THE RELATIONSHIP BETWEEN BODY MASS INDEX (BMI) AND PRE-EKLAMPSIA IN RSIA AMANAT MAKASSAR CITY

Andi Yusnita Latifa Bunayya Hartadi [1], Masita Fujiko M. Said [2*], Nur Fadhillah Khalid [3], M. Hamsah [2], Ida Royani [4]

[1] Prodi Sarjana Kedokteran, Fakultas Kedokteran, Universitas Muslim Indonesia
[2] Departemen Obstetri dan Ginekologi, Fakultas Kedokteran, Universitas Muslim Indonesia, RSP Ibnu Sina YW-UMI
Email: *masitafujikom.said@umi.ac.id*
[3] Departemen Farmakologi, Fakultas Kedokteran, Universitas Muslim Indonesia, RSP Ibnu Sina YW-UMI
[4] Departemen Gizi, Fakultas Kedokteran, Universitas Muslim Indonesia, RSP Ibnu Sina YW-UMI
Jl. Urip Sumoharjo Km. 05, Makassar, Indonesia

Abstract

The success of maternal health programs is often evaluated using the Maternal Mortality Rate (MMR), which measures deaths during pregnancy, childbirth, and the puerperium due to pregnancy-related causes. In 2020, hypertension in pregnancy was a leading cause of maternal deaths, with 1,110 cases reported. Pre-eclampsia, characterized by hypertension (blood pressure $\geq140/90$ mmHg) and proteinuria after 20 weeks of gestation, is a significant concern. Overweight and obesity are high-risk factors associated with increased pregnancy complications, including pre-eclampsia. This study aimed to analyze the relationship between Body Mass Index (BMI) and pre-eclampsia at Amanat Hospital in Makassar City. Using an observational analytic design with a cross-sectional approach, 284 pregnant women were assessed. The prevalence of pre-eclampsia was found to be 9.9%, with 28 women diagnosed. Bivariate analysis using the Chi-Square test revealed a significant association between BMI and pre-eclampsia ($p = 0.001$), while no significant association was found between Upper Arm Circumference (LILA) and pre-eclampsia ($p = 0.348$). The study concludes that BMI is significantly associated with pre-eclampsia, whereas LILA does not show a significant relationship.
Keywords: Body Mass Index, Upper Arm Circumference, Pre-eclampsia

Introduction

Body Mass Index (BMI) is one of the factors that can affect the incidence of Pre-eclampsia in pregnant women (1–3). Pre-eclampsia is a condition characterized by increased blood pressure and protein in the urine that occurs after 20 weeks of gestation (4,5). This condition has the potential to cause serious complications for the mother and fetus, including maternal death (6,7). Several studies have shown a significant relationship between BMI and the incidence of Pre-eclampsia. Pregnant women with high BMI are at greater risk of developing Pre-eclampsia compared to pregnant women with normal BMI (2,3,8). Obesity, which is associated with high BMI, can lead to increased insulin resistance, endothelial dysfunction, and systemic inflammation which are factors that trigger the occurrence of Pre-eclampsia (3,9). Obesity also contributes to increased blood pressure and proteinuria, the two main symptoms of Pre-eclampsia (2,3). In addition to BMI, other factors such as age, parity, history of hypertension, and history of diabetes mellitus can also affect the incidence of Pre-eclampsia (2,7,10). Research shows that pregnant women with older age, primigravida, or a history of hypertension and diabetes mellitus have a higher risk of developing Pre-eclampsia (2,7,10). Therefore,

proper monitoring and treatment of pregnant women with risk factors for Pre-eclampsia, including high BMI, is very important to prevent complications that can occur (11,12). Midwives and other health workers need to pay special attention and enthusiastic efforts in providing quality Antenatal Care services to detect and treat Pre-eclampsia as early as possible (8,11).

