Journal of Nutrition and Health Development
Vol.1, No.1, 2025, pg.21-34, DOI:
E-ISSN:
Newspaper homepage: https://www.journalmpci.com/index.php/jnhd

The Relationship of Diet and Physical Activity to the Prevalence of Hypertension in the Elderly: A *Cross Sectional Study* at the Klampis Ngasem Health Center, Surabaya City

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ARTICLES

Submitted: 19 August 2025

Accepted: 25 August 2025

Keywords:
Hypertension, Elderly, Diet, Physical Activity, Cross Sectional

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ABSTRACT

Hypertension is one of the main health problems that often occur in the elderly, with a growing prevalence both globally and nationally. Modifiable factors such as diet and physical activity play an important role in the incidence of hypertension. This study aims to analyze the relationship between diet and physical activity to the incidence of hypertension in the elderly at the Klampis Ngasem Health Center, Surabaya City. This study uses an analytical observational design with a cross-sectional approach. The research sample totaled 65 elderly people, determined by the Slovin formula and taken by simple random sampling. Data was collected through questionnaires and interviews, and analyzed using the Chi Square test. Most of the elderly were aged 60–69 years (69.2%), female (73.8%), and had no family history of hypertension (89.2%). Based on diet, most of the respondents were classified as adequate food (80%), good eating frequency (67.7%), but still dominated by poor diet (57%). According to the classification of hypertension, the majority of respondents with a poor diet were in the pre-hypertension category (38.8%). Statistical tests showed a significant relationship between diet and hypertension (p = 0.021), as well as between physical activity and hypertension (p = 0.001). The conclusion of this study is that diet and physical activity are significantly related to the incidence of hypertension in the elderly. It is recommended to improve diet and increase physical activity to reduce the risk of hypertension.

Key Messages:

- Most elderly hypertensive people are 60–69 years old, female, and have no history of hypertension.
- Most elderly people with hypertension have a poor diet and light physical activity.
- There is a significant relationship between diet and physical activity with the prevalence of hypertension in the elderly.
- These findings emphasize the importance of healthy lifestyle interventions in the form of a balanced diet and regular physical activity to reduce the risk of hypertension in the elderly.
- The results of the study can be the basis for hypertension prevention programs in primary health services.

https://doi.org/10.56303/jnhd.v1i1

INTRODUCTION

Hypertension is one of the non-communicable diseases (NCDs) that is the largest public health problem in the world (1). This condition is characterized by an increase in systolic blood pressure ≥140 mmHg and diastolic blood pressure ≥90 mmHg which occurs on a regular basis, so that it can trigger serious complications such as stroke, heart failure, chronic kidney disease, and even death. According to the *World Health Organization* (WHO), hypertension causes about 7.5 million deaths annually worldwide and is a major risk factor for cardiovascular disease (2). The prevalence of hypertension continues to increase as the global population ages, especially in developing countries.

WHO projections show that by 2025, around 29.2% of the world's population will suffer from hypertension, with 639 million of them coming from developing countries including Indonesia (2). *Riskesdas* data in 2018 shows that the national prevalence of hypertension is 34.1% (3). Meanwhile, the *2023 Indonesian Health Survey* (SKI) reported that East Java is the province with the third highest prevalence of hypertension in Indonesia (4). The city of Surabaya itself is one of the areas with a fairly high number of hypertension cases, especially in the elderly group (elderly) who are the most vulnerable population.

Hypertension has many risk factors that can be grouped into non-modifiable factors and modifiable factors. Non-modifiable factors include age, gender, and family history, while modifiable factors include diet, physical activity, obesity, stress, and smoking habits (5,6). The elderly group is at greater risk because the aging process causes physiological changes such as stiffness of blood vessels, decreased arterial elasticity, and changes in kidney function, which directly affect blood pressure regulation (7,8). Therefore, lifestyle modification through a healthy diet and physical activity is an important step in the prevention and control of hypertension (9,10,11).

An unbalanced diet, particularly high consumption of sodium, saturated fat, and low fiber, has been shown to be closely associated with the incidence of hypertension (6). High salt intake increases plasma volume and peripheral blood vessel resistance, thus triggering an increase in blood pressure (11). Excessive saturated fat can cause atherosclerosis, reduce the elasticity of blood vessels, and inhibit blood flow (12). Meanwhile, low consumption of fruits and vegetables results in a lack of potassium, magnesium, and fiber intake, which actually play a role in maintaining blood pressure balance (6,11).

