



Factors Related to the Incidence of Hypertension Among Hajj Pilgrims from Banjarmasin Indonesia in 2025

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Abstract: This study aimed to analyze the factors related to the incidence of hypertension among Hajj pilgrims from Banjarmasin Indonesia in 2025. This study used a quantitative approach with a cross-sectional study design. The sampling technique used total sampling with secondary data, as many as 1050 prospective Hajj pilgrims. Data analysis was carried out using SPSS software. The variable of age range with a p-value of <0.001 and adjusted PR was 6.23 with 95% CI (5.27-8.13). Age 41 to 60 years old had adjusted PR was 3.46 with 95% CI (2.38-5.22). The variable of diabetes mellitus had a p-value of <0.001 and adjusted PR of 1.74 with 95% CI (1.44-1.95). The variable of hyperlipidemia had a p-value of <0.001 and adjusted PR of 1.36 with 95% CI (1.28-1.59). The variable of heart disease/heart failure with p-value <0.001 and obtained adjusted PR of 1.28 with 95% CI (1.20-1.47). The variable of family history of hypertension with p-value <0.001 and obtained adjusted PR of 1.72 with 95% CI (1.62-1.94). The study concluded that the factors related to hypertension incident in Hajj pilgrims of Banjarmasin Indonesian in 2025, were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension.

Keywords: Hajj Pilgrims; Hypertension; Hypertension Incidents

Introduction

Hypertension causes 8.5 million deaths annually worldwide, including those from ischemic heart disease, stroke, vascular disease, and kidney disease (Chen et al., 2022; Harahap & Nurwahyuni, 2018). According to Ghosh & Kumar (2019), the number of people aged 30 to 79 with hypertension has doubled worldwide from 1990 to 2019. Globally, 59% of women and 41% of men have hypertension, and only 47% of women and 38% of men receive treatment (Harrison et al., 2021). A major contributor to cardiovascular disease in Indonesia is the increasing prevalence of hypertension, which reached 34.1% of the adult population in 2018, up from 25.8% in 2013 (Ardiana & Nirwana, 2024).

Persistent pressure on blood vessels is known as hypertension, also referred to as high blood pressure. Hypertension is a serious medical condition that can increase the risk of heart, brain, kidney, and other diseases, where systolic blood pressure is the peak pressure produced by heart contractions when expelling blood from the arteries, while diastolic blood pressure is blood pressure that is lower or higher than normal (Angell et al., 2015; Asresahegn et al., 2017; Liberty et al., 2019).

Hypertension is a disease characterized by elevated systolic and diastolic blood pressure above normal values, or above 140/90 mmHg (Sahadevan et al., 2024). Hypertension is a major risk factor for cardiovascular disease, a leading cause of morbidity and mortality during the Hajj (Aldosarry et al., 2019; Ayoade & Umoh,

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2020). Abnormal cholesterol levels are a sign of hypertension, characterized by elevated serum levels of total cholesterol, triglycerides, and LDL cholesterol, and decreased serum levels of HDL cholesterol, which are indicative of atherosclerotic cardiovascular disease (Wyszyńska et al., 2023).

According to Gaddoury & Armenian (2023), hypertension-induced shear stress on the endothelium leads to oxidative stress, which increases lipoprotein permeability in blood vessels and leads to arteriosclerosis. Hypertension is a risk factor for blood vessel damage and cardiovascular disease, and is often associated with diseases that cause death during the Hajj pilgrimage (Alandijany, 2023; Yezli et al., 2021).

The Hajj is the fifth Islamic obligation, performed once in a lifetime by every able-bodied Muslim. In Surah Ali Imran, verse 97 of the Quran, it is explained that performing the Hajj is a human obligation towards Allah, specifically for those who are able (istithaah) to travel to the House of Allah. Consequently, istithaah (including health istithaah) is considered a mandatory requirement for performing the Hajj in Islamic jurisprudence. Indonesia is a Muslim country with the largest number of Hajj pilgrims.

According to Law Number 13 of 2008 concerning the Implementation of the Hajj Pilgrimage, the purpose of organizing the Hajj pilgrimage is to provide the best possible guidance, service, and protection to Hajj pilgrims so that they can perform their pilgrimage in accordance with Islamic teachings. Hajj pilgrims are Muslims who intend to perform the Hajj pilgrimage, have the physical ability to carry out the pilgrimage rituals, and pay for travel expenses, whether they join the Hajj Guidance Group (KBIH) or the government (Imamah et al., 2025; Pusparina et al., 2020).

