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Risk factors for hypertension in pregnant women in Indonesia: A cross-sectional study

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ABSTRACT

Objective: To determine the risk factors for hypertension in pregnant women, which is a significant cause of maternal and newborn morbidity and mortality in Indonesia.

Methods: This was a cross-sectional study used secondary data from the 2018 Indonesian Basic Health Research. Pregnant women aged 15-54 years in the second and third trimesters were eligible. The history of hypertension in pregnant women was the dependent variable. The independent variables consisted of the demographic characteristics of pregnant women including pregnancy age, gestational age, education, occupation, place of residence, and region of residence. This study used multivariate logistic regression to determine the risk factors for hypertension in pregnant women in Indonesia.

Results: . Among 6 479 respondents included in this study, 11 (7.0%) had a history of diabetes mellitus (DM) and hypertension compared to pregnant women who did not have a history of DM (0.1%). The dominant risk factors for hypertension in pregnant women in Indonesia include maternal age above 35 years (*OR* 3.67, 95% *CI* 2.54-5.32), third-trimester pregnancy (*OR* 2.40, 95% *CI* 1.72-3.35), primigravida (*OR* 1.78, 95% *CI* 1.19-2.68), excessive consumption of salty foods (*OR* 1.44, 95% *CI* 1.03-2.03), and diabetes mellitus (*OR* 10.20, 95% *CI* 3.04-32.23).

Conclusions: Great efforts must be made to increase public awareness about the dangers of hypertension in pregnant women through early diagnosis and treatment, education on sodium intake, and appropriate care for pregnant women with DM.

KEYWORDS: Hypertension; Pregnancy; Maternal hypertension; Hypertension in pregnancy

1. Introduction

Two-thirds of the population in developing countries, or as many as 972 million (26%) adults worldwide, from 1 billion adults, suffer from hypertension. This figure continues to increase and it is predicted that by 2025, around 29% of adults will have hypertension[1]. In Southeast Asia, one-third of adults had been diagnosed with hypertension, responsible for more than one million annual deaths. According to a recent comprehensive analysis, Southeast Asian metropolitan populations have a 33.8% prevalence of hypertension[2]. Based on the results of Basic Health Research (RISKESDAS), the number of hypertension cases in Indonesia

Significance

Hypertension in pregnant women is essential to overcoming maternal mortality. Older maternal age, third trimester of pregnancy, primigravida, excessive intake of salty foods, and diabetes mellitus are the dominant risk factors for hypertension. These results can encourage the government to simplify diagnosis services, early treatment, and education on sodium intake.

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increased from 25.8% to 34.1%; there was an 8.3% increase in hypertension cases from 2013 to 2018; and there are still many incidents of hypertension in the community that have not been detected[3,4].

Hypertension in pregnancy can be defined as the occurrence of a blood pressure reading of 140 mmHg or higher after 20 weeks of gestation in a woman who previously had normal blood pressure or as an elevation in systolic pressure of 30 mmHg and diastolic pressure of 15 mmHg beyond their usual values[5]. Most pregnant women are unaware of hypertension because they did not show specific symptoms[6]. Based on data from the Maternal Perinatal Death Notification (MPDN), the maternal death recording system of the Ministry of Health of the Republic of Indonesia, the number of maternal deaths in 2022 reached 4 005 and in 2023 increased to 4 129. A number of health problems experienced by pregnant women include 48.9 percent of pregnant women with anemia, 12.7 percent with hypertension, 17.3 percent with chronic energy deficiency, and 28 percent with the risk of complications[7]. The proportion of hypertension is increasing in pregnancy (preeclampsia and eclampsia), while bleeding and infection tend to decrease[8].

Hypertension is a symptom of a syndrome that triggers the hardening of the arteries, causing damage to specific organs. Premature parturition and stillbirth are both caused by hypertension in pregnancy[9]. Complications of high blood pressure in pregnant women can include preeclampsia, and eclampsia[10]. Meanwhile, the impact of complications on fetuses whose mother suffer from high blood pressure is that the mother will have difficulty getting enough oxygen and nutrition for their growth and development, so the mother may have to give birth early. Effects on the baby: premature birth, which means the baby is born before 37 weeks of gestation, and low birth weight, which means the baby is born weighing less than 5 pounds or 8 ounces[11]. Nearly one-tenth of all maternal deaths in Asia and Africa are related to hypertension in pregnancy. In contrast, a quarter of all maternal deaths in Latin America are due to complications[1].

