

## The correlation between calcium intake and magnesium intake and hypertension among outpatients

Umi Hasanah<sup>1</sup>, Effatul Afifah<sup>1</sup>, Esti Nurwanti<sup>1</sup>

<sup>1</sup>Department of Nutrition Science, Faculty of Health Sciences, Universitas Alma Ata,  
Jalan Brawijaya 99, Tamantirto Yogyakarta.

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### ABSTRACT

**Background :** *Hypertension still has been a great health problem in Indonesia. In Indonesia, the prevalence of hypertension in 2013 was as many as 28.5%, and in The Yogyakarta special was as many as 25,7%. Several factors that can affect hypertension, some unavoidable as aging and sex, but some can as lifestyle very closely related to nutrition as deficiency intake calcium and magnesium. Calcium may affect blood pressure because it inhibits the effects of the intake of salt naci high on blood pressure. And if less magnesium it can increase levels of sodium intracellular and sent down the potassium intracellular.*

**Objectives:** *To know the relationship between calcium and magnesium intake with the genesis hypertension in outpatients at RSUD Panembahan Senopati Bantul Yogyakarta.*

**Methods:** *The research was observational with case-control design. Research was carried out in February 2016 and population research was outpatients RSUD Panembahan Senopati Bantul Yogyakarta. Sample case was outpatients the age of 30-60 years with the diagnosis hypertension. Control is outpatients with the age of 30-60 years who do not hypertension. The sample of the 45 patients with comparison cases control 1: 1, so the total sample was 90 patients with 45 patients hypertension and 45 a patient was not hypertension. Sampling method was by purposive sampling. Variable dependent was hypertension and independent variable was calcium and magnesium intake. An instrument was form food frequency questionnaire (FFQ) form that was taken by means of interview. Data analysis using analysis univariate ( descriptive with the spss version 19 and bivariat (test chi-square).*

**Results :** *Bivariat analysis showed that calcium intake ( $p = 0.827$ ;  $or = 0.909$ ;  $el\ 95\ \% = 0.385 - 2.143$ ) no significant relationship with the occurrence of hypertension. While intake of magnesium ( $p = 0.035$ ;  $or = 2.471$ ;  $el\ 95\ \% = 1.058-5.768$ ) had significant relationship with the occurrence of hypertension.*

**Conclusions:** *A significant relation was between magnesium and the genesis hypertension. Was proven but intake calcium did not prove the relationship with the genesis hypertension.*

**KEYWORDS :** hypertension, calcium and magnesium intake

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### INTRODUCTION

Hypertension is a chronic disease often called silent killer because in general patients do not know that they suffer from hypertension disease before checking his blood pressure. In addition, people with hypertension generally do not experience a sign or symptoms before complications occur (1). Hypertension is often found in primary health care. This is a health problem with high prevalence. Based on National Riskesdas data in 2013 the prevalence of hypertension based on measurement of 25.8%, although in 2007 amounted to 31.7% there is a significant decline. The decrease in the number

shows the awareness of the people who have checked into health workers began to increase, seen from the prevalence of hypertension diagnosis by health personnel based on interview in 2013 by 9.5% higher than in 2007 at 7.6%.

Prevalence of hypertension for DIY region of 25.7% including high number with the prevalence of reason in 2007 until 2013 did not show decreasing (2). The distribution of essential hypertensive diseases in Bantul, both in puskesmas and in hospitals, is included in the top 10 non-communicable diseases. In 2013, the incidence of essential hypertension at puskesmas in Bantul reaches 18.259 people and according to Hospital Information

System (SIRS) report, the distribution of essential hypertension occurrence at RSUD Panembahan Senopati Bantul regency reach 22.591 people (3). Approximately 95% of hypertension in Indonesia is an essential hypertension that is unknown cause and is multifactorial (4). Some factors can affect the occurrence of hypertension, some can not be avoided as age and sex, but some can be prevented lifestyle is very closely related to nutrition such as lack of calcium and magnesium intake (5). Calcium can affect blood pressure because it inhibits the effect of high salt intake of NaCl on blood pressure. Meanwhile, if less magnesium it can increase intracellular sodium levels and decrease intracellular potassium levels (6).

