Risk Factors of Mortality Among Hajj Pilgrims in SOC 1444 H Group

Safaya Amada[1], Dina Nur Anggraini Ningrum[1✉], Lili Junaidi[2], Usman Iqbal[3,4]

[1]Public Health Department, Faculty of Medicine, Universitas Negeri Semarang, Indonesia
[2]Semarang Port Health Office, Indonesia
[3]University of New South Wales, Australia
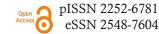[4]Taipei Medical University, Taiwan

Article Info

Abstract

Background: Hajj is an annual international ritual because it is carried out every year and involves Muslims from various parts of the world. Based on data from Siskohatkes, in 2022 there was a decrease in the number of pilgrims who died, which is 101 pilgrims, while in 2023 there was an 8 times increase to 856 pilgrims who died. In 2022, the number of pilgrims with SOC embarkation who died was 19 pilgrims, while there was a significant increase in the number of deaths of pilgrims by approximately 6 times with the number of 129 pilgrims who died. **Objective**: The purpose of this study was to determine the risk factors for the death of pilgrims for the SOC group. **Methods:** This study is an observational quantitative study with a nested case-control research design. This research was conducted in Central Java Province and Yogyakarta Special Region Province during the Hajj period 1444 H (2023). **Results:** The result is that cardiomegaly (p-value:0,009; OR: 2.058; 95% Cl: 1.195-3.543), disease history (p-value<0.001; OR: 0.242; 95% Cl: 0.155-0.377), overweight and/or obesity (p-value<0.001; OR: 0.460; 95% Cl: 0.302-0.700) have a significant impact on the mortality of the Hajj pilgrims. **Conclusion:** It is hoped that the Semarang Port Health Office can carry out monitoring and give more attention to pilgrims who have cardiomegaly.

INTRODUCTION

One of the important rituals in Islam is Hajj. Hajj is an annual international ritual because it is carried out every year and involves Muslims from various parts of the world (Aldossari et al., 2019; Jafar, 2020; Niu & Xu, 2019; Webber et al., 2020). The implementation of Hajj every year is attended by more than two million pilgrims from 180 countries from various countries in the world gathered in Makkah, Saudi Arabia, and other holy sites around Makkah (Alandijany, 2023). Indonesia as a country with the largest Muslim population in the world contributes the largest population every year with a range of 10% also three times larger than the population of other countries (Rustika et al., 2020). With the majority of Hajj pilgrims included in the elderly category (Hakim et al., 2022; Puriatarza & Kamso, 2019). Most of the Indonesian pilgrims are elderly and have chronic diseases which contribute to the high number of morbidity and mortality (Indharty et al., 2023). There was a 5-day event that gathered more than 3.5 million pilgrims from various countries in the desert with extreme heat and also without a roof. This increase in the number of pilgrims presents challenges to health security globally including high mortality rates (Khan et al., 2018). Due to activities that are quite heavy

during the Hajj, such as walking around Kaaba, walking between two hills as far as approximately 3.15 km, and other activities, the performance of pilgrims in good health must be able to undergo Hajj (Widhidewi et al., 2020).

There are several conditions in Islam to carry out Hajj, such as *baligh* or maturity, freedom, and *istithaah* or capability (Singka & Ericca, 2020; Zuardin & Akfan, 2022). *Istithaah* is the physical, mental, financial, and safety ability of pilgrims to carry out Hajj without leaving their respective family obligations (Bakhrudin & Muawanah, 2023; Singka & Ericca, 2020). Medical examinations on Hajj pilgrims are carried out in Indonesia before departure. Its implementation is divided into three stages with the aim of early detection so that it can prepare the condition of Hajj pilgrims so that it can be controlled properly and smoothly (Vestabilivy, 2021). In the medical examination of pilgrims, it is important for coordination between primary healthcare, hospitals, as well as embarkation sites (Rahmah et al., 2020). It is also important to engage people's awareness towards early detection (Emma et al., 2021). In accordance with the technical guidelines for the operationalization of siskohatkes (Kemenkes RI, 2019), status of the health of Hajj pilgrims is carried out with the following information: a) red color: high risk with the age category of ≥60 with disease; b) yellow color: high risk with the age category <60 with the disease; c) green color: high risk with the age category ≥60 without disease; and d) white color: not high risk. Providing Hajj health services requires health workers in the appropriate number, type, and qualifications to provide optimal performance to reduce the death rate of Hajj pilgrims (Purwita et al., 2022).