In addition to diet, physical activity has a significant influence on blood pressure. Regular physical activity can lower blood pressure by increasing the elasticity of blood vessels, strengthening the heart muscle, reducing peripheral vascular resistance, and improving insulin sensitivity (7). Physical activity also helps control weight, which is an important factor in the prevention of hypertension (13). Conversely, a sedentary or sedentary lifestyle can worsen the functioning of the cardiovascular system and accelerate the onset of hypertension (8,14). Unfortunately, many seniors have low levels of physical activity due to limited mobility, joint pain, or lack of motivation to exercise (7,8).

Previous studies have revealed that lifestyle interventions can significantly lower blood pressure in the elderly (10,15). However, most of the research was conducted at the national or provincial level, while local data specific to the work area of the Klampis Ngasem Health Center was still limited. In addition, research at the primary health service level, especially in health centers, is still limited and rarely examines the relationship between diet and physical activity at the same time. Therefore, a more in-depth study is needed to determine the relationship between diet and physical activity and the incidence of hypertension in the elderly in the region. This study presents a different approach, namely using a cross-sectional design with the Chi-Square test to analyze the relationship between diet and physical activity and the incidence of hypertension in the elderly. Although there is quite a lot of research related to hypertension, it is still rare to specifically examine the lifestyle factors of the elderly at the primary service level such as health centers with this approach.

This research is expected to provide benefits in two aspects. First, practically, the research results can be used by health workers at the Klampis Ngasem Health Center to design more effective health promotion programs, such as balanced nutrition education, preparation of low-salt menus, and the formation of elderly gymnastics groups. Second, academically, this research can be a scientific

https://doi.org/10.56303/jnhd.v1i1

reference that strengthens the evidence of the relationship between diet and physical activity to hypertension in the elderly, so that it can be a foundation for further research and public health policy (14,15).

Based on the description above, this study aims to analyze the relationship between diet and physical activity to the incidence of hypertension in the elderly at the Klampis Ngasem Health Center, Surabaya City, so that it is expected to be able to make a real contribution to efforts to prevent and control hypertension in the elderly group.

METHODS

This study used an analytical observational design with a *cross-sectional approach* to analyze the relationship between diet and physical activity and the incidence of hypertension in the elderly in the working area of the Klampis Ngasem Health Center, Surabaya City. This research was conducted over a period of two months, starting from February 17, 2025 to April 17, 2025. The study population is all elderly aged 60 years and older who are registered at the Klampis Ngasem Health Center, with inclusion criteria namely being willing to be respondents, able to communicate well, and present at the time of data collection. Older adults with severe cognitive impairment or acute medical conditions that hinder interviews were excluded from the study. The sample size was calculated using the Slovin formula, so that 65 respondents out of 130 respondents were obtained. Sample selection was carried out using *a simple random sampling* technique based on predetermined criteria.

The dependent variable in this study is the incidence of hypertension which is measured through blood pressure checks using a digital cuff or sphygmomanometer by health center health workers. The hypertension category is established when the systolic blood pressure is ≥140 mmHg and/or diastolic ≥90 mmHg. Independent variables include diet and physical activity. Diet was measured by *the Semi Quantitative Food Frequency Questionnaire* (SQ-FFQ) which recorded the frequency of food consumption, type of meals, and number of meals, while for physical activity was measured by *the Baecke Physical Activity Scale*.

Data collection was carried out through face-to-face interviews by researchers with respondents, accompanied by direct blood pressure checks by health care workers at the health center. Data analysis was carried out in a univariate manner to show the characteristics of respondents based on age, gender, family history of hypertension, diet, physical activity, and hypertension status. In addition, data analysis was performed bivariously using the Chi-square test to see the relationship between independent and dependent variables, with a significance level of $p<0.05$. All respondents were given an explanation of the objectives, benefits, and procedures of the research and signed an *informed consent sheet*. The confidentiality of respondents' identities and data is fully guaranteed and is only used for the purposes of this research.

