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Association between Maternal Dietary Patterns and Preeclampsia Incidence: A Cross-Sectional Study at Rehatta Hospital, Indonesia

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ABSTRACT

Preeclampsia is a severe pregnancy disorder and causes high maternal mortality rates in Indonesia, with 1,077 cases in 2021. This study aims to investigate the association between maternal dietary patterns and the incidence of preeclampsia, particularly among pregnant women in Jepara Regency, a coastal region. This study is a quantitative correlational study, with the population being all mothers with a gestational age above 20 weeks who underwent examinations at Rehatta Hospital, Jepara Regency. Respondents were determined by consecutive sampling, obtaining 50 pregnant women who underwent pregnancy checks during August-September 2024. Data on maternal dietary patterns were obtained by filling out the FFQ (Food Frequency Questionnaire) sheet. Data on the incidence of preeclampsia were determined based on a doctor's diagnosis. The collected data were analyzed univariately and bivariately using SPSS software. The Pearson test results for carbohydrate diet obtained p-value = 0.001, animal side dishes p-value = 0.001, vegetable side dishes p-value = 0.007, vegetables p-value = 0.001, fruits p-value = 0.001, fast food p-value = 0.001, and drinks p-value = 0.056. Based on the seven nutrients and drinks, high carbohydrate intake, lack of animal side dishes, vegetables, fruit, irregular eating, and fast food consumption have p-values <0.05, meaning maternal diet has a significant relationship with the incidence of preeclampsia. This finding confirms that a balanced diet during pregnancy plays a vital role in preventing preeclampsia. Therefore, monitoring diet and nutritional education for pregnant women needs to be a focus in efforts to prevent preeclampsia in health services.

Key Messages:

- Poor diet and nutritional status in pregnant women can increase the risk of preeclampsia.
- Previous studies have only described the diet and nutritional status of pregnant women with preeclampsia; no studies have specifically examined the relationship between maternal dietary patterns and preeclampsia in coastal regions
- This study more specifically examines the association between maternal dietary patterns and preeclampsia incidence at Rehatta Hospital, Jepara Regency.

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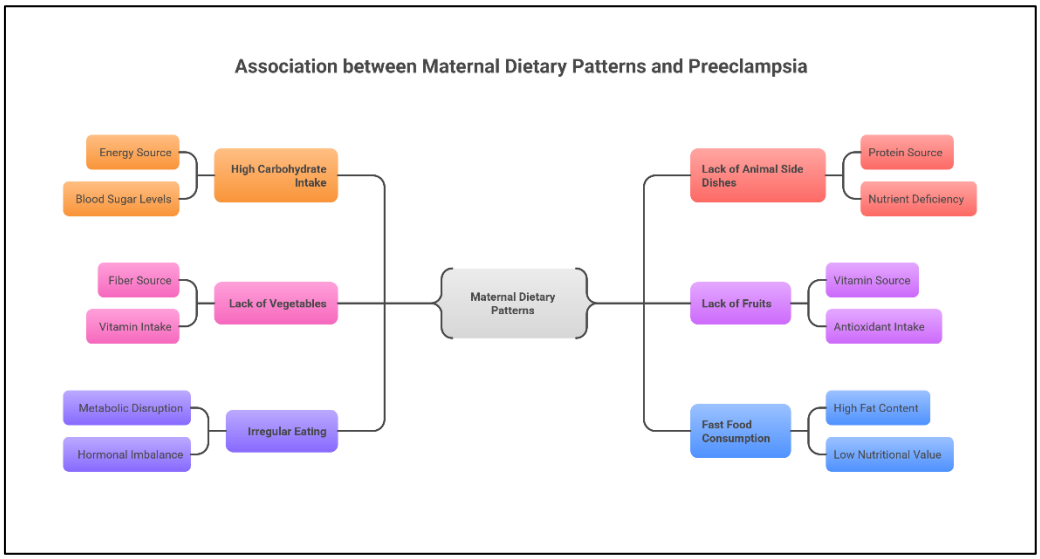
GRAPHICAL ABSTRACT



INTRODUCTION

The global number of maternal deaths in 2023, according to the World Health Organization (WHO), reached around 260,000 cases due to pregnancy and childbirth complications such as hypertension and preeclampsia (1). In Indonesia, severe preeclampsia and its complications were leading causes of maternal mortality, with 30.7 and 76.9 deaths per 100,000 live births in 2012 and 2013, respectively (2). Maternal deaths from preeclampsia reached 1110 cases in 2020 and slightly decreased to 1077 cases in 2021 (3). In 2023, there were 4,482 maternal deaths, primarily caused by hypertension in pregnancy (412 cases), followed by obstetric hemorrhage (360 cases) and other obstetric complications (204 cases) (4). The maternal mortality rate in Central Java remains a significant issue. In Central Java and Jepara Regency, hypertension during pregnancy remains a major cause of maternal death (5).

