Jurnal Keperawatan Indonesia, 2019, 22 (3), 228–236
DOI: 10.7454/jki.v22i3.726
Received August 2018; Accepted June 2019

pISSN 1410-4490; eISSN 2354-9203

THE IMPACT OF VEGETARIAN DIETS AND BODY MASS INDEX ON HYPERTENSION

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Abstract

A vegetarian diet is believed to prevent hypertension. This study aims to identify the impact of vegetarian diets, including fat, salt, potassium, and body mass index (BMI), on hypertension. Data was taken by systematic random sampling method from 173 vegetarians and analyzed using chi-square. The result showed that there is no significant association between the intake of fat, sodium, and potassium with hypertension in vegetarians (p> 0.05). However, there is a significant relationship between BMI with the incidence of hypertension (p= 0.025), where overweight res-pondents are 3.837 more likely to have hypertension (OR 3.837; 95% CI= 1,256–11,721). It implies that vegetarians tend to have a safe intake of fat, salt, and potassium, and therefore, this condition prevents hypertension. Thus, health promotion about the selection of sources of fat, regulation of salt, potassium intake, and weight management will be beneficial for vegetarians in preventing hypertension.

Keywords: BMI, diet, hypertension, vegetarian

Abstrak

Dampak Diet Vegetarian dan Indeks Massa Tubuh terhadap Hipertensi*. Diet vegetarian diyakini dapat mencegah hipertensi. Penelitian ini bertujuan untuk mengetahui dampak diet vegetarian, meliputi asupan lemak, garam, kalium, dan Indeks Massa Tubuh (IMT) terhadap hipertensi. Data diperoleh melalui metode systematic random sampling pada 173 vegetarian dan dianalisis menggunakan chi-square. Tidak ada hubungan yang signifikan antara asupan lemak, garam, dan kalium pada vegetarian dengan hipertensi (p> 0.05). Namun, terdapat hubungan yang signifikan antara IMT dengan kejadian hipertensi (p= 0.025), dimana responden dengan berat badan berlebih 3.837 kali berpeluang lebih besar untuk mengalami hipertensi (OR 3.37; 95% CI= 1.256–11.721). Hal ini menunjukkan bahwa vegetarian cenderung memiliki asupan lemak, garam, dan kalium yang aman sehingga kondisi ini dapat mencegah hipertensi. Dengan demikian, promosi kesehatan mengenai pemilihan sumber lemak, pengaturan asupan garam:kalium, dan manajemen berat badan akan sangat bermanfaat bagi vegetarian untuk mencegah hipertensi.*

Kata kunci: diet, hipertensi, IMT, vegetarian

Introduction

Hypertension or high blood pressure need to be considered and monitored by everyone because hypertension is a major independent risk factor on the incidence of non-communicable diseases, particularly cardiovascular disease (Bromfield & Muntner, 2013). Hypertension accounts for 13% of global deaths (Krishnan, Garg, & Kahandaliyanege, 2013) and in Indonesia, hypertension is the second biggest cause of death (Kemenkes RI, 2007). Currently, 40% of adults in the world, and 26.5% in Indonesia are diagnosed with hypertension (WHO, 2011; Ministry of Health Republic of Indonesia, 2013).

The quality of diet consumed daily, and BMI is contributing factors to the incidence of hypertension. For instance, high consumption of foods that are high in fat and salt increases the risk factors for hypertension. Saturated fat and cholesterol particularly increase the number of

LDL (Low-Density-Lipoprotein) in the body that can lead to atherosclerosis, so the blood vessels become hard and inhibit the release of nitric oxide that contributes to relaxing blood (Sherwood, 2012; Rolfes, Pinna, & Whitney, 2012). Salt intake can increase blood pressure through the increasing of water retention. In contrast, the low intake of potassium can interfere the contractility of the heart muscle and its role as natriuresis (Smeltzer, Bare, Hinkle, & Cheever, 2010). In general, animal products, fast food and processed foods such as beef, dairy products, and eggs, and low intake of fiber are the sources of high fat, high salt, and low potassium (Rolfes, Pinna, & Whitney, 2012). Besides, obesity status or BMI ≥ 27,0 is also a proven of risk factor for hypertension (Tee, et al., 2010). The mechanism is associated with the excess adipose tissue in the body.