RESULTS

The results of the study include characteristics of age, gender, and history of hypertension in the family, diet based on amount, type, frequency, and physical activity including:

1. **Age**

Based on the results of the study, it was found that the age of the respondents was elderly to the incidence of hypertension. It can be seen in the following table:

Table 1. Frequency Distribution Based on Age of Hypertension Incidence in the Elderly at Klampis Ngasem Health Center

Elderly Age	Quantity (n)	Present (%)
Early Elderly (60-69 years)	45	69.2
Middle Elderly (70-79 years)	17	26.2
Elderly (>80 years)	3	4.6
Total	**65**	**100.0**

Source: Primary Data, 2025

Based on Table 1, most of the elderly with hypertension at the Klampis Ngasem Health Center are in the age group of 60-69 years (69.2%). Meanwhile, the middle elderly (70–79 years)

https://doi.org/10.56303/jnhd.v1i1

amounted to 26.2% and the elderly (>80 years) only 4.6%. These findings indicate that the beginning of old age is a critical period of hypertension, in line with the process of physiological changes in the body that begin to manifest at that age. Although the risk of hypertension increases with age, these results confirm that hypertension has appeared significantly since the beginning of the elderly. In the early age of the elderly, some individuals are still exposed to unhealthy lifestyles, such as high salt consumption and low physical activity, before experiencing a decrease in appetite or mobility at a later age.

2. Gender

Based on the results of the study, it was found that the gender of the elderly respondents to the incidence of hypertension. It can be seen in the following table:

Table 2. Frequency Distribution Based on Gender of Hypertension Incidence in the Elderly at Klampis Ngasem Health Center

Gender	Quantity (n)	Present (%)
Man	17	26,2
Woman	48	73,8
Total	**65**	**100.0**

Source: Primary Data, 2025

Based on Table 2, most of the hypertensive patients are female elderly with a total of 48 people (73.8%), while male elderly are only 17 people (26.2%). These findings show that there is a striking difference in proportions between the sexes, where elderly women tend to experience hypertension more than men. Physiologically, this can be explained because women who enter menopause experience a decrease in the hormone estrogen, which previously played a role in maintaining the elasticity of blood vessels and regulating lipid metabolism. Decreased estrogen levels contribute to increased stiffness of blood vessels and the risk of hypertension.

3. Family History

Based on the results of the study, it was found that the family history of elderly respondents to the incidence of hypertension. It can be seen in the following table:

Table 3. Frequency Distribution Based on Family History with Hypertension on the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Family History With Hypertension	Quantity (n)	Present (%)
Exist	7	10.8
None	58	89.2
Total	**65**	**100.0**

Source: Primary Data, 2025

Based on Table 3, most of the elderly respondents who experienced hypertension at the Klampis Ngasem Health Center did not have a family history of hypertension, which was 58 people (89.2%). Meanwhile, only 7 people (10.8%) had a family history of hypertension. This indicates that in the case of this study, genetic or hereditary factors are not the dominant cause of hypertension in the elderly, but are more influenced by other factors such as diet, lifestyle, and physical activity. In theory, family history is indeed one of the risk factors for hypertension due to genetic predispositions that affect blood pressure regulation. However, the findings of this study suggest that although most elderly people do not have a family history of hypertension, they still have hypertension. This condition reinforces the view that environmental factors, the habit of consuming foods high in salt and fat, and declining physical activity in old age also have a greater role.

4. Diet

a. Types of Food

Based on the results of the study, it was found that the type of food of elderly respondents to the incidence of hypertension. It can be seen in the following table:

https://doi.org/10.56303/jnhd.v1i1

Table 4. Frequency Distribution Based on Food Type on the Incidence of Hypertension in the Elderly at Klampis Ngasem Health Center

Types of Food	Quantity (n)	Present (%)
Enough	52	80
Less	13	20
Total	**65**	**100.0**

Source: Primary Data, 2025

Based on Table 4, most of the elderly with hypertension at the Klampis Ngasem Health Center have a pattern of food types that are classified as sufficient, namely 52 people (80%), while 13 people (20%) are classified as inadequate. These findings indicate that even though most elderly people have eaten a variety of foods, hypertension still occurs. This shows that the adequacy of food types alone does not guarantee the achievement of a healthy diet for the elderly. The type of food consumed by the elderly is indeed important to maintain nutritional balance. However, the adequacy of the type of food is not always directly proportional to the quality of the food consumed. For example, the elderly may already eat staple foods, side dishes, vegetables, and fruits, but with a high salt or fat content, so they are still at risk of triggering hypertension. In theory, diet is closely related to the incidence of hypertension, especially if the consumption of foods high in sodium, saturated fat, and cholesterol is more dominant than foods rich in fiber, vitamins, and minerals. These findings reinforce the view that dietary interventions emphasize not only the diversity of food types, but also on the selection of healthy food ingredients and how they are processed.

b. Total Calories

Based on the results of the study, it was found that the number of calories of elderly respondents was related to the incidence of hypertension. It can be seen in the following table:

Table 5. Frequency Distribution Based on the Number of Calories to the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Total Calories	Quantity (n)	Present (%)
Weight level deficit	3	4.6
Medium level deficit	9	13.8
Deficit level Mild	25	38.5
Usual	23	30.8
Excess	5	7.7
Total	**65**	**100.0**

