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Association of Physical Activity and Family History with Blood Pressure in Women Aged ≥40 Years: A Cross-Sectional Study

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Abstract

Introduction: Hypertension is a major global health concern and a leading risk factor for cardiovascular diseases. Its development is influenced by modifiable factors, such as physical activity, and non-modifiable factors, such as family history. Women aged ≥40 years are particularly vulnerable to hypertension due to physiological changes associated with aging. This study aimed to examine the association between physical activity levels and family history with blood pressure among women aged ≥40 years in Mengwitani Village.

Methods: This cross-sectional analytical study included 83 purposively selected women aged ≥40 years who met the inclusion and exclusion criteria. Physical activity was assessed using the Global Physical Activity Questionnaire (GPAQ), family history was determined through structured interviews, and blood pressure was measured with a sphygmomanometer. Data were analyzed using Spearman's rho and chi-squared tests.

Results: Spearman's rho analysis revealed a significant inverse correlation between physical activity and blood pressure ($p = 0.001$; $r = –0.419$), indicating that lower physical activity was associated with higher blood pressure. Chi-squared testing showed a significant association between family history and blood pressure ($p < 0.001$), with respondents reporting a family history of hypertension at greater risk of developing elevated blood pressure.

Conclusion: Physical activity and family history are significantly associated with blood pressure in women aged ≥40 years. These findings highlight the importance of promoting physical activity and early screening, particularly in individuals with a family history of hypertension.

Keywords: Hypertension, blood pressure, physical activity, family history, women

Introduction

Hypertension is a chronic medical condition that can affect anyone and is often unnoticed due to its asymptomatic nature. According to the 2018 Basic Health Research (Riskesdas), the prevalence of hypertension in Indonesia reached 34.1%, an increase from 25.8% in 2013.[1] If left untreated, hypertension can become a risk factor for various diseases such as stroke, myocardial infarction, heart failure, dementia, kidney failure, and even blindness. Women aged ≥40 years undergo various hormonal changes that can affect the cardiovascular system and increase the risk of hypertension. After age 40, women begin to experience a significant decline in hormonal function, which impacts blood pressure regulation.[1]

These hormonal changes, combined with other risk factors—both modifiable and non-modifiable—contribute to the increased risk of hypertension. Modifiable risk factors include smoking habits, excessive salt consumption, saturated fat intake, the use of reused cooking oil, alcohol consumption, obesity, physical inactivity, stress, and the use of estrogen. Non-modifiable risk factors include age, sex, family history, and genetics. The high prevalence of hypertension among women can be attributed to the influence of hormonal changes.[2]

According to Aristoteles, there is a relationship between gender and the occurrence of hypertension. Rosdiana further suggests that the likelihood of developing hypertension in women aged ≥40 years is also influenced by family history and the use of contraceptive pills.[3] Hypertension is a hereditary disease; therefore, women with a family history of hypertension are at higher risk of developing the condition. Furthermore, the use of oral contraceptives can increase the risk of hypertension in women aged ≥40 years due to the progesterone hormone content, which can affect heart function and potentially lead to hypertension.[3]

Physical activity is an essential variable in blood pressure control. Physical activity has been shown to reduce both systolic and diastolic blood pressure, improve insulin sensitivity and glycemic control, and help achieve an ideal body weight. The World Health Organization (WHO) reports that 27.5% of the global population does not engage in

sufficient physical activity.[4] Riskesdas 2018 states that 33.5% of the Indonesian population is insufficiently active, indicating low physical activity levels. In a study by Sesso et al., individuals with low physical activity had a higher risk of hypertension compared to those who were physically active. Meanwhile, family history of hypertension remains a major non-modifiable determinant of high blood pressure.[5]