Research that proves that calcium intake less influence blood pressure with a value of  $q$  of 0.009 which means the relationship between calcium intake with hypertension (7). In a cohort study that proved that high calcium intake can lower blood pressure with Relative Risk (RR) of 1.00 (8). Another study showed a significant association between low magnesium intake and the incidence of hypertension in postmenopausal women ( $p = 0.02$ , OR = 4.27, 95% CI = 1.135-16.137) (9).

From the preliminary study at Panembahan Senopati Bantul General Hospital in March-May 2015, the number of primary hypertension patients aged 20-60 reached 1099 patients. Based on this background, the researchers are interested to examine further how big risk factors for hypertension associated magnesium and calcium intake of hypertension incidence in outpatients Panembahan Senopati Bantul Hospital Yogyakarta.

## MATERIALS AND METHODS

This research was an observational analytic research with case-control case design. The research was conducted in February 2016 in Poly Outpatient Panembahan Senopati Bantul Yogyakarta Hospital. The population used were hypertensive patients (cases) and not hypertension (control). The method of selecting the sample by non-random sampling (90) with 45 cases (hypertension) and 45 controls (not hypertension).

Instruments used in the form of questionnaire data sample characteristics and forms of Food Frequency Questionary (FFQ). The sample size was 45 patients with a ratio of 1: 1 control cases, so

**Table 1. Characteristics of respondents in the hypertension group and not hypertension**

Characteristic	Hypertension		Not Hypertension		Total		p
	n	%	n	%	n	%	
Sex							
Male	10	22.22	9	20	19	21.11	0.798
Female	35	77.7	36	80	71	78.9	
Age (years)							
$\geq 45$	36	80	26	57.78	62	68.89	0.023
$< 45$	9	20	19	42.22	28	31.11	
Education							
Never School	1	2.22	2	4.44	3	3.33	0.469
Graduated from elementary school	12	26.67	6	13.33	18	20	
Graduated from junior high school	9	20.00	11	24.44	20	22.22	
Graduated from senior high school	13	28.89	18	40	31	34.44	
Occupation							
Labor	8	17.78	14	31.11	22	24.44	0.772
Traders / Entrepreneurs	1	2.22	1	2.22	2	2.22	
Farmer	2	4.44	2	4.44	4	4.44	
Private Company Employee	2	4.44	1	2.22	3	3.33	
PNS/TNI/POLRI	4	8.89	3	6.67	7	7.78	
Retired	1	2.22	0	0	1	1.11	
Housewife	27	60	24	53.33	51	56.67	

the total sample of 90 patients with 45 hypertensive patients and 45 patients was not hypertensive. The dependent variable of hypertension research and the independent variables of calcium and magnesium. The data collected were analyzed using chi square test to see the relationship between calcium and magnesium intake with hypertension incidence using SPSS version 19, while the sample characteristic data was analyzed descriptively.

**RESULTS**

**Characteristics of respondents**

Respondents in this study amounted to 90 people. In **Table 3**. it can be seen that female respondents are more female than male respondents in control group or non-hypertensive (80%) or case group or hypertension (77.78%). By age, the study respondents were between the ages of 30 and 60. When seen from **Table 3**. age group of respondents most are age group above 45 years both in case group or hypertension (80%) and control (57.78%).

Most of the research respondents had a high school education background of 28.89% in case group or hypertension and 40% in the control group, while the smallest percentage of educational background of respondents was never school either

in case group or hypertension that was 2.22% control group of 4.44%. Respondents' occupations were mostly housewives (both) in the case group or hypertension (60%) as well as in the control group (53.33%), whereas the smallest percentage of respondent's job was either retired group of case group or hypertension (2.22 %) or control group or no hypertension (0%).