Preeclampsia is a hypertensive disorder that can develop during pregnancy, childbirth, or the postpartum period. It is defined by new-onset high blood pressure after 20 weeks of gestation. It is typically accompanied by signs of organ involvement, such as proteinuria (protein in the urine), kidney or liver dysfunction, thrombocytopenia (low platelet count), or evidence of utero-placental dysfunction (6). Several studies have identified risk factors for preeclampsia, such as extreme maternal age (<20 or >35 years) (7), nulliparity (8), history of hypertension, and obesity (Body Mass Index (BMI) ≥ 30 kg/m^2) (9). Two factors can increase the risk of preeclampsia: internal and external factors. Internal risk factors include age, obesity, genetics, stress, and anxiety, while external factors include exposure to tobacco smoke, inadequate antenatal care, and poor nutrition (10). Preeclampsia can lead to serious maternal complications such as kidney disease, pulmonary edema, and stroke, as well as fetal complications including hypoxia and growth restriction (11)

Despite extensive research on genetic and medical risk factors, evidence linking maternal diet to preeclampsia remains limited and inconsistent (12). Nutritional factors may influence blood pressure regulation and endothelial function, suggesting that diet could be a modifiable risk factor. During pregnancy, nutritional needs increase, particularly in the second trimester, when appetite and fetal growth accelerate (13). A balanced diet should include carbohydrates, proteins, fats, vitamins, minerals, and adequate water intake, while avoiding excessively spiced or unhealthy foods (14).

A study by Habbullah (2023) found that poor nutritional status, both malnutrition and obesity, was associated with a higher incidence of preeclampsia (15) Other studies have explored associations between preeclampsia and factors such as BMI (16), vegetable and fruit consumption (17), vitamin D intake (18), and the intake of vitamin C, fat, and sodium from junk food (19). These findings indicate that maternal nutrition plays a crucial role in pregnancy outcomes, yet comprehensive research on dietary patterns is still lacking.

Interestingly, the incidence of preeclampsia and eclampsia has been reported to be higher in low-lying areas (20), possibly due to environmental and nutritional factors such as infection, heat, dehydration, and diet

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(21). However, no studies have specifically examined the relationship between maternal dietary patterns and preeclampsia in coastal regions. Therefore, this study aims to investigate the association between maternal dietary patterns and the incidence of preeclampsia, particularly among pregnant women in Jepara Regency, a coastal region.

METHODS

This study employed a correlational quantitative research design to examine the relationship between two variables. Data for these variables were collected cross-sectionally, meaning that all information was collected simultaneously at a single point in time. The research took place at Rehatta Hospital in Jepara Regency from August to September 2024. The study population consisted of all pregnant women with a gestational age greater than 20 weeks who visited Rehatta Hospital for medical care during the study period. Consecutive sampling was used, which involved including every eligible participant who met the study criteria. Ultimately, fifty pregnant women who attended antenatal care services during August–September 2024 were enrolled as respondents in this study.

This study examined two variables: dietary patterns and the incidence of preeclampsia. Data related to dietary patterns or habits were collected using a Food Frequency Questionnaire (FFQ), and preeclampsia incidence was determined through medical records or doctors' diagnoses. Preeclampsia data were categorized into two categories: preeclampsia and non-preeclampsia. In addition to these two research variables, this study collected data on respondent characteristics, including name, occupation, maternal education, gestational status, pregnancy spacing, congenital diseases, gestational age, and obstetric status. Before data collection, respondents were provided with an understanding of the study's objectives and procedures. Respondents who agreed to participate signed an informed consent form as a sign of their willingness to participate. Respondents then completed a sheet containing respondent characteristics and an FFQ containing food types and consumption frequency. Respondents completed the FFQ questionnaire independently and were assessed by counting the number of meals and observing the frequency of eating patterns per week. The choices for eating frequency were more than three times per day, one to two times per day, three to six times per week, one to two times per week, one to two times per month, and never. The dietary data obtained were divided into seven categories: beverages, fast food, vegetables, fruits, carbohydrates, plant and animal proteins, and carbohydrate sources. These categories were evaluated based on weekly consumption frequency. The data obtained from the questionnaire were analyzed by calculating the total consumption frequency for each type of food. Dietary patterns were then categorized based on the median value of consumption frequency. The “rare” category was assigned to consumption below the median value, while the “frequent” category was assigned to consumption above the median value (22).