A vegetarian diet is a diet which is believed to prevent the occurrence of hypertension. Vegetarianism is a plant-based diet with fruits, vegetables, and grains in a large amount (Escott, 2012). American Dietetic Association (2009) defines a vegetarian as someone who does not eat meat, poultry, or seafood, or products containing these foods. Commonly, vegetarians are divided into two groups, including vegans and non-vegans. Vegan is a diet that does not consume all forms of food or products of animal origin, while the non-vegans still consume milk and eggs (lacto-ovo vegetarian), milk and dairy products (lacto vegetarian), and even fish (pesco vegetarian) (Turner, Sinclair, & Knez, 2014).

The vegetarian diet is associated with a lower risk of experiencing health problems, including hypertension (American Dietetic Association, 2009; Sinclair, & Knez, 2014). The condition is due to the intake of fiber-rich and minimal animal foods. Researches showed that the salt levels, total cholesterol, and LDL cholesterol are lower in vegetarians than non-vegetarians (Tripathi, Mishra, Mishra, & Tripathi, 2010; McEvoy, Temple, & Woodside, 2012; Shridar, et al., 2014). The intake of plant-based also makes vegetarians tend to have higher potassium levels and lower BMI than non-vegetarians (*American Dietetic Association*, 2009). Despite this evidence, there is very little research exploring hypertension in vegetarians in Indonesia. Further, as there is an increased uptake of vegetarianism in Indonesia, it is necessary to explore what, if any, impact this has on hypertension risk.

This study aims to identify whether the intakes of fat, salt, and potassium consumed by vegetarians can protect them from hypertension. Further, participants' BMI will also be measured to explore whether it is associated with an increased risk of hypertension and compared with the general population. The results will contribute towards clinical practices of nurses, especially community nurses, to conduct health promotion to vegetarian groups and to identify innovative methods about hypertension management for the general public.

Methods

This cross-sectional study took place in a Buddhist center named Pusdiklat Maitreyawira in West Jakarta, based on the recommendation of the Indonesia Vegetarian Society (IVS). This center was chosen based on the IVS database, which indicated that most of the vegetarians in Jakarta were Buddhist and members of that center. The center has a total of 320 members. The samples size was calculated using Isaac and Michael formulas (Sukardi, 2004) with the confidence level of 95%, the precision of 0.5, the proportion of the incident as the basis for the assumption of 0.28 obtained from the previous study (Herna & Fikawati, 2014). Based on this calculation, 173 respondents were recruited in this study.

Visitors who attended the Buddhist center were approached by a researcher and were provided with information about the study. Verbal and written consent was obtained by the visitor if they were eligible and interested to participate. Recruitment used systematic random sampling with interval 1. Interval is the distance between

one respondent to the next respondent. Once an eligible visitor agreed to be involved in the study, interval 1 was implemented to select the next respondent. If a visitor refused to participate, the next visitor that walked in was invited, and if this visitor agreed to participate, then interval 1 was re-applied.

Visitors were eligible to participate if they came through the main door of the center, were invited to be a respondent, were aged 18–65 years old, vegetarian (either vegan or non-vegan), and did not consume alcohol.

Respondents' blood pressure was collected using aneroid sphygmomanometer and stethoscope with auscultation methods and procedures established according to the Joint National Committee 7 (JNC 7). The respondents who met the established criteria of JNC-7 were classified as hypertensive (systolic pressure ≥ 140 mmHg or diastolic pressure ≥ 90 mmHg). Those who did not fulfill the criteria considered were respondents who have optimum blood pressure. The researcher (TM) and five assistants who were third-year-nursing students that had passed the module for blood pressure measurement were involved in measuring respondents blood pressure. Before the study was conducted, these students were tested twice to measure the blood pressure of a subject, and they showed the same result of measurements with the researcher.