The guidance, services, and protection provided to Hajj pilgrims include both general and health-related matters (Noh et al., 2020; Rustika et al., 2020). According to the Integrated Computerized Hajj Health System (Siskohatkes), as of May 23, 2025, 53 pilgrims had died in the Holy Land. The Hajj pilgrimage in 2025 concluded with the return of flight group (Kloter) KJT 28 to Indonesia on July 10, 2025. During the Hajj, the Madinah Hajj Work Unit (KKHI) provided inpatient and outpatient care to 241 pilgrims.

Pneumonia, hypertension, and diabetes mellitus were the three most frequently treated conditions. Of those, 19 died from heart attacks due to acute ischemic heart disease and cardiogenic shock. According to the Ministry of Health, the health profile of Indonesian Hajj pilgrims is dominated by the elderly (lansia) aged 60 and over, accounting for 44% in 2023 and 37% in 2024 (Wirda et al., 2025). The Indonesian Ministry of Health reminds pilgrims, especially those who are older and have other

medical conditions, to be more cautious when performing the voluntary pilgrimage, as data collected shows alarming figures.

The Indonesian Ministry of Health's 2025 Hajj pilgrim health profile data covers 203,149 regular pilgrims from Banjarmasin, grouped into 502 groups. Furthermore, 73% of pilgrims in 2024 had comorbidities. In 2025, the Ministry of Health proposed four strategic policies for the implementation of Hajj health services, in line with the theme of Hajj in 2025, "Elderly and Disability-Friendly Hajj." First, improving health guidance for pilgrims through health screening during the waiting period, integrating guidance with related Ministry of Health programs, preparing standard guidance materials in Indonesia and Saudi Arabia, and collaborating with cross-sectoral, professional organizations, KBIH (Islamic Board of Trustees), and other community groups.

Second, to determine the health status of Hajj pilgrims, it is necessary to improve the standards of health examinations for Hajj pilgrims in accordance with the Decree of the Minister of Health No. HK.01.07/MENKES/508/2024 concerning Technical Standards for Health Examination in the Context of Determining the Health Status of Hajj Pilgrims, through increasing the capacity and certification of health examination teams in provinces and districts/cities, as well as strengthening the integrated Hajj computerized system (Siskohat and Siskohatkes) (Ardiana et al., 2023).

Finally, improving Hajj health services in Saudi Arabia by adding satellite health posts at every hotel in Mecca, employing specialist doctors and health promotion personnel in every sector, and purchasing medical equipment to improve the quality of services at the KKHI, such as mobile X-rays, echocardiograms, electrocardiograms, and sanitation kits. This study aims to analyze the factors related to the incidence of hypertension among Hajj pilgrims from Banjarmasin Indonesia in 2025.

Method

This study uses a quantitative approach with a cross-sectional study design. Secondary data used comes from data on visits to the Hajj polyclinic in 2025 from the Ministry of Health of the Republic of Indonesia. The sampling technique use total sampling, as many as 1050 prospective Hajj pilgrims based on sociodemographic characteristics such as gender, age range, job profile, educational background, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension as independent variables through the level of hypertension diagnosis as dependent variable.

The inclusion criteria for this study were Hajj pilgrims who underwent the third stage of health checks at the Banjarmasin embarkation point and had no duplicate data. Meanwhile, the exclusion criteria are not having complete risk factor and disease data in the health examination results contained in Siskohatkes. Data analysis was carried out using SPSS to identify descriptive statistics, bivariate analysis and multivariate analysis comprehensively to draw significant conclusions.

Result and Discussion

The results of the study on the 2025 Hajj pilgrims suffering from hypertension in Banjarmasin obtained the characteristics of the sociodemographic profiles of the respondents consisting of gender, age range, job profile, educational background, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension as independent variable which are presented in Table 1.

Table 1. Sociodemograph Profile Characteristics as Independent Variables

Variable	Frequency (n)	Percentage (%)
Hypertension Incident		
Hypertension	313	29.80
Non-Hypertension	737	70.20
Gender		
Male	436	41.52
Female	614	58.48
Age Range		
Under 40 years old	135	12.85
41 to 60 years old	547	52.09
More than 60 years old	368	35.06
Job Profile		
Private Sector	816	77.71
Public Sector	139	13.23
Student	10	0.95
Military/Police	3	0.28
Retired of	82	7.83
Military/Police/Public Sector		
Educational Background		
Low Education Level (Did not complete elementary school/Elementary school)	367	34.91
Middle Education Level (Junior high school/ Senior high school)	465	44.29
High Education Level (Diploma/Bachelor/Master/PhD)	218	20.80

Variable	Frequency (n)	Percentage (%)
Hypertension Incident		
DM (Diabetes Mellitus)		
Yes	244	23.27
No	806	76.73
Hyperlipidemia		
Yes	176	16.76
No	874	83.24
Heart Disease/Heart Failure		
Yes	164	15.61
No	886	84.39
Family History of Hypertension		
Yes	203	19.33
No	847	80.67

