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ORIGINAL ARTICLE

Predictors of hypertension among pregnant women

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Abstract

This study investigated factors associated with hypertension during pregnancy (HDP) in Langkat Regency, Indonesia, where HDP cases have been increasing. Conducted at Sei Bamban Health Center between November 2023 and April 2024, the study included 47 third-trimester pregnant women. Data on maternal age, parity, BMI, family history of hypertension, secondhand smoke exposure, dietary habits, physical activity, and antenatal care (ANC) adherence were collected via questionnaires. Gestational hypertension was defined as systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg. Bivariate and multivariate analyses were performed using SPSS. While age and parity showed no significant association with HDP, elevated BMI (≥22.9 kg/m²) (p=0.010; OR 5.120; 95%CI: 1.427-18.373), a history of hypertension (p=0.016; OR 4.411; 95%CI: 1.282-15.174), exposure to cigarette smoke (p=0.000; OR 27.273; 95%CI: 3.165-235.024), low fat/salt intake (p=0.000; OR 0.088; 95%CI: 0.020-0.382), low physical activity (p=0.000; OR 31.667; 95%CI: 5.676-176.680), and non-adherence to ANC (p=0.000; OR 17.944; 95%CI: 3.391-94.948) were significantly associated with HDP. These findings highlight the importance of ANC adherence and risk factor management, including lifestyle modifications, for HDP prevention. The study recommends targeted education, counseling, screening, and monitoring of at-risk pregnant women.

Keywords: hypertension during pregnancy, body mass index, smoking, physical activity

Introduction

Maternal mortality remains a significant global health challenge, with 303,000 maternal deaths reported in 2015.[1] Recent studies indicate mixed progress in reducing maternal mortality globally. While significant improvements were made from 2000 to 2015, progress has stalled or worsened in most regions from 2016 to 2020, with only Australia/New Zealand and Central/Southern Asia showing reductions.[2] South Asia contributes significantly to this global burden, but has seen varied progress across countries. Thailand, South Korea, Sri Lanka, and the Maldives demonstrate better maternal health indicators, while others such as Bangladesh and India lag behind.[3] Of the countries in the region, Indonesia has the fourth-highest MMR (173/100,000 LB), preceded only by Timor-Leste, Cambodia, and Myanmar.[4] Indonesia faces significant challenges in reducing its high maternal mortality ratio (MMR). Key obstacles include inadequate health budgets, lack of facilities and personnel, and limited access to emergency obstetric services, particularly in remote areas.[5] The decentralized health system and regional disparities contribute to inequities in maternal healthcare access.[6] Despite high skilled birth attendance rates, many maternal deaths occur in health facilities, indicating issues with quality of care.[7] Transportation barriers, including distance, costs, and poor road quality, hinder access to adequate health services for women in rural areas.[8]

Hypertension during pregnancy (HDP) is a significant cause of maternal and fetal morbidity and mortality.[9,10] It is typically defined as systolic blood pressure ≥140 mmHg or diastolic blood pressure ≥90 mmHg in at least two separate measurements. Gestational hypertension occurs after 20 weeks of

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pregnancy.[11] Recent research suggests that new-onset blood pressures of 130-139/80-89 mmHg after 20 weeks gestation in previously normotensive women may be associated with increased risk of hypertensive disorders in pregnancy, including a nearly threefold higher risk of preeclampsia with severe features.[12]

Research has found that women of advanced maternal age, residing in rural areas, experiencing their first pregnancy, with no previous live births, a history of abortion, carrying multiple fetuses, and receiving inadequate antenatal care, as well as those with pre-eclampsia, and family history of hypertension, are at an increased risk of developing HDP.[13] Another study found that rural residence, less fruit consumption, multiple pregnancies, gestational diabetes mellitus, and pre-pregnancy overweight were associated with an increased risk of HDP.[14] Other studies identified additional risk factors, including urinary tract infections and alcohol consumption.[15] Body mass index was also found to be a significant risk factor (OR=2.60).[16] An unhealthy maternal diet, particularly that rich in preservatives, is associated with an increased risk of gestational hypertension. Conversely, a balanced and nutritious diet is crucial for maintaining a stable blood pressure during pregnancy.[17] Moreover, paternal smoking habits have a significant influence on the maternal risk of hypertension. Compared with husbands who smoke outdoors, those who smoke indoors pose a greater risk to their pregnant wives. Continuous exposure to secondhand smoke can increase maternal blood pressure.[18]