The collected data were analyzed univariately and bivariately using SPSS software. Univariate analysis described the respondents' dietary patterns and characteristics. Bivariate analysis was conducted using the Pearson test to determine the relationship between dietary patterns and the incidence of preeclampsia. The test results showed a p-value <0.05, indicating a significant relationship between the two variables.

CODE OF HEALTH ETHICS

This study has met ethical eligibility based on the ethical clearance certificate issued by the Ethics Committee of the Faculty of Health Sciences, Satya Wacana Christian University, Number: REC.2024050202/06.26/2025.

RESULTS

Based on Table 1, the characteristics of the pregnant women, the majority of respondents were in the safe age range for pregnancy, between 20 and 35 years (80%), with the majority (84%) being over 28 weeks pregnant (Trimester 3). Sixty percent of respondents were multigravida, meaning they had experienced more than one pregnancy, and 34% had high-risk pregnancies. Of the 50 respondents, 18 (36%) had preeclampsia.

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Table 1. Characteristics of Pregnant Women (n=50)

Indicators	n	%
Gestational Age		
Trimester 1	0	0
Trimester 2	8	16
Trimester 3	42	84
Maternal Age		
At Risk (<20 and >35 Years)	10	20
Not at Risk (20 – 35 Years)	40	80
Number of Pregnancies		
Primigravida	20	40
Multigravida	30	60
Pregnancy Interval (multigravida)		
At Risk (<2 and >5 Years)	17	34
Good (2 – 5 Years)	13	26
Illnesses During Pregnancy		
Preeclampsia	18	36
No Preeclampsia	32	64

Table 2. Maternal Dietary Patterns

Food Source	Average (times/week)
Carbohydrate Sources	
Rice	19.60
Biscuits	6.55
Bread	5.72
Noodles	1.04
Potatoes	0.97
Corn Rice	0.12
Gatot	0.02
Animal Protein Sources	
Chicken Eggs	6.28
Chicken	5.33
Milkfish	3.77
Shrimp	2.79
Beef	2.10
Squid	2.05
Sausage	1.50
Chicken Liver	1.19
Duck Eggs	0.63
Plant-Based Protein Sources	
Tempe	12.66
Tofu	9.62
Green Beans	3.12
Soybeans	2.27
Vegetables	
Spinach	7.86
Cabbage	4.75
Carrots	4.42
Kangkung	4.33
Mustard greens	3.11
Cucumber	2.76
Pumpkin	2.69
Green beans	1.83
Basil	0.78
Fruits	
Banana	7.24
Orange	7.06
Soursop	6.62

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Food Source	Average (times/week)
Apple	3.51
Watermelon	3.35
Dragon fruit	3.02
Melon	2.69
Manga	2.10
Wine	1.86
Kedongdong	0.88
Papaya	0.60
Fast Food	
Chips	3.98
Ice Cream	3.25
Ciki Sticks	2.93
Nuggets	1.37
Drinks	
Water	21.00
Tea	1.94
Packaged milk	1.08
Coffee	0.86
Soda	0.01

Table 2 shows the dietary patterns of pregnant women. The most frequently consumed carbohydrate source was rice, with a frequency of 19.6 times per week, and the animal side dish was chicken eggs, with a frequency of 6.28 times per week. The most frequently consumed vegetable side dish was *tempe*, with a frequency of 12.66 times per week, followed by spinach, with a frequency of 7.86 times per week. The most frequently consumed fruit was bananas, with a frequency of 3.98 times per week, and water was the most frequently consumed beverage, with a frequency of 21 times per week.

Table 3 Relationship between dietary pattern and preeclampsia (n = 50)

	Dietary Habit				*P-value*
Diet	Rarely (n)	%	Often (n)	%	
Carbohydrate Diet	35	70	15	30	0.001
Animal Food Diet	33	66	17	34	0.001
Vegetable Side Dish Diet	24	48	26	52	0.007
Vegetable Diet	36	72	14	28	0.001
Fruit Diet	34	68	16	32	0.001
Fast Food	23	46	27	54	0.001
Drinking Patterns	18	36	32	64	0.056

Table 3 presents the relationship between maternal dietary patterns and the incidence of preeclampsia at Rehatta Hospital, Jepara Regency. The analysis revealed a significant association between carbohydrate intake and preeclampsia, with a p-value of 0.001 ($\rho < 0.05$). The majority of pregnant women (70%) reported rarely consuming other sources of carbohydrates, apart from rice.

