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*ORIGINAL ARTICLE*

# RISK FACTORS FOR PNEUMONIA IN ELDERLY INDONESIAN HAJJ PILGRIMS (DATA ANALYSIS OF SISKOHATKES 2023)

***Faktor Risiko Pneumonia Pada Jemaah Haji Indonesia Usia Lanjut (Analisis Data Siskohatkes 2023)***

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**ABSTRACT**

**Background:** Pneumonia is the most common health problem encountered during the Hajj pilgrimage and has been recognized globally as a major cause of morbidity, hospitalization and death. During the 2023 Hajj season, pneumonia is known to be among the top five diseases that cause hospitalization of elderly Indonesian Hajj pilgrims. **Purpose:** This research aimed to determine the risk factors for pneumonia in elderly Indonesian Hajj pilgrims. **Methods:** This research uses a cross-sectional study design with secondary data from the Integrated Hajj Computerized System for Health Sector (Siskohatkes) 2023. The population in this study was all elderly Hajj pilgrims recorded at Siskohatkes 2023 totaling 93,000 pilgrims. The sample used was 1,858 Hajj pilgrims aged ≥ 60 and hospitalized in Saudi Arabia. The data are analyzed at the multivariate level using the Cox Regression. **Results:** The study showed that the prevalence of pneumonia in elderly Indonesian Hajj pilgrims was 37.10% and the factor most significantly associated with the incidence of pneumonia was chronic obstructive pulmonary disease (COPD) comorbid (p-value <0.01; Adjusted PR= 1.43; 95%CI= 1.19–1.70). **Conclusion:** Comorbid COPD can increase the risk of elderly Hajj pilgrims being infected with pneumonia.



***ABSTRAK***

***Latar Belakang:*** *Pneumonia merupakan masalah kesehatan yang paling umum ditemui selama ibadah haji dan telah diakui secara global sebagai penyebab utama morbiditas, rawat inap dan kematian. Pada musim haji 2023,*

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*pneumonia diketahui termasuk dalam lima penyakit teratas yang menyebabkan rawat inap jemaah haji Indonesia lanjut usia.* ***Tujuan:*** *Penelitian ini bertujuan untuk mengetahui faktor risiko pneumonia pada jemaah haji Indonesia lanjut usia.* ***Metode:*** *Penelitian ini menggunakan desain penelitian cross-sectional dengan data sekunder dari Sistem Komputerisasi Haji Terpadu Bidang Kesehatan (Siskohatkes) 2023. Populasi dalam penelitian ini adalah seluruh jemaah haji lanjut usia yang tercatat di Siskohatkes 2023 yang berjumlah 93.000 jemaah. Sampel yang digunakan adalah 1.858 jemaah haji berusia ≥ 60 tahun yang dirawat di rumah sakit di Arab Saudi. Data dianalisis secara multivariat dengan menggunakan Regresi Cox.* ***Hasil:*** *Penelitian ini menunjukkan prevalensi pneumonia pada jemaah haji Indonesia usia lanjut sebesar 37,10% dan faktor yang paling signifikan berhubungan dengan kejadian pneumonia adalah penyakit paru obstruktif kronik (PPOK) komorbid (nilai p < 0,01; Adjusted PR = 1,43; 95%CI = 1,19–1,70).* ***Simpulan:*** *PPOK komorbid dapat meningkatkan risiko jemaah haji usia lanjut untuk terinfeksi pneumonia.*



## INTRODUCTION

Pneumonia is a respiratory disease characterized by inflammation of the lungs, specifically in the alveoli, which can be caused by several pathogenic agents such as viruses, bacteria, and fungi (1). The symptoms typically include productive cough, fever, rapid breathing, wheezing, and abnormal findings on radiological examination such as uneven consolidation (2). However, in the elderly, the symptoms often do not present in a typical manner, leading to delayed diagnosis (3). In older adults, the symptoms usually manifest as falls, confusion, gastrointestinal discomfort, and sometimes without fever (3,4).

This disease has long been recognized as a major cause of morbidity and mortality among the elderly, not only in developing countries but also in developed nations. The annual incidence rate ranges from 1.07 to 14 per 1,000 people per year (5). Population-based studies on hospitalized patients indicate that the incidence of pneumonia in the UK, Germany, Portugal, and the United States is 1.48, 2.75, 3.61, and 1.76 – 7.03 per 1,000 people per year, respectively (5). Meanwhile, the mortality rate for hospitalized patients is approximately 5 – 15%, and it is higher for patients in the intensive care unit (ICU), ranging from 20 – 50% (6).