A study showed that hypertension tends to occur in women, people living in urban areas, unemployed people, and people with low education[12]. Another study found that coastal communities tend to have higher risk of hypertension. Consumption of salt from dried salted fish, staple foods high in sodium, and cholesterol is thought to be the cause[13]. Some of the factors that cause hypertension include individual characteristics (age, sex, lower education level, and lower household income)[14], diet (lack of consumption of fruits and vegetables)[15], lifestyle or lack of physical activity[16], and smoking habits[17]. Age greatly determines the incidence of hypertension in pregnant women, especially in young and old pregnancies, which is a condition that can pose a risk of complications and maternal death[18]. Based on this background, this study aims to analyze the risk factors associated with the incidence of hypertension during pregnancy based on Indonesian Basic Health Research data.

2. Materials and methods

2.1. Data source

This article employed secondary data from research conducted by the Health Research and Development Agency, Ministry of Health of the Republic of Indonesia. The research design was a cross-sectional study on a national scale. Subjects represented 33 provinces spread over 441 districts/cities in all provinces in Indonesia[4]. Further processing and analysis were carried out from January to February 2023. Data collection, determining the sample and number of respondents in the 2018 RISKESDAS were conducted through interviews and measurements by the RISKESDAS enumerator team from the Indonesian Research and Development Agency in collaboration with the Central Statistics Agency (BPS).

BPS has a role in determining the sample size so that this survey can be nationally representative. Apart from that, BPS also calculates the sample size that must be taken both nationally and at the district/city level. It used the probability proportional to size (PPS) method and the stratified multistage systematic random sampling design to determine the household samples. In the first stage, the current research used PPS to select 30 000 primary sample units (PSU) from the 2010 Indonesian Population Census. Each PSU consists of several census blocks (BS) as census enumeration areas (EA). The second stage was the selection of BS in each selected PSU using PPS based on the estimated number of households from the 2010 Indonesian Population Census. The third stage was BPS random selection of 25 selected households based on inclusion criteria. A total of 295 720 households and 1 091 528 household members were successfully surveyed/visited as a sample of the 2018 Basic Health Research in 34 provinces[4]. Exceptions for BS were inaccessible due to extreme geographical conditions, social unrest/conflict, and natural disasters. Our analysis focuses on the 15 to 54-year-old age group from 6 479 pregnant women respondents in the 2018 RISKESDAS data (Figure 1).

Data collection in the Basic Health Research was done by trained enumerators. Enumerator officers must have a health education background, including doctors, midwives, nurses and medical analysts. Previously, enumerators received training on how to use questionnaires, approach respondents, communicate effectively,