Regarding animal-based side dishes, 33 respondents (66%) rarely consumed them, while 17 respondents (34%) reported frequent consumption. A Pearson correlation test showed a significant relationship between animal-based food intake and the incidence of preeclampsia (p-value = 0.001; $\rho < 0.05$). Similarly, vegetable side dish consumption demonstrated a significant association with preeclampsia (p-value = 0.007; $\rho < 0.05$), where 24 pregnant women (48%) rarely and 26 (52%) frequently consumed vegetable side dishes.

Furthermore, 36 respondents (72%) reported rarely consuming vegetables, while only 14 (28%) consumed them frequently. Statistical analysis showed a significant relationship between vegetable consumption patterns and the incidence of preeclampsia (p-value = 0.001; $\rho < 0.05$). Fruit consumption also showed a similar pattern, where 34 pregnant women (68%) rarely consumed fruit. A significant association was found between fruit intake and preeclampsia incidence (p-value = 0.001; $\rho < 0.05$).

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In contrast, fast-food consumption showed that more than half of the respondents (54%) frequently consumed fast food. The Pearson test indicated a significant relationship between fast-food consumption habits and preeclampsia ($p = 0.001$; $\rho < 0.05$). However, the analysis of drinking habits revealed no significant association with preeclampsia incidence ($p = 0.056$; $\rho > 0.05$), even though most pregnant women (64%) reported frequent fluid consumption.

Overall, these findings suggest that inadequate intake of carbohydrates, animal-based foods, vegetables, and fruits, as well as frequent fast-food consumption, are significantly associated with a higher risk of preeclampsia. In contrast, drinking frequency was not found to be a determining factor in the incidence of preeclampsia among pregnant women at Rehatta Hospital, Jepara Regency.

DISCUSSION

During pregnancy, a mother's nutritional needs increase compared to a non-pregnant pregnant. This is because the nutrients consumed are needed not only by the mother but also by the developing fetus (23). The fetus absorbs nutrients from the mother's food and from the body's nutrient reserves. Pregnant women need to consume a wider variety of foods to meet their energy, protein, and micronutrient needs (such as vitamins and minerals), as these nutrients are needed to maintain maternal health, support fetal growth and development, and provide nutritional reserves for breastfeeding. During pregnancy, protein requirements increase along with the increased need for iron, which is necessary for the formation of new cells and tissues. Fish, meat, liver, and *tempe* are good food sources for pregnant women because they are rich in iron. Meanwhile, colorful fruits are good sources of vitamins for the body, and fruits containing fiber can help smooth bowel movements, thereby reducing the risk of constipation (24)

Research results show that the dietary patterns of pregnant women in coastal areas are dominated by carbohydrate consumption, primarily from rice and fast food. Consumption of animal protein, vegetables, and fruit remains relatively low and lacking in variety. This consumption pattern reflects the community's high dependence on rice as a staple food. This habit occurs because both urban and rural communities in Indonesia perceive that they haven't eaten if they haven't consumed rice. White rice, a source of simple carbohydrates, has a high glycemic index but is low in fiber, vitamins, minerals, and antioxidants, which are essential for the body's metabolic balance. Excessive rice consumption can increase blood glucose levels, cause insulin resistance, and trigger oxidative stress, leading to endothelial dysfunction, a key mechanism for hypertension and preeclampsia in pregnancy (25–27). Therefore, a high rice consumption pattern without dietary diversification has the potential to increase the risk of preeclampsia in pregnant women in Indonesia.

In addition to high carbohydrate consumption, research results also indicate low animal protein consumption among pregnant women in coastal areas. This condition is thought to be related to economic constraints, limited access to nutritious food sources, and dietary habits that focus more on carbohydrates and seafood with varying protein content. Previous studies have shown a significant association between seafood consumption patterns and the incidence of anemia in pregnant women in coastal areas. Seafood tends to contain non-heme iron and compounds that inhibit iron absorption, so if not balanced with the consumption of red meat or liver, it can lead to iron deficiency. A deficiency in animal protein, the main source of heme iron, vitamin B12, and essential amino acids, will impact hemoglobin formation and increase the risk of anemia. Anemia in pregnancy can subsequently lead to tissue hypoxia and endothelial dysfunction, which are trigger factors for preeclampsia. Therefore, low animal protein consumption in pregnant women in coastal areas not only impacts nutritional status and hemoglobin levels but also has the potential to increase the incidence of preeclampsia through impaired circulation and placental oxygenation (28,29).

