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Behavioral risk factors and maternal nutrition as predictors of pre-eclampsia among pregnant women in rural areas: cross-sectional study

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ABSTRACT

Introduction: The behavior of pregnant women in caring for pregnancy is influenced by the environment, culture, and lifestyle of the community. This study aimed to analyze the behavior of pregnant women and their nutritional status during pregnancy contributes to the incidence of pre-eclampsia in rural areas.

Methods: This study used a cross-sectional approach to 210 pregnant women who visited a community health center in East Java, Indonesia, in the period June 2020-February 2022. Potential risk factors, including maternal behavior in care during pregnancy, and obesity were evaluated as determinants of pre-eclampsia and its subtypes. The assessment instrument uses a structured questionnaire and has been tested for validity and reliability. Logistic regression analysis was used to determine potential risk factors. Odds ratios with 95% confidence intervals (CI) were calculated to estimate the effects of individual factors. All statistical analyses were performed with SPSS version 22.0 with a p-value < 0.05 considered significant.

Results: There were 65 (31%) pregnant women experiencing pre-eclampsia from 210 samples. Maternal behavior during pregnancy could predict the incidence of pre-eclampsia (p = 0.001; 95% CI 0.121-0.583; OR = 0.266) while obesity was able to predict pre-eclampsia (p = 0.00; 95% CI 1.705-5.209; OR = 3.00). the age of pregnant women p = 0.014; 95% CI 1.143-3,355; OR = 1.959), and history of hypertension p = 0.036; 95% CI 1.053 – 4.550; OR = 2.189).

Conclusions: The behavior and nutritional status of pregnant women have been proven to influence the incidence of pre-eclampsia.

Keywords: behavior risk factor, obesity, pre-eclampsia

Introduction

Pre-eclampsia (PE) is one of the high-risk pregnancies and a leading cause of maternal and fetal death, and disability globally and can be identified after 20 weeks of gestation (Mayrink, Costa and Cecatti, 2018; Rokotyanskaya et al., 2020). In addition, pre-eclampsia is also a cause of prematurity and babies born with low birth weight, especially in low- and middle-income countries (Fox et al., 2019; Lotfy et al., 2019). In low-income countries, a woman has an approximately 300 times higher risk of dying from pre-eclampsia and eclampsia than a woman in high-income countries (Wassie and Anmut, 2021; Yang et al., 2021). Although the exact cause of pre-eclampsia is unknown, several clinical risk have been reported including obesity, history of hypertension, maternal age, and nulliparity, as well as lifestyle associated with food consumption habits (Lopez-Jaramillo et al., 2018; Tyas, Lestari and Aldika Akbar, 2020). The National Institute of Health and Care Excellence (NICE) in the UK discloses its findings on moderate and high-risk factors for pre-eclampsia and recommends prophylaxis in cases with

signs of one or more high-risk factors, or two or more moderate (Barrett, 2020; Yang et al., 2021). Several research results regarding unhealthy lifestyles of pregnant women, such as lack of exercise, delaying antenatal visits due to believed myths, and unhealthy nutritional consumption patterns are also predicted to be risk factors contributing to pre-eclampsia (Rana et al., 2019; Lin et al., 2021). Meanwhile, cultural behavior that is still trusted by the public includes choosing to go to traditional services and healers and postponing pregnancy checks before four months of gestation, because the spirit of life has not yet been infused into the fetus. Although there have been research results to develop models for predicting the risk of pre-eclampsia in early pregnancy, research on risk factors for pre-eclampsia in low-income countries needs to be studied more deeply into whether there is a relationship between the lifestyle and cultural behavior of pregnant women.