The prevalence of hypertension among pregnant women in the Langkat Regency has exhibited a consistent upward trend in recent years. According to the Langkat Regency Health Office's profile, the number of reported cases will increase from 124 in 2021[19] to 142 in 2022[20], and further to 155 in 2023[21]. These data underscore the concern of escalation of hypertensive disorders during pregnancy within the region. Notably, the Sei Bamban Health Center in Batang Serangan District consistently recorded the highest number of cases annually.[21] The elevated incidence of HDP in this area highlights the urgent need for enhanced antenatal care (ANC) services. The underutilization of ANC, coupled with the high prevalence of hypertension, poses a significant risk to both maternal and fetal health. The aim of this study was to identify and analyze the factors associated with HDP. The findings of this study will enhance our understanding of HDP, facilitate the development of effective prevention and treatment strategies, and improve the quality of life of pregnant women and their fetuses.

Method

This descriptive study assessed relationship between various contributing factors and occurrence of hypertension in pregnant women. The research was conducted in the catchment area of Puskesmas Sei Bamban, Batang Serangan District, Langkat Regency, between November 2023 and April 2024. The study population comprised all third-trimester pregnant women registered as patients at Puskesmas Sei Bamban during the study period, totaling 47 individuals. Given the relatively small population size, the entire population of pregnant women in their third trimester at Puskesmas Sei Bamban was included in the study.

This study identified several independent variables that may increase the risk of hypertension in pregnant women, including maternal age, parity (number of previous births), body mass index (BMI), family history of hypertension, exposure to secondhand smoke, low-fat and low-salt dietary intake, and physical activity level. These variables were measured using a questionnaire administered to participants. Maternal age was defined as the number of years between birth and the date of data collection. Parity refers to the total number of pregnancies in which the fetus reaches at least 22 weeks of gestation, regardless of the outcome. BMI was calculated as a measure of obesity, based on weight and height. A family history of hypertension was defined as prior diagnosis of hypertension in a first-degree relative. Exposure to secondhand smoke was assessed on the basis of self-reported exposure to environmental tobacco smoke. Dietary intake of low-fat and low-salt foods was measured using a food frequency questionnaire, and physical activity was assessed using a modified version of the Global Physical Activity Questionnaire (GPAQ). Antenatal care adherence was defined as the frequency of prenatal visits with at least four recommended visits. Gestational hypertension was diagnosed if the systolic blood pressure was ≥ 140 mmHg and/or diastolic blood pressure was ≥ 90 mmHg during the third trimester.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS). The analysis was conducted in three stages. First, univariate analysis was conducted to describe the characteristics of each variable. Second, bivariate analysis was used to examine the relationship between the independent

and dependent variables using the chi-square test with a significance level of 5% (α = 0.05). Finally, multivariate logistic regression was employed to identify the significant predictors of the dependent variable.

Results

Table 1 presents an overview of the characteristics of the women who participated in this study. These characteristics include age, parity (number of previous births), body mass index (BMI), history of hypertension, exposure to cigarette smoke, consumption of low-fat and low-salt diets, physical activity, adherence to antenatal care (ANC) guidelines, and the occurrence of hypertension during pregnancy.

The majority of the pregnant women (72.3%) were within the optimal reproductive age range (21-35 years). Only 27.7% fell into the at-risk age category, being under 20 years or over 36 years. Nearly two-thirds (68.1%) of the pregnant women in this study were classified as low-risk based on the number of previous births. The remainder (31.9%) were considered at-risk, possibly because of risk factors associated with first pregnancies or closely spaced subsequent pregnancies. More than half (55.3%) of the pregnant women had a BMI within the normal range. However, nearly half (44.7%) had a BMI classified as at-risk, potentially indicating issues such as obesity or underweight, which could have implications for pregnancy outcomes.