**The difference in average intake of calcium and magnesium in hypertensive patients**

The average difference of intake in the test using t test is independent samples t-test. Based on **Table 4**. Calcium intake did not show any difference between the hypertension group and not hypertension because the difference in intake was only 1 and the value of  $p < 0.829$ . While magnesium intake proves there is a relationship between magnesium intake with the incidence of hypertension because there is a significant difference between intake in hypertensive and non hypertensive group with a value of  $p = 0.035$ . This suggests that a sufficient magnesium intake statistically affects the incidence of hypertension, so it can be concluded that sufficient magnesium intake may affect the decrease in the incidence of hypertension.

**Table 2. Mean potassium and magnesium intake of hypertensive and non hypertensive groups**

Variable	Hypertension (Case)	Not Hypertension (Control)	SD	p-value
Male	861.1	858.8	0.504	0.829
Female	340.5	488.5	0.493	0.035

**Table 3. Bivariate analysis of the relationship of calcium intake with the incidence of hypertension**

Calcium Intake	Hypertension (Case)		Not Hypertension (Control)		P	OR	(95% CI)
	n	%	n	%			
Less (<1000 mg)	28	62.22	29	64.44	0.827	0.909	0.385-2.143
Enough (≥1000 mg)	17	37.78	16	35.56			

**Table 4. Bivariate analysis of relationship between and hypertension**

Magnesium Intake	Hypertension (Case)		Not Hypertension (Control)		P	OR	(95% CI)
	n	%	n	%			
Less (<350 mg/day or <320 mg/day)	28	62.22	18	40	0.035*	2.471	1.058-5.768
Enough (≥350 mg/day or ≥320 mg/day)	17	37.78	27	60			

### Relationship of Calcium Intake with Hypertension Occurrence

Based on **Table 5**. most calcium intake of respondents are in the less category in case group or hypertension (62.22%) as well as control group (64.44%). Chi Square statistical analysis results showed no significant relationship between calcium intake with incidence of hypertension ( $p=0.078$ ).

### Relationship of Magnesium Intake with Hypertension Occurrence

Based on **Table 6**. It shows that less magnesium intake in the hypertension group (62.22%) and adequate intake of magnesium in patients with no hypertension (60%). The result of Chi-Square statistic analysis showed that there was a significant correlation between magnesium intake and hypertension ( $p=0.035$ ) where responder with magnesium intake was more risk 2.471 times higher for hypertension (OR = 2.471; CI = 1.058 – 5.768).

## DISCUSSION

### Characteristics of respondents

#### Sex

Number of respondents in this study were 90 respondents consisting of 45 case groups and 45 control groups Respondents in this study amounted to 90 people. In **Table 3**. it can be seen that female respondents are more female than male respondents in the control group or non-hypertensive (80%) or case group or hypertension (77.78%). Gender is also one of the factors that affect blood pressure. Other research suggests that women tend to suffer from hypertension rather than men<sup>10</sup>.

Women will experience an increased risk of high blood pressure (hypertension) after menopause ie age over 45 years. Women who have not menopause are protected by the hormone estrogen that plays a role in increasing levels of High Density Lipoprotein (HDL). Low HDL cholesterol and high LDL cholesterol (Low Density Lipoprotein) affect the occurrence of atherosclerosis and result in high blood pressure (11).

#### Age

Age is one of the risk factors of hypertension, where the risk of hypertension at age 60 years and above 11.340 times greater when compared with age less than the same as 60 years. This study is in line with the results of studies in which for the age of 56-65 years have a 4.76 times greater risk of hypertension when compared with the age of 25-35 tahun (12).