Data from the World Health Organization (WHO) on the maternal mortality rate (MMR) in 2020 reached 810 per 100,000 live births on a global daily basis due to pregnancy or childbirth complications (Cunningham,et al., 2018; Quan et al., 2018). Data on maternal mortality in developing countries reach 462 per 100,000 live births, while in developed countries it is 11 per 100,000 live births (Shennan, Duhig and Vandermolen, 2018; Lin et al., 2021). When viewed from the factors that cause maternal death due to pre-eclampsia in general, it is reported to reach 25% worldwide, in developing countries the incidence of pre-eclampsia is reported to be seven times higher than in developed countries (Quan et al., 2018) . In Nigeria, pre-eclampsia is a contributor to the maternal mortality rate of 28.3% cases, while data in Indonesia in the period 2018-2019 show 4,226 maternal deaths, of which 1,066 (25%) mothers died from pre-eclampsia and eclampsia (Akeju et al., 2016; Sripad et al., 2019). In developed countries, one of the main factors causing pre-eclampsia is obesity in pregnant women (Singh, Shankar and Singh, 2017; Lopez-Jaramillo et al., 2018). The incidence of obesity tends to increase in alarming conditions and can be a risk factor for pre-eclampsia , which is about three times what occurs in developed and developing countries (Utami and Susilaningrum, 2022). The percentage of women who are obese in developed countries has increased by almost 60% (Roberts et al., 2011; Warriner, 2016).

Pre-eclampsia is an idiopathic disorder of pregnancy characterized by proteinuric hypertension. The Indonesian government has made many efforts to reduce the incidence of pre-eclampsia during pregnancy including free pregnancy checks, providing low-dose aspirin, and providing easy access to referrals if the mother experiences complications, but the incidence of these cases has not shown a significant decrease (Kemenkes RI, 2020). Solutions are needed with community involvement in preventing pre-eclampsia (Khowaja et al., 2016; Petras, Israelashvili and Miller, 2021). The identification of its predisposing factors before and during the early stage of pregnancy will help in reducing mortality (Yeasmin and Uddin, 2017). Although the cause of pre-eclampsia is not yet known, it is important to understand how obesity and other factors are risk factors (Kim, Park and Park, 2016; Lopez-Jaramillo et al., 2018). Clinical and pathological studies show that the process of placental formation is the basis for the pathogenesis of pre-eclampsia (Rana et al., 2019; Kenny et al., 2020). Improper development of the placenta as a result of dysfunctional cell proliferation, migration, and invasion leads to inappropriate dilation of uterine spiral arterioles, decreased placental blood flow, and placental hypoxia (Burton et al., 2019; Fox et al., 2019). In addition, inadequate nutritional consumption factors such as deficits in intake of calcium, vitamins, and essential fatty acids have been shown to play a role in the origin of pre-eclampsia , while obesity as a risk factor for pre-eclampsia is based more on insulin resistance, maternal systemic inflammation, and hyperinsulinism (Robillard et al., 2019; Fogacci et al., 2020). The behavior of mothers in rural communities which is strongly influenced by culture and myths about pregnancy needs to be identified (Salminen, 2014; Kim, Park and Park, 2016). Pregnant women who are not compliant in maintaining their pregnancy include being late in attending ante-natal care visits, lack of maintaining the quality of nutritional consumption, and having unhealthy lifestyles are thought to be risk factors for pre-eclampsia (Sripad et al., 2019; Ni Ketut and Nurul, 2020). Problems regarding risk factors for pre-eclampsia can be identified from the mother's lifestyle during pregnancy in consuming food and prenatal examinations. This study aims to analyze the behavior of pregnant women and how their nutritional status during pregnancy contributes to the incidence of pre-eclampsia in rural areas.

Materials and Methods

Design, population, and sample

This study used a cross-sectional study approach on 210 pregnant women who made antenatal visits to a community health center in East Java, Indonesia in the

Table 1. Characteristics of pregnant women respondents (n= 210)

Variable	n	%
Maternal age		
≤ 20 years	21	10
21– 35 years	99	47
> 35 years	90	42
Education		
Elementary	41	19.5
Middle School	73	34.8
High School	96	45.7
Employment		
Not working	122	58.1
Entrepreneur	54	25.7
Farmer	34	16.2
Income		
Less than the regional minimum income	103	49
Same or more than the regional minimum income	107	51
Parity		
Primigravida	91	43.3
Multigravida	119	56.7
Maternal ANC checkup		
Regular	73	34.8
Nonregular	137	65.7
ANC check-up		
Integrated Healthcare Center	134	63.8
Midwife	74	35.2
Healer	3	1
Mother's perception of preeclampsia		
Negative	105	50
Positive	105	50
Pregnancy care behavior		
Negative	119	56.7
Positive	91	43.3
Body mass index /BMI		
Severe	35	16.7
Normal	120	57.1
Obese	55	26.2
History of hypertension		
Yes	63	30
No	147	70
Pre-eclampsia		
Positive	65	31
Negative	145	69