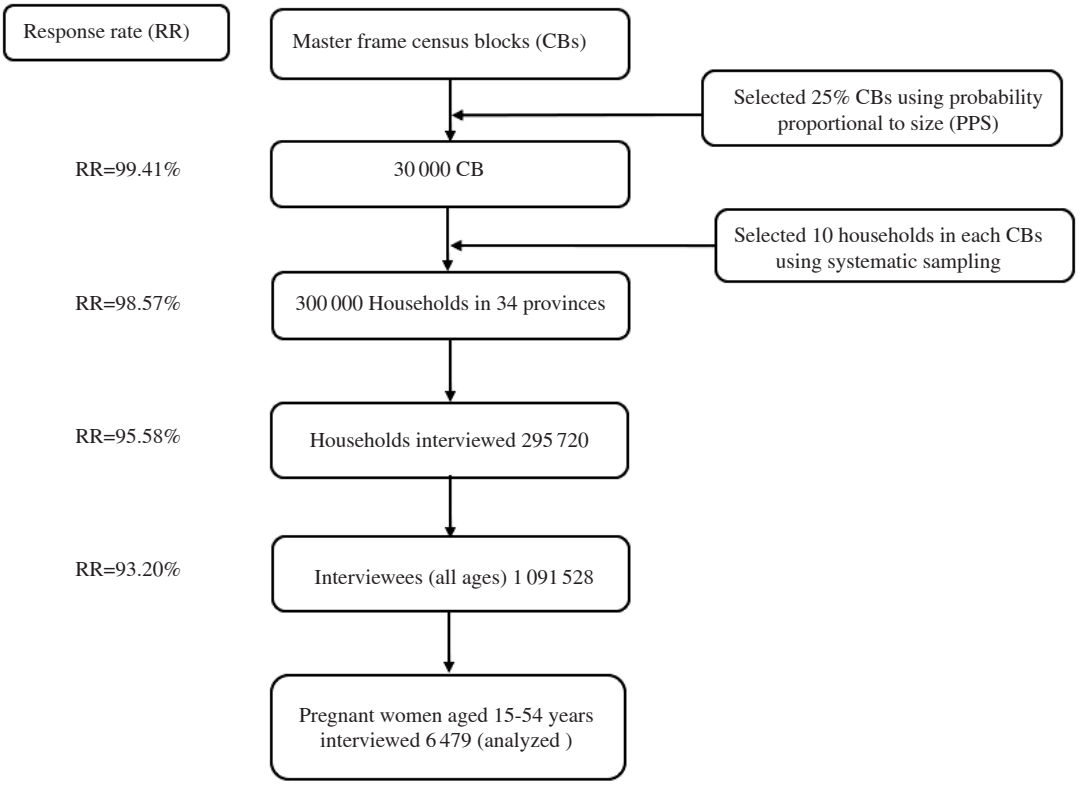

Figure 1. Data selection flow diagram. Modified from the 2018 national public health survey report by Oktarina *et al*[22].

and get approval from respondents. Village officers and local health workers accompanied the enumerators in visiting the selected households. Before starting the interview, the enumerators asked for consent from all family members who needed to fill out a consent form. Data collection was done using a structured paper-based questionnaire about household and individual levels. There are two types of RISKESDAS questionnaires in 2018: Household and individual. The use of household questionnaires at the beginning of the interview, where the enumerators asked various questions about individual information in the household. Meanwhile, the use of individual questionnaires contained questions about diseases, one of which was hypertension in pregnant women, behavior, knowledge and maternal health.

Apart from that, the individual questionnaire also contained questions related to measuring medical indicators, such as blood pressure. The measuring instruments used by enumerators to measure blood pressure were standardised, had the same type, and were recalibrated before being used for data collection. To measure blood pressure, the enumerator measured blood pressure three times using a standardized measuring instrument. The value recorded in the measurement results column was the average value of the results of three measurements.

2.2. Variables and instruments

Respondents in this study were all pregnant women aged 15-54 years, in the second and third trimesters of pregnancy. After going through the respondent selection process, 6 479 respondents were obtained. From this sample, two categories were made: pregnant women with a history of hypertension and those who did not have a history of hypertension. This variable was the dependent variable in this study/article. Hypertension was identified among participants based on the average blood pressure value of three measurements. The Joint National Committee 7 algorithm was used to classify blood pressure. A participant was considered to have hypertension if their average systolic blood pressure was $\geqslant$140 mmHg or their average diastolic blood pressure was $\geqslant$90 mmHg[19].

The independent variables consisted of the demographic characteristics of pregnant women consisting of pregnant women's age, gestational age, education, occupation, place of residence, and region of residence. The age of pregnant women was categorized into 2 groups: 15-35 years and 36-54 years. Meanwhile, gestational age was grouped into 2 groups: the first was second trimester gestational age, and the second was third trimester gestational age. The level of education assessed was categorized into 2 groups: low

Table 1. Bivariate analysis of risk factors for hypertension in pregnant women, Indonesian Basic Health Research 2018 (n=6 479).