Table 1. Characteristics of pregnant women (n=47)

Characteristic	n	%
Age		
At risk (< 20 years dan > 36 years)	13	27,7
Not at risk (21-35 years)	34	72,3
Parity		
At risk	15	31,9
Not at risk	32	68,1
Body Mass Index (BMI)		
At risk (≥ 22,9kg/m^2)	21	44,7
Not at risk/normal (18,5-22,9 kg/m^2)	26	55,3
History of hypertension		
Yes	27	57,4
No	20	42,6
Exposure to cigarette smoke		
Exposed	16	34,0
Not exposed	31	66,0
Low fat and salt diet consumption		
Yes	19	40,4
No	28	59,6
Physical Activity		
At risk	22	46,9
Not at risk	25	53,2
Antenatal Care (ANC) adherence		
Non-routine	19	40,4
Routine	28	59,6
Incidence of hypertension		
Yes	26	55,3
No	21	44,7

More than half (57.4%) of the pregnant women had a history of hypertension either before or during pregnancy. This condition is a significant risk factor for pregnancy-related complications. Approximately one-third (34%) of pregnant women were exposed to cigarette smoke, which is known to increase the risk of various health problems for both the mother and fetus. Almost half (40.4%) of pregnant women reported consuming low-fat and low-salt diets, which is a key aspect of a healthy diet during pregnancy. Approximately half (53.2%) of the pregnant women had low levels of physical activity. However, nearly half (46.9%) had a level of physical activity considered at-risk, which could impact the health of both the mother and fetus. Almost 60% (59.6%) of pregnant women routinely attended ANC check-ups. However, approximately 40% of women did not routinely attend these check-ups, which could hinder the early detection of pregnancy complications. More than half (55.3%) of the pregnant women experienced hypertension, which is a common and serious pregnancy complication.

Table 2 presents the results of statistical tests examining the association between risk factors and the incidence of hypertension in pregnant women. Analysis of age revealed that 61.5% (8 13) of pregnant women in the at-risk age group (<20 years and >36 years) experienced hypertension, compared to 52.9% (18 34) in the 21-35 year age group. However, this difference was not statistically significant (p=0.596; OR 1.422; 95%CI: 0.386-5.243). Similarly, parity was not significantly associated with hypertension. 60.0% (9 of 15) of pregnant women in the at-risk parity group experienced hypertension, compared to 53.1% (17 of 32) in the non-risk group (p=0.695; OR 1.324; 95%CI: 0.381-4.595). Thus, neither age nor parity was a significant independent risk factor for hypertension in this study.

A significant association was found between BMI and hypertension (p=0.010). The percentage of hypertension in the at-risk BMI group (≥22.9 kg/m²) was significantly higher, at 72.6% (16 of 21), compared to the normal BMI group (18.5-22.9 kg/m²), which was only 38.5% (10 of 26). Pregnant women with at-risk BMI had more than five times the odds of experiencing hypertension compared to those with normal BMI (OR 5.120; 95%CI: 1.427-18.373). A history of hypertension was also significantly associated with

hypertension in the current pregnancy (P =0.016). The group with a previous history of hypertension had a higher percentage of hypertension at 70.4% (19 of 27) than the group without a history (35.0%; 7 of 20). Pregnant women with a previous history of hypertension had more than four times the odds of experiencing hypertension in the current pregnancy (OR 4.411; 95%CI: 1.282-15.174).

Table 2. The relationship between risk factors and the incidence of hypertension in pregnant women

