Journal of Health Sciences and Medical Development
Vol. 3, No. 02, pp. 64-73
journal.iistr.org/index.php/HESMED
DOI: 10.56741/hesmed.v3i02.492

Evaluating Hypertension Risk Factors: A Study in Sidoarjo Regency, Indonesia

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ARTICLE INFO

Article history
Received 9 January 2024
Revised 30 April 2024
Accepted 14 May 2024

ABSTRACT

Hypertension is a public problem that is national-focused. The prevalence in Indonesia reaches 34.1%. Sodium intake, physical activity, central obesity status, and family history are risk factors for hypertension. This study aims to prove sodium intake, physical activity, central obesity status, and family history of hypertension. This cross-sectional approach, a quantitative method, was conducted in Sawotratap Village. Sixty-eight people underwent health checks at Posbindu Saworatap from February to November 2022 and only 63 met the criteria. Measurements of hypertension status using a digital sphygmomanometer, measuring sodium intake using the SQ-FFQ forms, measuring physical activity using a questionnaire, and measuring central obesity status with an abdominal circumference indicator measured by a meter with an accuracy of 1 mm. Data analysis using chi-square test. The results showed that there was a relationship between sodium intake and the incidence of hypertension. There is a relationship between central obesity status and the incidence of hypertension. There is a relationship between family history and the incidence of hypertension. There is no relationship between physical activity and the incidence of hypertension. Sodium intake, central obesity status, and family history are risk factors for hypertension. While physical activity was not associated with the incidence of hypertension.

Keywords
Central Obesity Status
Family History
Hypertension
Physical Activity
Sodium Intake

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Introduction

Hypertension is a non-communicable disease characterized by a systolic blood pressure higher than 140 mmHg and diastole higher than 90 mmHg [1],[2]. It is a significant contributor to complications such as stroke, kidney failure, coronary heart disease, and other health issues [3],[4]. Hypertension ranks fourth among the leading causes of death, following diabetes mellitus [5]. Additionally, hypertension serves as one of the indicators of metabolic syndrome, a collection of symptoms indicating metabolic abnormalities in the body [6]. In Indonesia, hypertension remains a prioritized health concern, with a noticeable increase in incidence from 27.8% to 34.1% between 2013 and 2018 based on Indonesian Health Data [7],[8]. East Java Province, particularly Sidoarjo, exhibits a prevalence higher than the national average, with Sidoarjo reporting an incidence rate of 42% [9].

Changing dietary patterns, specifically transitioning from traditional to modern eating habits with a reliance on fast food high in sodium, is identified as a significant factor contributing to hypertension. Fast food, known for its elevated sodium content, promotes hypertension by binding water and increasing blood volume [10],[11]. Diets lacking in potassium and fiber further exacerbate sodium buildup, elevating the risk of hypertension [11].

Furthermore, a sedentary lifestyle emerges as another contributing factor to hypertension, often resulting from obesity. Individuals with a sedentary lifestyle exhibit minimal physical activity leading to an energy imbalance. Epidemiological studies demonstrate a correlation between central obesity and hypertension in the Minangkabau ethnic group [12]. Additional research highlights the relationship between obesity and hypertension particularly in Minangkabau women [13].

As part of the government's health initiatives, particularly under the Health Service, early detection of hypertension is conducted through integrated development posts known as Posbindu. These services involve health personnel engaging with the public to prevent and promote integrated preventive measures against non-infectious diseases [14]. In a preliminary study, researchers gathered data from 34 active *Pos Binaan Terpadu* (POSBINDU, an integrated health center) participants in Sawotratap village in Jawa Timur, Indonesia revealing a significant prevalence of hypertension in the village. This village holds the second-highest

ranking for hypertension, with a prevalence of 32%. This prompted researchers to delve into the examination of risk factors associated with hypertension among active POSBINDU participants. The variables under investigation include sodium intake, physical activity, central obesity, and family history.

Material and Methods

This research adopts an observational analytic approach, as it involves the observation of research subjects without administering any specific treatment. The chosen methodology employs a quantitative cross-sectional approach, as outlined by Ref. [15]. This research has been approved by the ethics commission of Ahmad Dahlan University with number 012206058.

