



CORRELATION BETWEEN 25-HYDROXYVITAMIN D LEVELS AND PREECLAMPSIA AMONG PRIMIGRAVIDA MOTHERS

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ABSTRACT

Maternal Mortality Rate (MMR) is still a health challenge at the global and national levels. One of the main causes of maternal mortality is preeclampsia, which can cause serious complications in both the mother and the fetus. Risk factors for preeclampsia include reproductive status, health conditions, and nutritional deficiencies, including vitamin D. Vitamin D has an important role in placental implantation and function through angiogenic, anti-inflammatory, and immunomodulatory effects. Some studies suggest low levels of vitamin D are associated with an increased risk of preeclampsia. In addition, primigravida is known to be more prone to preeclampsia than multigravidae. This study aims to determine the correlation between vitamin D 25-OH levels and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period. Cross-sectional research was carried out at RSPAL dr. Ramelan Surabaya. A total of 66 primigravida mothers were selected by total sampling. The dependent variable is the occurrence of preeclampsia. The independent variable is the vitamin D 25-OH level. Data in the form of medical records of the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period. The data were analyzed by the Kendall's Tau-b test. The results of Kendall's Tau-b test showed that the age variable showed a weak positive association with the incidence of preeclampsia but was not statistically significant ($\tau = 0.195$; $p = 0.116$). Body mass index (BMI) had a positive association with moderate strength and significant to the incidence of preeclampsia ($\tau = 0.334$; $p = 0.005$), suggesting that an increase in BMI was associated with an increased incidence of preeclampsia. Mean Arterial Pressure (MAP) showed a very strong and significant positive association with the incidence of preeclampsia ($\tau = 1.000$; $p < 0.001$), confirming the role of blood pressure as a factor strongly related to preeclampsia. Meanwhile, vitamin D 25-OH levels showed a weak and statistically insignificant positive association with the incidence of preeclampsia ($\tau = 0.217$; $p = 1,000$). There is no correlation between vitamin D 25-OH levels and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period.

Keywords: 25-hydroxyvitamin D; preeclampsia; pregnancy; primigravida; vitamin D 25-OH

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INTRODUCTION

Maternal Mortality Rate (MMR) serves as the main parameter in evaluating the success of maternal health programs. Maternal death is defined as all deaths that occur throughout the pregnancy period, parturition, and postpartum period caused by its management, not by other factors, such as accidents or incidentals (Ministry of Health, 2023). According to the World Health Organization (WHO) in 2021, AKI in 2020 reached 295,000 cases caused by hypertension during pregnancy (preeclampsia and eclampsia), bleeding, infections after childbirth, and dangerous abortions. One of the main factors contributing to this mortality is preeclampsia which affects 2-8% of pregnant women, resulting in around 76,000 female deaths and 500,000 infant deaths per year (Chaemsaitong et al., 2022).

In Indonesia, the incidence of preeclampsia reaches around 24% (Ajizah et al., 2024). According to the East Java Health Profile in 2023, preeclampsia is the third highest type of pregnancy complication with 16,095 cases per 588,048 pregnant women. Preeclampsia is characterized by new-onset hypertension with an increase in systolic blood pressure ≥ 140 mmHg or diastolic ≥ 90 mmHg, accompanied by proteinuria. Proteinuria is defined as >300 mg in a 24-hour urine specimen or $\geq 1+$ proteinuria identified with a urinary dipstick after 20 weeks of gestation (Bartal et al., 2020). Preeclampsia can cause adverse effects on pregnant women, namely physiological disturbances of several organs and systems that may be caused by vasospasm and ischemia in the placenta. Vasospasm causes a reduced supply of oxygen to the organs which can lead to arterial hypertension. This condition affects the organs of the brain, liver, kidneys, and placenta (Sinaga, 2022).

Until now, the etiology of preeclampsia has not been fully understood. Several theories that have been proposed related to the etiology of preeclampsia, include the theory of placental ischemia, immunological factors, genetic influences, prostasclintrombosces, and mineral deficiencies in food intake. There are determinants that can affect preeclampsia through the safe motherhood approach, namely reproductive status (age, parity, twin pregnancies, genetic factors), health conditions, healthy behavior (Antenatal Care (ANC), contraceptive use), socioeconomic aspects, and education (Dzikrullah et al., 2023). Recent research reveals that there is a link between vitamin D 25-OH deficiency and preeclampsia. A study studying the relationship between vitamin D 25-OH and preeclampsia stated that pregnant women diagnosed with preeclampsia had lower levels of vitamin D 25-OH than healthy pregnant women (Dolati et al., 2024).

