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## Relationship between intake of fruits and vegetables toward hypertension among elderly in Yogyakarta



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### ABSTRACT

**Introduction:** Hypertension resembles a medical condition affecting mostly patients over 60 years. Hypertension might be influenced by antioxidant activity and anti-inflammatory components contained in fruits and vegetables. Based on 2013 data, the prevalence of hypertension in the elderly in Indonesia was 25.8%. This study aimed to analyze the relationship between fruit and vegetable intake among geriatric hypertensive patients in the city of Yogyakarta.

**Methods:** Analytical observational study was designed with Cross-sectional type. The subjects of recent study were 138 elderly in integrated service post located in the area of Umbulharjo 1 and Umbulharjo 2 community health center in Yogyakarta City and selected by a multi-stage sampling technique. The consumption of

fruits and vegetables measured by Semi-Quantitative food frequency questionnaire (FFQ) and 24-hour recall, meanwhile blood pressure examination used mercury sphygmomanometer.

**Results:** Chi-Square test results showed a relationship between fruits consumed by elderly people and the prevalence of hypertension ( $p = 0.003$ ) and vegetable intake in elderly significantly associated with the prevalence of hypertension ( $p = 0.032$ ). The multivariate test results showed there were significant relationship regarding fruit intake with the prevalence of hypertension in elderly (OR = 1.82;  $p = 0.01$ ).

**Conclusion:** Intake of fruits and vegetables may reduce the risk of hypertension.

**Keywords:** Antioxidant, anti-inflammatory, blood pressure, geriatric, intake

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### INTRODUCTION

Blood pressure is blood velocity flow against the arterial wall, it starts from the heart and pumps blood through the arteries. Hypertension is a condition of high blood pressure that may lead to other complicating diseases, such as heart disease. Blood pressure is correlated linearly with the increase of age.<sup>1</sup> Generally, hypertension occurs in people over 40 years old. Thus, its manifestation mostly asymptomatic and at an early stage do not cause a serious health implication.<sup>1</sup> Globally, it is estimated 7.5 million deaths are caused by high blood pressure. In 1980, the number of people with hypertension was predicted  $\pm$  600 million and it was increased to almost 1 billion in 2008.<sup>2</sup> In Indonesia, based on health research in 2007 it was found that the prevalence of hypertension in Indonesia was very high with the average of 3.17% of the total adult population. As a comparison to total population, out of 3 adults, 1 person will be suffered from hypertension.<sup>3</sup> The prevalence of hypertension in Indonesia in 2013 was 25.8%, meanwhile in Yogyakarta the prevalence of hypertension reaches 25.7%.<sup>4</sup>

A research conducted in Northern Ethiopia showed fruit consumption was statistically related to hypertension. Respondents who did not consume any fruits were at higher risk of becoming hypertensive than those who consumed fruits.<sup>5</sup> This phenomenon might be partially explained because fruits intake reduces the risk of hypertension.<sup>6</sup>

Fruits become one of the agricultural commodities that contribute significantly to food diversity and the adequacy of community nutrition in terms of vitamins, minerals and fiber. Fruit contains two to eight times grain fiber.<sup>7</sup> The human body needs fruits as the source of minerals, fiber and vitamins for achieving a healthy diet as recommended in balanced nutrition allowance daily.<sup>4</sup> Some vitamins and minerals contained in the fruits also play a role as antioxidant to prevent the incidence of non-communicable diseases related to nutrition, as a consequence of nutrition imbalance.<sup>8</sup>

In conjunction to fruits, vegetables also play an important role in decreasing the incidence of hypertension. Vegetables are food ingredients derived from plants. There were varied edible parts of plants, such as the leaves, stems, flowers

and unripe, hence, it is concluded all parts of the plants can be utilized as vegetables.<sup>9</sup> The survey results from Central Bureau of Statistics Republic of Indonesia (2016), vegetables that are widely consumed by the community were spinach, kale, mustard greens, beans, and long beans.<sup>10</sup> Research conducted by Medina-Remon et al. (2013) stated an increase in daily vegetable intake is associated with a decrease in blood pressure.<sup>11</sup> Based on these rational, recent study aimed to elucidate the relationship of intake of fruits and vegetables with blood pressure in elderly.

