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ORIGINAL ARTICLE

RISK FACTORS OF CHRONIC KIDNEY DISEASE AMONG INDONESIAN PROSPECTIVE HAJJ PILGRIMS (DATA ANALYSIS OF SISKOHATKES 2024)

Faktor Risiko Gagal Ginjal Kronis pada Calon Jemaah Haji Indonesia (Analisis Data Siskohatkes 2024)

Istyarahma Kansya Kusumastuti[1], Chandrayani Simanjorang[2], Laily Hanifah[3], Heri Budianto[4]
[1]Public Health Department, Universitas Pembangunan Nasional "Veteran" Jakarta, Indonesia, 16514, rahma.kansya@gmail.com
[2]Public Health Department, Universitas Pembangunan Nasional "Veteran" Jakarta, Indonesia, 16514, chandrayanis@upnvj.ac.id
[3]Public Health Department, Universitas Pembangunan Nasional "Veteran" Jakarta, Indonesia, 16514, laily.hanifah@upnvj.ac.id
[4]Indonesian Hajj Health Center, Ministry of Health of Republic Indonesia, Indonesia, 12940, hbudianto@gmail.com
Corresponding Author: Chandrayani Simanjorang, chandrayanis@upnvj.ac.id, Department of Public Health, Faculty of Health Science, Universitas Pembangunan Nasional "Veteran" Jakarta, Depok, West Java, 16514, Indonesia

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ABSTRACT

Background: Chronic Kidney Disease (CKD) is an escalating global public health issue. By 2024, CKD ranked sixth among the top ten causes of death among Indonesian hajj pilgrims and served as a comorbidity for the two leading causes of mortality, hypertension and cardiovascular diseases. **Purpose:** This study aims to identify the risk factors of CKD among Indonesian prospective hajj pilgrims in 2024. **Methods:** A cross-sectional design was utilized using secondary data from the Integrated Hajj Computerized System for Health Sector (Siskohatkes) for all registered pilgrims in 2024. A total of 217,476 participants were enrolled using purposive sampling. Data were analyzed using multivariate logistic regression. **Results:** The prevalence of CKD among prospective Indonesian hajj pilgrims was 0.2%. Multivariate analysis revealed significant risk factors, including family history of CKD (aPOR = 3.51; 95% CI: 1.30–9.48), diabetes mellitus (aPOR = 2.25; 95% CI: 1.82–2.78) male (aPOR = 2.10; 95% CI: 1.71–2.57), age ≥ 60 years (aPOR = 1.93; 95% CI: 1.48–2.52), and hypertension (aPOR = 1,90; 95% CI: 1,48–2,44). **Conclusions:** This study highlights risk factors for CKD among prospective Indonesian hajj pilgrims, with a family history of CKD being the most dominant risk factor. The Indonesian Hajj Health Center is advised to standardize the diagnostic methods for CKD and integrate health information systems to serve as a reference for comparison of examination results.

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ABSTRAK

Latar Belakang: *Gagal Ginjal Kronis (GGK) merupakan permasalahan kesehatan masyarakat global yang terus berkembang setiap tahunnya. Pada 2024, GGK menduduki peringkat ke-6 dalam 10 penyakit penyebab kematian terbanyak jemaah haji Indonesia dan menjadi komorbid dua penyakit lain dengan kasus kematian terbanyak, yaitu hipertensi dan penyakit jantung.* ***Tujuan:*** *Penelitian ini bertujuan untuk mengetahui faktor risiko GGK pada calon jemaah haji di Indonesia tahun 2024.* ***Metode:*** *Penelitian ini berdesain studi cross-sectional dengan data sekunder yang berasal dari Sistem Komputerisasi Haji Terpadu Kesehatan (Siskohatkes) 2024 terhadap seluruh calon jemaah haji yang terdaftar. Sebanyak 217,476 calon jemaah haji diseleksi dengan teknik purposive sampling. Analisis data dilakukan sampai dengan multivariat dengan uji regresi logistik berganda.* ***Hasil:*** *Hasil penelitian menunjukkan prevalensi GGK pada calon jemaah haji Indonesia adalah 0,2%. Berdasarkan hasil analisis multivariat, terdapat peningkatan risiko GGK pada calon jemaah haji yang memiliki riwayat keluarga GGK (aPOR = 3,51; 95% CI: 1,30–9,48), diabetes melitus (aPOR = 2,25; 95% CI: 1,82–2,78), pria (aPOR = 2,10; 95% CI: 1,71–2,57), berusia ≥ 60 tahun (aPOR = 1,93; 95% CI: 1,48–2,52), dan hipertensi (aPOR = 1,90; 95% CI: 1,48–2,44).* ***Simpulan:*** *Penelitian ini menganalisis faktor risiko GGK pada calon Jemaah haji Indonesia dengan riwayat keluarga GGK ditemukan sebagai faktor risiko yang paling dominan. Pusat Kesehatan Haji disarankan untuk menstandardisasi metode penegakan diagnosis GGK dan mengintegrasikan sistem informasi kesehatan sebagai acuan dalam perbandingan hasil pemeriksaan.*