Source: Primer Data, 2025

Based on Table 5, most of the elderly with hypertension at the Klampis Ngasem Health Center have a number of calories that are classified as a mild level deficit, which is as many as 25 people (38.5%). In addition, there were 23 people (30.8%) with normal calorie count, 9 people (13.8%) with moderate deficits, 3 people (4.6%) with severe deficits, and 5 people (7.7%) with excess calories. This distribution illustrates that most elderly people with hypertension tend not to get the calorie intake that their bodies need, although the number of those who experience excess calories is still there. This condition is interesting because in general, excess calories are often associated with the risk of hypertension due to body fat accumulation and an increase in body mass index. However, in this finding, most of the respondents were in the category of light calorie deficit. This can be caused by an unbalanced diet, for example low calorie intake but still high in sodium, saturated fat, or cholesterol, so that it still increases the risk of hypertension even though the total energy is classified as a deficit.

On the other hand, the presence of the group with excess calories (7.7%) also shows that hypertension can occur in the elderly who experience excess energy. Excess calories are associated with central obesity, which can physiologically affect blood pressure regulation. Meanwhile, the group with normal calories (30.8%) showed that even though

https://doi.org/10.56303/jnhd.v1i1

energy needs were met, food quality factors still had a significant effect on the onset of hypertension. Thus, these findings confirm that calorie regulation alone is not enough to prevent hypertension in the elderly. It is also important to pay attention to the source of calories consumed and the nutritional quality contained in them.

c. Number of Meals

Based on the results of the study, it was found that the number of elderly respondents ate the incidence of hypertension. It can be seen in the following table:

Table 6. Frequency Distribution Based on the Number of Meals on the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Feeding Frequency	Quantity (n)	Present (%)
Good	44	67.7
Bad	21	32.3
Total	**65**	**100.0**

Source: Primer Data, 2025

Based on Table 6, most of the elderly with hypertension at the Klampis Ngasem Health Center have a good eating frequency, which is as many as 44 people (67.7%). Meanwhile, as many as 21 people (32.3%) were included in the category of poor eating frequency. These findings show that most of the respondents already follow a diet with an appropriate amount of frequency, even though hypertension is still experienced. This condition indicates that a good eating frequency does not always guarantee that the elderly are free from hypertension. This can be caused by the selection of the type of food and the content of nutrients consumed. Seniors may already be eating the appropriate amounts, but their daily food intake remains high in sodium (e.g. from salt, instant food, or salted side dishes) or saturated fats that have the potential to increase blood pressure.

d. Diet

Based on the results of the study, it was found that the diet of elderly respondents to the incidence of hypertension. It can be seen in the following table:

Table 7. Frequency Distribution Based on Diet on the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Diet	Quantity (n)	Present (%)
Good Diet	16	19.6
Poor Diet	49	57
Total	**65**	**100.0**

Source: Primer Data, 2025

Based on Table 7, most of the elderly with hypertension at the Klampis Ngasem Health Center have a poor diet, which is as many as 49 people (57%). Meanwhile, only 16 people (19.6%) were classified as having a good diet. These findings indicate that most respondents are still not able to implement a healthy diet that is in accordance with the needs of the elderly with hypertension. A poor diet can include several things, such as excessive salt consumption, frequent consumption of fatty foods and high cholesterol, low intake of vegetables and fruits, or an imbalance between energy needs and daily food intake. This condition contributes to an increase in blood pressure because high sodium will increase blood volume, while excess saturated fat can speed up the process of atherosclerosis. On the other hand, even though there is a small percentage of the elderly with a good diet, hypertension can still occur due to other risk factors, such as age, family history, stress, and lack of physical activity. This means that the implementation of a healthy diet is not enough if it is not balanced with a healthy lifestyle as a whole.