The death rate of pilgrims varies over the years. In 2012 the death toll of pilgrims was 1315 pilgrims. Over time, the death rate continued to decline until in 2016 it increased again but decreased again in 2017 with 657 pilgrims who died (Gaddoury & Armenian, 2023). In 2017 the total number of Indonesian Hajj pilgrims was more than 200 thousand people, where the majority of elderly pilgrims were also included in the red high-risk group (having health problems due to chronic and degenerative diseases). In 2017 as many as 659 pilgrims from Indonesia died while performing the pilgrimage (Darmareja et al., 2023). Based on data from Siskohatkes, in 2022 there was a decrease in the number of pilgrims who died, which is 101 pilgrims, while in 2023 there was an 8 times increase to 856 pilgrims who died (Kemenkes RI, 2023). In 2023, it will be dominated by pilgrims aged ≥60 with congenital diseases. In 2022, the number of pilgrims with SOC embarkation who died was 19 pilgrims, while there was a significant increase in the number of deaths of pilgrims by approximately 6 times with the number of 129 pilgrims who died. The disease with the greatest frequency among Hajj pilgrims in 2023 SOC embarkation is hypertension followed by hypercholesterol, diabetes mellitus, and cardiomegaly.

Previous research stated that an individual's risk of dying during the Hajj pilgrimage is influenced by many factors that are interrelated with each other, one of which is a disease that has been diagnosed since the examination before departure (Huda et al., 2022). Based on previous research in addition to diseases owned by individual pilgrims, factors that affect the mortality of hajj pilgrims are age, sex, educational level, physical debility, and employment status, obesity (Handayani et al., 2017; Puriatarza & Kamso, 2019).

The thing that distinguishes this study from previous studies is the addition of variables in the form of cardiomegaly which is included in the 5 diseases with the most frequency in Hajj pilgrims. Researchers also provide calculations of the probability of death of pilgrims with various specific criteria. The purpose of this study was to determine the risk factors for the death of pilgrims for the SOC group.

METHOD

This study is an observational quantitative study with a nested case-control research design. This study used a nested case-control research design because the data source is secondary data obtained with a cohort design. This study used 12 risk factors with 1 effect. This research was conducted in Central Java Province and Yogyakarta Special Region Province during the Hajj period 1444 H (2023).

The independent variables in this study included age, sex, disease history, education level, employment status, hypertension, physical debility, hypercholesterol, diabetes mellitus, overweight and obesity, and cardiomegaly. While for the dependent variable is the mortality of Hajj pilgrims. Categorization of age variables based on age cutoff in pilgrims of high-risk group. The categorization of jobs is categorized based on work and non-work. Categorization of educational level based on the last level of education of pilgrims. The categories of hypertension, diabetes mellitus, hypercholesterol, physical debility, cardiomegaly, and overweight and/or obesity are based on the

diagnosis given by the examining physician from stage one to stage 3 before embarkation. The category of hajj pilgrims' mortality is based on the living status of each pilgrim that is recorded in the Siskohatkes.

The source of data used in this study is secondary data belonging to the Semarang City Class II Port Health Office from the Siskohatkes (Integrated Hajj Computerized System for Health) (Kemenkes RI, 2023). The study had a population of 35,314 records. The sample of this study is Hajj pilgrims with SOC embarkation status who have airworthiness status and belong to the high-risk status group. The case group in this study is hajj pilgrims who died and the control group is hajj pilgrims who are alive. The total sample was 128 pilgrims as the case group and 512 pilgrims as the control group.

The instrument used in this study is a data collection table. The table is used to move data variables from the data contained in the Siskohatkes website. Data analysis was conducted univariately, bivariate, and multivariate. Univariate analysis was carried out for each variable to see the distribution of variability in this study. Bivariate analysis in this study used the chi-square test. For multivariate analysis using logistic regression tests.
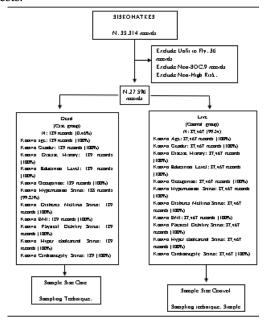

