processes occur in various organs, including blood vessels. (Suzani, 2025). Decreased blood vessel elasticity and changes in vascular structure can lead to increased vascular resistance, triggering hypertension during pregnancy. Furthermore, older women are also more likely to have comorbidities such as chronic hypertension, diabetes mellitus, and other metabolic disorders, which can worsen pregnancy outcomes.

Pathophysiologically, changes in blood vessels can lead to impaired uteroplacental perfusion, resulting in suboptimal blood supply to the placenta. This condition triggers endothelial dysfunction and vasospasm, which are the primary mechanisms responsible for preeclampsia. Impaired blood flow to the placenta can also increase the risk of fetal complications, such as growth retardation.

The results of this study align with those of Eka (2023), which demonstrated a significant association between maternal age and the incidence of preeclampsia, with a p-value of 0.000. The study explained that pregnancies under 20 years of age and over 35 years of age carry a higher risk of preeclampsia compared to pregnancies of healthy reproductive age.

Therefore, maternal age can be used as an important indicator in identifying high-risk pregnancies. Health workers need to conduct more intensive monitoring of pregnant women at risk through routine antenatal care checkups, blood pressure monitoring, and education about pregnancy danger signs. These efforts are expected to help detect the possibility of preeclampsia early so that treatment can be administered quickly and appropriately.

3. The Relationship Between BMI and the Incidence of Preeclampsia

Body Mass Index (BMI) is an indicator used to assess a person's nutritional status based on the ratio of weight to

height. A mother's nutritional status before and during pregnancy significantly impacts the health of both mother and fetus. An abnormal BMI, whether too low or too high, can increase the risk of various complications during pregnancy, one of which is preeclampsia.

Based on the results of a study of 202 respondents, it was found that 68 pregnant women with an overweight BMI (64.8%) experienced preeclampsia, while 37 pregnant women (35.2%) did not experience preeclampsia. Meanwhile, in the group of pregnant women with a BMI that was not overweight, 33 respondents (34%) experienced preeclampsia and 64 respondents (66%) did not. The results of the Chi-Square statistical test showed a p-value of 0.000, indicating a significant association between maternal BMI and the incidence of preeclampsia. Therefore, the hypothesis stating a relationship between BMI and the incidence of preeclampsia is statistically accepted.

The results of this study indicate that pregnant women with an abnormal BMI have a higher incidence of preeclampsia compared to those with a normal BMI. This condition is particularly prevalent in women with a high BMI or obesity. Obesity can increase the risk of preeclampsia through various physiological mechanisms, such as increased insulin resistance, chronic inflammation, and impaired vascular endothelial function. These disorders can cause vasoconstriction and increased blood pressure, which are key signs of preeclampsia.

Furthermore, obese women have increased levels of the hormone leptin, produced by adipose tissue. Leptin can activate blood vessel endothelial cells and increase sympathetic nervous system activity, triggering increased blood pressure. This condition can also disrupt blood flow to the placenta, which plays a role in the development of preeclampsia. (Riani Widia Parantika1*, Gatut Hardianto2, 2021)

Conversely, a BMI that is too low can also affect the mother's health during pregnancy because it is associated with insufficient nutritional intake needed to support fetal growth and development. Nutritional deficiencies can affect the body's metabolic balance and disrupt cardiovascular function during pregnancy.

The results of this study align with those of Nur Isra (2026), which demonstrated a significant association between Body Mass Index (BMI) and the incidence of preeclampsia. The

study showed that most pregnant women with preeclampsia were in the normal to high BMI category, with a higher proportion of women with high BMI (overweight and obesity) than those with low BMI. Statistical analysis showed a significant association between BMI and the incidence of preeclampsia ($p < 0.05$). Therefore, nutritional status, as measured by BMI, is an important factor to consider in efforts to prevent preeclampsia. Health workers need to monitor maternal nutritional status both before pregnancy and during antenatal care (ANC). Furthermore, education about a balanced diet, ideal weight management, and monitoring weight gain during pregnancy should be routinely provided to reduce the risk of pregnancy complications, including preeclampsia. (Nur Isra Awaliyah Suhardin1*, Masita Fujiko2, 2026)

Therefore, BMI is a factor that needs to be considered in efforts to prevent preeclampsia. Health workers need to monitor the nutritional status of pregnant women by measuring their BMI and providing education on a balanced diet, appropriate physical activity, and weight management before and during pregnancy. Proper monitoring of maternal nutritional status is expected to help reduce the risk of preeclampsia and improve maternal and fetal health during pregnancy.

The discussion section contains a comprehensive interpretation and analysis of the results of research obtained and associated with previously reported concepts and results. Repetition of the presentation of research methods and results and things that have been disclosed in the Preliminary Chapter should be avoided.

CONCLUSION

Based on the results of this study on the relationship between maternal age and Body Mass Index (BMI) with the incidence of preeclampsia in pregnant women at the Klego I, Klego II, and Karanggede Community Health Centers in Boyolali Regency, with 202 respondents, it can be concluded that:

1. The proportion of preeclampsia cases in pregnant women in this study was 101 respondents (50%).
2. There was a significant relationship between maternal age and the incidence of preeclampsia. The Chi-Square statistical test results showed a p-value of 0.003 ($p \leq 0.05$), indicating that pregnant women at risk ($\leq$20 years or $\geq$35 years) were more likely to experience preeclampsia than

pregnant women of healthy reproductive age (20–35 years).

3. There was a significant relationship between Body Mass Index (BMI) and the incidence of preeclampsia. The chi-square test results show a p value of 0.000 ($p \leq 0.05$).

Overall, maternal age and BMI were shown to have a significant association with the incidence of preeclampsia in pregnant women. Therefore, early detection efforts, routine pregnancy monitoring, and increased health education for pregnant women are needed to reduce the risk of preeclampsia..

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