5. Physical Activity

Based on the results of the study, it was found that the physical activity of elderly respondents was related to the incidence of hypertension. It can be seen in the following table:

https://doi.org/10.56303/jnhd.v1i1

Table 8. Frequency Distribution Based on Physical Activity on the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Physical Activity	Quantity (n)	Present (%)
Light	31	47.7
Moderate	22	35.4
Heavy	11	16.9
Total	**65**	**100.0**

Source: Primer Data, 2025

Based on Table 8, most of the elderly with hypertension at the Klampis Ngasem Health Center have light physical activity, which is as many as 31 people (47.7%). A total of 22 people (35.4%) were classified as doing moderate physical activity, while only 11 people (16.9%) were doing strenuous physical activity. These findings indicate that the majority of respondents are not used to doing enough physical activity to support heart and blood vessel health. Light physical activity, such as a leisurely walk or just doing simple household chores, is less able to provide a protective effect on blood pressure. In fact, various studies show that moderate to strenuous physical activity can help improve blood circulation, maintain blood vessel elasticity, and control weight, all of which play a role in lowering the risk of hypertension. The low level of physical activity in the elderly can be caused by age factors that limit mobility, the presence of comorbidities, a feeling of tiredness quickly, and less active lifestyle habits. This condition shows that interventions in controlling hypertension in the elderly do not only focus on dietary aspects, but also need to encourage increased physical activity according to the abilities and health conditions of each individual.

6. Incidence of Hypertension

Based on the results of the study, it was found that the incidence of hypertension in elderly respondents. It can be seen in the following table:

Table 9. Distribution of Hypertension Incidence Frequency in the Elderly at Klampis Ngasem Health Center

Blood pressure	Quantity (n)	Present (%)
Pre-Hypertension	31	47.7
Hypertension Stage I	22	33.8
Stage II Hypertension	12	18.5
Total	**65**	**100.0**

Source : Primary Data 2025

Based on Table 9, it is known that most of the elderly at the Klampis Ngasem Health Center are in the pre-hypertension category, which is 31 people (47.7%). Meanwhile, 22 people (33.8%) were in the category of stage I hypertension, and 12 people (18.5%) were included in the category of stage II hypertension. These results show that almost half of the respondents are already in the pre-hypertensive stage. This condition is important to pay attention to because pre-hypertension is an early phase that is at risk of developing into hypertension if prevention efforts are not taken. Older adults who have already entered stage I and II hypertension signal that their blood pressure is at a more serious level, which can increase the risk of cardiovascular complications, such as stroke and coronary heart disease. These findings show that the majority of older adults need health interventions to prevent progression from pre-hypertension to more severe hypertension. Education about the importance of maintaining a healthy diet low in salt, increasing physical activity according to ability, and regular blood pressure checks are needed so that the condition of the elderly remains under control and the risk of complications can be minimized.

7. The Relationship of Diet to the Occurrence of Hypertension

The results of the cross-tabulation analysis between hypertension and diet using *Chi Square* correlation testing to prove that the two factors can be represented in the following table:

https://doi.org/10.56303/jnhd.v1i1

Table 10. Cross-Tabulation of the Relationship between Diet and the Incidence of Hypertension in the Elderly at the Klampis Ngasem Health Center

Diet	Blood pressure						Total		P
	Pre-Hypertension		Hypertension Stage I		Hypertension Stage II				
	n	%	n	%	n	%	n	%	
Good Diet	12	75%	4	25%	0	0	16	100%	0,021
Poor Diet	19	38.8%	18	38.7%	12	22.5%	49	100%	
Total	**31**	**47.7%**	**22**	**33.8%**	**12**	**18.5%**	**65**	**100%**	

Source : Primary Data 2025

Based on the results of cross-tabulation analysis using the Chi-Square test, a value of p = 0.021 (< 0.05) was obtained. This shows that there is a significant relationship between diet and the incidence of hypertension in the elderly at the Klampis Ngasem Health Center. From the table, it can be seen that the elderly with a good diet are mostly in the pre-hypertension category (75%), and only a small percentage have experienced stage I hypertension (25%), and none have reached stage II. On the other hand, the elderly with a poor diet had a more even distribution, namely pre-hypertension (38.8%), stage I hypertension (38.7%), and stage II hypertension (22.5%).

These results show that diet is less closely related to the severity of hypertension. Elderly people with a poor diet are less likely to experience hypertension at a heavier level (stages I and II) compared to the elderly who have a good diet. A diet high in salt, saturated fat, low in fiber, and lack of consumption of fruits and vegetables can be factors that accelerate the increase in blood pressure.

Thus, it can be concluded that diet has an important role in influencing the incidence of hypertension in the elderly. Therefore, sustainable nutrition education is needed for the elderly to encourage healthy eating habits as an effort to prevent and control hypertension.