The study took place at Posbindu Saworatap in the Gedangan District, Sidoarjo Regency, spanning from February 2022 to November 2022. The population under consideration consisted of individuals who underwent health checks at Posbindu Saworatap, totaling 68 people. The sampling technique employed was total sampling, adhering to inclusion and exclusion criteria. Inclusion criteria encompassed active Posbindu Sawotratap participants aged 15-64, willing to become respondents, committed to participating from the beginning to the end of the research and possessing effective communication skills. Exclusion criteria were individuals aged over 64 due to potential difficulties in recall and pregnant women. Ultimately, 63 individuals met the specified criteria.

Measurement of the sodium intake variable utilized the semi-quantitative food frequency (SQ-FFQ) method, categorizing sodium intake as more if exceeding 2300 mg per day and sufficient if below 2300 mg per day [16]. Physical activity was gauged through a questionnaire, deeming activity insufficient if the duration fell below 150 minutes per week or occurred less than 3 times per week, and sufficient if meeting the frequency of 3-5 times per week or 150 minutes per week [17]. Central obesity status was determined by measuring abdominal circumference, considering it central obesity if exceeding 90 cm in men and 80 cm in women, while not obese if below these thresholds [18]. A family history of hypertension was assessed through a questionnaire, and blood pressure was measured using a digital blood pressure monitor, defining hypertension as blood pressure higher than 149/90 mmHg and non-hypertension as less than 140/90 mmHg [2].

In this study, data analysis comprised both univariate and bivariate analyses. Univariate analysis served to elucidate the characteristics of sodium intake, physical activity, central obesity status, family history of hypertension, and hypertension status. On the other hand, bivariate analysis was employed to scrutinize the relationships between independent variables and the dependent variable. The statistical tool utilized for this analysis was the chi-square test.

Results

A. Univariate Analysis

According to Table 1, the prevalence of hypertension within the total sample stands at 54% (n=34). Among the respondents, 19 individuals, constituting 30.2%, exhibit excessive sodium intake. The majority of participants, numbering 48 individuals (76.2%), lack sufficient physical activity. Central obesity status is prevalent among 38 respondents, representing 60.3%. Additionally, the distribution of a family history of hypertension is observed in 37 respondents, accounting for 58.7% of the participants.

Table 1. Distribution of hypertension status, sodium intake, physical activity, central obesity status, and family history

Type categorical	Frequency (n)	Percentage (%)
Incident hypertension		
Hypertension	34	54
Not hypertensive	29	46
Sodium Intake		
More	19	35.8
Enough	44	64.2
Physical Activity		
Not enough	48	76.2
Enough	15	23.8
Central Obesity Status		
Yes	38	60.3
Not	25	39.7
Family History of Hypertension		
Yes	37	58.7
No	26	41.3
Total	63	100

B. Bivariate Analysis

Based on Table 2, the associations between sodium intake, physical activity, central obesity, and family history of hypertension are examined. Notably, among the 19 respondents with higher sodium intake, 16 experienced hypertension, while 3 had normal blood pressure. Of the 41 respondents with adequate sodium intake, 18 had hypertension, and 23 did not.

The chi-square test yielded a significant *p*-value of 0.004, indicating a relationship between sodium intake and hypertension. The Prevalence Ratio (PR) of 2.058 implies that respondents with excessive sodium intake are at a 2.058 times higher risk of hypertension compared to those with sufficient sodium intake. Regarding physical activity, 48 respondents with lower activity levels were identified, with 27 experiencing hypertension and 21 not. However, the chi-square test yielded a non-significant *p*-value of 0.724, suggesting no connection between physical activity and incident hypertension.

Table 2. The incidence of hypertension

Type categorical	The incidence of hypertension				Total		PR (CI 95%)	p-value
	Hypertension		Non-Hypertension					
	n	%	n	%	n	%		
Sodium Intake								
More	16	84,2	3	15,8	19	100	2058 (1.373-3.086)	0.004
Enough	18	40,9	26	59,1	44	100		
Physical Activity								
Less	27	56,3	21	43,8	21	100	1205 (0.664-2.187)	0.724
Enough	7	46,7	8	53,3	8	100		
Central Obesity Status								
Yes	25	65,8	13	34,2	38	100	1827 (1.033-3.234)	0.039
No	9	36,0	16	64,0	25	100		
Family History of Hypertension								
Yes	28	75,7	9	24,3	37	100	3279 (1.588-6.772)	0.000
No	6	23,1	20	76,9	26	100		
Total	34	54,0	29	46,0	63	100		

For central obesity, among the 38 respondents with this condition, 25 had hypertension, and only 13 had normal blood pressure. The chi-square test showed a significant *p*-value of 0.039, indicating a meaningful relationship between central obesity status and incident hypertension. The Prevalence Ratio (PR) of 1.827 indicates that respondents with central obesity status have a 1.827 times higher risk of hypertension compared to those without.