Figure 1. Study Workflow from Siskohatkes with Nested Case Control Design

Based on the study workflow in Figure 1., it is known that the pilgrims recorded in the SOC departure system are 35,314 records. Furthermore, identification was carried out according to this study's exclusion and inclusion criteria. The inclusion criteria in this study are Hajj pilgrims who have SOC embarkation status in the period 1444 H and have airworthiness status and are included in the group with high-risk status, while the exclusion criteria are the pilgrims who don't have complete data. The reason why one of the inclusions in this study is the pilgrims with the high-risk status is because the pilgrims that belong to the high-risk group are the riskier group of all pilgrims. Furthermore, a selection of completeness of data on Hajj pilgrims was obtained by pilgrims with unknown hypertensive status. Meanwhile, no data were found in the control group sample. So, the number of sample cases was 128 records, while for the control group as many as 27,467. The next stage was carried out simple random sampling in the control group with a ratio of 1: 4 with the number of samples for the control group so that 512 records were obtained. This study was carried out after obtaining Ethical Clearance (EC) approval from the Semarang State University Health Research Ethics Commission with number 418/KEPK/EC/2023.

RESULT AND DISCUSION

Table 1 shows that this research subject is dominated by people aged 60 and older with 448 people (70%), while Hajj pilgrims aged less than 60 are 192 (30%). The male gender with 380 people (59.4%) dominates this pilgrimage, while the female Hajj pilgrims are 260 (40.6%). People with a disease history 492 (76.9%) while Hajj pilgrims who don't have a disease history 148 (23.1%) People who have a higher education level 328 people (51.2%), while people with lower education 312 (48.8%).

Table 1. Univariate Test Result of Risk Factor of Mortality among Hajj Pilgrims in SOC Group 1444 H

Variable	Frequency (N)	Percent (%)
Age		
Less Than 60	192	30
60 and More	448	70
Total	640	100
Gender		
Male	380	59.4
Female	260	40.6
Total	640	100
Disease History		

Yes	492	76.9
No	148	23.1
Total	640	100
Educational Level		
High Education	328	51.2
Low Education	312	48.8
Total	640	100
Occupational Status		
Not working	156	24.4
Working	484	75.6
Total	640	100
Hypertension		
No	156	24.4
Yes	484	75.6
Total	640	100
Physical Debility		
No	236	36.9
Yes	404	63.1
Total	640	100
Hypercholesterol		
No	448	70
Yes	192	30
total	640	100
Diabetes Mellitus		
No	507	79.2
Yes	133	20.8
Total	640	100
Overweight and Obesity		
No	252	39.4
Yes	388	60.6
Total	640	100
Cardiomegaly		
Yes	100	15.6
No	540	84.4
Total	640	100
Mortality		

Live	512	80
Dead	128	20
Total	640	100

Hajj pilgrims who are workers with 484 people (75.6%) dominate, while Hajj pilgrims who are not working are 156 (24.4%) people. Among the subjects, 484 people have hypertension (75.6%), 404 people have physical debility (63.1%), 133 people have diabetes mellitus (20.8%), 192 people have hypercholesterol (30%) and 388 are overweight and/or obese (60.6%), and 100 people have cardiomegaly (15.6). Age categorization is based on the categorization of the high-risk (risti) group, where the age cut-off is 60 years. The categorization of overweight and obesity is based on the Ministry of Health's classification where a BMI <23 is declared overweight to obese (Kemenkes, 2018).

This analysis continued by the chi-square analysis. According to the result of the bivariate analysis, as shown in Table 2., 6 variables have a significant affection on the mortality of Hajj pilgrims (p-value <0.05). The variables included age (p-value: <0.0001), education (p-value: 0.001), disease history (p-value<0.0001), physical debility (p-value: 0.009), hyper cholesterol (p-value: 0.005), and overweight and/or obesity (p-value: <0.0001).

The age has a p-value<0.0001, which means that age has a significant impact on the mortality of Hajj pilgrims. Age has the OR: 3.146, this means that Hajj pilgrims aged 60 and over have 3.146 times more risk of mortality of Hajj pilgrims. This result is in accordance with previous studies, Idris (2022), where age over 60 years was found to be statistically significant for the death of Hajj pilgrims and have 6.619 times more risk to mortality of Hajj pilgrims. This is because the elderly experience a decrease in functional capacity and the presence of comorbid diseases (Sakti et al., 2020).