8. The Relationship of Physical Activity to the Occurrence of Hypertension

The results of the cross-tabulation analysis between hypertension and diet using *the Chi Square* correlation test to prove that the two factors can be represented in the following table:

Table 11. Cross-Tabulation of the Relationship between Physical Activity and Hypertension Incidence in the Elderly at the Klampis Ngasem Health Center

Physical Activity	Blood pressure						Total		P
	Pre-Hypertension		Hypertension Stage I		Hypertension Stage II				
	n	%	n	%	n	%	n	%	
Light	21	67.7%	6	19.4%	4	12.9%	31	100%	0,001
Moderate	5	29.4%	11	64.7%	1	5.9%	17	100%	
Heavy	5	29.4%	5	29.4%	7	41.2%	17	100%	
Total	**31**	**47.7%**	**22**	**33.8%**	**12**	**18.5%**	**65**	**100%**	

Source : Primary Data 2025

Based on the results of cross-tabulation analysis using the Chi-Square test, a value of p = 0.001 (< 0.05) was obtained. This shows that there is a significant relationship between physical activity and the incidence of hypertension in the elderly at the Klampis Ngasem Health Center. The results of the table show that the elderly with light physical activity are mostly in the pre-hypertension category (67.7%), while those with stage I (19.4%) and stage II (12.9%) hypertension are fewer. In the group with moderate physical activity, the distribution tended to be different, where most actually experienced stage I hypertension (64.7%), and only a small percentage were in the pre-hypertension (29.4%) and stage II (5.9%) categories. Meanwhile, the elderly with heavy physical activity are more likely to experience stage II hypertension (41.2%), although there are also those in pre-hypertension (29.4%) and stage I (29.4%).

These findings show that unbalanced physical activity, whether too light or too strenuous, is associated with an increased risk of hypertension in the elderly. Elderly people with light activity

https://doi.org/10.56303/jnhd.v1i1

tend to lack heart and blood vessel function, so they are at risk of increased blood pressure. Conversely, too strenuous physical activity can also trigger excessive pressure on the cardiovascular system, causing blood pressure to rise higher. Moderate physical activity seems to play a greater role in maintaining blood pressure stability, although in this study data there is still a tendency for many respondents with moderate activity to experience stage I hypertension.

Thus, it can be concluded that physical activity has an important role in influencing the incidence of hypertension in the elderly, so assistance is needed in choosing the appropriate form and intensity of physical activity to maintain heart and blood vessel health in old age.

DISCUSSION

1. Respondent Characteristics

Referring to the research findings, the majority of respondents are classified as early elderly, namely between 60 and 69 years old, with a frequency of 65 elderly people (69.2%) belonging to this group. According to the theory proposed, age is a major factor in the development of hypertension, because as we age, the structure of blood vessels changes, with the risk increasing at age 40 and further beyond age 60. Along with the aging process, the physiological changes that occur can affect the increase in blood pressure (16). Nevertheless, the finding that the majority of respondents were early elderly gave an important indication: hypertension is not only a problem in the elderly >70 years old, but actually begins to manifest itself in early old age. This emphasizes the importance of early detection and preventive efforts in the 60s, not waiting for old age.

The findings of this study indicate that the gender distribution of the majority of respondents is women, a total of 48 elderly (73.8%). These results are in line with research that highlights a correlation between hypertension and gender. Women tend to be more susceptible to the negative effects of hypertension than men, with 51.7% of female subjects experiencing greater hypertension impacts than men (17). One biological explanation is hormonal changes, specifically a postmenopausal decrease in estrogen, which can contribute to an increase in blood pressure. However, social factors also need to be considered, elderly women often have lower physical activity than men, so their susceptibility to hypertension can be higher. This means that these findings not only show biological differences, but also open up the space for analysis of the different lifestyles between elderly men and women.

Furthermore, this study also indicates that 58 elderly people (89.2%) do not have a family history of hypertension. These findings are in line with the study (18) which concluded that there was no significant correlation between the history of relatives with hypertension. If only a few elderly people suffer from it, then the chance for the elderly not to have hypertension is around 50%. Family history is indeed a number of major risk triggers for hypertension, considering that genetic factors play a large role in an individual's tendency to experience high blood pressure. This emphasizes that environmental, lifestyle, and physiological aging factors may have a greater contribution to the elderly group at the study site. In other words, hypertension in respondents is more likely to be influenced by non-genetic factors, so healthy lifestyle interventions are still very relevant to reduce the number of cases in this group.