INTRODUCTION

Chronic kidney disease (CKD) is a growing global public health issue that continues to escalate annually. In addition to its rising prevalence, the risk factors for CKD are closely linked to global health conditions influenced by behavioral changes. CKD is defined as a state of kidney damage characterized by an estimated glomerular filtration rate (eGFR) of less than 60 mL/min/1.73m² or persistent albuminuria, indicated by a urinary albumin-to-creatinine ratio (UACR) of ≥30 mg/g, lasting for three months or more, regardless of the underlying cause (1).

The prevalence of CKD has been reported to continue rising over time (2). According to data collected by the Global Burden of Disease, the global prevalence of CKD was 8.49% in 2016, rising to 8.56% (2017), 8.63% (2018), 8.72% (2019), 8.79% (2020), and reaching 9.46% in 2021 (2,3). In Indonesia, the prevalence of CKD increased from 0.20% in 2013 to 0.38% in 2018, with the number of affected individuals reaching 27.23 million in 2017. This places Indonesia as the fourth-highest country regarding CKD cases, followed by China, India, and the United States (4–6).

At least three risk factors for CKD are characteristic of Indonesian Hajj pilgrims, including aging, hypertension, and diabetes mellitus. Annually, 30% of elderly pilgrims are selected to perform Hajj in Saudi Arabia (7). During the 2023 Hajj season, there were 66,943 (30.29%) elderly pilgrims aged 65–94 years, while 154,692 (73.70%) were classified as high-risk pilgrims (8). Given the relatively long waiting period (15–30 years), prospective Hajj pilgrims currently aged 40–59 years will likely be older by the time of their departure, placing them at higher risk of developing CKD.

During the 2024 Hajj season, CKD ranked as the sixth leading cause of death among Indonesian Hajj pilgrims and was a comorbidity in two other leading causes of death, namely hypertension (0.90%) and heart disease (0.40%) (9). Furthermore, data gathered by the Saudi Arabia Ministry of Health reported a 169.80% increase in the number of pilgrims undergoing hemodialysis (10). The Saudi Arabia Ministry of Health provides free hemodialysis services during Hajj through selected

designated healthcare facilities and mobile units, strategically located based on pilgrims' movement and ritual activities (11).

The primary rationale for this study is the lack of publications regarding risk factors for CKD among Indonesian Hajj pilgrims. This research aims to analyze the risk factors associated with CKD among prospective Hajj pilgrims. The findings are expected to serve as a basis for policy-making in promotive and preventive efforts, thereby minimizing health risks and enabling Hajj pilgrims to perform their religious duties in optimal health conditions.

METHODS

This study utilized a cross-sectional design using secondary data from the 2024 Indonesian Integrated Hajj Computerized System for Health Sector (Siskohatkes), obtained from the Hajj Health Center of the Indonesian Ministry of Health. The research was conducted between November and December 2024. The study population consisted of all Indonesian prospective Hajj pilgrims registered in Siskohatkes. Purposive sampling was applied based on the inclusion and exclusion criteria. The study sample included Hajj pilgrims with completed data who fulfilled these criteria. The inclusion criteria were defined as Indonesian prospective Hajj pilgrims registered in the 2024 Siskohatkes database who had undergone basic medical examinations. In contrast, the exclusion criteria included respondents with incomplete data (e.g., missing data entries).

The required sample size was calculated using Lemeshow's formula for comparing two proportions and was determined using the WHO-recommended Sample Size Determination in Health Studies software. Based on the confidence level of 95% and a power of 95%, the required sample size was calculated to be 814 respondents. This number was multiplied by two to accommodate a two-group comparison, resulting in a minimum required sample size of 1,628 respondents. An additional 10% was added to account for potential missing data, bringing the final minimum required sample size for this study to 1,791 respondents.

The dependent variable in this study was chronic kidney disease (CKD), defined as structural and/or functional kidney damage persisting for three months or longer, with diagnoses confirmed by physicians based on the ICD-10 codes N18.3, N18.4, N18.5, or N18.6. Independent variables included age (<60 years and ≥60 years), sex, education (categorized as low if the last formal education level was from no schooling to junior high school and high if it was from senior high school to higher education), occupation, obesity (categorized as usual if BMI <30 kg/m² and categorized as obese if BMI ≥30 kg/m²), hypertension (diagnosed by a physician with ICD-10 codes I10–I15.9), diabetes mellitus (diagnosed by a physician with ICD-10 codes E10–E11.9), and family history of CKD.