## MATERIAL AND METHODS

This study was an observational analytic study with a cross sectional design. Samples were selected by matching the eligibility criteria, such as the elderly aged 60-79 years at the integrated service post located in the area of Umbulharjo 1 and Umbulharjo 2 community health center in Yogyakarta City. Sampling was done by multi stage sampling method. The first step was purposive sampling in 18 health centers in Yogyakarta, hence, 2 health centers obtained based on consideration of the prevalence of elderly who were active in integrated service post. In the second step, purposive sampling repeated to obtain 13 active integrated service post, particularly 3 integrated service post located at the area of Umbulharjo 1 community health center and 10 integrated service post located at the area of the Umbulharjo 2 community health center. The third step in sampling conducted for the selection of elderly for every integrated service post by simple random sampling.

Inclusion criteria for sampling were: elderly men and women aged >60 - 79 years, elderly with healthy oral cavity, elderly capable to communicate and hear well, elderly who live with their relatives, elderly who not obese. Exclusion Criteria for recent study were elderly people who have dementia, elderly with health problems, such as weakness or bed ridden. Primary data taken in recent study were vegetables intakes, fruits intake and blood pressure. This study used instrument consisting of the characteristics of the elderly, fruits intake and vegetables intake obtained through interviews with the elderly. Interviews were conducted using questionnaire as a guidance. Intake of fruits and vegetables were measured using Semi Qualitative FFQ, in the other hand, blood pressure was measured by mercury sphygmomanometer (Erka®). Measurement of nutritional status was done based on the assessment of Body Mass Index (BMI). Classification of nutritional status based on BMI reference according to Asia Pacific criteria as follow: <18.5 is underweight, 18.5-22.9 optimal nutritional

status, 23-24.9 overweight, 25-29.9 obesity grade I, and  $\geq 30$  obesity grade II. Data collection was conducted in August 2018 on each integrated service post.

In recent study, univariate analysis was proceed to describe variable vegetables intake and fruits intake. The data were grouped and tabulated into the frequency distribution table and then interpreted. Bivariate analysis was conducted to determine the relationship between fruits intake and blood pressure, and the relationship between vegetable intakes and blood pressure. The statistical test used was Chi Square test with a degree of error  $\alpha = 0.05$ . Multivariate analysis were followed by logistic regression analysis to evaluate the relationship of one or several independent variables with a dichotomous/binary dependent variable. An important and often used measurement parameter in regression analysis was Odd Ratio (OR) to elucidate the degree of association and the coefficient of determination were symbolized by R<sup>2</sup> (R Square).

## RESULTS

There were 138 elderly sample who participated in recent study. Sample distribution from Umbulharjo 1 community health center were 44 person (32%) and Umbulharjo 2 community health center were 94 person (68%). All participants were recorded as actively conducting medical examination and monitoring nutritional status in the city of Yogyakarta. Subject characteristics were dominated by women, accounting for 105 person (76.1%) compared to men with 33 person (23.9%) (Table 1).

The variation of vegetables intake was relatively similar in type, but has a difference in terms of the number and frequency. Based on level of vegetables consumption, it was found 77 person (55.8%) have fulfilled the vegetables intake, and the rest of them did not meet the parameter of vegetables intake. The un-fulfilled group divided into 28 person (20.3%) as twice/day, 24 person (17.4%) as 3-6 times/week, and 9 person (6.5%) as 1-2 times/week. In term of fruits intake, 41.3% of the elderly have fulfilled parameter, while the rest (58.7%) have not met the recommendation of fruits intake. The results of measurements of nutritional status revealed 87 respondents (63%) were optimal nutritional status, 34 respondents (24.6%) were underweight and 17 respondents (12.3%) were overweight. In blood pressure characteristics, most of the elderly had hypertension (63%).

There was a relationship between fruits consumed by the elderly and the prevalence of hypertension ( $p = 0.003$ ), while vegetables intake in elderly was significantly associated with the prevalence of

hypertension ( $p = 0.032$ ) (Table 2). However, there was no correlation between the nutritional status and the prevalence of hypertension in elderly ( $p = 0.151$ ).