Table 2 also highlights that among the 37 respondents with a family history of hypertension, 28 suffered from hypertension, while only 9 did not. The chi-square test resulted in a highly significant *p*-value of 0.000, indicating a substantial relationship between a family history of hypertension and incident hypertension. The Prevalence Ratio (PR) of 3.279 signifies that respondents with a family history of hypertension have a 3.279 times higher risk of developing hypertension compared to those without such a history.

Discussion

A. Connection between sodium intake and hypertension

The observed significant relationship between sodium intake and hypertension underscores the critical role of dietary habits in cardiovascular health. The elevation of blood volume, triggered by heightened sodium levels in the extracellular fluid, serves as a mechanistic link to the development of hypertension [19]. The body's compensatory response, involving the extraction of intracellular fluid, contributes to an overall increase in blood volume, further emphasizing the impact of sodium intake on blood pressure regulation.

In line with these findings, the recommended dietary approaches to stop hypertension diet advocates for the restriction of sodium intake to 2300 mg per day [20]. This dietary guideline is designed to mitigate the risk of hypertension by promoting healthier sodium levels in daily nutrition. The alignment of our results with the diet recommendations reinforces the practical

implications of these dietary guidelines in hypertension prevention. However, it is noteworthy that the contrasting findings in Ref. [21] research, where no significant relationship between sodium intake and hypertension was identified, may be attributed to variations in dietary compliance among participants. The strong adherence to dietary recommendations might have influenced the outcomes of the study, highlighting the importance of considering individual dietary behaviors and adherence levels when interpreting research findings in this context.

This research emphasizes the significance of public health interventions aimed at promoting dietary awareness, especially concerning sodium intake, to reduce the prevalence of hypertension. Education campaigns, nutritional counseling, and community-wide initiatives can play pivotal roles in fostering healthier eating habits and, consequently, reducing the burden of hypertension in the population. Moreover, further research exploring the nuances of dietary compliance, cultural influences on dietary patterns, and the long-term effects of sodium intake on hypertension development would contribute to a more comprehensive understanding of the complex interplay between diet and cardiovascular health. Such insights can inform targeted interventions and policies for more effective hypertension prevention and management strategies.

B. Connection between physical activity and hypertension

Despite an extensive exploration of the relationship between physical activity and the incidence of hypertension, the results yielded a non-significant in this study. This indicates that within the scope of the measured parameters—primarily duration and frequency—no clear association was observed between physical activity levels and the occurrence of hypertension in the studied population. It is noteworthy that existing literature presents conflicting findings on this topic. Ref. [22] study aligns with the outcomes of our research, supporting the notion that there may not be a direct connection between physical activity and hypertension. In contrast, the study conducted by Ref. [23] suggests a link between physical activity and hypertension.

These inconsistencies in the literature may stem from variations in the dimensions used to measure physical activity. In our study, the evaluation focused predominantly on the duration and frequency of physical activity, overlooking crucial aspects such as types and intensity. Physical activity encompasses a spectrum, and different types and intensities may have distinct impacts on cardiovascular health. Neglecting these dimensions in our analysis could be a contributing factor to the non-significant relationship observed. Therefore, while our study contributes valuable insights into the measured dimensions of physical activity, further research with a more comprehensive assessment, including types and intensity, is

warranted. This would enable a nuanced understanding of how specific physical activities, their intensity levels, and durations may influence the likelihood of developing hypertension.

The inconclusive findings in this study emphasize the complexity of the relationship between physical activity and hypertension. As researchers continue to explore this association, it is essential to consider the multifaceted nature of physical activity and its diverse impact on cardiovascular health. Future investigations should strive for a more comprehensive analysis to unravel the intricate dynamics between different dimensions of physical activity and the risk of hypertension.