The success of maternal health programs is often assessed by the main indicator of maternal mortality rate (MMR), which measures deaths during pregnancy, childbirth, and postpartum due to pregnancy, childbirth, or postpartum itself, not due to accidents or other causes (6). MMR illustrates the degree of public health and is sensitive to improvements in health services, both in terms of accessibility and quality. Data from 2020 shows that most maternal deaths were caused by bleeding (1,330 cases), hypertension in pregnancy (1,110 cases), and circulatory system disorders (230 cases) (6). Pre-eclampsia, which is a hypertensive disorder with blood pressure ≥140/90 mmHg at ≥20 weeks gestation and accompanied by proteinuria, is often the main cause of increased maternal and child morbidity and mortality, especially before aterm gestation (13). Based on WHO data, the incidence of Pre-eclampsia worldwide ranges from 2-10%, with a higher prevalence in developing countries (1.8-16.7%) than developed countries (0.4%) (14,15). This prevalence varies across regions, for example Asia (0.2-6.7%), Africa (0.5-2.3%), North America (2.6-4.0%), Europe (2.8-5.2%), Oceania (2.8-9.2%), and South America (1.8-7.7%) (14,15).

In Indonesia, the maternal mortality rate (MMR) continues to be a significant health issue, reflecting the quality of healthcare services provided during pregnancy and the postpartum period. Despite a reduction in maternal deaths due to hypertension in pregnancy from 41 cases in 2019 to 30 cases in 2020 (16,17). Indonesia still has one of the highest MMRs in Southeast Asia. Overweight and obesity are linked to an increased risk of pregnancy complications, including miscarriage, operative delivery, pre-eclampsia, thromboembolism, perinatal mortality, and macrosomia (18,19). Obesity can elevate cholesterol levels and strain heart function. As body weight increases, the volume of blood in the body rises, causing the heart to work harder and leading to elevated blood pressure, which can result in pre-eclampsia. High blood pressure can constrict uterine blood vessels, limiting the oxygen and nutrient supply to the fetus (18,19). Additionally, excess fat contributes to endothelial damage associated with pre-eclampsia. Elevated triglyceride levels can harm placental blood vessels, leading to endothelial dysfunction, atherosclerosis, and thrombosis. Women with high triglyceride levels are twice as likely to develop pre-eclampsia compared to those of normal weight (20). Assessing the nutritional status of pregnant women is crucial, and one straightforward method for evaluating obesity is calculating Body Mass Index (BMI), which is derived by dividing weight (kg) by the square of height (m²). BMI is commonly used to assess nutritional status as it offers a clearer comparison of body weight to height, unlike the Upper Arm Circumference (LILA) method, which only measures arm circumference without considering height or weight (18,21).

This study aims to analyze the relationship between BMI and the incidence of Pre-eclampsia in pregnant women at RSIA Amanat Makassar City. Given the high morbidity and mortality rates due to Pre-eclampsia, as well as the significant relationship between BMI and the incidence of Pre-eclampsia, this study is expected to provide further understanding of the importance of monitoring the nutritional status of pregnant women in an effort to prevent Pre-eclampsia and other complications that can harm the mother and fetus.

Method

This study used an observational analytic design with a cross-sectional approach (22) conducted at the Amanat Mother and Child Hospital Makassar from September to October 2024. The population in this study were all pregnant women registered at RSIA Amanat Makassar City, while the research sample consisted of pregnant women who suffered from Pre-eclampsia and met the inclusion criteria, namely pregnant women who performed pregnancy checks and were recorded in the medical records of RSIA Amanat in 2023, pregnant women who were diagnosed with Pre-eclampsia, and pregnant women with gestational age ≥ 20 weeks. The sampling technique used was total sampling, considering that the population was less than 100, so that the entire population was sampled. Inclusion criteria included pregnant women with complete medical record data and diagnosed with Pre-eclampsia, while exclusion criteria were pregnant women with incomplete medical records or a history of kidney disease and hypertension. Data collection was carried out using secondary data from patient medical records, which was then processed using Microsoft Excel 2020 and analyzed with SPSS (23,24). Data analysis was performed univariately to describe the frequency distribution of IMT variables as independent variables and Pre-eclampsia as the dependent variable (25,26). Furthermore, bivariate analysis was performed with the Chi-Square test to test the significant relationship between BMI and Pre-eclampsia. Hypothesis testing was carried out on the basis of the p value, where if the p value is <0.05 then H0 is rejected and H1 is accepted, while if the p value is >0.05 then H0 is accepted and H1 is rejected (27).