period June 2020-February 2022 by purposive sampling. Sample criterion of pregnant women with more than 20 weeks of gestation who came to the polyclinic for ante natal care (ANC) are included in this study. Potential risk factors obtained through demographic data questionnaires, including maternal age, obesity, parity, history of hypertension, maternal behavior during pregnancy, and adherence to ANC visits were evaluated as determinants for pre-eclampsia and its subtypes. Maternal age was defined as age at pregnancy and was divided into three groups: < 20 years, 21-30 years, and > 30 years. Parity is the condition of the mother's pregnancy, whether it is prime gravida or multigravida.

Data collection tools

The data collection process was carried out on pregnant women who were having their pregnancy checked at the community health center. Data were collected using a modified questionnaire General Health Behavior Scale to assess risk behavior in caring for pregnancy. Behavioral assessments consist of a total of 30 questions that carried out to assess how pregnant women care for their pregnancy in terms of nutrition, personal hygiene, and activities during pregnancy. The conclusion of the behavioral assessment is said to be positive, if the behavior of caring for the pregnancy is by the recommendations of health workers, while negative behavior is that which is not appropriate. Meanwhile, nutritional status assessment is carried out using BMI assessment, namely weight (kg)/height^2 (m). Pregnant women who visit the health center have their weight and height measured, then these are calculated to get the BMI measurement results. There are three categories of BMI measurement in this study, namely underweight (BMI < 18.5 kg/m2), normal weight (BMI 18.5–23.9 kg/m2), overweight/obesity (BMI: 28.0 kg/m^2). The instrument for assessing pre-eclampsia risk factors uses a structured questionnaire consisting of maternal health history and demographic data. All questionnaires have been tested for validity r > 0.5 and Cronbach's alpha reliability > 0.70 on 30 samples.

Data processing and analysis

Logistic regression analysis was used to determine the potential risk factors for pre-eclampsia. Odds ratios with 95% confidence intervals (CI) were calculated to estimate the effects of individual factors. Logistic regression analysis was applied to explore the association between risk factors and the incidence of pre-eclampsia. All statistical analyses were performed with SPSS version 22.0 with a p-value < 0.05 considered significant.

Ethical consideration

This research uses humans as research subjects, the researcher provided an informed consent sheet as approval to participate in the research. To maintain patient confidentiality, coding is used on the questionnaire sheet and anonymity. This study was approved by the Ethics Committee of the Faculty of Health Sciences, Universitas Muhammadiyah Jember (Number: 182/KEPK/FIKES/IX/2020).

Table 2. Logistic regression analysis of predictive factors for pre-eclampsia in pregnant women in rural areas of East Java, Indonesia (n=210)

Independent variable	Preeclampsia		B	p-value	Adjusted OR	95 % CI	
	yes	no				lower	Upper
Maternal Age			0.672	0.014*	1.959	1.143	3.355
< 20 years	8	14					
– 35 years	20	78					
> 35 years	38	52					
Parity			0.128	0.719	1.137	0.566	2.283
Primigravida	25	66					
Multigravida	41	78					
ANC checkpoint			0.077	0.832	1.080	0.531	2.197
Integrated Healthcare Center	46	88					
Midwife	20	54					
Healer		2					
Perceptions of preeclampsia			0.337	0.638	1.401	0.672	2.919
Negative	35	70					
Positive	31	74					
			0.783	0.036*	2.189	1.053	4.550
No	42	105					
Yes	24	39					
Pregnancy care behavior			-1.326	0.001*	0.266	0.121	0.583
Negative	50	69					
Positive	16	75					
BMI			1.100	0.001*	3.003	1.705	5.290
Severe	7	28					
Normal	27	93					
Obese	32	32					