Vitamin D is a steroid hormone that is fat-soluble and synthesized by the skin when exposed to ultraviolet light and absorbed from food. Then, it undergoes hydroxylation in the liver into an inactive form of 25-hydroxy vitamin D. The circulating 25(OH)D is converted by 1-alpha-hydroxylase in the kidneys to an active form of 1,25-dihydroxy vitamin D (vitamin D₃) (Ali et al., 2018). Vitamin D has an important role during pregnancy, namely in the implantation and function of the placenta due to its angiogenic and anti-inflammatory effects that play a role in the immune response in the fetus-placental as well as immunological adaptation to reduce the risk of inflammation and infection (Samanta et al., 2021).

One among other factors that increase the risk of preeclampsia is primigravida (Yanuarini et al., 2020). Primigravida are women who are experiencing pregnancy for the first time and are a high-risk group (Parveen et al., 2024). Findings from Harumi and Armadani (2019) while conducting research at the Jagir Health Center in Surabaya show that preeclampsia results are more common in primigravida and there is a correlation between primigravida and the incidence of preeclampsia. Stress in facing childbirth is often experienced by primigravida mothers. These stressful events trigger an increase in the action of the hypothalamus in releasing corticotropic-releasing hormone (CRH) which will result in an increase in cortisol. Cortisol plays a role in preparing the body to face various stressors by increasing sympathetic responses, including responses to increase heart rate and maintain blood pressure (Harumi and Armadani, 2019). The incidence rate of preeclampsia in East Java is still relatively high. The explanation of vitamin D 25-OH above shows that the occurrence of preeclampsia often occurs in pregnant women who have low levels of vitamin D 25-OH. Therefore, the author wants to find out the correlation between vitamin D 25-OH levels and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period.

METHOD

The cross-sectional study was conducted at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan from June 2025 to August 2025. Data collection was carried out on independent and bound variables at one time simultaneously with the aim of determining the correlation between vitamin D 25-OH levels as an independent variable and the incidence of preeclampsia as a bound

variable. The population in this study is primigravida mothers who are registered as patients at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya during the period January 2023 - June 2025 and have data on vitamin D 25-OH levels checked. The sample in the study was 66 primigravida mothers who were taken by total sampling. This study uses secondary data from the medical record data of primigravida mothers who are diagnosed with preeclampsia or not at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period, then an analysis is carried out related to the results of the examination of vitamin D 25-OH levels stated in the medical records. The dependent variable was the incidence of preeclampsia. The independent variable was 25-OH vitamin D levels. Characteristic variables included age, body mass index (BMI), and mean arterial pressure (MAP). Research ethics permission was obtained from the Health Research Ethics Commission of the Faculty of Medicine, Hang Tuah University, Surabaya No. I/062/UHT.KEPK.03/VIII/2025. Data analysis in this study was carried out based on the results of patients' medical records that have met the inclusion criteria and eliminated the exclusion criteria. The data were analyzed using the Kendall's Tau correlation test.

RESULT

Based on Table 1, it shows that the majority of primigravida mothers in this study are <35 years old (98%), have a normal body mass index (53%), and a Mean Arterial Pressure (MAP) value of ≤90 mmHg (61%). In addition, most respondents were deficient in vitamin D 25-OH (89%). Based on the incidence of preeclampsia, the most dominant category is mothers who do not experience preeclampsia (71%), although there is still a proportion of mothers who experience preeclampsia. Furthermore, although most mothers do not develop preeclampsia, a significant proportion still do. These findings suggest that vitamin D deficiency remains a condition that warrants attention, as it has the potential to contribute to the development of preeclampsia even when other clinical risk factors are relatively low.

Table 1.
Characteristics Sample

Categories	f	%
Age		
< 35 years old	65	98
≥ 35 years old	1	2
BMI		
< 18.5 (Underweight)	2	3
18.5–24.9 (Normal weight)	35	53
25–29.9 (Overweight)	23	35
≥ 30 (Obese)	6	9
MAP		
≤ 90 mmHg	40	61
> 90 mmHg	26	39
Vitamin D 25-OH		
Deficiencies	59	89
Insufficiency	6	9
Sufficiency	1	2
Occurrence of Preeclampsia		
Preeclampsia	19	29
No Preeclampsia	47	71