Based on the descriptive analysis on Tabel 1 show that a total of 313 respondents (29.80%) in this study had hypertension, while 737 (70.20%) respondents did not. Gender distribution showed a predominance of female respondents at 614 (58.48%), while males comprised 436 (41.52%). Based on age range, the largest age group was 41–60 years old about 547 (52.09%), followed by under 40 years old about 135 (12.85%) and the smallest proportion are more than 60 years old about 368 (35.06%) from total respondents. In terms of occupational profile, the largest group came from private sector about 816 (77.71%), followed by public sector about 139 (13.23%), retired of military/police/public sector about 82 (7.83%), the smallest group came from student about 10 (0.95%), and military/police about 3 (0.28%).

In terms of educational background, the majority of respondents had a middle education about 465 (44.29%), followed by low education about 367 (34.91%), and the minority of respondents had a high education about 218 (20.80%). Meanwhile, in terms of diabetes mellitus, the majority of respondent have no diabetes mellitus about 806 (76.73%) and they have diabetes mellitus about 244 (23.27%). In terms of hyperlipidemia, the majority of respondent have no hyperlipidemia about 874 (83.24%) and they have hyperlipidemia about 176 (16.76%).

In terms of heart disease/heart failure, the majority of respondent have no heart disease/heart failure about 886 (84.39%) and they have heart disease/heart failure about 164 (15.61%). In terms of family history of hypertension, the majority of respondent have no family history of hypertension about 847 (80.67%) and they have family history of hypertension about 203 (19.33%). Based on the results of the descriptive analysis of the independent variables, it can be concluded that the incidence of hypertension occurred in 313 people, but there were fewer accompanying diseases such as diabetes mellitus, hyperlipidemia, heart disease/heart failure and a family history of hypertension.

The bivariate analysis of respondents' sociodemographic profile characteristics consisting of gender, age range, job profile, educational background, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension as independent variables on hypertension as dependent variable among the Hajj pilgrims of Banjarmasin Indonesia in 2025. The bivariate Chi-Square test is a statistical analysis method used to test the relationship or association between two categorical variables (nominal or ordinal).

This test compares the observed frequency in each category with the expected frequency if there were no

relationship between the variables. The significance value (p-value) of this test indicates whether the difference between the observed and expected frequencies occurred by chance or is statistically significant. The decision-making criteria typically use a significance level (α) of 0.05, where: p-value < 0.05 indicates a significant relationship between the variables; p-value \geq 0.05 indicates no significant relationship between the variables. The results of the bivariate analysis are presented in Table 2.

Table 2. Risk Factors Related to Hypertension on Hajj Pilgrims of Banjarmasin Indonesia in 2025

Variable	Hypertension n (%)	Non-Hypertension n (%)	p-value	PR (95%CI)
Gender				
Male	166 (53.04)	270 (36.64)	0.244	0.91 (0.86-1.13)
Female	147 (46.96)	467 (63.36)		Ref
Age Range				
More than 60 years old	101 (32.27)	267 (36.23)	0.000*	4.82 (3.65-6.42)
41 to 60 years old	186 (59.42)	361 (48.98)	0.018*	4.26 (3.46-6.27)
Under 40 years old	26 (8.31)	109 (14.79)		Ref
DM (Diabetes Mellitus)				
Yes	157 (50.16)	87 (11.80)	0.000*	1.28 (1.12-1.78)
No	156 (49.84)	650 (88.20)		Ref
Hyperlipidemia				
Yes	118 (37.70)	58 (7.87)	0.000*	1.16 (0.8-1.28)
No	195 (62.30)	679 (92.13)		Ref
Heart Disease/Heart Failure				
Yes	122 (38.98)	42 (5.70)	0.017*	1.68 (1.61-1.82)
No	191 (61.02)	695 (94.30)		Ref
Family History of Hypertension				
Yes	144 (46.00)	59 (8.00)	0.024*	1.72 (1.65-1.87)
No	169 (54.00)	678 (92.00)		Ref

Based on the results of bivariate analysis in Table 2, it was found that several risk factors that were significantly associated with the incidence of hypertension which p-value <0.05 were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension. Variable of age range above 60 years old (PR = 4.82; 95%CI: 3.65-6.42; p-value = 0.000) means that the chance of hypertension in Hajj pilgrims aged above 60 years old is 4.82 times greater than Hajj pilgrims aged under 40 years, aged 41 to 60 years old (PR = 4.26; 95%CI: 3.46-6.27; p-value = 0.018) means that the chance of hypertension in Hajj pilgrims aged 41 to 60 years old is

4.26 times greater than Hajj pilgrims aged under 40 years old.