The situation in ASEAN countries, more precisely in the Philippines and Malaysia, shows the incidence of pneumonia (respectively) is around 1425 cases per 10,000 people and 99 cases per 10,000 people. Apart from that, in India, there are four million cases of pneumonia per year and 20% of them require intensive care in hospital. In Vietnam, the rate of hospitalization is around 8.1 per 10,000 people (7).

Meanwhile, in Indonesia, there were 988 cases of pneumonia per 100,000 hospitalizations. In addition, the case fatality rate (CFR) of pneumonia is also known to be quite high, reaching 11.30% (8). The incidence of pneumonia is around 421 per 10,000 people (7). Based on the 2018 Riskesdas report, it is known that the prevalence of pneumonia increases with age. In the 45-54 year age group it was 5.40%, in the 55-64 year age group it was 6.2%, in the 65-74 year age group it was 7.70% and over 75 years it was 7.80% (9).

A person's chance of being infected with pneumonia can also be higher if they are in a crowded and congested environment such as the situation during the Hajj pilgrimage. During the Hajj, pneumonia is known to be the most common infectious disease and causes many pilgrims to be hospitalized (10). In 2023, the Indonesian Ministry of Health's Hajj Health Center (Puskes Haji) reported that there was an increase in pneumonia cases every day among Hajj pilgrims. The first reported case of pneumonia occurred on the third day of the Hajj (26 May 2023) and the latest report, as of 14 July, 2023, stated that a total of 584 sick Hajj pilgrims were being treated for pneumonia. Apart from that, pneumonia is also known to have contributed to the increase in the death rate for Indonesian Hajj pilgrims in 2023 which was recorded at 774 deaths. This number of deaths is the highest number of deaths in the previous four Hajj seasons. If we look at age groups, most of the Hajj pilgrims who died were > 60 years old (11).

Unfortunately, research related to pneumonia in elderly Hajj pilgrims in the world and in Indonesia is still limited and receives little attention. In fact, this disease can spread very easily from one person to another because it has a short incubation period, namely 1 – 3 days (12). Therefore, researchers want to conduct further research related to this disease with the aim of finding out the risk factors for pneumonia in elderly Hajj pilgrims in Indonesia.

## METHODS

This research is secondary data research with a cross-sectional study design. The secondary data were obtained from the 2023 Integrated Hajj Computerized System for Health (Siskohatkes) data which are managed by the Hajj Health Center, Ministry of Health of the Republic of Indonesia. The population used is all 93,000 elderly Hajj pilgrims recorded in Siskohatkes 2023. The sample was selected using purposive sampling with the following inclusion criteria, namely: 1. Hajj pilgrims aged ≥ 60 years who were registered in Siskohatkes 2023; and 2. received inpatient services in Saudi Arabia (registered at the Indonesian Hajj Health Clinic (KKHI) Mecca, KKHI Medina, Arafah health post, and Saudi Arabian hospitals) in the period 24 May - 1 August 2023 Based on these criteria, the total sample in this study was 1,858 pilgrims, consisting of 690 people infected with pneumonia and 1,168 people not infected with pneumonia.

The dependent variable in this study was the incidence of pneumonia obtained from Saudi Arabian inpatient medical record data recorded in Siskohatkes 2023. The incidence of pneumonia was determined based on the International Classification of Diseases-10 (ICD-10) code J12 – J18.9, while non-pneumonia is a Hajj pilgrim who is not diagnosed with this code. Meanwhile, the independent variable consists of three parts, namely individual factors, comorbid factors, and lifestyle behavior factors. Individual factors include age, gender, education level, and body mass index BMI. BMI was classified into underweight (<18.50 kg/m2), normal (18.50 - 24.90 kg/m2), overweight (25 – 29.90 kg/m2), and obese (≥30 kg/m2) (13). Comorbid factors consist of asthma, COPD, diabetes, stroke, chronic kidney failure and congestive heart failure. The lifestyle behavioral factors studied were smoking habits and vaccinations. All variables used in this study were determined based on national guidelines for medical services for the management of pneumonia in adults (decision of the Indonesian Minister of Health NO. HK.01.07/MENKES/2147/2023), the results of previous studies and considerations of the availability of data in the Integrated Computerized Hajj System for Health (Siskohatkes) 2023.