Results and Discussion
Univariate Analysis
A. Prevalence of Pre-eclampsia

Table 2: Prevalence of Pregnant Women with Pre-eclampsia at RSIA Amanat Makassar City

Diagnosis	Frequency	Percentage (%)
Pre-eclampsia	28	9,9
No Pre-eclampsia	256	90,1
Total	**284**	**100,0**

Source: Primary Data Processed, 2024

Table 2 shows the prevalence of pre-eclampsia among pregnant women admitted to RSIA Amanat Makassar City. Of the total 284 pregnant women recorded during the study, 28 pregnant women (9.9%) were diagnosed with pre-eclampsia, while 256 pregnant women (90.1%) did not experience the condition. The recorded pre-eclampsia prevalence rate of 9.9% indicates that almost 10% of the total pregnant women undergoing screening at the hospital had pre-eclampsia, a hypertensive condition that can pose significant health risks to both mother and fetus. In contrast, the 90.1% of pregnant women who were not diagnosed with pre-eclampsia, reflects that most of the pregnant women undergoing screening had pregnancy conditions that did not show symptoms of hypertension or organ disorders associated with pre-eclampsia.

B. Age of Respondent

Table 3. Characteristics of Pregnant Women at RSIA Amanat Based on Age

Age	Frequency (n)	Percentage (%)
<20 years	16	5,6
20-35 years	237	83,5
>35 years old	31	10,9
Total	**284**	**100,0**

Source: Primary Data Processed, 2024

Table 3 shows the age distribution of pregnant women admitted to RSIA Amanat Makassar City during the study period. Of the total 284 pregnant women, the majority, 237 pregnant women (83.5%), were in the age range of 20-35 years. This age group dominated the population of pregnant women at the hospital, reflecting that the optimal reproductive age for pregnancy for most pregnant women at RSIA Amanat is in this age range. A total of 31 pregnant women (10.9%) were above 35 years of age, indicating a higher risk group of pregnant women associated with various pregnancy complications, including pre-eclampsia. The group of pregnant women under 20 years of age, which amounted to 16 pregnant women (5.6%), was the smallest group, although still indicative of the number of pregnancies at a young age in Amanat Hospital. Pregnancy at this age often carries a higher risk of health problems for both mother and baby.

C. Body Mass Index (BMI)
Table 4. Characteristics of Body Mass Index (BMI) of Pregnant Women at Amanat Hospital

IMT	Frequency (n)	Percentage (%)
Underweight	10	3,5
Normal	177	62,3
Overweight	35	12,3
Obesity Grade 1	29	10,2
Obesity Grade 2	33	11,6
Total	**284**	**100.0**

Source: Primary Data Processed, 2024

Based on Table 4. the distribution of Body Mass Index (BMI) of pregnant women who were treated at RSIA Amanat Makassar City. Of the total 284 pregnant women analyzed, most pregnant women had BMI in the normal category, as many as 177 pregnant women (62.3%). This indicates that most pregnant women in the hospital have a good nutritional status and are in the ideal weight range according to BMI standards. Meanwhile, there were 35 pregnant women (12.3%) who fell into the overweight category and 29 pregnant women (10.2%) who had BMI in the Grade 1 Obesity category (mild obesity). The grade 2 obesity category, which is pregnant women with very high BMI, recorded a total of 33 pregnant women (11.6%). The combination of overweight and obesity reflects that almost 34% of pregnant women at RSIA Amanat have an overweight problem, which puts them at risk of various pregnancy complications, including pre-eclampsia. On the other hand, there were 10 pregnant women (3.5%) who fell into the underweight category, indicating the proportion of pregnant women with less than ideal body weight. Although the number is relatively small, pregnant women with underweight BMI still need special attention, because they are at risk of nutritional problems that can affect the health of mothers and babies.