In a study by Eva and Syafie Ishak, it was found that out of 43 women in the hypertensive group, the majority had a family history of hypertension, with 33 individuals (76.7%) reporting a family history. In the control group (43 women without hypertension), 22 individuals (51.2%) had a family history.[2] Women aged ≥40 years with a family history of hypertension are 3.710 times more likely to develop hypertension compared to women without such a family history.[2] No local study has specifically examined the relationship between physical activity, family history, and blood pressure in women aged ≥40 years in Mengwitani Village. The researcher was motivated to conduct the study in Mengwitani due to the high incidence of hypertension, with 431 cases, the majority of which occur in women over 40 years old.[2] Mengwitani Village has unique demographic characteristics and lifestyle factors, such as low physical activity levels and a high prevalence of family history of hypertension, which may influence blood pressure in women aged ≥40 years. Therefore, conducting a local study to understand the factors contributing to hypertension in this area is essential.[2]

This study aims to analyze the relationship between physical activity and blood pressure, and the relationship between family history and blood pressure in women aged ≥40 years in Mengwitani Village. This study hypothesizes a significant relationship between physical activity and blood pressure (a negative relationship), and between family history and blood pressure (a positive relationship).

Methods

This study used an analytical observational method with a cross-sectional approach, with independent variables being physical activity and family history, and the dependent variable being blood pressure. This design was chosen because it allows for an efficient evaluation of the relationship between variables simultaneously, particularly within a community population. The study was conducted in Mengwitani Village in February 2025. Data collection took place over one week, from February 3 to 9, 2025.

From the total population of women aged ≥40 years, which amounts to 431 individuals in Mengwitani Village, the sampling technique used in this study was purposive sampling. The sample size was 83 individuals, selected from the population based on inclusion and exclusion criteria. The initial sample based on inclusion criteria consisted of 102 individuals; however, only 83 met all requirements and agreed to participate. Local Posyandu cadres assisted subject recruitment through counseling sessions at the local Banjar hall.

Bias control was implemented by controlling for gender and age, which were selected through inclusion and exclusion criteria. The inclusion criteria for this study were as follows: subjects were women aged 40 years and older, residing in Mengwitani Village, and voluntarily willing to participate by signing an informed consent form provided by the researcher. The exclusion criteria included subjects with mental health disorders and those unable to communicate, as identified through an initial interview.

The research procedure began with providing information about the study, such as the objectives, benefits, and procedures, and obtaining informed consent from the participants as their agreement to participate. This was followed by a general anamnesis, which included collecting information such as name, age, gender, occupation, and whether there was a family history of hypertension. The next step involved measuring physical activity levels using the Indonesian version of the Global Physical Activity Questionnaire (GPAQ), which has been translated and validated by the Ministry of Health of the Republic of Indonesia. The researcher distributed the questionnaire to the subjects and explained how to fill it out. If any subjects encountered difficulties, the researcher assisted. Physical activity levels were categorized as low, moderate, or high based on the GPAQ scoring guidelines from the World Health Organization (WHO).

Blood pressure was measured seated after a 5-minute rest, with two measurements taken 5 minutes apart. If the difference between the two readings was >5 mmHg, a third measurement was taken, and the average of the two closest values was used. Measurements were conducted by the researcher, who had received prior training. The device used was an Omron HEM-7130 digital blood pressure monitor validated for clinical use. Blood pressure categories were determined based on the 2020 PERKI guidelines: normal (<120/80 mmHg), prehypertension (120–139/80–89 mmHg), and hypertension (≥140/90 mmHg). Family history of hypertension in this study was defined as having a father, mother, or sibling who had been diagnosed with hypertension by a healthcare provider.

Following data collection, data processing was carried out statistically using IBM SPSS 27.0, which included both univariate and bivariate analyses. Univariate analysis aimed to describe each variable's characteristics and frequency distribution, including age, occupation, physical activity level, family history of hypertension, and blood pressure. Bivariate analysis was used to examine the relationships between physical activity and blood pressure, as well as family history and blood pressure. The Spearman correlation test was employed to analyze the relationship between two ordinal variables (physical activity level and blood pressure). In contrast, the chi-square test was used to examine the relationship between the nominal variable (family history of hypertension) and categorical blood pressure. A significance level of $p < 0.05$ was used for statistical analysis. In cases of missing data, the corresponding subjects were excluded from the study for the relevant variable.