Educational level has a p-value: of 0.001, this means that education has a significant impact on the mortality of Hajj pilgrims. Education level has the OR: 1.931, which means that people with lower education have 1.931 times more risk of mortality of Hajj pilgrims. The results of this study are not in line with previous research, Idris (2022), where the level of education was not significantly related to the deaths of Hajj pilgrims.

The disease history has the p-value<0.0001, this means that disease history has a significant impact on the mortality of Hajj pilgrims. Disease history has the OR: 0.225, this means that peo-

ple with disease history have 0.225 times more risk to mortality of Hajj pilgrims. This is in line with previous research, by Idris and Huda (2022), where the 3 most common medical histories of the subjects of this study were taken as the representative to match the result of the previous research, namely hypertension, diabetes mellitus, and hyper cholesterol, which have a significant impact on the mortality for Hajj pilgrims and had a 1.34 times greater risk of death for hypertension, 3.84 times greater risk of death for diabetes mellitus, and a 0.34 times greater risk of death for hypercholesterol against death for hypercholesterolemia. Regards at this study population, most of the congregation with red and yellow high-risk bracelets had a history of diseases including hypertension (39%), hypercholesterolemia (27.8%), and diabetes Diabetes mellitus is the second most common history of disease experienced by SOC Hajj pilgrims. In people with diabetes mellitus, high blood sugar levels that last a long time and are not properly intervened can cause narrowing of the blood vessels which can lead to cardiovascular disease. (Idris & Nurwahyun, 2022). The same is true for hypercholesterolemia, high cholesterol will cause problems if it exceeds normal limits and will cause blockage of arteries. (Huda et al., 2022). If there are cholesterol deposits that clog the blood vessels, it will make the heart work harder and indirectly worsen hypertension (Huda et al., 2022). The elderly who suffer from chronic medical conditions can be aggravated during Hajj (Shaikh et al., 2020).

Physical debility has a p-value<0.0001, this means that physical debility has a significant impact on the mortality of Hajj pilgrims. Physical debility has the OR: 1.802, this means that people with physical debility have 1.802 times more risk to mortality of Hajj pilgrims. This result is in accordance with previous studies, by Handayani (2017), where Hajj pilgrims with physical debility were found to be statistically significant for the death of Hajj pilgrims and have 2.7 times more risk mortality of Hajj pilgrims. Routine physical preparation is required from before the time of departure to face the pilgrimage activities due to the harsh environmental terrain. Congregants who are ready and physically fit will be more resistant to the temperature there, so physical preparation is necessary (Handayani et al., 2017).

There are few various factors that can affect a person's such as food, exercise, age, living habits, and the environmental support. Activities during Hajj require good physical strength because the worship activities are draining (Hakim et al., 2022).

Hypercholesterol has a p-value: of 0.005, this means that hypercholesterol has a significant impact on the mortality of Hajj pilgrims. Hypercholesterol has the OR: 0.501, this means that people with hyper cholesterol have 0.501 times more risk of mortality of Hajj pilgrims. This result is in accordance with previous studies, by Huda (2022), where Hajj pilgrims with hypercholesterol were found to be statistically significant for the death of Hajj pilgrims and have 0.34 times more risk of mortality of Hajj pilgrims. As age increases, the number of illnesses will increase. A disease that is one of the main causes of death for the Indonesian population (Lasanuddin et al., 2022)

Overweight and/or obese has the p-value<0.0001, this means that overweight and/or obesity have a significant impact on the mortality of Hajj pilgrims. Overweight and/or obese have the OR: 0.358, this means that people who are overweight and/or obese have 0.501 times more risk of mortality than Hajj pilgrims. This result is in accordance with previous studies, Ardiana (2023), where Hajj pilgrims who are overweight and/or obese was found to be statistically significant for the death of Hajj pilgrims. Obesity is linked to an elevated risk of illness and death, particularly from cardiovascular disease (CVD) and cancer. The connection between body mass index (BMI) and the likelihood of dying can vary significantly among different populations and causes of death, and it may change over time. Higher mortality rates associated with obesity are driven by additional health conditions, including type 2 diabetes mellitus (T2DM), abnormal lipid levels, high blood pressure, obstructive sleep apnoea (OSA), specific forms of cancer, steatohepatitis, gastroesophageal reflux, arthritis, polycystic ovary syndrome (PCOS), and infertility (Abdelaal et al., 2017).