Data for individual factors and lifestyle behavior were obtained from the second stage of Hajj pilgrims' health examination data, while data on comorbid factors came from Saudi Arabian inpatient medical record data which were viewed based on ICD-10 codes. Following are details of comorbid diseases along with ICD-10 codes: Asthma (ICD-10: J45, J45.0, J45.8, J45.9), COPD (ICD-10: J44, J44.0, J44.1, J44.8 and J44.9), diabetes (ICD-10: E10-E14.9), stroke (ICD-10: I61.5, I61.9, I63, I63.8, I63.9, I64), chronic renal failure (ICD-10: N18 and N18.9), congestive heart failure (ICD -10: I50.0). The data will be analyzed using the chi-square test for bivariate analysis and the Cox regression model for multivariate analysis. This research has received approval from the Health Research Ethics Committee (KEPK) UPN "Veteran" Jakarta with letter number 179/V/2024/KEP.

## RESULTS

Based on the distribution table of risk factors for pneumonia (Table 1), it is known that 56.80% of elderly Hajj pilgrims who are hospitalized in Saudi Arabia were male, 16.60% had a tertiary education background, and 19.80% had a normal body mass index. From the aspect of comorbid factors, it was found that the majority of congregants did not have comorbid diseases, including asthma (96.70%), COPD (82.90%), diabetes (83.40%), stroke (96.00%), congestive heart failure. (91.60%), and chronic renal failure (98.30%). On the other hand, if we look at the aspect of lifestyle behavioral factors, it was found that 37.80% were non-smokers and 51.00% were not vaccinated against influenza.

Meanwhile, the bivariate analysis results using the chi-square test (Table 2) show that only four variables are associated with the incidence of pneumonia: asthma, COPD, diabetes, and stroke comorbid. These results also show that asthma and COPD are risk factors, while diabetes and stroke are protective factors for pneumonia. Diabetes mellitus is a protective factor in this study, possibly because the data of people living with diabetes used are a combination of all types of diabetes mellitus, so it may affect the study results. Meanwhile, stroke is a protective factor because, in the Hajj pilgrim

population, stroke does not have much effect on pneumonia infection. This can be proven from the p-value, which is only 0.05.

**Table 1**
Distribution of Pneumonia Risk Factors in Elderly Indonesian Hajj Pilgrims in 2023

| Variable | n | % |
|---|---|---|
| Individual Factors | | |
| Sex | | |
| Male | 1,056 | 56.80 |
| Female | 802 | 43.20 |
| Education | | |
| Primary | 286 | 15.40 |
| Secondary | 150 | 8.10 |
| Tertiary | 309 | 16.60 |
| Unknown | 1,113 | 59.90 |
| Body Mass Index | | |
| Underweight | 27 | 1.50 |
| Overweight | 309 | 16.60 |
| Obese | 95 | 5.10 |
| Normal | 368 | 19.80 |
| Unknown | 1,059 | 57 |
| Comorbid Factors | | |
| Asthma | | |
| Yes | 61 | 3.30 |
| No | 1,797 | 96.70 |
| COPD | | |
| Yes | 318 | 17.10 |
| No | 1,540 | 82.90 |
| Diabetes | | |
| Yes | 308 | 16.60 |
| No | 1,550 | 83.40 |
| Stroke | | |
| Yes | 74 | 4 |
| No | 1,784 | 96 |
| Congestive Renal Failure | | |
| Yes | 156 | 8.40 |
| No | 1,702 | 91.60 |
| Chronic Renal Failure | | |
| Yes | 32 | 1.70 |
| No | 1,826 | 98.30 |
| Lifestyle behavioral Factors | | |
| Smoking Habit | | |
| Yes | 98 | 5.30 |
| No | 703 | 37.80 |
| Unknown | 1,057 | 56.90 |
| Influenza Vaccination | | |
| Yes | 948 | 51 |
| No | 910 | 49 |

Hajj pilgrims with asthma comorbid have a 1.78 times risk of being infected with pneumonia compared to pilgrims who do not have asthma comorbid (Crude PR= 1.78; 95%CI= 1.07 – 2.98; p-value= 0.03). Elderly Hajj pilgrims who have COPD comorbid are 1.84 times more likely to be infected with pneumonia compared to Hajj pilgrims who do not have COPD comorbid (Crude PR= 1.84; 95%CI= 1.44 – 2.35; p-value= 0.00). Elderly pilgrims with diabetes comorbid are 0.69 times less likely to be infected with pneumonia compared to Hajj pilgrims who do not have diabetes comorbid (Crude PR= 0.69; 95%CI= 0.53 – 0.90; p-value= 0.00). Congregants with comorbid stroke were 0.57 less likely to be infected with pneumonia than those without stroke comorbid (Crude PR= 0.57; 95%CI= 0.34 – 0.97; p-value= 0.05).