By age, the study respondents were between the ages of 30 and 60. When seen from **Table 3**. age group of respondents most are age group above 45 years both in case group or hypertension (80%) and control (57.78%). Supportive studies that show a significant association between age and incidence of hypertension in the population aged 20-65 years (15). This happens because at that age a large artery loses its flexibility and becomes stiff therefore the blood on each heartbeat is forced to pass through a narrower blood vessel than usual and causes a rise in blood pressure (13).

#### Education

Most of the research respondents had a high school education background of 28.89% in case group or hypertension and 40% in the control group, while the smallest percentage of educational background of respondents was never school either in case group or 2.22% control of 4.44%. According to Riskesdas (2007) hypertension disease tends to be high in low education and decreases according to education improvement. This relationship is not solely due to different levels of education, but the level of education affects the healthy lifestyle by not smoking, not drinking alcohol, and more often exercise. The high risk of hypertension in low education, probably due to lack of knowledge in patients with low education on health and difficult or slow to receive information provided by the officer so that the impact on the behavior / healthy lifestyle.

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### **Work**

Respondents' occupations were mostly housewives (both) in the case group or hypertension (60%) as well as in the control group (53.33%), whereas the smallest percentage of respondent's job was either retired group of case group or hypertension (2.22 %) or control group or no hypertension (0%). This study is in line with studies that suggest that there is a significant relationship between work with hypertension (14). However, different results suggest that there is no significant association between work with hypertension. Work affects the physical activity of a person. People who do not work so much activity can increase the incidence of hypertension(15).

### **Average intake of calcium and magnesium in hypertensive and non hypertensive patients**

Low intake of calcium will greatly affect blood pressure because calcium has a role to regulate blood pressure, such as reducing the activity of the renin-angiotensin system, improving the balance of sodium and potassium, and inhibit blood vessel constriction. Increased calcium intake can lower blood pressure in people with hypertension (16).

Based on **Table 4**. Calcium intake did not show any difference between the hypertension group and not hypertension because the difference in intake was only 1 and the value of  $p < 0.829$ . The same study was conducted to prove that calcium consumption with systolic pressure showed a weak correlation strength ( $r = -0.083$ ) and a negative pattern. The result of statistical test showed no relation between calcium consumption and systolic blood pressure ( $p = 0,189$ ) (17).

While magnesium intake proves there is a relationship between magnesium intake with the incidence of hypertension because there is a significant difference between intake in hypertensive and non hypertensive group with a value of  $p=0.035$ . This suggests that a sufficient magnesium intake statistically affects the incidence of hypertension, so it can be concluded that sufficient magnesium intake may affect the decrease in the incidence of hypertension.

Magnesium intake is good enough to prevent the increase in blood pressure due to magnesium deficiency affect the increase in intracellular sodium levels and decrease intracellular potassium levels that cause hypertension (6).

### **The relationship between calcium intake with hypertension occurrence**

Calcium intake is less common in people with hypertension so it is suspected that a lack of calcium intake can cause hypertension. Adequate calcium intake can lower blood pressure because it can inhibit the effect of high salt intake of NaCl at blood pressure (6).

Based on **Table 5**. most calcium intake of respondents was in the category less in case group or hypertension (62.22%) as well as control group (64.44%). Chi Square statistical analysis results showed no significant relationship between calcium intake with incidence of hypertension ( $p=0.078$ ). the results of the analysis showed no association because in the hypertensive group or not hypertension percentage of calcium intake did not differ greatly. Calcium intake of respondents was known through interviews using a Food Frequency Questionary (FFQ) questionnaire for 1 month intake.