Variable of diabetes mellitus (PR = 1.28; 95%CI: 1.12-1.78; p-value = 0.000), this means that Hajj pilgrims with diabetes mellitus have a 1.28 times higher risk of developing hypertension compared to pilgrims without diabetes mellitus. Variable of hyperlipidemia (PR = 1.16; 95%CI: 0.8-1.28; p-value = 0.000), this means that Hajj pilgrims with hyperlipidemia have a 1.28 times higher risk of developing hypertension compared to pilgrims without hyperlipidemia.

Variable of heart disease/heart failure (PR = 1.68; 95%CI: 1.61-1.82; p-value = 0.027) means that in Hajj pilgrims with heart disease/heart failure have a 1.28 times higher

risk of suffering from hypertension compared to Hajj pilgrims who do not have heart disease/heart failure. Variable of family history of hypertension (PR = 1.72; 95%CI: 1.65-1.87; p-value = 0.027) means that in Hajj pilgrims who have a family history of hypertension have a 1.72 times higher risk of suffering from hypertension compared to Hajj pilgrims who do not have a family history of hypertension.

The purpose of the multivariate analysis in this study is to determine the relationship between the independent and dependent variables simultaneously. To determine the relationship about risk factors related to hypertension incident on Hajj pilgrims, the statistical test used is the Chi-Square test. The interpretation of the magnitude of the effect is expressed as a PR (Prevalence Ratio) and a 95% CI (Confident Interval). The PR is the estimated risk value for the outcome as influenced by the presence of an independent variable. PR>1 indicates a risk factor for the disease. Multivariate analysis uses Cox regression. Cox regression analysis is recommended for calculating the PR in cross-sectional designs.

Selection of candidate variables for inclusion in the model: From the results of the bivariate analysis that has been tested using the Chi-Square test, independent variables with a p-value <0.25 are selected as candidates for inclusion in the multivariate model. Next, the first multivariate model is performed. All selected variables are entered into the first multivariate model. The second model is then performed, leading to the final model. In the first model, variables with a p-value >0.05 are examined. Then, these variables were removed one by one, starting with the highest P-value, to determine the risk factors associated with hypertension.

The independent variables that contributed most significantly to the risk factors were those in the final stage of the modeling. The results of the multivariate analysis between the full model and final model that related to hypertension incident among Hajj Pilgrims Banjarmasin Indonesia in 2025 which can be presented in Table 3.

Table 3. Multivariate Analysis of Full Model and Final Model on Hypertension Incident Among Hajj Pilgrims Banjarmasin Indonesia in 2025

Variable	Full Model		Final Model (Adjusted)	
	PR	p-value	PR	p-value
Age Range*				
More than 60 years old	6.36 (5.68-8.34)	<0.001	6.23 (5.27-8.13)	<0.001
41 to 60 years old	3.78 (3.57-4.42)	<0.001	3.46 (2.38-5.22)	<0.001
Under 40 years old	Ref		Ref	
DM (Diabetes Mellitus)*	1.33 (1.27-1.56)	<0.001	1.74 (1.44-1.95)	<0.001
Hyperlipidemia	1.15 (1.04-1.31)	<0.001	1.36 (1.28-1.59)	<0.001
Heart Disease/Heart Failure	1.24 (1.16-1.43)	<0.001	1.28 (1.20-1.47)	<0.001
Family History of Hypertension*	1.66 (1.48-1.74)	<0.001	1.72 (1.62-1.94)	<0.001

*After adjusted with hyperlipidemia and heart disease/heart failure

From the bivariate analysis, independent variables with a p-value <0.25 or significant significance were selected as candidates for inclusion in the multivariate model. Based on the bivariate selection results, five independent variables were identified for inclusion in the multivariate analysis (see Table 3). Next, the variables with the highest p-values were removed one by one until a final model (fit model) was obtained. The results of the final multivariate analysis, as shown in Table 3, indicate that the risk factors related to hypertension on Hajj pilgrims Banjarmasin Indonesia in 2025, were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and a family history of hypertension.

The variable of age range with a p-value of <0.001 and adjusted PR for ages over 60 years old was 6.23 with 95% CI (5.27-8.13), which means that Hajj pilgrims aged over 60 years old have 6.23 times risk of suffering from hypertension compared to Hajj pilgrims aged under 40 years old. Age 41 to 60 years old have adjusted PR is 3.46 with 95% CI (2.38-5.22), which means that Hajj pilgrims aged 41 to 60 years old have 3.46 times risk of experiencing hypertension compared to Hajj pilgrims aged under 40 years old.