Based on table 2, the results of the Kendall's Tau-b test showed that the age variable showed a weak positive association with the incidence of preeclampsia but was not statistically significant ($\tau = 0.195$; $p = 0.116$). Body mass index (BMI) had a positive association with moderate strength and significant to the incidence of preeclampsia ($\tau = 0.334$; $p = 0.005$), suggesting that an increase in BMI was associated with an increased incidence of preeclampsia. Mean Arterial Pressure (MAP) showed a very strong and significant positive association with the incidence of preeclampsia ($\tau =$

1.000; $p < 0.001$), confirming the role of blood pressure as a factor strongly related to preeclampsia. Meanwhile, vitamin D 25-OH levels showed a weak and statistically insignificant positive association with the incidence of preeclampsia ($\tau = 0.217$; $p = 1,000$).

Table 2.

Kendall's Tau-b test results age, BMI, MAP, vitamin D 25-OH levels with the incidence of preeclampsia in primigravida mothers

Categories	Correlation Coefficients (r)	p-value
Age	0,195	0,116
BMI	0,334	0,005
MAP	1,000	<0.001
Vitamin D 25-OH	0.217	1.000

DISCUSSION

The purpose of this study was to determine the correlation between vitamin D 25-OH levels and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic of RSPAL dr. Ramelan Surabaya for the 2023-2025 period. However, in addition to the data, the researcher included secondary data from medical records including the patient's age, BMI, MAP.

Incidence of Preeclampsia Based on Age Distribution

Based on Table 1 of the characteristics of the respondents, most of the primigravida mothers are in the age group of <35 years, which is as many as 65 people (98%), while mothers with the age of ≥ 35 years are only 1 person (2%). This shows that the majority of respondents are of safe reproductive age, so the elderly age factor contributes relatively little in the study population. The results of this study show a connection with the research conducted by Utari and Hasibuan, showing that from a total of 84 samples, 40 pregnant women (63.5%) aged 20-35 years and 2 pregnant women (11.1%) aged >35 years old did not experience preeclampsia. Meanwhile, as many as 3 pregnant women (100%) aged <20 years, 23 pregnant women (36.5%) aged 20-35 years, and as many as 16 pregnant women (88.9%) aged >35 years old were diagnosed with preeclampsia (Utari and Hasibuan, 2022). This study has results that are contrary to the research that has been conducted by Farhani et al. (2025), which obtained results from a total of 92 samples of pregnant women at Pertamedika Ummi Rosnanti Hospital, Banda Aceh, where pregnant women with preeclampsia diagnoses were more in the risk age group (<20 and >35 years). A total of 23 pregnant women with preeclampsia (25%) were in the risk age group (<20 and >35 years) and 4 pregnant women (4.3%) were in the non-risk age group (20-35 years). Meanwhile, as many as 60 pregnant women who do not have preeclampsia (65.2%) are in the non-risk age group and 5 pregnant women (5.5%) are in the risk age group (Farhani et al., 2025).

Pregnant women under the age of 20 and over 35 years are included in the age group at high risk of experiencing complications during pregnancy. In the age group of less than 20 years, the uterus generally does not develop optimally to support during pregnancy, which has the potential to increase the risk of pregnancy disorders. Meanwhile, at the age of 35 years, there is a degenerative process that causes changes in peripheral blood vessels both structurally and functionally, thus contributing to an increased risk of preeclampsia (Utari and Hasibuan, 2022). This is not related to the results of the research conducted by the author, where based on the significance value (p) was obtained as 0.116 which is higher than 0.05 which means $p > \alpha$ ($\alpha = 0.05$) which means that there is no correlation between age and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic of RSPAL dr. Ramelan Surabaya for the 2023-2025 period. In this study, it was found that most primigravida mothers with preeclampsia have an age range of 20-35 years or <35 years, which is a non-risk age. This study is not in line because the sample is all primigravida mothers with an age range of 18-36 years, where the number of primigravida mothers diagnosed with preeclampsia with a risk age is only 1 sample aged 36 years.

The incidence of preeclampsia is based on the distribution of body mass index (BMI)

Overweight and obesity are thought to increase the risk of preeclampsia. A high BMI increases the overall risk of preeclampsia by about 1.7–3.4 times, and the risk of preeclampsia increases progressively as BMI increases (Abramova et al., 2022). Based on body mass index (BMI), more than half of the respondents had a normal BMI (18.5–24.9), which was 35 people (53%). However, the proportion of mothers with excess BMI and obesity is quite high, with the overweight category as many as 23 people (35%) and obesity as many as 6 people (9%). These findings show that nearly half of the respondents have an over-nourished status, which has the potential to increase the risk of pregnancy complications.