Variable	No hypertension	Hypertension	*P* value	*OR* (95% *CI*)
Age, years				
36-54	683 (92.5)	55 (7.5)	<0.001*	4.73 (3.37-6.65)
15-35 (Ref.)	5 644 (98.3)	97 (1.7)		
Education				
Low	2 888 (97.6)	71 (2.4)	0.825	0.95 (0.69-1.33)
High (Ref.)	3 439 (97.7)	81 (2.3)		
Employment				
Unemployed	4 083 (97.5)	105 (2.5)	0.248	1.23 (0.87-1.74)
Employed (Ref.)	2 244 (98.0)	47 (2.0)		
Domicile				
Urban	3 570 (97.6)	87 (2.4)	0.886	1.03 (0.74-1.42)
Rural (Ref.)	2 757 (97.7)	65 (2.3)		
Gestational age				
Third trimester	1 497 (95.8)	66 (4.2)	<0.001*	2.51 (1.82-3.48)
Second trimester (Ref.)	4 830 (98.3)	86 (1.7)		
Smoking behaviour^				
Smoke	118 (99.2)	1 (0.8)	0.300	0.36 (0.05-2.51)
Not smoking (Ref.)	6 209 (97.6)	151 (2.4)		
Consume fruits and vegetables				
Lack of fruit and vegetables	6 217 (97.7)	149 (2.3)	0.809	0.87 (0.27-2.75)
Enough fruit and vegetables (Ref.)	110 (97.3)	3 (2.7)		
Excessive consumption of salty foods				
Often (every day)	1 982 (97.2)	57 (2.8)	0.117	1.31 (0.94-1.82)
Seldom (not every day) (Ref.)	4 345 (97.9)	95 (2.1)		
Pregnancy gravida				
Primigravida	2 844 (98.8)	36 (1.2)	<0.001*	0.38 (0.26-0.55)
Multigravida (Ref.)	3 483 (96.8)	116 (3.2)		
DM				
Yes DM	147 (93.0)	11 (7.0)	<0.001*	19.51 (6.56-57.97)
No DM (Ref.)	6 316 (99.9)	5 (0.1)		

*Significant at *P*-value<0.05. ^Smoking behaviour was categorized into two groups: Non-smokers (never smoked) and smokers (still smoking at this time and smoking every day).

education (no education, completed elementary school and junior high school) and high education (completed high school, Diploma 1, Diploma 2, Diploma 4, Strata-1, Strata-2, and Strata-3). The occupations were categorized into 2 categories: Unemployed (not working or not having a job) and employed (government employees, private employees, self-employed, farmers or agricultural workers, fishermen, labourers or drivers of household assistants, and other workers in the informal sector). Residential areas are categorised into two groups, namely urban and rural areas[20].

In addition to demographic characteristics, the independent variables used as risk factors were smoking behaviour, diabetes mellitus, fruit and vegetable consumption, excessive consumption of salty foods, and gravida pregnancy. Smoking behaviour was categorized into two groups: Non-smokers (never smoked) and smokers (still smoking at this time and smoking every day)[4]. Diabetes mellitus (DM) is an acknowledgement during an interview from a respondent regarding diabetes that a doctor had diagnosed. Diabetes was categorized into two groups, namely "Yes" and "No". The grouping of fruit and vegetable consumption was assessed by asking if there is a fruit and vegetable eating day in one week to determine whether the amount of measure was sufficient or not using props. The salty foods asked about in this study were foods with a predominantly salty taste or high salt levels, such as salted fish, salted eggs, salty snacks, and other foods with a dominant salty taste. Excessive consumption of salty foods was categorized into 2 groups: frequent (consumed >1 time per day, 1 time per day, and 3-6 times per week) and infrequent (consumed 1-2 times per week and <3 times monthly). Gravida pregnancies were categorized into 2 groups, namely primigravida and multigravida[4].

2.3. Data analysis

The division of tasks in RISKESDAS is not only related to the data collection process, but some officers have the main task of supervising the data that has been sent to the server. If there are any irregularities in the data, the officer will contact the officer who collected and entered the data to check and correct them if an error occurs. In addition, to support the accuracy of data entry, use Census

Table 2. Multivariate analysis of risk factors for hypertension in pregnant women, Indonesian Basic Health Research 2018 (n=6 479).

Characteristics of pregnant women	*OR*	95% *CI*		*P* value
		Lower	Upper	
Age, years				
36-54	3.67	2.54	5.32	<0.001*
15-35 (Ref.)	-	-	-	-
Gestational age				
Third trimester	2.40	1.72	3.35	<0.001*
Second trimester (Ref.)	-	-	-	-
Excessive consumption of salty foods				
Often (every day)	1.44	1.03	2.03	0.034*
Seldom (not every day) (Ref.)	-	-	-	-
Pregnancy gravida				
Primigravida	1.78	1.19	2.68	0.005*
Multigravida (Ref.)	-	-	-	-
DM				
Yes	10.20	3.04	32.23	<0.001*
No (Ref.)	-	-	-	-

*Significant at *P*-value<0.05.

and Survey Processing System (CSPro) 7.3 data entry software to perform data entry, so that data entry is entered in a structured manner and that missing a question is impossible.