*p-value < 0,05

Results

Based on Table 1, the prevalence of pre-eclampsia was 65 pregnant women (31%) from a sample of 210. Based on the logistic regression analysis in Table 2, it was found that maternal behavior in caring for pregnancy P = 0.001 (OR 0.266), and obese P = 0.00 (OR 3.00) can predict pre-eclampsia in the rural area. In addition, the age of the pregnant woman P = 0.014 (OR 1.959), and history of hypertension p = 0.036 (OR 2,189) can affect the occurrence of pre-eclampsia. Meanwhile, parity factors, examination compliance, and perceptions of pre-eclampsia do not affect the incidence of pre-eclampsia. The B or beta value in the results of this study shows that the variables maternal age, parity, ANC checkpoint, perceptions of pre-eclampsia, history of hypertension and BMI have a positive relationship.

Discussions

The results of this study show that maternal behavior in caring for pregnancy and obesity experienced by pregnant women can predict the occurrence of pre-eclampsia. Obesity exerts significant negative effects on pregnancy, directly and indirectly through associated metabolic dysfunction and increased basal inflammatory states. These two conditions can cause various obstetric complications such as gestational diabetes and hypertension, thus becoming the basis for an increased risk of pre-eclampsia (Kim, Park and Park, 2016; Afulani et al., 2019). In line with the role of obesity as a risk factor for pre-eclampsia, lifestyle, and consumption of sweet foods are also major risk factors for pre-eclampsia because they both contribute to increased gestational weight gain (Mayrink, Costa and Cecatti, 2018; Peres, Mariana and Cairrão, 2018). Impaired blood circulation in the placenta can cause irregular blood pressure regulation in the mother (Bakouei et al., 2020; Lin et al., 2021). At the same time, a large number of studies have attempted to identify possible biomarkers that may predict an increased risk of pre-eclampsia. The incidence of several adverse pregnancy outcomes is associated with increased body weight (Birhanu et al., 2020; Billah et al., 2021; Idris et al., 2022).

The NICE 2019 classifies high-risk groups for pre-eclampsia including a history of hypertension in a previous pregnancy, autoimmune disease, diabetes, or chronic hypertension (Al-Rubaie et al., 2020; Barrett, 2020). The classification of moderate risk of pre-eclampsia is nulliparous mother, 40 years old, has a BMI of 35 kg/m, family history of preeclampsia, multifoetal pregnancy, or pregnancy interval of more than 10 years (Robillard et al., 2019; Tyas, Lestari and Aldika Akbar, 2020). In addition, there are clinical factors that significantly increase the risk of pre-eclampsia, including an increase in mean arterial blood pressure before 15 weeks' gestation (Mayrink et al., 2019).

The World Health Organization identified the main risks of pre-eclampsia as obesity, chronic hypertension, diabetes, nulliparity, teenage pregnancy, and eclampsia in previous pregnancies. kidney disease, autoimmune disease, and multiple pregnancies (World Health Organization, 2018). The results of this study indicate that maternal behavior during pregnancy which is strongly influenced by culture and myths can predict the incidence of pre-eclampsia. In addition, mothers who are obese during pregnancy and age can also be at risk of triggering preeclampsia. The relationship between maternal age during pregnancy and adverse complications has mostly been studied, and some explanations include the aging process of blood vessels, arterial stiffness, impaired maternal hemodynamic adaptation, and lower egg quality (Khowaja et al., 2016; Gebreweld and Tsegaye, 2018). Women over 35 years old [Advanced Maternal Age (AMA)] have 4.5 times the risk of developing pre-eclampsia than women younger than 25 years (Allotey et al., 2020; Tyas, Lestari and Aldika Akbar, 2020). Maternal behavior that is inadequate in caring for her pregnancy can harm the development of a fetus. Delays in ANC visits can result in pregnancy complications not being detected early. During pregnancy, pregnant women must carry out regular checks on the condition of the fetus. ANC visits can help mothers find out the progress of their pregnancy and can identify early the possibility of the mother experiencing complications in her pregnancy. Studying the development of maternal pregnancy and its relationship with the behavior of pregnant women is very important to note. Poor maternal behavior during pregnancy may be a significant driver of complications, some unhealthy behaviors in pregnant women that can be risk factors include smoking, poor nutritional intake, avoiding certain foods due to local culture that is believed to be, and low consumption of folic acid, and calcium (Wassie and Anmut, 2021). Research conducted in China provides evidence that high levels of maternal unhealthy behavior during pregnancy have a major impact on children in rural China, including suboptimal fetal development due to exposure to substances, inadequate nutrition, and inadequate antenatal care (Xiao et al., 2014; Lin et al., 2021).