The analysis will be continued until multivariate with a Cox regression model to obtain the dominant risk factors for pneumonia, as well as to evaluate the results of the bivariate analysis. Variables that have a p-value <0.25 based on the results of bivariate analysis will be included in the Cox regression model. However, in this study the influenza vaccination variable was still included in the model because it has a substantively important role. The influenza vaccine is known to reduce the risk of developing pneumonia (13) and various cardiovascular diseases so it can be a good combination for controlling risk factors for pneumonia (14).

Thus, there are seven variables that will be entered in the model in the multivariate analysis, namely influenza vaccination, BMI, asthma, COPD, diabetes, stroke and congestive heart failure. Then, variables that have been included in the multivariate model will be eliminated one by one from the Cox regression model starting from the largest p-value until there are no variables that have p > 0.05.

The final model results in multivariate analysis (Table 3) show that the factor that is most significantly associated with the incidence of pneumonia is COPD comorbid (Adjusted PR= 1.43; 95%CI= 1.19 – 1.70; p-value= 0.00). Elderly pilgrims who have COPD comorbid have a 1.43 times chance of getting pneumonia compared to those who do not have COPD comorbid.

**Table 2**
Results of Bivariate Analysis of Pneumonia Risk Factors in Elderly Indonesian Hajj Pilgrims in 2023

| Variable | Pneumonia | | | | Crude PR (95% CI) | p-value |
|---|---|---|---|---|---|---|
| | Yes | | No | | | |
| | n | % | n | % | | |
| Individual Factors | | | | | | |
| Sex | | | | | | |
| Male | 383 | 36.30 | 673 | 63.70 | 0.92 (0.76-1.11) | 0.40 |
| Female | 307 | 38.30 | 495 | 61.70 | Ref | |
| Education | | | | | | |
| Primary | 104 | 36.40 | 182 | 63.60 | 0.91 (0.65-1.27) | 0.64 |
| Secondary | 52 | 34.70 | 98 | 65.30 | 0.85 (0.56-1.27) | 0.48 |
| Tertiary | 119 | 38.50 | 190 | 61.50 | Ref | |
| Unknown | 415 | 37.30 | 698 | 62.70 | 0.95 (0.73-1.23) | 0.74 |
| BMI | | | | | | |
| Underweight | 14 | 51.90 | 13 | 48.10 | 1.71 (0.78-3.75) | 0.24 |
| Overweight | 101 | 32.70 | 208 | 67.30 | 0.77 (0.56 – 1.06) | 0.13 |
| Obese | 37 | 38.90 | 58 | 61.10 | 1.02 (0.64 – 1.61) | 1.00 |
| Normal | 142 | 38.60 | 226 | 61.40 | Ref | |
| Unknown | 396 | 37.40 | 663 | 62.60 | 0.95 (0.75 – 1.21) | 0.73 |
| Comorbid factors | | | | | | |
| Asthma | | | | | | |
| Yes | 31 | 50.80 | 30 | 49.20 | 1.78 (1.07 – 2.98) | 0.03 |
| No | 659 | 36.70 | 1,138 | 63.30 | Ref | |
| COPD | | | | | | |
| Yes | 157 | 49.40 | 161 | 50.60 | 1.84 (1.44 – 2.35) | 0.00 |
| No | 533 | 34.60 | 1,007 | 65.40 | Ref | |
| Diabetes | | | | | | |
| Yes | 93 | 30.20 | 215 | 69.80 | 0.69 (0.53 – 0.90) | 0.00 |
| No | 597 | 38.50 | 953 | 61.50 | Ref | |
| Stroke | | | | | | |
| Yes | 19 | 25.70 | 55 | 74.30 | 0.57 (0.34 – 0.97) | 0.05 |
| No | 671 | 37.60 | 1,113 | 62.40 | Ref | |
| Congestive Heart Failure | | | | | | |
| Yes | 50 | 32.10 | 106 | 67.90 | 0.78 (0.55 – 1.11) | 0.19 |
| No | 640 | 37.60 | 1,062 | 62.40 | Ref | |
| Chronic Renal Failure | | | | | | |
| Yes | 11 | 34.40 | 21 | 65.60 | 0.89 (0.42 – 1.85) | 0.88 |
| No | 679 | 37.20 | 1,147 | 62.80 | Ref | |
| Lifestyle Behavioral Factors | | | | | | |
| Smoking Habit | | | | | | |
| Yes | 32 | 32.70 | 66 | 67.30 | 0.81 (0.52 – 1.27) | 0.42 |
| No | 263 | 37.40 | 440 | 62.60 | Ref | |
| Unknown | 395 | 37.40 | 662 | 62.60 | 1.00 (0.82 – 1.22) | 1.00 |
| Influenza Vaccination | | | | | | |
| Yes | 326 | 35.80 | 584 | 64.20 | Ref | |
| No | 364 | 35.80 | 584 | 61.60 | 1.12 (0.93 – 1.35) | 0.27 |