The researcher also considered potential confounding variables such as body mass index (BMI) and occupation, which were analyzed descriptively but not included in the bivariate model due to sample size limitations. Although these variables were not studied in the bivariate test due to sample constraints, they will be considered for further analysis or future research.

Potential biases, such as recall bias in reporting physical activity and family history, were minimized using a structured questionnaire and repeated explanations from the researcher. Interviewer bias was controlled by training the

data collectors to ensure consistency in their data collection procedures. This study has obtained ethical approval from the Ethics Research Committee of the Faculty of Medicine, Udayana University, with the ethical approval number: 0454/UN14.2.2.VII.14/LT/2025.

Results

From the accessible population of women aged ≥40 years in Mengwitani Village, 83 individuals met the inclusion criteria, and no missing data were identified during the data collection phase. A flow diagram of recruitment and subject selection is shown in Figure 1, which illustrates the process from placing the initial population to the final number of subjects analyzed.

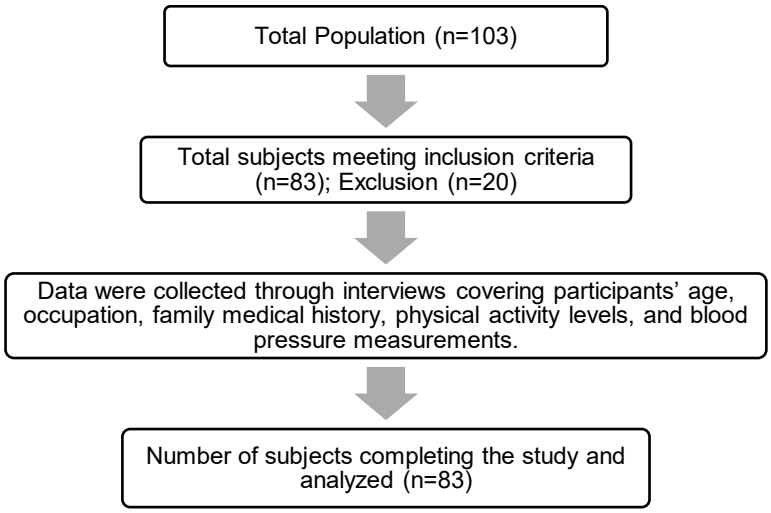

Figure 1. Research Flowchart

The characteristics of the study subjects, including age, occupation, physical activity level, family history of hypertension, and blood pressure, are presented in several tables. There were no missing data for any of the variables analyzed. The subject characteristics based on age and occupation are shown in Table 1, indicating that most subjects were from the non-working group, followed by an equal number of subjects in the categories of private employees, traders, and farmers.

Table 1. Distribution of Subjects Based on Age and Occupation

Variable	Frequency (n)	Percentage (%)
Age (years)		
41–50	25	30.1
51–60	21	25.3
61–70	29	34.9
71–80	8	9.6
Occupation		
Unemployed	37	44.6
Civil Servant	10	12.0
Seamstress	3	3.6
Private Employee	11	13.3
Trader	11	13.3
Farmer	11	13.3
Total	83	100

As shown in Table 1, the most significant proportion of subjects came from the non-working group, totaling 37 individuals (44.6%). The largest groups were private employees, traders, and farmers, with 11 individuals (13.3%). There were 10 civil servants (12%) and three seamstresses (3.6%).

The distribution of subjects based on physical activity level is shown in Table 2, which indicates that most subjects were classified in the moderate physical activity category, followed by the low and high activity categories.

Table 2. Distribution of Subjects Based on Physical Activity Level

Physical Activity	Frequency (n)	Percentage (%)
High (>3000 METs/min/week)	13	15.7
Moderate (600–3000 METs/min/week)	45	54.2
Low (<600 METs/min/week)	25	30.1
Total	83	100

Based on Table 2, the majority of subjects (54.2%) had moderate physical activity (600–3000 METs/min/week), followed by 25 subjects (30.1%) in the low activity category (<600 METs/min/week), and 13 subjects (15.7%) in the high activity category (>3000 METs/min/week).

The family history of hypertension among subjects is presented in Table 3, which shows that most subjects did not have a family history of hypertension.