The variable of diabetes mellitus had a p-value of <0.001 and adjusted PR of 1.74 with a 95% CI (1.44-1.95), indicating that Hajj pilgrims with a history of diabetes mellitus have 1.74 times higher risk of developing

hypertension compared to Hajj pilgrims without diabetes mellitus. The variable of hyperlipidemia with a p-value of <0.001 and adjusted PR of 1.36 with 95% CI (1.28-1.59), indicating that Hajj pilgrims with a history of hyperlipidemia had a 1.36 times higher risk of developing hypertension compared to Hajj pilgrims without hyperlipidemia.

The variable of heart disease/heart failure with p-value <0.001 and obtained adjusted PR of 1.28 with 95% CI (1.20-1.47), which means that pilgrims who have heart disease/heart failure have 1.28 times higher risk of suffering from hypertension compared to pilgrims who do not have heart disease/heart failure. The variable of family history of hypertension with p-value <0.001 and obtained adjusted PR of 1.72 with 95% CI (1.62-1.94), which means that pilgrims who have a family history of hypertension have 1.72 times greater risk of experiencing hypertension compared to pilgrims who do not have a family history of hypertension.

This study show that proportion of hypertension incident on Hajj pilgrims of Banjarmasin Indonesian in 2025 around 29.80%. Based on the results of the final multivariate modeling analysis, it was found that the factors related to the incidence of hypertension, were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension. Hajj pilgrims aged over 60 years old have 6.23 times risk of suffering from hypertension compared to Hajj pilgrims aged under 40 years old. Hajj pilgrims aged 41 to 60 years old have 3.46 times risk of experiencing hypertension compared to Hajj pilgrims aged under 40 years old.

The research result from Rahimi (2021) stated that participants varied in age from 21 to 105 years (median age 65 [IQR 59–75]), with 42960 (12.0%) under 55, 128437 (35.8%) between 55 and 64, 128506 (35.8%) between 65 and 74, 54016 (15.1%) between 75 and 84, and 4788 (1.3%) above 85. For each age group, the hazard ratios for the risk of major cardiovascular events per 5 mm Hg reduction in systolic blood pressure were 0.82 (95% CI 0.76–0.88) for those under 55, 0.91 (0.88–0.95) for those between 55 and 64, 0.91 (0.88–0.95) for those between 65 and 74, 0.91 (0.87–0.96) for those between 75 and 84, and 0.99 (0.87–1.12) for those 85 years and older (adjusted p-interaction=0.050).

Oppositely from Cheng et al. (2022), between the ages of 35 and 79, the risk of high SBP increased steadily, while the risk of high DBP increased at the same time. After the ages of 50 and 65, the risk of high DBP decreased. For men, the risk of SBP grows linearly with age, but for women, it increases nonlinearly. Furthermore, it was discovered that middle-aged individuals had a markedly higher risk of high SBP over

the previous ten years, with men experiencing a longer but later rise in high SBP than women.

Hajj pilgrims with a history of diabetes mellitus have 1.74 times higher risk of developing hypertension compared to Hajj pilgrims without diabetes mellitus. The research result from Damayanti, Yonata, & Kurniawaty (2023) stated that only 48% of people can reach a blood pressure goal of less than 130/80 mmHg. Sedentary lifestyle, excessive calorie intake, insulin resistance, autonomic nervous system dysregulation, early vascular aging, elevated intravascular volume, renal dysfunction, renin-angiotensin-aldosterone system (RAAS), innate and acquired immunity, as well as environmental and socioeconomic factors, are all linked to the pathophysiology of hypertension in diabetes mellitus.

Age, gender, education, marital status, blood type, total cholesterol, HDL, LDL, and triglyceride levels, smoking, employment, physical activity, body mass index, hypertension and diabetes mellitus heredity, length of time with DM, and blood glucose levels are risk factors for hypertension in diabetes mellitus (Damayanti et al., 2023). Additionally, a summary and presentation of the target blood pressure for individuals with diabetes mellitus as suggested by several guidelines were provided. Patients with diabetes mellitus who have high-risk clinical symptoms should have their blood pressure regulated to less than 130/80 mm Hg, whereas those with hypertension and diabetes mellitus should aim for a blood pressure of less than 140/90 mm Hg.

Hajj pilgrims with a history of hyperlipidemia had a 1.36 times higher risk of developing hypertension compared to Hajj pilgrims without hyperlipidemia. Wang et al. (2022) defined that 5.7% of people had an ischemic stroke. After controlling for age, sex, race, education level, family income, current smoking and drinking status, physical activity, body mass index, diabetes, family history of stroke, and atrial fibrillation, subjects with both HTN and HLP had a higher risk of ischemic stroke (odds ratio [OR]: 3.369, 95% confidence interval [CI]: 2.579–4.402) than those with only HTN (OR: 1.995, 95% CI 1.526–2.610) or HLP (OR: 1.321, 95% CI 0.937–1.862).