2. Diet

The findings of the study revealed that of the 65 elderly who became respondents, the majority of hypertension patients at the Klampis Ngasem Health Center were included in the category of sufficient food consumption patterns, with a frequency of 52 elderly (80%). Furthermore, this study also indicates that most of the elderly who experience hypertension fall into the category of a mild level calorie deficit, as many as 25 people (38.5%). This condition occurs because the frequency of food consumed is lower than it should be due to a number of factors. These findings are in line with researchers who state that diets that do not meet nutritional standards such as carbohydrates, sodium, protein, fat, and fiber may increase the risk of hypertension (16).

https://doi.org/10.56303/jnhd.v1i1

Interestingly, although the majority of the elderly eat more than three meals a day (67.7%), the portion of food tends to be small. It can be interpreted that a high frequency of meals is not always directly proportional to good nutritional quality, so hypertension is still possible. Factors such as economic limitations, decreased appetite due to aging, indigestion, and limited access to nutritious food are likely contributing to this phenomenon. In addition, the results showed that 49 respondents (57%) overall had a relatively poor diet. This fact is in line with previous research that states that poor diets in the elderly are generally caused by low consumption of carbohydrate, protein, and fat sources (17).

This shows that the main problem is not only in the amount of food consumed, but also in the diversity and balance of the daily menu. In the context of the elderly, unmet nutritional needs can accelerate degenerative processes, worsen blood pressure control, and reduce quality of life. Thus, these findings confirm that diet plays an important role as a risk factor for hypertension in the elderly, so nutritional interventions that emphasize balanced energy intake, dietary variation, and education about healthy consumption patterns are needed to reduce the incidence of hypertension in the elderly age group.

3. Physical Activity

Physical activity is a crucial element in supporting physical fitness in the elderly and preventing a number of degenerative diseases. Referring to the results of the study, the majority of respondents showed the category of light activity, namely 31 elderly people (47.7%). The study is in line with the fact that a lack of physical activity can inhibit the performance of the body's organs and reduce the smooth flow of blood and oxygen supply which can ultimately trigger a number of health problems, such as weight gain and high blood pressure (15).

Getting enough activity also plays a role in maintaining body fitness, encouraging blood circulation, and maintaining the stability of body blood pressure. In line with the findings of this study, there needs to be an effort to encourage the elderly to understand the importance of regular physical activity. Seniors can start with simple activities such as a 30-minute walk, often participating in senior gymnastics at senior posyandu or events around the house, doing stretching exercises, and participating in community activities that involve physical activity. Lack of physical activity in the elderly contributes to increased blood pressure through a mechanism of decreasing vascular elasticity and increasing peripheral resistance (19).

From a practical perspective, these findings emphasize the importance of community-based education and programs to encourage the elderly to increase their physical activity, as gradually increasing the intensity of physical activity can lower the risk of hypertension and improve quality of life. Thus, low physical activity patterns in the elderly not only reflect lifestyle, but also serve as a real indicator of hypertension risk. Interventions that target increasing the frequency, duration, and intensity of physical activity are important strategies in controlling blood pressure in the elderly population.

4. Incidence of Hypertension

The results of the study showed that out of 65 elderly respondents at the Klampis Ngasem Health Center, it was indicated that a total of 31 elderly people (47.7%) showed pre-hypertension. If the national data of this figure is higher with a hypertension incidence rate of 40% (20). The findings in this study are consistent with research that states that pre-hypertension is often found in the elderly due to physical changes related to aging, such as decreased elasticity of blood vessels and changes in the kidneys' ability to regulate blood pressure (21).

Hypertension is one of the main health problems in the elderly with a prevalence that tends to increase with age (22). The nutritional content that is good for health shows that red beans can be processed into flour that is beneficial for people with hypertension (23). Thus, early detection of pre-hypertension and prevention efforts through a balanced diet and increased physical activity are essential to reduce the risk of progression to advanced hypertension.

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5. The Relationship of Diet to the Occurrence of Hypertension

Referring to the findings of the analysis applying the *Chi Square correlation test, a* p score = 0.021(p<0.05), so that it can be interpreted that there is a significant correlation between food consumption patterns and the occurrence of hypertension for elderly individuals. These findings are in line with research that shows a link between diet and the occurrence of hypertension in the pre-elderly group at the Kubu 1 Health Center, with *a value of p* = 0.03.

From these findings, researchers concluded that diet has a crucial role in controlling hypertension for the elderly. Seniors who eat foods high in salt and fat are at a much greater risk of developing hypertension than those who control their eating patterns appropriately. This is in line with physiological mechanisms, where excess sodium intake increases plasma volume and vascular resistance, while saturated fat can decrease the elasticity of blood vessels and accelerate atherosclerosis. Therefore, interventions in the form of balanced nutrition education and food intake regulation have the potential to reduce the incidence of hypertension in the elderly.