In multivariate test for the prevalence of hypertension, the independent variables could be included in the multivariate analysis were fruits

intake and vegetables intake. As shown in Table 3, when analyzed based on hypertension in elderly, the results of multiple logistic regression between fruits intake and vegetable intake had denoted OR = 1.82 and 2.90, respectively. By this means, fruits intake associated with hypertension with almost 2 times compared to elderly people who did not consume fruits, whereas in vegetable intake it did not have significant results. This shows that fruit intake is the most dominant factor in the prevalence of hypertension.

## DISCUSSIONS

Lifestyle encouragement by integrated service post to recommend fruits and vegetables on daily menu affects community dietary practice. In our study, there was a relationship between fruits consumed by the elderly and the prevalence of hypertension ( $p = 0.003$ ,  $p < 0.05$ ). Elderly who did not consume enough fruits were 79.2% having hypertension. Many studies have suggested that fruits intake may provide cardio-protective effects and contribute to reductive effect on arterial stiffness.<sup>8</sup>

In hypertension cases, the mechanism of fruits intake in improving blood pressure control in elderly is not only found as in the intake of fruits consumed, but it is presumed as complex constellation interactions of the fruits and geriatric bodily functions. Varied fruits have been shown to improve arterial stiffness through increased NO bioavailability, decreased cIMT and increased endothelial function.<sup>8</sup>

In elderly, fruits have varied benefits for the body, as a cardio-protective agent as well as substance to improve digestive functions.<sup>8</sup> Elderly who take adequate fruits may reduce the high fat content in sedentary food, thus, help to increase the effects of fruit consumption. This mechanism implicated in decreasing arterial stiffness due to lipids excess, increasing endothelial function and decreasing inflammatory process.<sup>8</sup>

The recent study showed vegetables intake in elderly was significantly correlated with the prevalence of hypertension ( $p = 0.032$ ,  $p < 0.05$ ). There were 73.8% elderly who lack of vegetable intake experienced hypertension. Elderly with low vegetables intake tend to experience cardiovascular disease. A number of epidemiological studies have also indicated that vegetables are inversely proportional to cardiovascular events. Furthermore, many types of vegetables have cardio-protective and bioactive effects, such as tomatoes, potatoes, onions, cereals, and some other vegetables.<sup>12-14</sup>

The components in vegetables have been shown to provide health benefits in preventing and managing cardiovascular diseases, such as

**Table 1. Characteristics of subjects**

| Characteristics                       | N   | %    |
|---------------------------------------|-----|------|
| <b>Gender</b>                         |     |      |
| a. Male                               | 33  | 23.9 |
| b. Female                             | 105 | 76.1 |
| <b>Frequency of fruits intake</b>     |     |      |
| a. > 1 time/day                       | 57  | 41.3 |
| b. 1 time/day                         | 32  | 23.2 |
| c. 3-6 times/week                     | 34  | 24.6 |
| d. 1-2 times/week                     | 15  | 10.9 |
| <b>Frequency of vegetables intake</b> |     |      |
| a. > 2 times/day                      | 77  | 55.8 |
| b. 2 times/day                        | 28  | 20.3 |
| c. 3-6 times/week                     | 24  | 17.4 |
| d. 1-2 times/week                     | 9   | 6.5  |
| <b>Blood pressure</b>                 |     |      |
| a. Normal                             | 51  | 37   |
| b. Hypertension                       | 87  | 63   |
| <b>Nutritional status</b>             |     |      |
| a. Optimal                            | 87  | 63.0 |
| b. Underweight                        | 34  | 24.6 |
| c. Overweight/Obese                   | 17  | 12.3 |

Source: Primary data (2018)

**Table 2. Relationship between intake, nutritional status, and hypertension**

|                           | Blood Pressure |      |              |      | P            |
|---------------------------|----------------|------|--------------|------|--------------|
|                           | Normal         |      | Hypertension |      |              |
|                           | N              | %    | N            | %    |              |
| <b>Fruits intake</b>      |                |      |              |      |              |
| ≥2x/day                   | 40             | 47.1 | 45           | 52.9 | <b>0.003</b> |
| <2x/day                   | 11             | 20.8 | 42           | 79.2 |              |
| <b>Vegetables intake</b>  |                |      |              |      |              |
| ≥3x/day                   | 35             | 45.5 | 42           | 54.5 | <b>0.032</b> |
| <3x/day                   | 16             | 26.2 | 45           | 73.8 |              |
| <b>Nutritional status</b> |                |      |              |      |              |
| Optimal                   | 35             | 40.2 | 52           | 59.8 | <b>0.151</b> |
| Overweight/Obese          | 8              | 23.5 | 26           | 76.5 |              |
| Underweight               | 8              | 47.1 | 9            | 52.9 |              |