The Cardiomegaly variable has a p-value: 0.221, this means that cardiomegaly has no significant impact on the mortality of Hajj pilgrims. There is a risk of complications that can occur in conditions of cardiomegaly, one of which is cardiac arrest and sudden death. Cardiomegaly can cause the heart to beat too fast or too slow. This irregular heartbeat may lead to fainting, cardiac arrest, or sudden death (Amin & Siddiqui, 2022). Coronary artery disease stands as the primary cause of cardiomegaly, which signifies an enlarged heart. This condition arises due to the accumulation of plaque within the coronary arteries, potentially leading to a heart attack.

Hypertension in this research doesn't have a significant impact on the mortality of Hajj pil-

Table 2. Bivariate Test Result Risk Factor of Mortality among Hajj Pilgrims in SOC Group 1444 H

Variable	Dead (Case)		Live (Control)		OR (95%Cl)	p-value
	N	%	N	%		
Age						
60 and More	110	89.6	338	66	3.146 (1.850-5.349)	<0.0001*
Less than 60	18	14.1	174	34		
Total	128	100	512	100		
Gender						
Male	76	59.4	304	59.4	1.000 (0.674-1.483)	1.000
Female	52	40.6	208	40.6		
Total	128	100	512	100		
Disease History						
Yes	67	52.3	425	83	0.225 (0.148-0.341)	<0.0001*
No	61	47.7	87	17		
Total	128	100	512	100		
Education						
Low Education	79	61.7	233	45.5	1.931 (1.299-2.870)	0.001*
High Education	49	38.3	279	54.5		
Total	128	100	512	100		
Occupation						
Working	93	72.7	391	76.4	0.822 (0.530-1.275)	0.448
Not Working	35	27.3	121	23.6		
Total	128	100	512	100		
Hypertension						
Yes	53	41.4	254	49.6	0.718 (0.485-1.062)	0.118
No	75	58.6	258	50.4		
Total	128	100	512	100		
Physical Debility						
Yes	94	73.4	310	60.5	1.802 (1.171-2.771)	0.009*
No	34	26.6	202	39.5		
Total	128	100	512	100		
Hyper cholesterol						
Yes	25	19.5	167	30	0.501 (0.312-0.806)	0.005*
No	103	80.5	345	67.4		
Total	128	100	512	100		
Diabetes Mellitus						
Yes	26	20.3	108	21.1	0.954 (0.590-1.541)	0.942
No	102	79.7	404	78.9		
Total	128	100	512	100		
Overweight and/or Obesity						
Yes	52	40.6	336	65.6	0.358 (0.241-0.533)	<0.0001*
No	76	59.4	176	34.4		
Total	128	100	512	100		

Cardiomegaly						
Yes	25	19.5	75	14.6	1.414 (0.857-2.334)	0.221
No	103	80.5	437	85.4		
Total	128	100	512	100		

Table 3. Multivariate Test Result Risk Factor of Mortality among Hajj Pilgrims in SOC Group 1444 H

Variables	B	Wald	p-value	OR (95,0% CI)
Cardiomegaly	0.722	6.776	0.009	2.058 (1.195-3.543)
Disease History	-1.420	39.271	<0.001	0.242 (0.155-0.377)
Overweight and/or Obesity	-0.777	13.133	<0.001	0.460 (0.302-0.700)
Constant	-0.115	0.378	0.539	0.891

grims, this result is not in line with the previous research whereas in the Idris (2022) research, hypertension has a significant impact on the mortality of Hajj pilgrims. In the previous research hypertension has the OR: 1.845, this means that Hajj pilgrims with hypertension have 1.845 times more risk on mortality. The effects caused by hypertension include stroke, kidney failure, coronary heart disease, and can even cause death (Ariyani, 2020). Hypertension detection is carried out before the departure of the Hajj pilgrims, where the Hajj pilgrims are given awareness and knowledge about hypertension. With awareness and knowledge of hypertension, can make the community good practices and make people focus more on their own health so that they are closer to living a healthy life which can later reduce the increase in hypertension (Oktaviani et al., 2022).

In this research, Diabetes Mellitus doesn't have a significant impact on the mortality of Hajj pilgrims, while on the previous research, Idris (2022), diabetes mellitus had a significant impact on the mortality of Hajj pilgrims. If diabetes is left untreated, it can result in damage to multiple organs and systemic injury, affecting the heart, kidneys, nerves, and blood vessels. This not only diminishes the quality of life but also elevates the mortality rate due to diabetes-related complications. Certain complications are particularly significant contributors to the increased mortality observed in individuals with diabetes. For example, those with diabetes face a two times higher risk of cardiovascular mortality. (Li et al., 2019).