Data analysis aimed to determine the risk factors for hypertension in pregnant women in Indonesia. Bivariate analysis was used to determine variables related to the incidence of hypertension in pregnant women, and the *Chi* square test was used on all independent variables. The *P*-value was considered significant if it was less than 0.05, and the results were presented as the odds ratio (*OR*) along with the corresponding 95% confidence interval (*CI*).

Multivariate analysis used multiple logistic regression to predict the determinant characteristics and risk factors associated with a history of hypertension in pregnant women. Select independent variables with the condition that if the *P*-value was <0.25, it was included in the multivariate analysis. Then, multiple logistic regression was continued to predict the determinant characteristics and risk factors associated with a history of hypertension in pregnant women. The *P*-value was significant if less than 0.05, and the results were presented as the odds ratio (*OR*) along with the corresponding 95% confidence interval (*CI*)[21]. An *OR* value greater than 1 indicated an increased risk of hypertension in pregnant women compared to non-risk groups.

2.4. Ethics statement

This research had also received ethical approval from the Ethics Commission of the Research and Development Agency (Number: LB.02.01/2/KE.024/2018). Written consent was obtained prior to the implementation of research activities.

3. Results

The relationship between independent variables and hypertension can be seen in Table 1. The results were based on the respondent's age. Pregnant women aged 35-54 years have a higher prevalence of hypertension (7.5%) compared with those aged 15-34 years (1.7%). It seems that a higher percentage of pregnant women with third-trimester gestational age had hypertension (4.2%) than second-trimester pregnant women (1.7%). Less pregnant women with smoking habits had hypertension history (0.8%) compared to non-smokers (2.4%). Multigravida pregnant women had a higher risk of hypertension (3.2%) than primigravida pregnant women (1.2%). Pregnant women who had a history of diabetes mellitus (DM) had a higher risk of hypertension (7.0%), compared to pregnant women who did not have a history of DM (0.1%). However, education, employment, domicile, habitual behaviour, smoking, consumption of fruits and vegetables, and excessive consumption of salty food were not found to have a statistically significant relationship with hypertension in pregnant women (Table 1).

Based on Table 2, the results of maternal age, gestational age, salty food consumption behaviour, and the number of pregnancies with multigravida and diabetes mellitus were associated with higher risk of hypertension (*P*<0.05). Based on the characteristics of pregnant women, namely the variable age of pregnant women with an odds ratio (*OR*) of 3.67. This means that pregnant women aged 35 years above were 3.67 times more likely to develop hypertension than younger women aged 15-35 years. Furthermore, the variable for gestational age was related to the incidence of hypertension (*P*<0.05), with an *OR* value of 2.40, which means that pregnant women in the third trimester tend to develop hypertension 2.40 times

compared to pregnant women in the second trimester. The salty food consumption behaviour variable was related to the incidence of hypertension (P<0.05), with an OR value of 1.44, indicating that pregnant women who frequently consumed salty foods are 1.44 times more at risk of hypertension than pregnant women who rarely consumed salty foods. The number of pregnancies was related to the incidence of hypertension (P<0.05), with an OR value of 1.78, meaning that pregnant women who have a history of more than one pregnancy (multigravida) are 1.78 times more likely to experience hypertension compared to mothers who are pregnant for the first time (primigravida). The variable of pregnant women with a history of diabetes mellitus was associated with the incidence of hypertension (P<0.05), with an OR value of 10.20, proved that pregnant women who had a history of diabetes mellitus tended to be 10.20 times more at risk of hypertension than pregnant women who did not have a history of diabetes mellitus (Table 2).

4. Discussion

Based on the variable age of the mother and the incidence of hypertension, the results of this study stated that there was a relationship between mothers aged 36-54 years and the incidence of hypertension (P<0.001). This study's results aligned with previous studies, which stated that there was a relationship between the incidence of hypertension in pregnant women and the age factor[23]. Age can determine the level of hypertension experienced by pregnant women; pregnancy at a young or old age can cause a risk of complications or maternal death[24]. Pregnant women aged <20 years have a high risk of experiencing mild preeclampsia, while those aged ⩾35 years have a greater risk of developing hypertension, severe preeclampsia, and superimposed preeclampsia[25]. This is because older women are more likely to have narrowed arteries, such as arteries in the kidneys and uterus, which can cause hypertension in pregnancy. Meanwhile, in younger women, the development of the reproductive organs is not perfect, and the production of the hormone estrogen is not maximized[26]. Increasing age is in line with high hypertension due to structural changes in the large blood vessels. The lumen narrows, and the blood vessel walls become more rigid due to increased systolic blood pressure[27]. This is because the risk of hypertension can be prevented properly, and complications during pregnancy can be avoided. According to the researchers' assumptions, those aged ⩽19 years are highly risky because the function of the female reproductive organs is not optimal, and complications can easily occur at the young age, especially the rapid increase in blood pressure. Meanwhile, at the age of >35 years, the female reproductive organs have begun to decline, so there is a high risk of an increase in blood pressure[28].

