



Relationship Of Calcium Levels To Hypertension In Pregnancy

Nur Elly¹, Erli Zainal², Iin Nilawati³

¹ Politeknik Kesehatan Kementerian Kesehatan Bengkulu
Jalan Indra Giri No. 3 Padang Harapan, Kota Bengkulu

^{2,3} STIKes Sapta Bakti Bengkulu
Jalan Mahakam Raya, No. 16 Lingkar Barat, Bengkulu
Email : nurelly12@gmail.com

Abstrak

Hipertensi dalam kehamilan sering berlanjut menjadi pre eklampsia sebagai salah satu penyumbang terbesar angka kematian ibu. Faktor mineral dan gizi memiliki peran penting dalam etiologi hipertensi dalam kehamilan terutama pre eklampsia. Faktor mineral yang berhubungan dengan hipertensi adalah kalsium. Tujuan penelitian ini untuk menganalisis hubungan kadar kalsium dengan kejadian hipertensi pada kehamilan. Penelitian ini menggunakan rancangan penelitian Cross-Sectional yaitu mengukur/mengamati variabel bebas (kadar kalsium) dengan variabel terikat (hipertensi dalam kehamilan). Jumlah sampel 43 ibu hamil trimester II yang diambil dengan teknik consecutive sampling. Penelitian ini menggunakan data primer dengan melakukan pemeriksaan tekanan darah dan kadar kalsium pada serum darah ibu hamil. Hasil analisis univariat menunjukkan 30% ibu hamil mengalami hipertensi dalam kehamilan, serta 44% ibu hamil memiliki kadar kalsium tidak cukup. Hasil analisis bivariat membuktikan nilai ada hubungan yang bermakna kadar kalsium darah ibu dengan kejadian hipertensi pada ibu hamil trimester II (p value 0,000).

Kata Kunci : kadar kalsium; hipertensi; ibu hamil

Abstract

Pregnancy-induced hypertension often progresses to pre-eclampsia as one of the biggest contributors to maternal mortality. Mineral and nutritional factors have an important role in the etiology of pregnancy-induced hypertension, especially pre-eclampsia. A mineral factor associated with hypertension is calcium. This study attempts to analyze the relationship between calcium levels and the occurrence of pregnancy-induced hypertension. A cross-sectional study design was used to measure or observe independent variables (calcium levels) and dependent variables (hypertension in pregnancy). The number of samples was 43 second-trimester pregnant women taken by consecutive sampling technique. This study used primary data by examining blood pressure and calcium levels contained in the blood serum of pregnant women. Univariate analysis results showed that 30% of pregnant women experienced pregnancy-induced hypertension, and 44% of pregnant women had insufficient calcium levels. The results of the bivariate analysis proved that there was a significant correlation between maternal blood calcium levels and the occurrence of hypertension in second-trimester of pregnant women (p value 0,000).

Keywords: calcium levels; hypertension; pregnant women

Article info:

Article submitted on August 30, 2020

Articles revised on September 29, 2020

Articles received on October 30, 2020

DOI: [http://dx.doi.org/10.21927/jnki.2020.8\(3\).232-238](http://dx.doi.org/10.21927/jnki.2020.8(3).232-238)

INTRODUCTION

Pregnancy-induced hypertension is defined as a condition when the blood pressure reaches 140 mmHg or higher after twenty weeks of pregnancy, or the increasing of systolic pressures up to 30 mmHg and diastolic pressures up to 15 mmHg above normal. Hypertension is one of health problems often occurred during pregnancy and may cause complication in 2-3% pregnancy and 5-15% may lead to pregnancy difficulties.

Pregnancy-induced hypertension can threaten the safety of pregnant women because it may induce bleeding, abruptio placenta, and pre-eclampsia that lead to eclampsia or even death. Moreover, there are some of complications that can appear because of hypertension in pregnancy such as deficiency of plasma fluid due to vascular disorders, kidney disease, hematology disorder, cardiovascular illness, liver disorder, respiratory illness, and syndrome HELLP (*hemolysis, elevated liver enzymes, low platelet count*).