Risk factor	Incidence of hypertension				Total		p	OR (95%CI)
	Yes		No					
	n	%	n	%	n	%		
Age								
At risk (< 20 years dan > 36 years)	8	61,5	5	38,5	13	100,0	0,596	1,422 (0,386 -5,243)
Not at risk (21-35 years)	18	52,9	16	47,1	34	100,0		
Parity								
At risk	9	60,0	6	40,0	15	100,0	0,695	1,324 (0,381-4,595)
Not at risk	17	53,1	15	46,9	32	100,0		
Body Mass Index (BMI)								
At risk (≥ 22,9kg/m^2)	16	72,6	5	23,8	21	100,0	0,010	5,120 (1,427-18,373)
Not at risk/normal (18,5-22,9 kg/m^2)	10	38,5	16	61,5	26	100,0		
History of hypertension								
Yes	19	70,4	8	29,6	27	100,0	0,016	4,411 (1,282-15,174)
No	7	35,0	13	65,0	20	100,0		
Exposure to cigarette smoke								
Exposed	15	93,8	1	6,3	16	100,0	0,000	27,273 (3,165-235,024)
Not exposed	11	35,5	20	64,5	31	100,0		
Low fat and salt diet consumption								
Yes	9	33,3	18	68,7	27	100,0	0,000	0,088 (0,020-0,382)
No	17	85,0	3	15,0	20	100,0		
Physical activity								
At risk	20	90,9	2	9,1	22	100,0	0,000	31,667 (5,676-176,680)
Not at risk	6	24,0	19	76,0	25	100,0		
Antenatal Care (ANC) adherence								
Non-routine	17	89,5	2	10,5	19	100,0	0,000	17,944 (3,391-94,948)
Routine	9	32,1	19	67,9	28	100,0		

Exposure to cigarette smoke was significantly associated with hypertension (P =0.000). The percentage of hypertension in the smoke-exposed group was very high at 93.8% (15 of 16), compared to that in the non-exposed group (35.5%; 11 of 31). Exposure to cigarette smoke was a very strong risk factor for hypertension in pregnant women (OR 27.273; 95%CI: 3.165-235.024). Consumption of a low-fat and low-salt diet was significantly associated with hypertension (P =0.000). However, the analysis showed that this dietary consumption was actually protective against hypertension (OR 0.088; 95%CI: 0.020-0.382). This means that pregnant women who consume low-fat and low-salt diets have a very low chance of experiencing hypertension.

Physical activity also showed a highly significant association with hypertension (P =0.000). The group with low (at-risk) physical activity had a very high percentage of hypertension at 90.9% (20 of 22) compared to the non-risk group (24.0%; 6 of 25). Lack of physical activity was a very strong risk factor for hypertension in pregnant women (OR 31.667; 95%CI: 5.676-176.680). Adherence to antenatal care (ANC) also showed a highly significant association with hypertension (p=0.000). The group that did not routinely attend ANC had a very high percentage of hypertension at 89.5% (17 of 19) compared to the group that routinely attended ANC (32.1%; 9 of 28). Non-adherence to ANC was a very strong risk factor for hypertension in pregnant women (OR 17.944; 95%CI: 3.391-94.948).

Table 3. Multiple logistic regression

Variable	B	Sig	Exp (B)
Exposure to cigarette smoke	3,124	0,047	22,733
Physical activity	3,715	0,004	41,068
Antenatal Care (ANC) adherence	3,409	0,010	30,228

Multivariate analysis using multiple logistic regression was performed to examine the relationship between several variables and the incidence of hypertension. These variables were previously identified in bivariate analysis and included Body Mass Index (BMI), hypertension history, smoking history, low-fat and low-salt consumption, and adherence to Antenatal Care (ANC). The results indicated that exposure to cigarette smoke, physical activity, and ANC adherence were the most dominant or strongly influential factors on the incidence of hypertension. Data analysis indicates that exposure to cigarette

smoke, level of physical activity, and adherence to ANC are the most influential factors on the incidence of hypertension.

Discussion

This study highlights the significance of several risk factors in the development of hypertension in pregnant women. Specifically, BMI, history of hypertension, exposure to cigarette smoke, low fat and salt consumption, physical activity, and adherence to ANC have emerged as key factors that require attention from healthcare providers and expectant mothers to prevent serious pregnancy complications.

Elevated BMI, frequently observed during pregnancy due to physiological changes, such as increased blood volume, fetal growth, and fat accumulation, can be a risk factor for hypertension. An increased BMI leading to overweight or obesity can elevate blood plasma volume and cardiac output, subsequently potentially increasing blood pressure. These physiological changes can become pathological because of increased BMI.[22,23] Several studies have elucidated the mechanisms underlying obesity-related hypertension, encompassing sympathetic activation, altered vascular responsiveness, hormonal changes, and elevated inflammatory markers.[24] Maternal obesity can also predispose offspring to obesity and hypertension through various pathways, including activation of the renin-angiotensin system and epigenetic modifications.[25] Furthermore, research has demonstrated that obese offspring exhibit heightened arterial pressure responses to leptin, which can be normalized by the administration of a central melanocortin receptor antagonist, suggesting a role for the central melanocortin system in the development of hypertension.[26] Then, history of hypertension in previous pregnancies increased the risk of hypertension in subsequent pregnancies. Women with a history of pregnancy-induced hypertension (PIH) have an 11-fold higher risk of developing chronic hypertension later in life.[27] Family history of hypertension is a notable risk factor, particularly in cases of chronic hypertension and superimposed preeclampsia.[28]