Researches showed that the frequency of hypertension was higher in the third trimester (4.2%) than in the second trimester (1.7%). It is known that pregnant women in the third trimester tend to be at higher risk of experiencing hypertension 2.40 times compared to pregnant women in the second trimester (P<0.001). Changes in blood pressure during pregnancy are associated with hormonal changes that cause significant adaptations in maternal cardiovascular physiology[29]. A meta-analysis of 39 studies involving 1 479 women, assessing cardiac output during healthy singleton pregnancies, revealed significant alterations in cardiovascular parameters. On average, cardiac output, heart rate, and stroke volume exhibited increases of 31%, 24%, and 13%, respectively, compared to non-pregnant values at their peaks[30]. Conversely, systemic vascular resistance reached a nadir, dropping by 30% compared to non-pregnant levels. Peaks in cardiac output, heart rate, and the nadir in systemic vascular resistance were observed early in the third trimester. Conversely, the peak in stroke volume occurred early in the second trimester, gradually trending towards pre-pregnancy values as pregnancy progressed towards term[30]. Apart from that, another phenomenon that may occur is that the frequency of hypertension increases more in the third trimester than in the second trimester, which may be caused by an increase in vasorelaxant mediators in the first and second trimesters which masks the existing gestational hypertension[31].

Based on the variable of pregnant women who consume excessively salty food every day, the hypertension occurrence reached 2.3%. The data analysis results illustrated a relationship between consuming salty foods and the incidence of hypertension in pregnant women (P<0.001). This study was inversely proportional to the results of Arikah *et al*., which stated that there was no relationship between excessive salt consumption and the incidence of hypertension in pregnant women[32]. Excessive consumption of salty foods during pregnancy can interfere with intrauterine and harm fetal development[18]. According to the researchers' assumption, pregnant women who consume excessive salt daily can cause hypertension because consuming excessive salt can increase blood pressure. Salt retains water so that blood volume increases and causes the narrowing of the arteries[33]. As a result, it forces the heart to pump harder. WHO member countries have agreed to reduce global salt/salty food intake by 30% by 2025. If the reduction of salt/salty food consumption is successful globally, an estimated 7 million deaths can be prevented by 2030[34]. Salt consumption patterns can reduce the risk of hypertension. Recommended sodium levels are no more than 100 mmol (5 grams of salt) per day or the equivalent of one teaspoon per day[35].

The results of this study identified that 6316 respondents (99.9%) of pregnant women did not experience hypertension and did not suffer from diabetes mellitus. The data analysis results illustrated a relationship between pregnant women with diabetes mellitus and the incidence of hypertension (P<0.001). According to Mohanty *et al.*, other factors affecting the risk of preeclampsia in pregnant women are diabetes mellitus, multiple pregnancies, previous preeclampsia, and family history of preeclampsia[36]. Pregnant women with a history of diabetes mellitus during pregnancy can cause complications such as preeclampsia, dystocia, and others[37]. Pregnant women should carry out regular prenatal checks, pay attention to their health conditions by living a healthy lifestyle, maintaining their nutrition with nutritious foods, and consuming a diet of excessive salt to prevent excessive weight gain during pregnancy[38].