Table 3. Distribution of Subjects Based on Family History of Hypertension

Family History of Hypertension	Frequency (n)	Percentage (%)
No	49	59.0
Yes	34	41.0
Total	83	100

Based on Table 3, 49 subjects (59%) did not have a family history of hypertension, while 34 subjects (41%) had a family history of hypertension.

The blood pressure categories of the subjects are shown in Table 4, which indicates that the most significant proportion of subjects had normal blood pressure, followed by the pre-hypertension and stage 1 hypertension categories.

Table 4. Distribution of Subjects Based on Blood Pressure Category

Blood Pressure (mmHg)	Frequency (n)	Percentage (%)
Normal	31	37.3
Pre-Hypertension	19	22.9
Stage 1 Hypertension	15	18.1
Stage 2 Hypertension	5	6.0
Isolated Systolic Hypertension	13	15.7
Total	83	100

Based on Table 4, 31 subjects (37.3%) had normal blood pressure. Nineteen subjects (22.9%) were classified as pre-hypertensive, 15 subjects (18.1%) had stage 1 hypertension, five subjects (6.0%) had stage 2 hypertension, and 13 subjects (15.7%) were classified as having isolated systolic hypertension. The blood pressure classification followed the JNC 7 guidelines.

The results of the Spearman test between physical activity level and blood pressure are shown in Table 5, which indicates a significant negative correlation between the two variables.

Table 5. Results of Spearman Test Between Physical Activity Level and Blood Pressure

Correlation Variables	Correlation Coefficient (r)	p-value
Physical Activity Blood Pressure	-0.419	p < 0.001

Based on Table 5, the Spearman bivariate test results show a significant relationship between physical activity level and blood pressure, with a p-value of <0.001. The correlation coefficient of -0.419 indicates a moderate negative correlation, meaning that blood pressure tends to increase as physical activity levels decrease, and vice versa.

The results of the Chi-square test between family history of hypertension and blood pressure are presented in Table 6, which shows a significant relationship between family history of hypertension and blood pressure category.

Table 6. Results of the Chi-square Test Between Family History of Hypertension and Blood Pressure

		Blood Pressure					Total	p-value
		Normal	Pre-Hypertension	Stage 1 Hypertension	Stage 2 Hypertension	Isolated Systolic Hypertension		
Family History of Hypertension	No	30 (61.2%)	13 (26.5%)	2 (4.1%)	1 (2.0%)	3 (6.1%)	49 (100%)	<0,001
	Yes	1 (2.9%)	6 (17.6%)	13 (38.2%)	4 (11.8%)	10 (29.4%)	34 (100%)	
Total		31 (37.3%)	19 (22.9%)	15 (18.1%)	5 (6.0%)	13 (15.7%)	83 (100%)	

Based on Table 6, the Chi-square test indicates a significant relationship between family history of hypertension and blood pressure category, with a p-value of 0.027. Subjects with a family history of hypertension were more likely to be categorized in the hypertension categories compared to those without a family history.

Discussion

Characteristics of the Study Subjects

This study was conducted on women aged 40 years and older in Mengwitani Village, with a total sample of 83 individuals selected using purposive sampling. The research was conducted in February, beginning with subject selection based on inclusion and exclusion criteria, followed by interviews about hypertension history, occupation, physical activity levels via the GPAQ questionnaire, and blood pressure measurements.

The age distribution showed that the majority of the subjects were in the 61-70 years age group (34.9%), followed by the 41-50 years group (30.1%), the 51-60 years group (25.3%), and the 71-80 years group (9.6%). These findings are consistent with the study by Nurhayati et al., which found a significant relationship between age and hypertension (r = 0.632; p = 0.000), where aging contributes to increased blood pressure due to physiological aging processes such as endothelial dysfunction and arterial stiffness.[6] Additionally, postmenopausal women are at a higher risk of hypertension due to the decrease in estrogen levels, which protects the cardiovascular system [7]