Respondents' BMI was calculated using the standard formula, $kg/m^{2,}$ where kg is a person's weight in kilograms, and m^2 is their height in meters squared. The respondent's weight was measured by a manual scale with a precision level was 0.1 kg, and the respondent's height was measured by microtoise stature meter with a precision level was 0.1 cm. Data of BMI was also collected by the researcher and the assistants. Then, the BMI was classified based on the standard of the Indonesian Ministry of Health (2013). Respondents with BMI ≥ 25.0 were categorized as overweight and < 25.0 were categorized as not overweight.

The questionnaire used in this study consisted of two sections. Section A sought information on demographics including age, sex, type of vegetarian diet, and family history of hypertension. The respondents wrote their age and gave a checklist in their answer for sex and family history. The researcher filled the type of vegetarian diet by asking the respondents their food consumption and restriction. The respondents were categorized into vegan if they did not consume all forms of food or products of animal origin, lacto vegetarian if they did not consume any animal's food except milk and dairy products, lacto-ovo vegetarian if they still consume milk and egg, and pesco vegetarian if they still consume fish as the only animal they eat. The type of vegetarian was identified at the beginning when choosing the respondent.

Section B was the Food Frequency Questionnaire (FFQ) that sought information on the intakes of fat, salt, potassium. It was adopted from the previous study by Stefhany (2012) and had been tested for validity and reliability. The test was conducted in Vihara Ekayana, a Buddhist monastery, with 30 respondents. The test showed that this questionnaire has good reliability with value 0,793. The researcher simplified the questionnaire by choosing 22 out of 36 food items that had high validity (>5% or >0.361). Foods that represent high fat were ice cream, coconut milk, and fried food. Foods that represent high salt or sodium were white bread, instant noodle, skim milk, salted fish, and instant sauce. Foods that represent high potassium were spinach, cabbage, papaya leaf, string bean, avocado, orange, grape, and papaya. Furthermore, there were five foods that were categorized both high fat and high sodium, including biscuit, canned fish, cheese, egg, milk, and butter. The respondents were asked to provide a checklist on the frequency of their consumption of these foods in the last three months. Then, the frequency was transformed into a score that was also adopted from the same source as the questionnaire (3 times/day: 8, 2–3 times/day: 7, 1 times/day: 6, 4–6 times/week: 5,

2–3 times/week: 4, 1 times/week: 3, 2–3 times/ month: 2, 1 times/month: 1, never: 0) (Stefhany, 2012). The score was then summed up for each food category. Normality test was conducted to determine the cut off points to categorize the consumption level of fat, salt, and potassium. Based on the normality test, participants were categorized as consuming salt, fat, and potassium often if they scored ≥ median (13, 14, and 18 respectively) and not often if <median.

Univariate modelling was used to summarise the data of percentage. Chi-square bivariate test was used to determine the relationship of vegetarian diets and BMI to hypertension.

Results

A total of 173 respondents were involved in the study. Majority of the respondents were of early adulthood at 18–35 years (61.7%), female (58.4%), lacto-ovo vegan (61.3%), had no family history of hypertension (53.8%) and did not have hypertension (91.9%). More than half of respondents had regular intakes of fat (52%), salt (50.9%), and potassium (55.5%). Most of the respondents were not overweight (71.7%).

The statistical analysis showed that the consumption of salt, fat, and potassium was not significantly associated with hypertension ($p > 0.05$). The proportion of hypertension is higher in respondents with the consumption of fat, salt, and potassium that was 'often'. There was a significant relationship between BMI with hypertension in vegetarian ($p = 0.025$). The analysis showed that overweight respondents were 3.837 times more likely to have hypertension than non-overweight respondents (OR 3.837; 95% CI= 1.256-11.721).

Discussions

This study investigated the correlation between a vegetarian diet with hypertension. The finding of this study showed that the proportion of hypertension in the respondents who are vegetarians was low. Further, there was no statistical significance between the intake of fat, salt, and potassium among the vegetarians with hypertension. Although, there was a strong correlation between vegetarians' BMI to hypertension.