This study reinforces evidence that exposure to cigarette smoke is a significant risk factor for hypertension in pregnant women. Recent studies have reinforced the link between smoking and hypertension in pregnant women. Rublevskaya & Bichan[29] found that smoking increased the odds of developing hypertension during pregnancy by 13 times compared to non-smokers. This risk was further amplified when combined with other factors like age, obesity, and heredity. While de Jonge et al.[18] observed associations between parental smoking during pregnancy and adult-onset hypertension in offspring, these were largely explained by body weight throughout life. Interestingly, Engel et al.[30] reported that active smoking in the third trimester was associated with reduced odds of preeclampsia and gestational hypertension. Skipina et al.[31] highlighted that secondhand smoke exposure is also a significant risk factor for chronic hypertension, with effects nearly as large as active smoking.

The analysis results demonstrated a significant association between low-fat and low-salt consumption and the incidence of hypertension. Pregnant women who do not consume low-fat or low-salt diets have a higher risk of developing hypertension. A study found that eating patterns influence hypertension incidence in pregnant women.[32] High consumption of salty snacks was linked to increased hypertension risk during pregnancy.[33] High salt consumption leads to increased blood volume, endothelial dysfunction, and altered renal function, forcing the heart to work harder.[34] Another study identified six modifiable lifestyle factors, including BMI and adherence to the DASH diet, that were associated with lower hypertension incidence in women.[35] Additionally, visible fat consumption was found to be significantly related to hypertension in pregnancy. While one study[36] reported no significant relationship between vegetarian diets and hypertension in pregnancy, overall, these findings emphasize the importance of dietary modifications as a cost-effective strategy for preventing HDP.

In this study, physical activity was the dominant factor that influenced the risk of hypertension in pregnant women. Research on physical activity and hypertensive disorders in pregnancy shows mixed results. One study found that physical activity during pregnancy was associated with a lower risk of hypertensive complications, with a dose-response relationship observed.[37] However, another study among Hispanic women found no significant association between physical activity and hypertensive disorders after adjusting for confounders.[38] A secondary analysis of the nuMom2b study reported that physical activity during pregnancy was associated with decreased risk of hypertension.[39] Interestingly, a large study of

nurses found that prepregnancy physical activity was associated with a lower risk of gestational hypertension, particularly for women meeting or exceeding recommended activity levels, but not with preeclampsia risk.[40] These findings suggest that while physical activity may have protective effects against some hypertensive disorders in pregnancy, the relationship is complex and may vary depending on timing and type of activity.

This study emphasizes the importance of adherence to ANC in the detection and prevention of hypertension in pregnant women. Regular ANC visits are crucial for early detection and prevention of pregnancy complications, including hypertension. Complete adherence to ANC guidelines during the first visit is associated with a lower risk of anemia but a higher risk of pregnancy-induced hypertension.[41] Incomplete ANC visits are linked to a higher incidence of hypertension in pregnant women, emphasizing the need for improved educational approaches and awareness.[42] Family support plays a significant role in ANC adherence, with supportive families increasing the likelihood of regular ANC visits by 36 times for pregnant women with hypertension.[43]

Conclusion

The analysis results indicated that BMI, history of hypertension, exposure to cigarette smoke, low-fat and low-salt diet consumption, physical activity, and ANC adherence are significant risk factors for the incidence of hypertension in pregnant women. This study emphasizes the importance of ANC adherence and management of other risk factors to prevent hypertension and its complications in pregnant women. Healthcare professionals should provide comprehensive education and counseling to pregnant women regarding the importance of ANC, healthy lifestyles, and risk factors for hypertension. Rigorous screening and monitoring of pregnant women with risk factors such as a history of hypertension or obesity are also crucial.

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