Based on the results of the Kendall's Tau-b correlation test, a correlation coefficient value of 0.334 with a value of $p = 0.005$ was obtained. These findings show a positive and moderate relationship between BMI and the incidence of preeclampsia, and the relationship is statistically significant, indicating that the higher the BMI, the more likely it is to have preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic of RSPAL dr. Ramelan Surabaya for the 2023–2025 period. This study is in line with previous research conducted by Mao et al. (2025) which stated that the risk of preeclampsia is lower in women with underweight BMI and normal weight. In contrast, women with overweight and obese BMI have a higher risk of preeclampsia (Mao et al., 2025). The same study was also conducted by Handayani and Nurjanah who stated that out of a total of 41 samples, as many as 21 people (51.2%) with an overweight BMI and 10 people (24.3%) with an obese BMI experienced preeclampsia, and a total of 1 person (2.4%) had a normal BMI experienced preeclampsia (Handayani and Nurjanah, 2021).

Obesity is defined as a medical condition in which excess body fat accumulates in a person so that it can have a negative impact on health. Metabolic imbalances observed in metabolically active fats around the abdominal organs, namely visceral fat, are associated with metabolic dysregulation (Abraham and Romani, 2022). Metabolic syndrome is a specific health condition associated with obesity. This syndrome is characterized by a collection of health disorders that appear simultaneously. These disorders include obesity, insulin resistance with above-normal fasting glucose levels, hypertension, liver steatosis, and dyslipidemia, which together with chronic inflammation can lead to aggressive atherosclerosis (Abraham and Romani, 2022). The levels of cytokines produced in adipose tissue in patients with diseases such as metabolic syndrome and type 2 diabetes mellitus, suggest that plasma adiponectin levels decrease, while pro-inflammatory cytokines such as TNF- α and interleukin-6 (IL-6) increase, causing a proinflammatory state characterized by insulin resistance and endothelial dysfunction (Jaramillo et al., 2018). Endothelial dysfunction and related structures have been linked to many pregnancy complications, including preeclampsia, fetal growth restriction (FGR), and diabetes. Preeclampsia is the most common pregnancy complication related to endothelial injury and dysfunction (Kornacki et al. 2021).

The incidence of preeclampsia is based on the distribution of mean arterial pressure (MAP)

Various methods can be done for preeclampsia screening, one of the most possible screening methods to be done on antenatal examination is the Mean Arterial Pressure (MAP) method obtained from blood pressure examination. MAP is the average arterial pressure over a single heart, systolic and diastolic cycle. Mothers with normal pregnancies are known to have lower MAP in early pregnancy when compared to preeclampsia mothers (Helery et al., 2021). Based on the Mean Arterial Pressure (MAP) value, most of the respondents had a MAP of ≤ 90 mmHg, which was 40 people (61%), while respondents with a MAP of >90 mmHg were 26 people (39%). This condition indicates that although the majority of mothers have blood pressure within normal limits, there is still a considerable proportion with high MAP, which can be a risk factor for preeclampsia.

Based on the results of the Kendall's Tau-b correlation test, a correlation coefficient value of 1.000 with a p value of < 0.001 was obtained. These results show a very strong and significant positive

relationship between MAP and the incidence of preeclampsia, which confirms that the increase in MAP is strongly related to the increased risk of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic of RSPAL dr. Ramelan Surabaya for the 2023-2025 period. This study is in line with previous research conducted by Helery et al. (2021) which showed that as many as 31 pregnant women with a diagnosis of preeclampsia (62%) had MAP results >90 . Where this result is higher than mothers who have MAP ≤ 90 in a total of 19 samples (38%). Meanwhile, pregnant women who did not have preeclampsia had a MAP of ≤ 90 in 36 samples (72%), while those with a MAP of >90 had 14 samples (28%) (Helery et al., 2021). MAP is determined by blood pressure volume, the higher a person's blood pressure volume, the higher the MAP value, and vice versa, the lower a person's blood pressure volume, the lower the MAP value (Ningrum, 2020). Preeclampsia can occur when hypertension cannot be anticipated, this condition risks causing complications such as damage to other systems or organs during pregnancy that can lead to long-term consequences (Amdadi et al., 2020).