After controlling for covariates, the relative extra risk resulting from interaction (OR: 1.053, 95% CI 0.458–1.648) was positive with respect to the additive scale. Additionally, ischemic stroke had a synergistic index (S) of 1.8 (95% CI 1.157–2.801), indicating a synergistic interaction between HTN and HLP. After controlling for covariates, the interaction effect was likewise significant with respect to the multiplicative scale (OR: 2.163, 95% CI 1.817–2.575). Hajj pilgrims who have heart disease/heart failure have 1.28 times higher risk of

suffering from hypertension compared to pilgrims who do not have heart disease/heart failure.

The research result of Masenga & Kirabo (2023) stated that the number of processes contribute to the progression of hypertensive heart disease and raise the likelihood of unfavorable consequences. One of the modifiable elements that significantly contributes to the pathophysiology of hypertensive heart disease is excessive dietary salt. Cutting back on salt in the diet may lower blood pressure and the chance of developing hypertensive heart disease.

According to Camafort et al. (2025), the treatment of hypertensive heart disease in the elderly population may provide a therapeutic challenge since comorbidities, other pathologies, the ageing process itself, and the burden of high blood pressure must all be taken into account at the same time. Due to the possibility of subtle or unusual symptoms in older patients, caution is necessary with a low threshold for additional testing, such as imaging and electrocardiography. Results should be improved by frailty evaluation, shared decision-making, and suitable patient education.

Hajj pilgrims who have a family history of hypertension have 1.72 times greater risk of experiencing hypertension compared to pilgrims who do not have a family history of hypertension. Tozo et al. (2022) said in their result of research that 34.7% of the 118 parents who responded to the survey had a positive FH of AH. In comparison to girls without an FH, those with a positive FH had higher means of WC ($p=0,004$), BMI ($p=0,020$), and systolic blood pressure (SBP) ($p=0,006$), as well as a higher risk of being overweight (OR=4,48; 95%CI:1,55–12,94), having elevated WHtR (OR=5.98; 95%CI:1.66–21.47), and having elevated SBP (OR=3,07; 95%CI:1,03–9,13).

However, there were no variations in these parameters between those who had an FM of AH and those who did not. Insight from the research result of Chi et al. (2024) stated that the genetic predisposition to several types of stroke, such as ischemic stroke, subarachnoid hemorrhage, lacunar stroke, cardioembolic ischemic stroke, small vessel ischemic stroke, and large artery atherosclerosis-related ischemic stroke, was significantly influenced by the presence of a family history of hypertension.

This study presents an effective method for describing the distribution of hypertension in relation to various characteristics of the Hajj pilgrim population. This allows prevalence data to be used as an indicator of the disease burden experienced by the Hajj pilgrim population, which can ultimately inform the planning of Hajj health programs. Based on multivariate analysis, the factors related to hypertension incident in Hajj

pilgrims of Banjarmasin Indonesian in 2025, were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension.

Conclusion

The study concluded that the factors related to hypertension incident in Hajj pilgrims of Banjarmasin Indonesian in 2025, were age range, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension. Hajj pilgrims aged over 60 years old have 6.23 times risk of suffering from hypertension compared to Hajj pilgrims aged under 40 years old. Hajj pilgrims aged 41 to 60 years old have 3.46 times risk of experiencing hypertension compared to Hajj pilgrims aged under 40 years old. Hajj pilgrims with a history of diabetes mellitus have 1.74 times higher risk of developing hypertension compared to Hajj pilgrims without diabetes mellitus. Hajj pilgrims with a history of hyperlipidemia had a 1.36 times higher risk of developing hypertension compared to Hajj pilgrims without hyperlipidemia. Hajj pilgrims who have heart disease/heart failure have 1.28 times higher risk of suffering from hypertension compared to pilgrims who do not have heart disease/heart failure. Hajj pilgrims who have a family history of hypertension have 1.72 times greater risk of experiencing hypertension compared to pilgrims who do not have a family history of hypertension. This study has limitations in several aspects, especially related to the sample of respondents based on secondary data of embarkation Hajj pilgrims in Banjarmasin who have sociodemographic characteristics such as gender, age range, job profile, educational background, diabetes mellitus, hyperlipidemia, heart disease/heart failure, and family history of hypertension among the Hajj pilgrims of Banjarmasin Indonesia in 2025. so that more specific, complex and comprehensive data are needed. Future research can be conducted with a more complex and relevant design, incorporating more comprehensive variables, such as health awareness, health lifestyle, and health motivation, to identify other factors that may contribute more significantly to the incidence of hypertension among Indonesian Hajj pilgrims.