Gender has no significant impact on the mortality of Hajj pilgrims as the p-value: 1.000

(p-value>0.005), this result is in line with the previous research, Idris (2022), where gender doesn't have a significant impact. Occupational status has the p-value: 0.448, this means that in this research occupational status doesn't have a significant impact on the mortality of Hajj pilgrims. In the previous research, Huda (2022), occupational did not continue to the stage of bivariate analysis, only to the analysis of the characteristic frequency distribution

The logistic regression test was carried out on variables with a p-value <0.25. These variables are disease history, overweight and/or obesity, cardiomegaly, age, educational level, hypertension, physical debility, and hypercholesterol. After carrying out logistic regression, 3 variables were obtained which had a strong influence on the mortality of Hajj pilgrims.

In Table 3, it is shown that the OR value for cardiomegaly is 2.058 (p-value:0.009), so the possibility of Hajj pilgrims suffering from cardiomegaly to the mortality of Hajj pilgrims is 2.058 times compared to Hajj pilgrims who do not suffer from cardiomegaly. The OR value of disease history is 0.242 (p-value<0.001), so the probability that Hajj pilgrims who have a history of disease to mortality is 0.242 times greater than Hajj pilgrims who do not have a history of disease. The OR value of overweight and/or obesity is 0.460 (p-value<0.001), so the possibility of Hajj pilgrims who are overweight and/or obese will have Hajj mortality 0.460 times greater than Hajj pilgrims who are not overweight and/or obese. Cardiomegaly was assessed as not significant in the bivariate test but had the strongest influence on the results of the multivariate test. This is be-

Table 4. Probability of The Hajj Pilgrims Mortality

Respondents	Cardiomegaly	Disease history	Overweight and/or obesity	Probability of Mortality of Hajj pilgrims
Respondent A	Yes	No	No	65%
Respondent B	No	Yes	No	17%
Respondent C	No	No	Yes	29%
Respondent D	Yes	No	Yes	45%
Respondent E	Yes	Yes	No	30.7%
Respondent F	No	Yes	Yes	9%
Respondent G	Yes	Yes	Yes	17%
Respondent H	No	No	No	47%

cause the variable is not significant when considered alone but becomes significant when other variables are taken into account. This can happen because the effect of the variable is masked by other variables in the chi-square test, but becomes apparent in the multivariate test.

Based on the results obtained from the final model, a logistic regression equation can be created, as follows:
y=-0.115+(0.722)(Have Cardiomegaly)+(-1.420)(Have Disease history)+(-0.777)(Overweight and or obesity)

A logistic regression equation above can be used to calculate the probability of mortality of Hajj pilgrims using the formulation below:
p= 1/(1+exp[-(y)])

In the logistic regression equation, Hajj pilgrims with cardiomegaly are given code 1, and Hajj pilgrims without cardiomegaly are given code 0. Hajj pilgrims with a history of disease are given code 1 and Hajj pilgrims without a history of disease are given code 0. Hajj pilgrims with overweight and/or obese are given code 1 and Hajj pilgrims who are not overweight and/or obese are given code 0.

Based on the result of the probabilities calculation shown in Table 4., the probability of Hajj pilgrims who have cardiomegaly, a disease history, and are overweight and/or obese to mortality is 17%. The probability for Hajj pilgrims who don't have cardiomegaly, or disease history, and are not overweight and/or obese to mortality is 47%. For the highest probability of mortality is for the Hajj pilgrims who have cardiomegaly which is 65%.

CONCLUSION

The result of this research showed that the variable that has the most influence on the Hajj pilgrim's mortality in SOC 1444H is cardiome-

galy (OR: 2.058 [95%Cl: 1.195-3.543, p: 0.009]), which means the risk of Hajj pilgrims suffering from cardiomegaly to the mortality of Hajj pilgrims is 2.058 times greater compared to other variables.

The weakness of this research is that there are only a few researches on Hajj pilgrim mortality so there are limitations in finding references. This research uses secondary data then the variables that can be studied follow the availability of existing data. Suggestions for future researchers include finding more references as in comparation for the result of the research. This research showed that pilgrims with cardiomegaly have more risk to mortality, it is hoped that Semarang Port Health Office can carry out monitoring and give more attention towards pilgrims who have cardiomegaly.

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