Our research findings showed that pregnant women who have smoking behavior (0.9%) had less history of hypertension than non-smokers (2.4%). These results are supported by a literature review which states that smoking reduces the risk of hypertensive disorders in pregnancy and preeclampsia[39–41]. The protective effect of smoking on reducing blood pressure has even been confirmed through a large mendelian randomization meta-analysis[42]. The underlying mechanism for this protective effect has been suggested to be due to the effect of nicotine, which inhibits thromboxane production[43], as well as dilates blood vessels[44], leading to lower blood pressure. However, at the same time, nicotine also inhibits placental development both directly through inhibiting placental trophoblast cell invasion and indirectly by reducing blood flow, which can lead to increased risk of preeclampsia[45], as well as other hypertensive disorders in pregnancy. These findings contradicted several research results showing that smoking during pregnancy increases the risk of hypertension in pregnancy[46,47]. A study showed that women who smoked in the first trimester experienced an increase in the average systolic blood pressure during pregnancy, and an increase in the average diastolic blood pressure in late pregnancy, compared with non-smokers[48]. Meanwhile, other research found that women who never smoked and those who reduced the number of cigarettes smoked during pregnancy had the lowest risk of developing hypertension[49,50].

Based on the variable number of pregnancies with incident hypertension in this study, 98.8% of primigravida and 96.8% of multigravida pregnant women did not have hypertension. The number of pregnancies was related to the incidence of hypertension (P<0.05), with an OR value of 1.78, meaning that pregnant women who have a history of more than one pregnancy (multigravida) are 1.78 times more likely to experience hypertension compared to mothers who are pregnant for the first time (primigravida). This finding is in accordance with the results of a study in Gambella City, Southwest Ethiopia, which stated that pregnant women who were multigravida were twice as likely to experience hypertensive disorders during pregnancy compared to pregnant women who were primigravida[51]. The incidence of hypertension is higher in multigravida pregnant women because the uterus tightens during pregnancy, and there is a decrease in angiotensin, renin, and aldosterone levels[52]. According to the researcher's assumption, even though the birth interval is far from the previous birth with parity, pregnant women are still at risk. However, pregnant women are unlikely to experience hypertension if they live healthy lifestyles. Pregnant women with parity are not at risk but can experience hypertension due to unhealthy lifestyle factors, such as lack of sleep and excessive consumption of salty foods.

The strength of this study is that the 2018 RISKESDAS data employed nationally representative data and a large sample size, allowing it to evaluate the association between numerous factors contributing to hypertension in pregnant women in Indonesia. Furthermore, utilizing multivariate logistic regression modeling with sample weights in our research can assist reduce bias, allowing us to investigate the impact of provinces, districts, and clusters on stunting.

The first limitation of this study is that the 2018 RISKESDAS data was collected using a cross-sectional design, identifying only relationship instead of causal conclusions. The second limitation is that the available hypertension data must be in the form of numbers. The quality of maternal hypertension data depends on the accuracy of its recording, the mother’s ability to recall relevant information, and her capacity to provide details. The third limitation is the restricted data availability regarding the variables discussed in the article. The article did not include other factors associated with high blood pressure in pregnant women, such as quintile values, personal and lifestyle factors, obstetric-related factors, hereditary factors, medical-related variables, and the overall poor quality of data from facilities.

This study assessed various risk factors for hypertension in pregnant women in Indonesia. The dominant risk factors for hypertension in pregnant women in Indonesia included older maternal age (36-54 years), third-trimester pregnancy, primigravida, excessive consumption of salty foods, and diabetes mellitus. These findings stressed the need to expand early detection services (hypertension and diabetes mellitus) and familiarize pregnant women with routine pregnancy control with health workers down to the grassroots level so that people can get all types of services more efficiently.

Aside from that, there is a need to provide balanced nutrition

education to the public during and before pregnancy, emphasizing the importance of sodium intake. Furthermore, health providers should identify pregnant women with diabetes mellitus and offer appropriate advices.

Conflict of interest statement

The authors declare that they have no conflict of interest.

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Authors' contributions

The authors confirm contribution to the research as followed: OO, ZKN, BR, and RR: conceptualization; OO, RR, LH, WR, BR, and YFW: methodology; OO, ZKN, and BR: software; RR, BR, and YFW: validation; OO, ZKN, and RR: formal analysis; ZKN, BR, and RR: investigation; JN, RR, BR, YFW, and RR: resources; ZKN, BR, YFW, and RR: data curation; OO, ZKN, JN, WR, LH, BR, YFW, and RR: writing-original draft preparation; OO, ZKN, BR, LH, and RR: writing-review and editing; RR, LH, WR, and BR: visualization; OO, ZKN, and BR: supervision the project; OO, ZKN, LH, WR, and BR: project administration. All authors have read and agreed to the published version of the manuscript.

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