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Author Contributions

Author played an active role in the preparation of this article start from Aqso Ampri Harahap: Conceptualization, writing-early draft, data collection, data analysis. Kurnia Dwi Artanti: Supervisor, review, and editing. Dimas Agung Trisliatanto: Review, editing, and finishing.

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Conflicts of Interest

There is no conflict of interest in this research.

References

- Alandijany, T. A. (2023). Respiratory viral infections during hajj seasons. *Journal of Infection and Public Health*, 1–7. <https://doi.org/10.1016/j.jiph.2023.04.006>
- Aldosarry, M., Aljourdy, A., & Celentano, D. (2019). Health issue in the pilgrimage: A literature review. *Eastern Mediterranean Health Journal*, 25(10). Retrieved from <https://apps.who.int/iris/bitstream/handle/10665/333458/10203397192510-eng.pdf?sequence=1#page=82>
- Angell, S. Y., Cock, K. M., & Frieden, T. R. (2015). A public health approach to global management of hypertension. *The Lancet*, 385, 825–827. [https://doi.org/10.1016/S0140-6736\(14\)62256-X](https://doi.org/10.1016/S0140-6736(14)62256-X)
- Ardiana, M., & Nirwana, W. (2024). Dyslipidemia and hypertension among Indonesian hajj pilgrims: A cross-sectional study. *Jurnal Health Sains*, 5(8), 601–609. <https://doi.org/10.46799/jhs.v5i8.1344>
- Ardiana, M., Utami, E. R., Al Farabi, M. J., & Azmi, Y. (2023). The impact of classical cardiovascular risk factors on hospitalization and mortality among hajj pilgrims. *The Scientific World Journal*. <https://doi.org/10.1155/2023/9037159>
- Asresahegn, H., Tadesse, F., & Beyene, E. (2017). Prevalence and associated factors of hypertension among adults in Ethiopia: A community based cross-sectional study. *BMC Research Notes*, 10(1). <https://doi.org/10.1186/s13104-017-2966-1>
- Ayoade, O. G., & Umoh, I. (2020). Dyslipidemia and associated risk factors among Nigerians with hypertension. *Dubai Medical Journal*. <https://doi.org/10.1159/000509570>
- Camafort, M., Kasiakogias, A., Agabiti-Rosei, E., Masi, S., Iliakis, P., Benetos, A., Jeong, J. O., Lee, H. Y., Muiesan, M. L., Sudano, I., & Tsioufis, C. (2025). Hypertensive heart disease in older patients: considerations for clinical practice. *European Journal of Internal Medicine*, 134, 75–88. <https://doi.org/10.1016/j.ejim.2024.12.034>
- Chen, M. M., Huang, X., Xu, C., Song, X. H., Liu, Y. M. D., Y., H., L., W., G., Z., G.L., C., Z., S., T., Y., C., L., F., Q., J., J., Ji, Y. X., Wan, F., She, Z. G., & Li, H. (2022). High remnant cholesterol level potentiates the development of hypertension. *Frontiers in Endocrinology*, 13. <https://doi.org/10.3389/fendo.2022.830347>
- Cheng, W., Du, Y., Zhang, Q., Wang, X., He, C., He, J., Jing, F., Ren, H., Guo, M., Tian, J., & Xu, Z. (2022). Age-related changes in the risk of high blood pressure. *Frontiers in Cardiovascular Medicine*. *Frontiers in Cardiovascular Medicine*. <https://doi.org/10.3389/fcvm.2022.939103>
- Chi, X., Zhang, J., & Yin, X. (2024). Positive genetic effect of hypertension family history on stroke: A cross Mendelian randomization study. *Journal of Stroke Cerebrovascular Disease*, 33(10). <https://doi.org/10.1016/j.jstrokecerebrovasdis.2024.107901>
- Damayanti, V. W., Yonata, D., & Kurniawaty, E. (2023). Hipertensi pada Diabetes Melitus: Patofisiologi dan Faktor Risiko. *MEDULA: Medical Profession Journal of Lampung*, 13(7), 1253–1257. <https://doi.org/10.53089/medula.v13i7.896>
- Gaddoury, M. A., & Armenian, H. K. (2023). Epidemiology of hajj pilgrimage mortality: Analysis for potential intervention. *Journal of Infection and Public Health*, 1–13. <https://doi.org/10.1016/j.jiph.2023.05.021>
- Ghosh, S., & Kumar, M. (2019). Prevalence and associated risk factors of hypertension among persons aged 15-49 in India: A cross-sectional study. *BMJ Open*, 9(12). <https://doi.org/10.1136/bmjopen-2019-029714>
- Harahap, W. G., & Nurwahyuni, A. (2018). Factors related to the incidence of hypertension among prospective pilgrims in Medan, Indonesia during embarkation period 2016. *KnE Life Sciences*, 261–268. <https://doi.org/10.18502/cls.v4i10.3728>
- Harrison, D. G., Coffman, T. M., & Wilcox, C. S. (2021). Pathophysiology of hypertension: The mosaic theory and beyond. *Circulation Research*, 128(7), 847–863. <https://doi.org/10.1161/CIRCRESAHA.121.318082>
- Imamah, I. N. S., Alma, L. R., & Wardani, H. E. (2025). A study of the risk factors associated with the death of Surabaya embarkation hajj pilgrims in 2023. *Register: Medical Technology and Public Health Journal*, 9(1), 91–99. <https://doi.org/10.33086/mtphj.v9i1.6245>
- Liberty, I. A., Kodim, N., & Mukaramah. (2019). Hyperglycemic and hypertension are major component of metabolic syndrome that caused circulatory morbidity in hajj pilgrims. *Indian*