The majority of respondents in this study were unemployed (44.6%), consistent with research conducted at Puskesmas Janti and other studies that indicate being unemployed, particularly as housewives, is associated with an increased risk of hypertension due to low physical activity levels and high stress potential.[8] In terms of physical activity

levels, the majority of subjects fell into the moderate activity category (54.2%), followed by low activity (30.1%) and high activity (15.7%). This finding supports the study by Pefbrianti & Safitri, which also found that most elderly individuals fall into the moderate activity category.[9] Daily physical activities, such as walking, work, and household chores, are crucial in maintaining health, including blood pressure control. WHO guidelines and the Ministry of Health of the Republic of Indonesia (Permenkes No. 41 of 2022) emphasize the importance of engaging in at least 150 minutes of physical activity per week to reduce the risk of non-communicable diseases, including hypertension [10]

Regarding the family history of hypertension, most respondents did not have a family history (59%), while 41% did. This is consistent with the study by Widiyani et al., which found that individuals with a family history of hypertension have a 3.7 times greater risk of developing hypertension than those without a family history.[11] Regarding blood pressure measurements, 37.3% of respondents had normal blood pressure, while 62.7% were in the pre-hypertension to stage 2 hypertension range. These findings are consistent with the study by Heriziana, which found that 66.7% of respondents had high blood pressure.[12]

The Relationship Between Physical Activity and Blood Pressure

Spearman's rho analysis revealed a significant negative correlation between physical activity levels and blood pressure ($r = -0.419$; $p = 0.001$). This means that as physical activity decreases, blood pressure tends to increase. These findings support the study's primary aim: to identify the relationship between physical activity levels, family history of hypertension, and blood pressure in women aged 40 and older.

This result is consistent with studies by Maskanah et al. and Hasanudin et al., which found a negative correlation between physical activity and blood pressure.[13] The underlying mechanisms include increased vascular elasticity, reduced peripheral resistance, and improved blood flow to the heart. Regular physical activity can also reduce systolic and diastolic blood pressure by 4-9 mmHg.[14]

A study by Hasanudin et al. also revealed that physical activity is associated with hypertension levels. Their research demonstrated a negative correlation between physical activity and blood pressure among individuals with hypertension in the Tlogosuryo area, Tlogomas Subdistrict, Lowokwaru District, Malang City, indicating that lower physical activity is associated with higher blood pressure.[15] These findings are consistent with previous research stating that physical activity controls blood pressure by improving vascular elasticity and reducing peripheral resistance.[16]

These findings can serve as a basis for implementing the Posbindu PTM (Non-communicable Disease Integrated Health Post) program in the village, focusing on early detection and promoting physical activity among women aged 40 and older.

The Relationship Between Family History of Hypertension and Blood Pressure

Chi-square analysis revealed a significant relationship between family history of hypertension and blood pressure ($p = 0.001$). Subjects with a family history of hypertension had a higher prevalence of hypertension. These findings align with studies conducted in various regions, such as Pekanbaru, Kendal, and Kampar, which indicate that genetic factors and family history strongly predict hypertension.

These findings are consistent with a study on hypertension risk factors among communities living near the Siak River, Rumbai Subdistrict, Pekanbaru City. The study indicated that the majority of respondents with hypertension—71.8%—had a family history of the condition.[17] Individuals with a family history of hypertension or heart disease are at a 2- to 5-fold increased risk of developing hypertension. Genetic predisposition within families contributes to this elevated risk, particularly due to increased intracellular sodium levels and a lower potassium-to-sodium ratio. A person whose parents have hypertension is twice as likely to develop the condition compared to individuals without such a family history.[14]

When hypertension is inherited from parents, the likelihood of developing primary hypertension also increases. Genetic inheritance plays a significant role in the onset of hypertension. Studies have shown that 90% of individuals with hypertension have a genetic factor as the primary trigger. Nevertheless, while genetic factors do contribute to the development of hypertension, external factors such as lifestyle habits also play a significant role in elevating the risk of this disease.[12]

Family history of hypertension is considered an unmodifiable risk factor, but it is essential to monitor. Therefore, individuals with a family history of hypertension should adopt a healthy lifestyle, including increasing physical activity, maintaining a balanced diet, and controlling body weight and stress. According to the Health Belief Model, individuals aware of their health risks due to family history are more likely to take preventive actions, such as increasing physical activity.[11] The interaction between family history of hypertension and low physical activity may synergistically increase the risk of hypertension. Therefore, prevention strategies should consider a comprehensive approach addressing both factors.