**Table 3**
Final Model of Multivariate Analysis

| Variable | Adjusted PR (95% CI) | p-value |
|---|---|---|
| COPD | 1.43 (1.19 – 1.70) | 0.00 |

## DISCUSSION

Hajj is an obligatory act of worship for every Muslim who is able in terms of finances, physical capability, and knowledge. This ritual involves a journey to the Baitullah (Kaaba) and the performance of various activities, including the conditions, pillars, obligations, and Sunnahs such as Ihram, Tawaf, Sa'i, and Wuquf. It can only be performed once a year, specifically during the month of Dhu al-Hijjah in Saudi Arabia (15). However, the implementation of Hajj faced obstacles due to the COVID-19 pandemic. The Saudi Arabian government was forced to temporarily suspend the pilgrimage for international pilgrims in 2020 and 2021 to prevent the spread of COVID-19. During that time, the pilgrimage was only permitted for residents within Saudi Arabia (16).

The Saudi Arabian government began accepting international Hajj pilgrims again in 2022, with certain regulations, including a restriction to pilgrims under the age of 65 and a regular quota of 100,051 people (17). However, this regulation will no longer apply starting in 2023. The quota has also returned to normal as before the COVID-19 pandemic, which is known to be 229,000 people (11). With this change in regulations, the number of Hajj pilgrims significantly increased, with approximately 30% of them being elderly individuals (18).

On other hand, elderly individuals are often associated with weakened immune systems, making them particularly vulnerable to infectious diseases, including pneumonia (19). Research indicates that, in 2023, 690 Indonesian Hajj pilgrims were diagnosed with pneumonia, which accounts for 37.10% of the 1,858 samples analyzed. This figure is notably high, approaching half of the sample size. A retrospective cohort study conducted by AboEl-Magd et al (10) aimed at determining the prevalence of pneumonia during the Hajj season of 2017–2018, using data from all Hajj pilgrims treated in Saudi Arabian hospitals, also found that the prevalence of pneumonia reached 33% (203 of 614 patients). This research also shows that, in 2017, the proportion of Hajj pilgrims who experienced pneumonia was dominated by pilgrims from Indonesia, with a percentage of 26.50% (68 out of 258 patients). In contrast, in 2018, the majority of Hajj pilgrims with pneumonia came from Saudi Arabia, with a percentage of 25.30% (90 of 356 patients), followed by pilgrims from Indonesia who reached 18.80% (67 of 356 patients). Based on the explanation above, it can be concluded that there has been a significant increase in pneumonia cases compared to the previous year.

Based on the final results of the multivariate analysis, it was found that the risk factor that had the most influence on the incidence of pneumonia was COPD. Hajj pilgrims who have COPD comorbid are 1.43 times more likely (95%CI= 1.19–1.70) to be infected with pneumonia compared to pilgrims who do not have COPD comorbid. The risk factor that most influences the incidence of pneumonia is COPD comorbid (Adjusted OR= 2.37; 95%CI= 2.37 - 2.60) (20). In their research, Tejerina et al (21) also showed similar results that COPD is one of the most influential risk factors for the incidence of pneumonia (Adjusted OR= 3.90; 95%CI= 2.20 – 6.90).

COPD leads to long-term structural damage in the lungs, which reduces mucosal clearance and disrupts the balance of the microbiome, thereby increasing the lungs' vulnerability to pneumonia (22,23). The condition of lung damage in COPD sufferers can also cause them to have difficulty breathing, which is often associated with death due to respiratory failure (24,25). A prospective population-based cohort study conducted by Bordon et al. (2020) showed that COPD sufferers infected with pneumonia were 1.25 times more at risk of death (95% CI= 1.11–1.41; p-value= <0.01) (24).