Data analysis was conducted using SPSS version 25. Univariate analysis was performed to describe the characteristics of all prospective Hajj pilgrims. Multivariate analysis was conducted using multiple logistic regression. Candidate variables for the multivariate analysis were selected using simple logistic regression, with a p-value <0.25 in the model. Potential confounders were controlled for, and interaction effects between independent variables were assessed throughout the analysis. In the final stage, a fit model was used to identify the most dominant risk factors for CKD among prospective Indonesian Hajj pilgrims. In order to ensure compliance with ethical standards for research involving human participants, ethical approval and a recommendation letter were obtained from the Health Research Ethics Committee (KEPK) of Universitas Pembangunan Nasional "Veteran" Jakarta under approval reference 487/XI/2024/KEP.

RESULTS

The prevalence of CKD among Indonesian Prospective Hajj pilgrims in 2024 is 0.20%. Based on the distribution table of characteristics of Indonesian prospective hajj pilgrims (Table 1), out of a total of 217,476 Hajj pilgrims analyzed, 144,358 individuals (66.40%) were aged <60 years, 120,064 individuals (55.20%) were female, 129,742 individuals (59.70%) had a higher education level, and 143,785 individuals (66.10%) were employed. Additionally, 185,776 individuals (85.40%) were categorized as usual based on a body mass index (BMI) <30 kg/m², 148,856 individuals (68.40%) did not have hypertension, 186,427 individuals (85.70%) did not have diabetes mellitus, and 216,675 individuals (99.60%) had no family history of CKD.

Table 1
Characteristics Distribution of Indonesian Prospective Hajj Pilgrims

Variable	n	%
Chronic Kidney Disease		
Yes	406	0.20
No	217,070	99.80
Age		
≥60 Years	73,118	33.60
<60 Years	144,358	66.40
Sex		
Male	97,412	44.80
Female	120,064	55.20
Education		
Low	87,734	40.30
High	129,742	59.70
Occupation		
Yes	143,785	66.10
No	73,691	33.90
Obesity		
Normal	31,700	14.60
Obese	18,776	85.40
Hypertension		
Yes	68,620	31.60
No	148,856	68.40
Diabetes Mellitus		
Yes	31,049	14.30
No	186,427	85.70
Family History of CKD		
Yes	801	0.40
No	216,675	99.60

Table 2 presents the logistic regression analysis results conducted to select candidates for multivariate analysis. Six of the eight independent variables in this study were identified as candidates for multivariate analysis, each with a p-value <0.25. These six variables include age (p-value <0.001), sex (p-value <0.001), obesity (p-value = 0.06), hypertension (p-value <0.001), diabetes mellitus (p-value <0.001), and family history of CKD (p-value = 0.04).

Further analysis was performed using multiple logistic regression to adjust for potential confounders. Variables with a p-value >0.05 were excluded from the model. Obesity was removed due to a p-value of 0.39. Subsequently, an interaction test was conducted for variables considered to have substantive interactions with each other and influence chronic kidney disease, including age, hypertension, and diabetes mellitus. No statistically significant interaction was found between the variables age and diabetes mellitus (p-value = 0.52).

Table 2
Candidate Variables for Multivariate Analysis

Variable	p-value
Age	<0.001
Sex	<0.001
Education	0.82
Occupation	0.31
Obesity	0.06
Hypertension	<0.001
Diabetes Mellitus	<0.001
Family History of CKD	0.04

The fit model derived from multivariate analysis using multiple logistic regression (Table 3) shows that age (aPOR = 1.93, 95% CI: 1.48–2.52, p-value < 0.001), sex (aPOR = 2.10, 95% CI: 1.71–2.57, p-value <0.001), hypertension (aPOR = 1.90, 95% CI: 1.48–2.44, p-value <0.001), diabetes mellitus (aPOR = 2.25, 95% CI: 1.82–2.78, p-value <0.001), and family history of CKD (aPOR = 3.51, 95% CI: 1.30–9.48, p-value = 0.013) were identified as statistically significant risk factors of CKD. Among these variables, family history of CKD was found to be the most dominant risk factor of CKD. Additionally, a statistically significant interaction was observed between hypertension and age in relation to CKD (p-value = 0.001).