Pregnancy-induced hypertension that turns into pre-eclampsia and eclampsia may cause the death of both pregnant women and their fetus. Pre-eclampsia/eclampsia is one of the 3 highest causes of maternal mortality (1). Furthermore, *World Health Organization* (WHO) has stated that 20% mortality of pregnant women in developed country is related to pregnancy hypertension. In 2015, *Profil Kesehatan Indonesia* (Indonesian health profile) stated that hypertension caused 27,1% of maternal mortality, placed second only to bleeding (30,3%).

WHO also has reported that prevalence of pregnancy-induced hypertension has reached around 35-55% and continues to rise with the increasing of gestational age. The occurrence of hypertension in Primigravida was about 7-12%, Multigravida pregnancy was 5.5-8% and it would be more increasing in some cases such as gemelli pregnancy, diabetes mellitus in pregnancy, and mola hidatidosa pregnancy (2).

Pre-eclampsia affects the fetus as well. The placenta could not receive adequate blood intake which lead to the shortage of oxygen and food. This may cause low birthweight (BBLR) and transpire other problems to infants such as premature birth, asphyxia, as well as inhibited fetal growth disorder and death in the womb or at birth (3).

The cause of pregnancy-induced hypertension is yet to be clearly known. However, in general it is caused by vasospasm arteriola (2). Hypertension may occur as a result of nutritional factors and lack of rest. Sometimes, both of those factors are interlinked (1).

Other reasonable factors contribute to the onset of pregnancy-induced hypertension are: primigravida, gemelli pregnancy, hidramnion, mola hidatidosa, multigravida, severe malnutrition, mother aged under 18 years or over 35 years as well as anemia (4).

Mineral and nutritional factors have an important role as the etiology of pregnancy-induced hypertension, especially pre-eclampsia. The mineral factor related to hypertension is calcium. The need for calcium increases during pregnancy. Despite holding important value for the bone health of both mother and her fetus, adequate calcium intake can reduce the occurrence of pregnancy-induced hypertension, reduce pre-eclampsia and prevent premature birth (5) including severe maternal morbidity and death. Few studies have assessed the implementation of this intervention in clinical practice. The study aimed to assess the proportion of pregnant women who received calcium supplements in Brazilian public antenatal care clinics. Methods: This cross-sectional study interviewed women waiting for antenatal care visits in 9 public clinics in 4 Brazilian cities in 2010-2012. Trained interviewers used a standardized anonymous questionnaire to collect socio demographic and obstetric data, information on ingestion of dairy products and on prescriptions received during current pregnancy. Results: A total of 788 valid

questionnaires were analyzed. Participants were young (mean age 25.9). WHO has recommended calcium supplementation of 1500-2000 g/day in populations with low calcium intake as part of the ANC for the prevention of pre-eclampsia in pregnant women, especially those who possess a high risk of hypertension (6). Calcium adequacy in pregnant women during third trimester can be obtained from milk. Cheese, yogurt, and anchovy are also good sources of calcium (7).

Potential benefits gained from calcium supplementation during pregnancy in order to decrease pre-eclampsia has been widely analyzed. Changes in vascular function play an important role in the control of vascular resistance and blood pressure (8).

Calcium supplements have an important role in preventing pregnancy hypertension by keeping the levels of calcium ions in physiological range. Low calcium intake leads to the increased blood pressure by stimulating the release of parathyroid hormones and/or renin which leads to the increased intra-cellular calcium concentrations in vascular smooth muscle cells and resulting in vasoconstriction. The role of calcium supplementation in lowering hypertensive disorders in pregnancy is by lowering the release of parathyroid calcium and intra-cellular calcium concentration. Thus, there is a decrease in smooth muscle contraction and an increase in vasodilation (9).

Some studies show that maintaining normal range of calcium levels is very important in the synthesis of vasoactive substances such as prostacyclin and nitric oxide on endothelial in maintaining normal endothelial function and lowering blood pressure. Research and meta-analysis results suggest administering calcium and Vitamin D supplements to decrease pre-eclampsia (10)(11)the present study investigates vitamin D status and its determinants during the third trimester of women living in Sweden (latitudes 57-58°N(12).