Technically, controlling risk factors related to comorbid diseases in Hajj pilgrims has actually been implemented for a long time by Indonesian Hajj officers by conducting health screening (examinations) of Hajj pilgrims before departure. However, it seems that this effort is still not optimal for controlling the risk factors of Hajj pilgrims. This is because, if you look at it from the trend of deaths of Hajj pilgrims, in the 2023 hajj season, the number of deaths reached 774 people, higher than in previous years. In the 2022 and 2019 Hajj seasons, 89 people died from a total of 100,051 pilgrims and 453 people died from a total of 231,000 pilgrims (11).

The most common cause of death in the 2023 Hajj season is septic shock as many as 222 people

(11). Septic shock is a type of sepsis that is associated with hypotension (low blood pressure) and perfusion abnormalities. This disease is a form of complication due to infection. The infection that most often causes sepsis is pneumonia (25). Apart from that, in the 2023 Hajj season, there were also 33 deaths caused by pneumonia (11).

By looking at the conditions in the 2023 Hajj season, it may be necessary to evaluate the requirements for determining istitaah for Hajj pilgrims who have comorbid diseases, especially COPD comorbid. In that year, the requirements for determining istitaah still used references from the Technical Instructions of Minister of Health No. 15 of 2016 which stated that COPD sufferers who did not make istitaah to participate in the Hajj pilgrimage were only those suffering from stage IV COPD (having an FEV1 value < 30) (26). However, after research, in this study it was found that COPD comorbid was the risk factor that had the most influence on the incidence of pneumonia. Thus, there is a possibility that Hajj pilgrims who have COPD comorbid below stage IV are no longer istitaah so they need to be investigated further.

It is expected that, by conducting further research, it can provide a clear picture of the severity of COPD and the physical fitness of pilgrims who are eligible to participate in the Hajj pilgrimage with the latest developments, given that several years ago in Saudi Arabia, precisely Mecca, it was reported that they were facing air pollution problems due to increased construction activities, extreme weather and motor vehicle fumes (27). In fact, air population has a close relationship with human health, especially the lungs and respiratory tract. Air pollution can cause inflammation, oxidative stress (imbalance of free radicals and antioxidants in the body), and changes in the immune system (28).

### Research Limitations

In this study, there is a temporal ambiguity bias, which is the lack of clarity about which factors act as causes and effects. This occurs due to the limitations of the study design used. In a cross-sectional study design, the analysis process of all variables is carried out simultaneously so that it cannot be ascertained which disease appears first, especially for several variables such as congestive heart failure and stroke. Both diseases can appear suddenly (acute) or chronically. So, it is possible that the pilgrims suddenly suffered from the disease and were infected with pneumonia at the same time or they had suffered from the disease for a long time before being infected with pneumonia.

Another limitation was also found in this study, namely the presence of more than 10% missing data, namely in the variables of education, BMI, and smoking habits, so that it is possible that this can cause selection bias. This bias can affect the accuracy of the research results. In variables that are stated to be unrelated to the incidence of pneumonia, but have missing data, different results may be seen if all the data were filled in completely.

## CONCLUSION

This research found that only COPD comorbid has the most significant contribution to the incidence of pneumonia in elderly Hajj pilgrims in 2023. Thus, researchers suggest to relevant stakeholders to strengthen health from the period before Hajj departure, for example, by carrying out routine health guidance and monitoring, providing health promotion related to prevention efforts related to respiratory infectious diseases and evaluating the determination of istitaah status. By making these efforts, it is hoped that those who are elderly and have comorbid diseases will be able to perform the Hajj safely and comfortably in the future.

In order to help the government evaluate the determination of istitaah status, future researchers who are interested in a similar topic are advised to carry out further research on the risk of pneumonia based on the severity of COPD. It would be better if the research was carried out with a comprehensive study design to obtain a clear cause-and-effect relationship, for example, using a case-control or cohort study design and using a larger population or sample. In addition, to minimize selection bias, it is recommended to carry out random sampling.

## CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in this study

## AUTHOR CONTRIBUTIONS

ADF: analysis, visualizing data and interpreting them, writing original draft, and editing. CS: provided guidance related to research flow, analysis and interpretation of research results. UQK and FK: provided direction and revisions on data analysis and discussion of research results.

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