D. Upper Arm Circumference (LILA)
Table 5. Characteristics of Upper Arm Circumference (LILA) of Pregnant Women with Pre-eclampsia

LILA size (cm)	Frequency (n)	Percentage (%)
Risk of SEZ	10	3,5
No risk of SEZ	274	96,5
Total	**284**	**100.0**

Source: Primary Data Processed, 2024

Based on Table 5. the distribution of the size of the Upper Arm Circumference (LILA) in pregnant women who were treated at RSIA Amanat Makassar City, with a focus on pregnant women

who experienced pre-eclampsia. LILA is used to assess the nutritional status of pregnant women, especially to detect the risk of Chronic Energy Deficiency (CHD). Out of a total of 284 pregnant women analyzed, only 10 pregnant women (3.5%) had LILA measurements that indicated a risk of SEZ, which was <23.5 cm. This means that the majority of pregnant women, 274 pregnant women (96.5%), had LILA measurements that did not indicate a risk of SEVERITY, i.e. >23.5 cm. This suggests that most pregnant women at RSIA Amanat have a good nutritional status, with no indication of chronic energy deficiency. However, although the proportion of pregnant women at risk of chronic energy deficiency is relatively small, it should be noted that LILA measurements that are in the risk category of chronic energy deficiency indicate potential nutritional problems in pregnant women that can have an impact on maternal and fetal health.

Bivariate Analysis
A. Body Mass Index (BMI) with Pre-eclampsia
Table 6. Body Mass Index (BMI) with Pre-eclampsia in pregnant women at RSIA Amanat

IMT	Pre-eclampsia				Total		Statistical Test
	Pre-eclampsia		No Pre-eclampsia				
	n	%	n	%	n	%	
Underweight	0	0,0	10	3,9	10	3,5	
Normal	3	10,7	174	68	177	62,3	
Overweight	1	3,6	34	13,3	35	12,4	
Obesity Grade 1	9	32,1	20	7,8	29	10,2	p = 0.001
Obesity Grade 2	15	53,6	18	7	33	11,6	
Total	28	100.0	256	100.0	284	100.0	

Source: SPSS Data Processed, 2024

Based on Table 6. the relationship between Body Mass Index (BMI) with the incidence of pre-eclampsia in pregnant women at RSIA Amanat Makassar City. In this table, data is grouped by BMI category (Underweight, Normal, Overweight, Obesity Grade 1, and Obesity Grade 2) and pre-eclampsia status, with the percentage of pregnant women who experience pre-eclampsia and those who do not experience pre-eclampsia in each BMI category. From the results obtained, no pregnant women with underweight BMI were diagnosed with pre-eclampsia, while all mothers with underweight BMI (100%) did not experience pre-eclampsia. Meanwhile, in the normal BMI category, 3 pregnant women (10.7%) were diagnosed with pre-eclampsia, while 174 pregnant women (68%) were not diagnosed with pre-eclampsia. In the overweight group, 1 pregnant woman (3.6%) had pre-eclampsia, while 34 pregnant women (13.3%) did not have pre-eclampsia. In the grade 1 obesity category, 9 pregnant women (32.1%) had pre-eclampsia, and 20 pregnant women (7.8%) did not. The most striking was the grade 2 obesity category, where 15 pregnant women (53.6%) had pre-eclampsia, while 18 pregnant women (7%) were not diagnosed with pre-eclampsia. The results of statistical test analysis using the Chi-Square test showed a p value = 0.001, which is smaller than 0.05 (α = 0.05), so it can be concluded that there is a significant relationship between BMI and the incidence of pre-eclampsia in pregnant women at RSIA Amanat.

B. Upper Arm Circumference (LILA) with Pre-eclampsia

Table 7. Body Mass Index (BMI) with Pre-eclampsia in pregnant women at RSIA Amanat

LILA	Pre-eclampsia				Total		Statistical Test
	Pre-eclampsia		No Pre-eclampsi				
	n	%	n	%	n	%	
Risk of SEZ	0	0.0	10	3,9	10	3,5	
No risk of SEZ	28	100,0	246	96,1	274	96,5	p = 0.348
Total	**28**	**100.0**	**256**	**100.0**	**284**	**100.0**	