The study of epidemiologic clinic showed the relation between the low calcium intake and the development of pre-eclampsia and eclampsia. Previous studies linked the protective effects of calcium administration in pregnant women. The data showed that calcium supplements intake during pregnancy was associated with the decrease of pregnancy-induced hypertension even though there were diverse influences of the basic value of calcium intake among the population and the previous existing risk factors. Based on previous research carried out by Hofmyer and friends, calcium supplements during pregnancy had a significant effect on lowering the risk of pre-eclampsia (13).

The occurrence of hypertension in pregnancy varies from region to region. In 2016, pregnancy-induced hypertension occurred only 11.2% in Bengkulu Province. Meanwhile, based on the medical record of Dr. M. Yunus Hospital as a referral center, of the number of childbirth, there were 5.52% of pre-eclampsia in 2014, 8.31% in 2015, and in 9.25%. It means that the pre-eclampsia in this hospital is considered as quite high.

In 2018, there were 39 cases of maternal mortalities in Bengkulu: the death of 5 people were caused by pregnancy-induced hypertension (pre-eclampsia and eclampsia), 1 person by infection, 16 people by bleeding, 3 people by metabolic disorders, and 14 people by other causes (14).

According to the explanation above, the researchers were interested in analyzing the relationship between calcium levels and calcium intake with the occurrence of pregnancy-induced hypertension. Thus, early prevention of pregnancy-induced hypertension could be conducted.

MATERIALS AND METHODS

The study used *Cross-Sectional design* with free variables (serum calcium levels) and bound

variables (hypertension in pregnancy). The research population were all pregnant women in second-trimester who came to the ante-natal service in *Posyandu* (Integrated Healthcare Center), *Puskesmas* (Public Health Center) and *Bidan Praktek Mandiri* (Midwife Clinic) in Bengkulu. The number of samples were 43 pregnant women in the third trimester obtained by using *consecutive sampling techniques*. The inclusion criteria in this study were pregnant women entering the third trimester of pregnancy with no previous history of hypertension.

This research used primary data which means that the characteristic data were collected through interviews by using questionnaire. There were several questions asked including name, age, parity, history of hypertension/ pre-eclampsia, and level of education.

Blood pressure measurement was performed by a trained midwife who examined the right arm of the subject on a seated state after 10 minutes of rest by using digital tensimeter. The measurements were carried out twice interspersed with a 5-minute rest and then the mean value was calculated from the measurement results. Blood pressure check results were categorized as hypertension if the systolic blood pressure reached 140 mmhg or higher. 2 ml of vein blood sampling was obtained by trained analysts/laboratory assistants in the morning to determine calcium levels in the blood serum after the research samples had abstained from eating for 8 hours. The examination was carried out in Kimia Farma Laboratory Clinic, Bengkulu.

The statistical analysis used to figure out the relationship of the two variables was Chi Square ($\alpha = < 0.05$).

RESULTS AND DISCUSSION

A total of 43 pregnant women were enrolled in this study. 7% of the women were at-risk age, 51.2% were having primigravida, 86.0% were

employed, and 55.8% had high school education level (Table 1).

Table 1. Frequency Distribution of Respondent Characteristics

Kategori	F	%
At risk-age	3	7,0
No risk-age	40	93,0
Total	43	100,0
Primiparity	22	51,2
Multiparity	21	48,8
Total	43	100,0
Employed	37	86,0
Unemployed	6	14,0
Total	43	100,0
Primary	2	4,7
Middle School	11	25,6
High School	24	55,8
Graduates	6	14,0
Total	43	100,0

Table 2. Frequency Distribution of Hypertension Incidence and Calcium Levels

Categories	F	%
Hypertension	30	70
Normal blood pressure	13	30
Total	43	100
Abnormal Calcium Levels	19	44
Normal Calcium Levels	24	56
Total	43	100

The results of this study were obtained from 43 pregnant women in their third-trimester who conducted the ANC examination. Of these 43 pregnant women, 13 (30%) had hypertension and 19 (44%) had abnormal calcium levels.