The results of this study support a theory that explains that a low calcium intake strengthens the effect of salt intake of NaCl on elevated blood pressure in people at risk of hypertension because calcium has a natriuretic effect. Calcium has a role to regulate blood pressure, such as decreasing activity of the renin-angiotensin system, improving the balance of sodium and potassium, and inhibiting blood vessel constriction. Calcium is also associated with the occurrence of thickening of blood vessels

to the heart. If the calcium intake is less than the body's need to maintain the balance of calcium in the blood, parathyroid hormone stimulates the removal of calcium from bone and into the blood. Calcium in the blood will bind free fatty acid so that the blood vessels become thickened and hardened so as to reduce the elasticity of the heart that will increase blood pressure<sup>18</sup>. The results of this study support the results of research where most of the respondents in the case group (97.6%) and the control group (95.2%) calcium intake less, statistically showed no significant relationship between calcium intake with hypertension (19). Other studies that support show that the relationship between adequate calcium intake with hypertension degree (20).

#### **Relationship between magnesium intake with hypertension occurrence**

Magnesium intake can lower blood pressure because it can inhibit vascular tone and arteriole smooth muscle contractility will reduce sodium levels and increase potassium levels that cause a decrease in blood pressure (6). In this study it was found that Based on **Table 6.**, it showed that less magnesium intake in hypertension group (62.22%) and enough magnesium intake in non-hypertensive patients (60%). The result of Chi Square statistic analysis showed that there was a significant correlation between magnesium intake and hypertension ( $p=0.035$ ) where the respondent with magnesium intake was more risk 2,471 times higher for hypertension ( $OR=2.471$ ;  $CI = 1.058-5.768$ ). There was a significant relationship between magnesium intake and hypertensive occurrence due to low magnesium intake found in the hypertensive group, whereas in the non-hypertensive group adequate calcium intake.

These results are in line with studies that found a significant relationship between magnesium intake with blood pressure in adolescents at Senior High School 5 Semarang. A total of (66.7%) subjects consumed enough magnesium (21). Magnesium can play an important role in regulating blood pressure. This study is in line with studies that suggest there is a relationship between magnesium

intake with blood pressure in elderly (22). Different studies suggest no association between magnesium intake with hypertension ( $p = 0.273$ ) with OR values of 1.17 (95% CI: 0.65-4.51) (20).

The effect of magnesium intake with the incidence of hypertension is due to the occurrence of contractility and reduced relaxation of blood vessels in response to neurohormonal elements such as prostaglandin and beta adrenergic amines. The effect of magnesium on blood pressure plays an important role in the prevention of cardiovascular disease<sup>23</sup>. Magnesium plays an important role in controlling blood pressure by strengthening endothelial tissue, stimulating prostaglandins and increasing glucose capture so that insulin resistance can be reduced. In addition, magnesium also plays a role in the contraction of heart muscle. When the concentration of magnesium in the blood decreases the heart muscle can not work optimally, thus affecting blood pressure 5.

#### **CONCLUSIONS**

Based on the results of research and data analysis that has been done during the research on outpatient polyclinic Panembahan Senopati Bantu Hospital can be concluded that: Respondents' characteristics were female compared to male respondents in control group or non-hypertensive group (80%) or case group or hypertension (77.78%). By age, the study respondents were between the ages of 30 and 60. When seen from **Table 3.** age group of respondents most are age group above 45 years both in case group or hypertension (80%) and control (57.78%). Most of the research respondents had a high school education background of 28.89% in case group or hypertension and 40% in the control group, while the smallest percentage of educational background of respondents was never school either in case group or 2.22% control of 4.44%. Respondents' occupations were mostly housewives (both) in the case group or hypertension (60%) as well as in the control group (53.33%), whereas the smallest percentage of respondent's job was either retired group of case group or hypertension (2.22%) or control group or no hypertension (0%).

Calcium intake did not show any difference between hypertension group and not hypertension because the difference of intake was only 1 and p-value <0.829. While magnesium intake proves there is a relationship between magnetic intake and hypertensive group with a value of  $p = 0.035$ . Low calcium intake is not a risk factor for hypertension ( $p = 0.078$ ). Low magnesium intake increased the risk of hypertension ( $p=0.035$ ) in which respondents with magnesium intake were approximately 2.471 times more likely to have hypertension (OR = 2.471; CI = 1.058 - 5.768).

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