Source: SPSS Data Processed, 2024

Based on Table 7. the relationship between the size of the Upper Arm Circumference (LILA) with the incidence of pre-eclampsia in pregnant women at RSIA Amanat Makassar City. The LILA measure is used to assess the risk of Chronic Energy Deficiency (CHD), which reflects the nutritional status of pregnant women. Based on this table, LILA is grouped into two categories: pregnant women who have LILA with risk of SEZ (below 23.5 cm) and pregnant women with LILA without risk of SEZ (above 23.5 cm). From the table, it can be seen that in the group of pregnant women with LILA at risk of SEVERITY (<23.5 cm), no pregnant women were diagnosed with pre-eclampsia. All 10 pregnant women with LILA at risk of SEVERITY did not develop pre-eclampsia (100%). In contrast, in the group of pregnant women with LILA not at risk of SEVERITY (>23.5 cm), 28 pregnant women (100%) were diagnosed with pre-eclampsia, while 246 pregnant women (96.1%) were not diagnosed with pre-eclampsia. Statistical test results using the Chi-Square test showed a p value = 0.348, which is greater than 0.05 (α = 0.05). This means that there is no significant relationship between LILA size and the incidence of pre-eclampsia in pregnant women at RSIA Amanat. Although there was a difference in distribution between the two LILA groups, statistically there was no strong evidence to suggest that LILA size influenced the incidence of pre-eclampsia in pregnant women.

Prevalence of Pre-eclampsia at RSIA Amanat

The maternal mortality rate (MMR) serves as a key indicator for evaluating the quality of maternal health services, particularly those related to pregnancy, childbirth, and the postpartum period. MMR is defined as the number of maternal deaths occurring during pregnancy, childbirth, and the puerperium due to pregnancy-related conditions or their management, excluding deaths from accidents or other incidental causes. In Indonesia, pre-eclampsia is a significant contributor to maternal mortality. According to data from the South Sulawesi Provincial Health Office, maternal deaths due to hypertension in pregnancy decreased from 41 cases in 2019 to 30 cases in 2020 (17,28). Pre-eclampsia is a hypertensive disorder that typically arises after 20 weeks of gestation and is characterized by organ dysfunction, including proteinuria (the presence of protein in urine). If left untreated, pre-eclampsia can progress to eclampsia, a more severe and potentially fatal condition for both the mother and the baby. Therefore, early detection of pre-eclampsia is crucial to prevent serious complications. This study was conducted at Amanat Makassar Mother and Child Hospital (RSIA) from September to October 2024, involving 28 pregnant women diagnosed with pre-eclampsia out of a total of 284 pregnant women who underwent examination and delivery at the hospital. The prevalence of pre-eclampsia identified in this study was 9.9%, indicating that approximately 10% of pregnant women visiting the hospital were affected. This research offers valuable insights into the prevalence of pre-eclampsia at RSIA Amanat, which can serve as foundational data for the hospital to enhance awareness of hypertensive conditions during pregnancy and implement more effective preventive measures.

Relationship between Body Mass Index (BMI) and Pre-eclampsia

One of the factors that play a role in the incidence of Pre-eclampsia is the nutritional status of pregnant women, which can be measured using the Body Mass Index (BMI). BMI is the ratio between body weight and the square of height used to assess the nutritional status of a person's body. In pregnant women, BMI can provide an overview of whether a pregnant woman is underweight, normal, overweight, or obese. Several studies have shown that obesity, defined as a condition of excess body fat, can increase the risk of Pre-eclampsia, while underweight is also associated with an increased risk of complications in pregnancy. The results of this study indicate a significant relationship between BMI and the incidence of Pre-eclampsia in pregnant women. Based on the data obtained, no pregnant women with underweight BMI were diagnosed with Pre-eclampsia, while pregnant women with normal BMI, overweight, grade 1 obesity, and grade 2 obesity showed a higher prevalence of Pre-eclampsia. In detail, 3 pregnant women with normal BMI were diagnosed with Pre-eclampsia (10.7%), 1 pregnant woman with overweight BMI was diagnosed with Pre-eclampsia (3.6%), 9 pregnant women with obesity grade 1 were diagnosed with Pre-eclampsia (32.1%), and 15 pregnant women with obesity grade 2 were diagnosed with Pre-eclampsia (53.6%).

Statistical analysis using the Chi-Square test showed a significance value (P-Value) of 0.001, which is smaller than $\alpha = 0.05$. This indicates that there is a significant relationship between BMI and Pre-eclampsia in pregnant women at RSIA Amanat. This finding is in line with research conducted which also found a significant relationship between BMI and Pre-eclampsia (p = 0.000) [29] . Obesity is a major risk factor for Pre-eclampsia, and this risk increases with increasing BMI values. Some of the pathological mechanisms involved in this relationship include oxidative stress, insulin resistance, and hemodynamic disturbances caused by increased sympathetic activity and endothelial dysfunction.