- Journal of Public Health Research & Development*, 10(7), 839–844. <https://doi.org/10.5958/0976-5506.2019.01681.4>
- Masenga, S. K., & Kirabo, A. (2023). Hypertensive heart disease: risk factors, complications and mechanisms. *Frontiers in Cardiovascular Medicine*, 5(10). <https://doi.org/10.3389/fcvm.2023.1205475>
- Noh, L. M. M., Mohammad, N. H., Zamri, N. A. K., Yusof, R. M., Hussin, H., & Abdullah, Z. (2020). Standard operational procedure in health quality for hajj pilgrims by Lembaga Tabung Haji. *International Journal of Academic Research in Social Sciences*, 10(9), 44–54. <https://doi.org/10.6007/IJARBS/v10-i9/7707>
- Pusparina, A., Alma, L. R., & Nurrochmah, S. (2020). A cross sectional study of determinants of hypertension in Batu City, Indonesia. *Atlantis Press*, 31, 133–138. <https://doi.org/10.2991/ahsr.k.201203.025>
- Rahimi, K. (2021). Age-stratified and blood-pressure-stratified effects of blood-pressure-lowering pharmacotherapy for the prevention of cardiovascular disease and death: An individual participant-level data meta-analysis. *The Lancet*, 398, 1053–1064. Retrieved from [https://www.thelancet.com/article/S0140-6736\(21\)01921-8/fulltext](https://www.thelancet.com/article/S0140-6736(21)01921-8/fulltext)
- Rustika, R., Oemiati, R., Asyary, A., & Rachmawati, T. (2020). An evaluation of health policy implementation for hajj pilgrims in Indonesia. *Journal of Epidemiology and Global Health*, 10(4), 263–268. <https://doi.org/10.2991/jegh.k.200411.001>
- Sahadevan, P., Sasidharan, A., Bhavani Shankara, B., Pal, A., Kumari, D., Murhekar, M., Kaur, P., & Kamal, V. K. (2024). Prevalence and risk factors associated with undiagnosed hypertension among adults aged 15–49 years in India: Insights from the national family health survey. *Public Health*, 236, 250–260. <https://doi.org/10.1016/j.puhe.2024.07.032>
- Tozo, T. A., Pereira, B. O., Menezes Junior, F. J. D., Montenegro, C. M., Moreira, C. M. M., & Leite, N. (2022). Family history of hypertension: Impact on blood pressure, anthropometric measurements and physical activity level in schoolchildren. *International Journal of Cardiovascular Science*, 35(3), 382–390. <https://doi.org/10.36660/ijcs.20200346>
- Wang, C., Du, Z., Ye, N., Shi, C., Liu, S., Geng, D., & Sun, Y. (2022). Hyperlipidemia and hypertension have synergistic interaction on ischemic stroke: Insights from a general population survey in China. *BMC Cardiovascular Disorder*, 13(22). <https://doi.org/10.1186/s12872-022-02491-2>
- Wirda, N., Maulana, T., Usman, S., Yani, M., & Saputra, I. (2025). Analysis of factors associated with the risk of hypertension in aceh Embarkation hajj pilgrims. *International Journal of Public Health*, 2(2), 1–8. <https://doi.org/10.62951/ijph.v2i2.379>
- Wyszyńska, J., Łuszczki, E., Sobek, G., Mazur, A., & Dereń, K. (2023). Association and risk factors for hypertension and dyslipidemia in young adults from Poland. *International Journal of Environmental Research and Public Health*, 20(2). <https://doi.org/10.3390/ijerph20020982>
- Yezli, S., Mushi, A., Almuzaini, Y., Balkhi, B., Yassin, Y., & Khan, A. (2021). Prevalence of diabetes and hypertension among hajj pilgrims: A systematic review. *International Journal of Environmental Research and Public Health*, 16(3), 1221–1228. <https://doi.org/10.1017/dmp.2020.472>