The results of this study showed no association between fat intake and hypertension; which is in line with previous studies by Natalia (2008) and Herna and Fikawati (2014). Both studies in vegetarian also found that there is no link between fat con-sumption with hypertension. The result might emerge because of the type of fatty foods con-sumed by vegetarians, which are still contro-versial on its influence on hypertension. Non-vegan respondents eat fat found in fish and animal products, especially milk, eggs, and dairy. The correlation between the fat in these foods with hypertension is still inconsistent (Ralston, Lee, Palermo, & Walker, 2012). The fat contained in fish is omega-3 polyunsatu-rated, which has the effect of lowering blood pressure (Nguyen, Adelola, Rangaswami, & Amanullah, 2013). The result of a systematic review by Ralston, Lee, Palermo, and Walker (2012) showed that the sources of fat such as milk provides different effects on blood pres-sure, depending on the processing method. The study found that there was a relationship bet-ween the consumption of liquid dairy products (milk and yogurt) with a reduced risk of hy-pertension by 8%, but no relationship was found between the cheeses with a decrease in blood pressure. The different effect caused by diffe-rences in the levels of calcium, sodium, and saturated fat. The result indicates that the type of fat and types of processed dairy products have different effects on blood pressure.

The results of this study showed that there was no association between salt consumption habits with hypertension, which in line with a study by Lelong, et al (2014) and Natalia (2008). There are several possibilities of why salt consumption and hypertension is not associated. First, the quantity of salt intake per day of the

Table 1. Vegetarians' Demographic Characteristics, Hypertension Status, and Diet Intakes

Variable	N	%
Age Group		
Early adult (18-35)	107	61.8
Mid adult (36-65)	66	38.2
Sex		
Male	72	41.6
Female	101	58.4
Hypertension		
Yes	14	8.1
No	159	91.9
Family History of Hypertension		
Yes	80	46.2
No	93	53.8
Vegetarian Types		
Vegan	63	36.4
Non-vegan	110	63.6
Pesco	2	1.2
Lacto	2	1.2
Lacto-ovo	106	61.3
Fat Intake		
Often	90	52
Not often	83	48
Salt Intake		
Often	88	50.9
Not often	85	49.1
Potassium Intake		
Often	96	55.5
Not often	77	44.5
Caffeine Intake		
High	12	6.9
Low	161	93.1
1 cup	36	20.8
0 cup	125	72.3

respondents is unknown. Researchers classify salt consumption into often and not often category, which based on the median value of respondents' salt intake for the last three months. The value means that someone who consumes a low amount of salt daily can go into the category of consumption of salt often if the majority of respondents have a frequency of salt consumption habits in common with that person. According to WHO, the salt intake fewer than 5 grams per day is safe for consumption and prevent hypertension (WHO, 2013).

The second reason is that the relationship between the two is more complex than the original thought (Lelong, et al, 2014). The concept of salt sensitivity versus salt resistance become known as a result of the studies that demonstrate the value of blood pressure is varied among respondents in response to the consumption of salt (Nguyen, et al, 2013). However, the difficulty in determining whether someone has salt sensitivity or resistance causes the relationship between salt and blood pressure becomes difficult to identify.

Table 2. The Correlation Between Vegetarian Intake/ BMI and Hypertension

Variables	Hypertension		p
	Yes (%)	No (%)	
Fat Intake			
Often	8.9	91.1	0.904
Not Often	7.2	92.8	
Salt Intake			
Often	9.1	90.9	0.833
Not Often	7.1	92.9	
Potassium Intake			
Not Often	6.5	93.5	0.682
Often	9.4	90.6	
BMI			
Overweight	16.3	83.7	0.025*
Not Overweigh	4.8	95.2	