**Table 3. Logistic regression analysis of vegetables intake and fruits intake toward blood pressure in the elderly.**

| Variables         | OR   | 95% CI |       | p value      |
|-------------------|------|--------|-------|--------------|
|                   |      | Lower  | Upper |              |
| Fruits intake     | 1.82 | 1.289  | 6.557 | <b>0.010</b> |
| Vegetables intake | 2.90 | 0.850  | 3.905 | <b>0.123</b> |

plant-based protein, dietary fibers, vitamins, essential elements and phytochemicals.<sup>12</sup> Several cross-sectional studies regarding the relationship between vegetable intake and cardiovascular risk also in conjunction to recent study.<sup>11,15</sup> It was found that total cholesterol (TC), high density lipoprotein cholesterol (HDL-C), and hemoglobin A1c increased significantly in women who consumed more than 10 servings/week of tomato-based food products compared to those who consumed less from 1.5 servings/week.<sup>15</sup>

In other study involving 4774 respondents in Iran, it was found there were a significant correlation between potato intake and diabetes. High fasting blood sugar levels and low serum HDL levels were observed (odds ratio (OR): 1.38, 95% CI: 1.14–1.67,  $p < 0.001$ ). These results indicate the potential effects of potato consumption on cardiovascular disease as a complex correlation to diabetes. High fasting blood glucose, low serum HDL, and diabetes are recognized as cardiovascular risk factors in elderly.<sup>16</sup>

Our study in term of vegetable intake variables toward hypertension parameter were also in line with cross-sectional studies in 3995 subjects at risk of cardiovascular disease with the Mediterranean diet.<sup>11</sup> Based on previous study, intake of gazpacho (Mediterranean vegetable-based cold soup rich in phytochemicals) was negatively correlated with hypertension. It was found that the participants' systolic and diastolic blood pressure decreased with the average amount of gazpacho consumption from 19-20 g/day. In addition, the prevalence of hypertension decreased after intake of gazpacho 250 g/week.<sup>11</sup>

The result of recent study in multivariate test found fruit intake is the most dominant factor correlated with hypertension. The differences observed in two different parameters in terms of fruits and vegetables might be caused by different nutrient compositions, different residual patterns, different processing methods, or the addition of sodium to vegetables while fruit might not be added.

Nutrients such as vitamins and some phenolic compounds have a tendency to be lost due to cooking methods (frying, steaming, boiling and baking) in Yogyakarta. Salted sauces used in processing vegetables may deplete the beneficial effects of vegetables, particularly sodium intake may increase blood pressure.<sup>17,18</sup>

There were controversies regarding consistency of fruits and vegetables intake and its correlation in hypertension. Some researches stated fruits and vegetable intake have a relatively minimal effects on health due to some biases in observational studies,

such as socioeconomic factors.<sup>19</sup> Different research results might also be found as fruit and vegetable substances may correlate with other food nutrients that presumed to protect against cardiovascular diseases, particularly consumption of red meat and its correlation with other lifestyle factors (smoking habits and physical activities).<sup>20,21</sup> Greater understanding of the mechanism of fruits and vegetables intake in influencing cardiovascular risk may further help elucidate the role of these dietary intake in cardiovascular systems.

## CONCLUSION

There was a relationship between fruits consumed by the elderly and the prevalence of hypertension ( $p = 0.003$ ), while vegetables intake in elderly was significantly correlated with the prevalence of hypertension ( $p = 0.032$ ). Elderly who did not consume enough fruits were 79.2% having hypertension, meanwhile 73.8% elderly who lack of vegetable intake experienced hypertension. In relation to the intake of fruits and vegetables, fruit intake is the most dominant factor correlated with hypertension.

## CONFLICT OF INTEREST

The author states that there is no conflict of interest

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## AUTHOR CONTRIBUTIONS

AR, conceptualizes and designs studies, prepares drafts, collects and studies data, and prepare manuscripts; DH leads data collection, helps analyze and interpret data and review manuscripts; S leads data collection, helps analyze and interpret data and review manuscripts.

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