Low and varied fruit and vegetable intake was also found in the majority of respondents. Pregnant women with inadequate fruit and vegetable consumption are at risk of deficiencies in important micronutrients and antioxidants such as vitamin C, carotenoids, folate, and fiber. These deficiencies can disrupt endothelial function and increase oxidative stress, which plays a key role in the pathogenesis of preeclampsia. These results support previous research showing that a high fruit and vegetable consumption correlates with a reduced risk of preeclampsia, while an irregular consumption pattern

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actually increases the likelihood of hypertensive disorders in pregnancy (30). Therefore, increasing the consumption of a variety of fruits and vegetables is crucial to support the nutritional status of pregnant women and prevent preeclampsia.

Furthermore, the study also found that fast food consumption among pregnant women in coastal areas is quite high. A diet high in fast food has the potential to increase the risk of preeclampsia because its high content of saturated fat, cholesterol, sodium, and sugar can cause increased blood pressure, insulin resistance, and oxidative stress that triggers endothelial dysfunction. A diet high in fat and salt can also affect the balance of vascular function and increase the workload of the kidneys, two important mechanisms in the pathogenesis of preeclampsia. Previous research has shown that excessive junk food consumption in pregnant women is significantly associated with increased blood pressure and metabolic disorders that trigger preeclampsia (31–33). Therefore, limiting fast food consumption and promoting a balanced diet rich in vegetables, fruits, and high-quality protein sources are important steps in preventing preeclampsia, especially for pregnant women living in coastal areas.

The frequency or drinking patterns of pregnant women in this study did not have a direct effect on the likelihood of developing preeclampsia. These results indicate that although most pregnant women have good drinking habits, this factor alone is not strong enough to serve as a protective factor against the occurrence of preeclampsia. It is likely that other factors, such as the mother's prior health condition, as well as genetic and environmental factors, play a more significant role in the development of preeclampsia compared to drinking habits alone. Research conducted by Perry (2022) reports different findings, where total water intake, including water from both plain drinking water and other food and beverages, plays a crucial role during pregnancy because body fluid balance significantly affects the condition of pregnant women (34). This relationship is also supported by other studies, which indicate that adequate hydration is essential for maintaining bodily functions. At the same time, insufficient water intake or fluid imbalance can contribute to complications such as edema (swelling), which is one of the signs of preeclampsia. Moreover, changes in total body fluid and excessive weight gain due to fluid retention in late pregnancy have also been associated with the onset of preeclampsia, which may reflect early endothelial dysfunction (35).

This study has several limitations. First, the cross-sectional design does not allow for determining a causal relationship between dietary patterns and the incidence of preeclampsia. Second, the relatively small sample size (n = 50) and the study site, which included only one hospital, limit the generalizability of the findings. Third, dietary data were obtained through self-completed FFQs, making them susceptible to recall bias (response errors in recalling food consumption) and social desirability bias (respondents' tendency to answer in a way considered good or in accordance with the researcher's expectations). Fourth, potential confounding factors such as pre-pregnancy nutritional status, physical activity, and psychological stress were not analyzed multivariately.

CONCLUSION

The study revealed that the dietary patterns of pregnant women were characterized by low carbohydrate intake, a predominance of animal-based side dishes, and a lack of vegetables and fruit, with frequent consumption of fast food. These results indicate a significant association between pregnant women's dietary patterns, particularly their intake of carbohydrates, animal-based foods, vegetables, fruits, and fast food consumption, and the incidence of preeclampsia. Pregnant women with poor dietary patterns tend to have an unbalanced nutritional intake, thus having a higher risk of developing preeclampsia. Meanwhile, the beverage consumption patterns of pregnant women did not show a significant association.

The finding of this study emphasizes the importance of maintaining a healthy diet during pregnancy, including increasing fruit and vegetable consumption and limiting foods high in sodium, as a preventive measure for preeclampsia. Healthcare workers in healthcare facilities need to optimize nutrition education and monitor pregnant women's dietary patterns as part of promotive and preventive efforts against preeclampsia. Further research is recommended to employ a prospective design with a larger sample size and diverse locations, utilizing more objective dietary assessment methods, such as

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repeated 24-hour recall interviews, and multivariate analysis that considers confounding factors, including pre-pregnancy nutritional status, physical activity, and psychological stress.

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CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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