C. Connection between central obesity and hypertension

In this study, the prevalence of central obesity among the participants was notably high. This elevated prevalence not only underscores the significance of central obesity within the community but also suggests a potential influence on physical inactivity and an increased susceptibility to obesity-related health concerns. Our findings reveal a noteworthy correlation between central obesity status and hypertension. This result aligns with Ref. [24] study, providing further validation to the association between central obesity and hypertension. The robust statistical significance observed in our study strengthens the evidence supporting the link between excess abdominal fat and elevated blood pressure.

The impact of central obesity on blood pressure involves intricate physiological mechanisms, notably the decrease in adiponectin levels. Adiponectin, a protein secreted by fat tissue, plays a crucial role in various metabolic processes, and its reduction is associated with unfavorable outcomes such as atherosclerosis. This condition, characterized by the thickening and stiffening of arteries, contributes to increased blood pressure, accentuating the relevance of central obesity in the development of hypertension [25]. It is noteworthy, however, that Ref. [26] study presents conflicting findings, suggesting no significant relationship between excessive waist circumference and elevated blood pressure. Possible explanations for these divergent outcomes could be attributed to demographic diversity within the study populations and limitations in sample size. The intricacies of central obesity's impact on hypertension may vary across different demographics, emphasizing the need for comprehensive and context-specific investigations.

In conclusion, while our study aligns with existing research by highlighting the association between central obesity and hypertension, the diverging findings underscore the complexity of this relationship. Future research endeavors should consider demographic nuances and incorporate larger sample sizes to enhance the generalizability of findings. The acknowledgment of central obesity as a potential risk factor for hypertension calls for targeted interventions and preventive measures to address the underlying causes and reduce the burden of cardiovascular diseases within the studied population.

D. Connection Between Family History and Hypertension

A substantial majority of respondents in this study reported a family history of hypertension and our analysis revealed a pronounced and statistically significant association with incident hypertension. This finding underscores the considerable impact of genetic factors on the likelihood of developing hypertension, affirming the results of Ref. [27] research. The recognition of family history as a significant risk factor is crucial, as it not only sheds light on the hereditary component of hypertension but also emphasizes the importance of proactive health management in individuals with familial predispositions.

Ref. [27] provides additional support to our findings, reinforcing the notion that genetic factors play a pivotal role in the development of hypertension. The increased risk observed in individuals with a family history serves as a crucial piece of information for healthcare professionals, guiding them toward more targeted preventive strategies and early interventions. In contrast, Ref. [28] study reported no significant relationship between family history and hypertension. This discrepancy underscores the multifactorial nature of hypertension, where genetic factors interplay with various lifestyle and environmental elements. The presence of additional contributing factors such as obesity, knowledge levels, smoking habits, dietary patterns, and physical activity further complicates the understanding of hypertension's etiology.

The multifaceted nature of hypertension highlighted by Ref. [28] suggests that while genetic predisposition is a significant factor, it operates within a broader context influenced by various lifestyle choices and environmental factors. This emphasizes the importance of adopting a comprehensive approach to hypertension prevention and management, considering the intricate interplay of both genetic and modifiable risk factors.

In conclusion, the observed association between family history and incident hypertension in our study aligns with existing literature, emphasizing the substantial role of genetics in this health condition. However, the contrasting findings in Ref. [28] underscore the need for a holistic understanding of hypertension, recognizing its complex and multifactorial origins. This holistic perspective should guide future research and healthcare interventions, fostering a more nuanced and effective approach to hypertension prevention and management.

Conclusion

This research sheds light on crucial factors contributing to the incidence of hypertension in the context of Sawotratap Village, Gedangan District, Sidoarjo Regency. The study revealed noteworthy relationships and associations, providing valuable insights for public health considerations. Firstly, a significant association was established between sodium intake and hypertension, reinforcing the importance of dietary management in preventing

hypertension. Secondly, no conclusive relationship was found between physical activity and hypertension in the studied population. This suggests the need for further exploration of physical activity dimensions, considering types and intensity in addition to duration and frequency, to gain a comprehensive understanding of its impact on hypertension. Thirdly, the study confirmed a meaningful association between central obesity status and hypertension. This underscores the importance of addressing central obesity through comprehensive health interventions, as it contributes significantly to elevated blood pressure. Lastly, the strong link observed between a family history of hypertension and incident hypertension highlights the genetic predisposition to this health condition. The findings emphasize the importance of routine health check-ups, particularly for individuals with a family history of hypertension, to facilitate early detection and intervention.

Conflict of Interest

The authors declare that there is no conflict of interest.

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