6. The Relationship of Physical Activity to the Occurrence of Hypertension

From the correlation testing findings *Chi Square* that has been done is obtained that the score *p* = 0.001, then the p score < 0.05 so that it was found that there was a relationship between physical activity and the occurrence of hypertension for elderly individuals. The results of this study are relevant to the study that states that there is a relationship between physical activity and the occurrence of hypertension in Kapuas Hulu and the results of the study. *p* = 0.027 (24).

These findings indicate that low activity levels play a role in increasing the likelihood of hypertension, while the elderly who have higher activity levels tend to show more maintained blood pressure. Physiologically, physical activity helps maintain the elasticity of blood vessels, improves blood circulation, and reduces peripheral vascular resistance, so that blood pressure remains stable. Elderly people who move regularly are also better able to control their weight and improve cardiovascular function, which directly lowers the risk of hypertension. The results of this study are in line with previous studies that revealed that adequate activity can reduce the risk of hypertension and promote quality of life in the elderly (25). Therefore, increasing awareness and opportunities for regular physical activity is an important strategy in the prevention of hypertension in the elderly population.

7. Practical Implications and Intervention Strategies in Health Centers

The findings of the study show that there is a significant relationship between diet and physical activity on the incidence of hypertension in the elderly. This supports the principle of community-based health promotion in health centers. In terms of diet, the elderly with less consumption patterns have a higher risk of hypertension, so the Puskesmas can design interventions in the form of balanced nutrition education, counseling to reduce salt and fat consumption, and demonstrations of making healthy menus for the elderly.

In addition, low physical activity is also associated with an increased risk of hypertension. Therefore, intervention strategies can be in the form of routine elderly gymnastics, healthy walking, stretching exercises, or the formation of light exercise groups at the Elderly Posyandu. The integration of nutrition education and physical activity in hypertension prevention programs will support a holistic and community-based approach, so that the elderly can be more actively involved and hypertension prevention programs can run more effectively.

8. Research Limitations

This study has several limitations that need to be considered when interpreting the results. First, the number of samples used was limited, namely 65 elderly people at the Klampis Ngasem Health Center, so the results of this study could not be generalized to the entire elderly population in Surabaya and Indonesia. Second, the cross-sectional research design only allows

https://doi.org/10.56303/jnhd.v1i1

the identification of relationships between variables at one specific point in time, so it cannot confirm the cause-and-effect relationship between diet, physical activity, and hypertension.

CONCLUSION

This study shows that there is a significant relationship between diet and physical activity and the incidence of hypertension in the elderly in the working area of the Klampis Ngasem Health Center, Surabaya City. The results of the Chi-Square test showed that diet had a significant relationship with hypertension (p = 0.021), while physical activity was also significantly associated with hypertension (p = 0.001). Elderly people who have an unbalanced diet—for example, high sodium consumption and low fruit and vegetable intake—show a higher risk of developing hypertension than the elderly with a balanced diet. In addition, low physical activity also increases the risk of hypertension compared to adequate physical activity. Nonetheless, it should be noted that cross-sectional research designs only allow the identification of relationships between variables at a single point in time, so these results cannot be used to conclude direct cause-and-effect relationships. Other factors such as age, gender, and body mass index also play a role in increasing the risk of hypertension in the elderly, so the interpretation of the results must be done carefully. Based on the results of this study, several suggestions can be described, namely the following:

1. **Practical Advice**

   The results of this study can be the basis for health workers at the Klampis Ngasem Health Center to design an intervention program that emphasizes lifestyle modification for the elderly. Some of the steps that can be taken include balanced nutrition education, increasing the physical activity of the elderly through elderly gymnastics, regular walking, or other physical activities, and regular blood pressure monitoring.

2. **Academic Advice**

   For future researchers, it is recommended to conduct studies with a longitudinal design to examine the cause-and-effect relationship between diet, physical activity, and hypertension. Researchers can also use larger, representative samples to improve the generalization of research results. In addition, researchers can also consider additional factors that may affect hypertension in the elderly, such as comorbidities, drug use, or socio-economic factors, to make the results of the study more comprehensive.

FUNDING

This research and The APC was funded from Poltekkes Kemenkes Surabaya

ACKNOWLEDGMENTS

The author would like to express his deepest gratitude to the Head of the Klampis Ngasem Health Center in Surabaya City and all staff who have provided permission and support during this research process. Thank you also to all elderly respondents who have been willing to take the time and provide the necessary information in this study.

CONFLICTS OF INTEREST

The authors stated that there is no potential conflict of interest either financially or non-financially that could affect the results of this study. The entire process of research and report writing is carried out independently without the intervention of any party.

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