Blood pressure	Calcium levels				Total		P
	Normal		Abnormal				
	N	%	N	%	N	%	
Normal blood pressure	22	73,3	8	26,7	30	100	0,000
Hypertension	2	15,4	11	84,6	13	100	
Total	24		19		43		

The results of the Chi Square test were derived from 30 pregnant women who had normal blood pressure and 22 who had normal calcium levels. Of 13 pregnant women who had hypertension, 11 had abnormal calcium levels. P value = 0.000 showed the significant relationship

between calcium levels and hypertension incidence of pregnant women in the second-trimester.

The results of this study showed that the majority of hypertension-induced pregnancy occurred in women aged 29-34 years. This age is still categorized as reproductive age. Multiple studies have reported that women aged over 35 years had a higher risk of hypertension than those who were below 35 years (15). Similarly, another study reported that the higher the age of women (> 40 years) the higher the risk of pre-eclampsia and other risks either in the antenatal or labor stage (16).

Based on parity, the majority of women experiencing hypertension were women who had either primiparity or multiparity. This is in accordance with previous research reported that primiparous women had an increased risk of hypertension. However, another research reported that nulliparous women had a higher risk of hypertension. The different result of the research is likely due to other risk factors that are not examined, namely women diseases such as kidneys, antibody syndrome of antiphospholipids, *systemic lupus erythematosus*, chronic hypertension and diabetes mellitus. Other factors such as obesity, gemelli pregnancy and previous history of hypertension also contribute to hypertension (17). These factors are not examined in this research.

This research identified that there was a positive correlation between calcium levels and hypertension incident of pregnant women in the second-trimester. Pregnant women without hypertension had the highest rate of blood calcium levels which was categorized as normal range. This was in accordance with the research reported that pregnant women with hypertension had the lowest level of blood calcium levels compared to those without hypertension (18). Similarly, another study also

reported the low calcium levels of pregnant women with hypertension compared to those without hypertension (19). Rohtak from February 2015 to July 2015. Thirty apparently normal pregnant women and 30 preeclamptic pregnant mothers were enrolled in the study. Subjects were excluded if they had chronic medical disease or were taking medications known to interfere with Ca metabolism such as corticosteroids, thyroxine and heparin. Total SCa, Ionized calcium (Ca^{+2}).

Multiple researches reported the involvement of minerals such as calcium in the pathogenesis of pre-eclampsia. Calcium is indispensable for normal development and body function maintenance. Calcium is required for a wide range of important processes such as neuron excitation, neurotransmitter release, muscle contraction, membrane integrity and blood clotting (18). Calcium is also instrumental in the pregnancy process.

The contribution of low calcium levels of pregnant women in causing hypertension can be explained through several mechanisms. First, if calcium level is low, it will increase the production of parathyroid hormone and subsequently lead to the increase of intra-cellular calcium in vascular smooth muscles. The increased intra-cellular calcium in vascular smooth muscles will lead to the increased vascular and vasotrixy resistance that will trigger the increase of blood pressure (20). Another mechanism is by stimulating renin production that will increase angiotensin II and blood pressure. Low calcium levels can also reduce blood magnesium level and further trigger vascular smooth muscle vasotrixy and will decrease the effect of endothelial nitric oxide synthase (eNOS), a calcium-dependent enzyme that inhibits vasodilation of blood vessels. This vasodilatory barrier is also caused by the decrease of prostacyclin in the blood circulation. Prostacyclin is a calcium and potent vasodilator-dependent enzyme (21).

CONCLUSION AND RECOMMENDATION

Based on the results of the study, it can be concluded that of 43 pregnant women, 30 (70%) had normal blood pressure, 24 (56%) had normal calcium level. There was a significant relationship between calcium levels and hypertension in pregnancy. Health care providers, especially midwives should provide nutritional counseling to pregnant women during ANC about the source of calcium intake to prevent hypertension during pregnancy.

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