Another factor that is thought to be the cause of pregnancy complications is obesity (Allen et al., 2014; Xiao et al., 2014). Obesity is an epidemic and an increasing trend in developed countries that is currently expanding to developing countries. In America, in the last 30 years, there has been an increase in the number of obese women with a BMI > 30, almost 60% (Singh, Shankar and Singh, 2017; Lopez-Jaramillo et al., 2018). The results of a study conducted in Pistburg, Germany, found a threefold increase in the risk of pre-eclampsia associated with obesity (Singh, Shankar and Singh, 2017). Obesity triggers the occurrence of pre-eclampsia through several mechanisms, namely in the form of superimposed pre-eclampsia, as well as through triggers of metabolites and other micromolecules (Wadhwani et al., 2019). The risk of pre-eclampsia is increased by two times for every increase in body weight of 5-7 kg/m2. In addition, it was found that there was an increased risk of pre-eclampsia with an increase in BMI (Robillard et al., 2019; Wagata et al., 2020a). Clinical and experimental evidence suggests that obesity can affect placental function and perfusion, through metabolic changes associated with obesity namely: hyperleptinemia, hyperinsulinemia, and hyperlipidemia; however, the exact mechanism is unknown (Lopez-Jaramillo et al., 2018). One of the most important conditions of obesity is hyperinsulinemia and insulin resistance. Experimental studies show that hyperinsulinemia results in shallower implantation sites and limited intrauterine growth associated with nitric oxide (NO) synthesis (Lopez-Jaramillo et al., 2018; Wagata et al., 2020b). Hypertriglyceridemia that occurs is related to the pathogenesis of hypertension that occurs during pregnancy. High triglycerides will increase the risk of placental vascular abnormalities which will stimulate endothelial abnormalities, atherosclerosis, and thrombosis. Atherosclerosis in preeclamptic women occurs in the spiral arteries of the placenta (Mayrink et al., 2019).

One solution to prevent the occurrence of pre-eclampsia can be done through cultural negotiations, especially the negative culture that has been embraced by the community (Salminen, 2014). The involvement of community leaders and ulama can be a supporting factor for effective communication in the community (Kim, Park and Park, 2016). Wrong beliefs about pregnancy must be corrected so that the incidence of pre-eclampsia in rural communities with low socioeconomic status can be resolved (Salminen, 2014; Kim, Park and Park, 2016). Most pregnant women are not aware of this condition, leading to a high-risk lifestyle. In addition, gestational diabetes mellitus significantly contributes to the number of high-risk pregnancies that go undetected and are managed sub-optimally. The antenatal care center offers an optimal platform for screening, prevention, and treatment of

gestational diabetes mellitus by prioritizing high-risk women (Mdoe et al., 2021).

This research has limitations in that assessing maternal behavior using a questionnaire does not provide complete information, apart from that, a BMI assessment that is not followed by a biomarker test cannot provide a detailed description of the process of influencing obesity on the incidence of pre-eclampsia.

Conclusions

This research has shown that maternal behavior in caring for her pregnancy can predict the incidence of pre-eclampsia. The behavior of pregnant women is based on myths about cultural behavior that society believes can be a predictive factor in the occurrence of pre-eclampsia. Many rural communities still adhere to the culture and beliefs passed down from their ancestors regarding pregnancy. This can affect the sustainability of programs from community health centers in caring for pregnant women. In addition, the incidence of obesity during pregnancy is also increasing and this condition has contributed to increasing the occurrence of pre-eclampsia.

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Conflict of Interest

All authors have no conflict of interest related to this study.

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