Study Limitations

This study has several limitations that should be considered. First, the cross-sectional design does not allow for establishing causal relationships between the variables examined, such as whether low physical activity leads to hypertension or vice versa.

Second, using the self-report Global Physical Activity Questionnaire (GPAQ) may introduce information bias. For instance, respondents may tend to overestimate their physical activity levels due to social desirability or lack of awareness about the intensity of their activities.

Furthermore, the purposive sampling technique used in this study, which focused on a single village, Mengwitani, limits the generalizability of the findings to broader populations, as the local characteristics may differ from those in other regions.

Third, this study did not analyze other factors that may influence blood pressure, such as salt consumption, body weight, or psychological stress, which could significantly contribute to the development of hypertension. Therefore, future research should use longitudinal or cohort designs to assess cause-and-effect relationships more accurately and include other relevant lifestyle variables.

Generalization and Implications

The findings of this study provide a better understanding of the relationship between physical activity, family history of hypertension, and blood pressure among women aged 40 and older in Mengwitani Village. While this study is limited to a sample from a single village, the results still offer essential insights for hypertension prevention efforts at the community level. Thus, the findings can be generalized to similar populations in regions with comparable demographic characteristics, especially in rural areas or regions with similar population structures.

The implications of this study are highly relevant for public health policies, particularly in promoting physical activity as a preventive measure for hypertension. Programs such as the Posbindu PTM (Non-communicable Disease Integrated Health Post) should be enhanced to emphasize the importance of regular physical activity and provide education on managing risk factors, such as the family history of hypertension.

Additionally, the findings offer a basis for developing more personalized intervention programs, considering the family history of hypertension as an unmodifiable risk factor. Therefore, increasing public awareness regarding modifiable risk factors is crucial, such as increasing physical activity, adopting a balanced diet, and managing stress.

This study also opens up opportunities for further research in the future, including studies involving more diverse populations and exploring other factors that may influence blood pressure, such as salt consumption, psychological stress, and dietary habits. With a more comprehensive approach, more effective solutions could be found for managing hypertension among women aged 40 and older, both at the individual and community levels.

Conclusion

This study highlights the significant relationships between physical activity levels, family history of hypertension, and blood pressure among women aged 40 and older in Mengwitani Village. The results indicate that increased physical activity is associated with lower blood pressure, supporting the role of physical activity as a preventive measure against hypertension. Furthermore, a family history of hypertension was found to significantly increase the risk of developing hypertension, emphasizing the importance of monitoring and managing genetic risk factors.

Despite the study's limitations, including its cross-sectional design and use of purposive sampling, the findings provide valuable insights for hypertension prevention programs at the community level. The results suggest that interventions promoting physical activity, alongside raising awareness about the risks associated with a family history of hypertension, could play a crucial role in managing blood pressure and preventing hypertension among women in this age group.

Future research should aim to explore additional lifestyle factors, such as dietary habits and stress management, and employ longitudinal or cohort designs to establish causal relationships. Expanding research to diverse populations will also help generalize the findings and contribute to more effective public health strategies in hypertension management.

Author Contributions

I Komang Dino Suryadana Putra: Conceptualization, methodology, data collection, data analysis, and manuscript drafting.
Ni Luh Nopi Andayani: Supervision, guidance on research design, and critical review of the manuscript.
Anak Agung Eka Septian Utama: Supervision, validation, and manuscript editing.
I Wayan Sugiritama: Supervision, methodological consultation, and final manuscript review.

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Conflict of Interest Statement

The authors declare that there are no conflicts of interest related to this study.

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Ethics Statement

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of the Faculty of Medicine, Universitas Udayana (Approval No. 0454/UN14.2.2.VII.14/LT/2025). All participants provided informed consent prior to data collection.

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