Correlation of Vitamin D 25-OH Levels with Preeclampsia Incidence

The status of vitamin D 25-hydroxy showed that almost all respondents were deficient in vitamin D, namely 59 people (89%). Meanwhile, respondents with insufficiency and insufficiency status were 6 people (9%) and 1 person (2%) respectively. These findings illustrate the high prevalence of vitamin D deficiency in primigravida mothers in this study. Based on the results of the Kendall's Tau-b correlation test, the variable vitamin D 25-OH level has a correlation coefficient of 0.217 with a p value = 1.000. These results showed a weak positive association between vitamin D levels and the incidence of preeclampsia, but were not statistically significant, so vitamin D 25-OH levels were not shown to be associated with the incidence of preeclampsia in primigravida mothers in this study. The findings of this study are not in accordance with previous research conducted by Aboelazm et al. (2024) which stated that vitamin D 25-OH levels have a significant correlation with preeclampsia where pregnant women with low vitamin D 25-OH concentrations are more susceptible to the risk of preeclampsia. Based on the research of Aboelazm et al. (2024), the average vitamin D 25-OH level in preeclampsia was 29.02 ± 6.22 ng/ml, which was statistically significantly decreased compared to the control group (39.54 ± 11.21 ng/ml) ($P < 0.001$). In the preeclampsia group, there were 4 women (8.9%) with vitamin D deficiency, 19 women (42.2%) with vitamin D insufficiency, and 22 women (48.8%) with vitamin D insufficiency.

However, this study is in line with research conducted by Nagarajan (2024), who stated that it is difficult to show a correlation between vitamin D 25-OH levels and preeclampsia. The results of the study of Nagarajan (2024) showed that from a total of 50 sample groups of cases, the number of vitamin D deficiency and insufficiency of 25-OH was recorded at 32 (64%) and 18 (36%) respectively. In the control group of 50 samples, 30 samples (60%) were vitamin D deficient, 19 samples (38%) were in the vitamin D insufficiency category, and 1 sample (2%) was in the vitamin D deficiency category. The mean vitamin D levels between the case and control groups were not statistically significant ($p = 0.669$) (Nagarajan, 2024).

Vitamin D plays a role in the regulation of cell proliferation, cell differentiation, and apoptosis. Vitamin D triggers an immune response through the regulation of innate and adaptive immunity. This explains the correlation of vitamin D deficiency with the potential risk of various conditions such as hypertension, diabetes mellitus, cancer, multiple sclerosis, allergies, asthma, autoimmune diseases and infections, and depression (Samanta et al., 2021). Various studies have also confirmed the effect of 25-hydroxyvitamin D (25-hydroxycalciferol, 25(OH)D) concentrations on the development of preeclampsia and related complications, such as endothelial and vascular dysfunction. However, it is not clear whether 25(OH)D levels decrease due to the development of preeclampsia or whether low levels of 25(OH)D cause preeclampsia (Karpova et al., 2022). The results of this study showed that a person with a diagnosis of preeclampsia had vitamin D 25-OH levels in the deficiency group, but a person with vitamin D 25-OH levels in the deficiency group

was not fully diagnosed with preeclampsia. Vitamin D 25-OH levels in all primigravida mothers with preeclampsia diagnosis were 19 samples and 40 samples of primigravida mothers with non-preeclampsia diagnosis out of 66 total samples in this study were in the deficiency group. In this study, researchers only used the results of measuring vitamin D 25-OH levels in primigravida mothers in the first trimester of pregnancy. The results of statistical analysis showed that there was no significant correlation between vitamin D 25-OH levels and the incidence of preeclampsia. This is likely due to increased vitamin D 25-OH levels in the 2nd and 3rd trimester. Therefore, researchers recommend that vitamin D 25-OH levels be checked starting from the 1st to 2nd trimester so that they can analyze the profile of vitamin D 25-OH levels that can show a correlation with the incidence of preeclampsia.

Research Limitations

This study used a cross-sectional design so it could not explain the causal relationship between vitamin D 25-OH levels and the incidence of preeclampsia. The use of secondary data from medical records limits controls for confounding factors such as sun exposure, vitamin D intake, and supplement use. In addition, the majority of respondents were in the vitamin D deficiency category, so the variation in data was limited. Vitamin D 25-OH levels were measured only at one time of examination, and the number of samples was relatively small and came from one health facility, thus limiting the generalization of the study results.

CONCLUSION

The study concluded that there is no correlation between vitamin D 25-OH levels and the incidence of preeclampsia in primigravida mothers at the Obstetrics and Gynecology Polyclinic RSPAL dr. Ramelan Surabaya for the 2023-2025 period.

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