Obesity can cause oxidative stress, leading to increased inflammation and endothelial dysfunction. In addition, obesity is also associated with insulin resistance which interferes with the normal function of blood vessels and increases the risk of hypertension in pregnancy. This study supports the finding that pregnant women with higher BMI, especially those classified as obese, have a greater risk of developing Pre-eclampsia. Pre-eclampsia itself can cause impaired blood circulation to the placenta, which in turn can lead to stunted fetal growth, preterm birth, and increased maternal and infant morbidity and mortality [29,30].

Relationship between Upper Arm Circumference (LILA) and Pre-eclampsia

Another anthropometric measure used to assess the nutritional status of pregnant women is the Upper Arm Circumference (LILA). LILA is a parameter that measures the size of the body fat and muscle of pregnant women, without being affected by body fluids. LILA measurements are usually taken on the left arm, which is between the base of the upper arm and the tip of the elbow, with the standard in Indonesia being <23.5 cm for mothers with poor nutritional status and >23.5 cm for mothers with good nutritional status.

In this study, the analysis of the relationship between Upper Arm Circumference (LILA) and the incidence of pre-eclampsia yielded different results compared to Body Mass Index (BMI). The data indicated that pregnant women with a LILA measurement at risk of severity (<23.5 cm) were not diagnosed with pre-eclampsia, while those with a LILA measurement not at risk of severity (>23.5 cm) were all diagnosed with pre-eclampsia (100%). However, the Chi-Square test results revealed a significance value (p-value) of 0.348, which exceeds the alpha level of 0.05, leading to the conclusion that there is no statistically significant relationship between LILA and pre-eclampsia among pregnant women at RSIA Amanat. This finding aligns with another study that reported a similar result, indicating no significant relationship between LILA and pre-eclampsia (p = 0.253) [31]. While LILA is utilized to assess the nutritional status of pregnant women, particularly for detecting the risk of Chronic Energy Deficiency (CHD), it serves primarily as a screening tool and is not effective for monitoring short-term

changes in nutritional status. LILA is more beneficial for identifying pregnant women at risk of severe health issues during pregnancy.

Chronic Energy Deficiency (CED) can affect fetal growth and overall maternal health. SEZ in pregnant women can lead to a disruption in the supply of nutrients needed during pregnancy, which impacts maternal health and fetal development. Although LILA is a more practical and easier method to measure than BMI, the results are not always reliable for detecting the risk of Pre-eclampsia, especially in the population of pregnant women with better nutritional status. Therefore, although LILA measurement still has value in assessing the nutritional status of pregnant women , more factors need to be considered in identifying the risk of Pre-eclampsia in pregnant women (32,33).

Conclusion

Based on the research results regarding the relationship between Body Mass Index (BMI) and pre-eclampsia at RSIA Amanat, it can be concluded that measuring nutritional status using the BMI method is an effective approach to identify risk factors for pre-eclampsia in pregnant women. The study found a significant association between BMI and pre-eclampsia, indicating that higher BMI may increase the risk of developing this condition. In contrast, measurements using Upper Arm Circumference (LILA) did not demonstrate a significant relationship with pre-eclampsia, suggesting that LILA may not be a reliable indicator for this specific risk. Given these findings, the researcher recommends that RSIA Amanat implement educational programs to raise awareness about pre-eclampsia among women planning for pregnancy and those who are already pregnant. Such initiatives could help in identifying high-risk pregnant women and ultimately reduce the prevalence of pre-eclampsia. Additionally, it is crucial for pregnant women to engage in regular Antenatal Care (ANC) check-ups from the first trimester through the third trimester. These check-ups can help monitor health and identify potential complications early on. Furthermore, maintaining a healthy body weight through light exercise and a balanced diet is essential for pregnant women to mitigate the risk of pre-eclampsia. By promoting these practices, healthcare providers can support better maternal health outcomes and enhance the overall well-being of both mothers and their babies.

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