*Significance at α= 0.05

The finding of no relationship between consumption of potassium with hypertension in this study is consistent with research by Natalia (2008) on adult vegetarians with p-value 0.904, Herna and Fikawati (2014) in elderly vegetarians with p-value 0.945 and McLean (2015) in adults non-vegetarian in New Zealand with p-value 0.768. The absence of a relationship between potassium with hypertension can be caused by the influence of the salt consumed by the respondent. Lelong, et al. (2014) found that the relationship between potassium intake with the incidence of hypertension was found only in women while the ratio of salt: potassium with hypertension found a stronger relationship and relationships found in both sexes (p = 0.00001). The result shows that the consumption of potassium and salt are related to maintaining the blood pressure. The result is also supported by McLean, et al (2015) that found no association between consumption of potassium with blood pressure. Furthermore, after further analysis, it was found that the ratio of salt: potassium consumption in respondents is more than 1, which means that salt consumption in these respondents is also high.

The relationship between potassium and salt may explain the proportion of hypertension that was found to be greater in respondents with potassium consumption habits in often category of this study. Results of cross-tabulation show that 60.4% of respondents with often potassium consumption also have often consumption of salt, while respondents with potassium consumption not often only consume salt by 39%. This shows that although the respondents have a high level of potassium consumption, the level of salt consumption in these respondents is also high. It makes a higher proportion of hypertension found greater in respondents with often potassium consumption habit.

The strong correlation between BMI and hypertension was found in this study. This result is in line with the previous research by Natalia (2008) in vegetarian and research by Mungreiphy, Kapoor, and Sinha (2011) in non-vegetarian.

The relationship between overweight and the incidence of hypertension can be explained by several mechanisms. First, excessive adipose tissue in the fat body activates the leptin hormone. The leptin hormone sends a signal to the hypothalamus to increase blood pressure through activation of the sympathetic nervous system (Porth & Matfin, 2009). Second, adipocytes or

high-fat storage cells in the body of overweight people produce large amounts of cytokines (Seven, 2015). Cytokines are all chemicals other than antibodies produced by T cells during inflammation (Sherwood, 2012). The study by Ryan (2013) shows that the increase in the number of circulating cytokines is related to the incidence of hypertension. This is associated with inflammation due to atherosclerosis, which is at risk for people who are overweight. Third, large body size in overweight people causes an increase in the heart rate to be able to push blood to all parts of the body, which in turn can trigger an increase in the blood pressure (Aziz & Aziz, 2015).

Overweight status in vegetarian can be affected by the type of vegetarian diet. Le and Sabate's study (2014) showed that vegans' BMI was five points lower than non-vegetarians, while lacto-ovo vegetarians' BMI, who still consumed eggs, was three points lower than non-vegetarians. The research by Kaushik, Aggarwal, Singh, Deswal, and Kaushik (2015) found that the average vegans' BMI was 23.06 kg/m^2, while the non-vegan average BMI ranged from 25.7 kg/m^2–27.3 kg/m^2, according to the type of vegetarian diet. These studies support the findings in this paper in which the proportion of overweight was greater in non-vegan (61.2%) than in vegan (32,8%). The greater proportion of overweight in non-vegans can be caused by the intake of fish or animal products that are still consumed by non-vegans.

Conclusion

The result of no significant relationship between the intakes of fat, salt, and potassium with hypertension in vegetarian can be caused by the effects of fat source of vegetarian blood pressure vary and the inter-related correlation of salt and potassium intakes. However, there is a significant relationship between BMI and hypertension in vegetarian, indicating BMI ≥27,0 or overweight status can increase the risk for hypertension in vegetarian as many as 3,837 times. Thus, health promotion by nurses about the selection of sources of fat, regulation of salt, potassium intake, and weight management will be beneficial for vegetarians in preventing hypertension. The use of the Food Frequency Questionnaire in this research may limit the intake measurement of fat, salt, and potassium. The use of more detail and standard tools in measuring the intakes in further research is suggested (ST, DW, PN).

Acknowledgment

The authors would like to express their gratitude to the Community Nursing Departement of Faculty of Nursing Universitas Indonesia and to the board of Vihara Ekaya and Pusdiklat Maitreyawira who provided support during the data collection.

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