DISCUSSION

Family history of CKD is significantly associated with CKD (p-value = 0.013) and is the most dominant variable influencing CKD among prospective Hajj pilgrims in Indonesia. The adjusted POR for individuals with a family history of CKD was 3.51 (95% CI: 1.30–9.48), indicating that individuals with a family history of CKD are 3.51 times more likely to develop CKD than individuals without a family history of CKD. This finding is supported by studies from Kim et al. and Zhang et al., which report increased risks of 1.46 times (95% CI: 1.43–1.49) and 3.04 times (95% CI: 2.26–4.09), respectively, for individuals with a family history of CKD compared to those without (12,13).

The hereditary nature of kidney function and biomarkers, such as creatinine, affects eGFR by 44% and UAE by 20% (13). Individuals with a family history of CKD not only face a higher risk but also progress more quickly to end-stage renal disease (ESRD) (12). In addition to the genetic inheritance of CKD risk, environmental and socioeconomic factors within families may also contribute to the increased risk among individuals with a family history of CKD. Individuals living

with someone who has CKD, such as spouses, are more likely to develop CKD due to shared lifestyle and dietary behaviors (12–14). Additionally, partner selection based on similar traits, such as smoking habits, BMI, education, and occupation, may further increase the risk of developing CKD (13). This study found that four pilgrims with CKD who have a family history of CKD also had hypertension and higher education, suggesting lifestyle or dietary influences adopted from the family environment.

Table 3
Fit Model of Chronic Kidney Disease Risk Factors Among Indonesian Prospective Hajj Pilgrims (Multiple Logistic Regression)

Variable	Chronic Kidney Disease				Total		Adjusted POR (95% CI)	p-value
	Yes		No					
	n	%	n	%	n	%		
Age								
≥60 Years	257	0.40	72,861	99.60	73,118	100.00	1.93 (1.48 – 2.52)	<0.001
<60 Years	149	0.10	144,209	99.90	144,358	100.00	Ref	
Sex								
Male	258	0.30	97,154	99.70	97,412	100.00	2.10 (1.71 – 2.57)	<0.001
Female	148	0.10	119,916	99.90	120,064	100.00	Ref	
Hypertension								
Yes	241	0.40	68,379	99.60	68,620	100.00	1.90 (1.48 – 2.44)	<0.001
No	165	0.10	148,691	99.90	148,856	100.00	Ref	
Diabetes Mellitus								
Yes	127	0.40	30,922	99.60	31,049	100.00	2.25 (1.82 – 2.78)	<0.001
No	279	0.10	186,148	99.90	186,427	100.00	Ref	
Family History of CKD								
Yes	4	0.50	797	99.50	801	100.00	3.51 (1.30 – 9.48)	0.013
No	402	0.20	216,273	99.80	216,675	100.00	Ref	
Hypertension * Age							2.03 (1.34 – 3.06)	0.001

Diabetes mellitus is the second most influential variable, with an adjusted POR of 2.25, indicating that prospective Hajj pilgrims with diabetes mellitus are 2.25 times (95% CI 1.82–2.78) more likely to develop CDK than those without diabetes mellitus. This finding is supported by research from Saminathan et al., Hustrini et al., Poudyal et al., and Ko et al., who report that individuals with diabetes mellitus are at a risk of developing CKD that is 3.32 times (95% CI: 2.20–5.03), 2.46 times (95% CI: 1.97–3.06), 3.20 times (95% CI: 2.50–4.10), and 1.82 times (95% CI: 1.71–1.94) respectively, compared to those without diabetes mellitus (6,15–17).

Indonesia's high carbohydrate and fat consumption, along with the growing popularity of sugary packaged foods, could explain the elevated CKD risk in individuals with diabetes mellitus. The main staple food, rice, is consumed by almost everyone. According to March 2024 data from the Indonesian Central Statistics Agency (BPS), the most consumed foods are processed foods and sugary beverages (18). Excess sugar intake can result in diabetes and obesity, which are major risk factors for CKD. Elevated blood sugar thickens kidney blood vessels and induces scarring, impairing kidney function and oxidative stress, further disrupting fluid balance (19,20).

This study found a significant association between sex and CKD in prospective Hajj pilgrims from Indonesia (p-value < 0.001). With an adjusted POR of 2.10 (95% CI 1.71–2.57), indicating that male pilgrims are 2.10 times more likely to develop CKD than female pilgrims. This finding is consistent with studies by Hustrini et al. and Ko et al., which report that men are 1.52 times (95% CI: 1.39–1.66) and 1.7 times (95% CI: 1.57–1.83) greater risk of developing CKD compared to women (6,17).

Kidney function deteriorates more rapidly in men than in women, likely due to the influence of sex hormones, which can lead to differences in kidney structure and function, such as glomerular structure differences and variations in growth factor synthesis and release (21,22). Additionally, lifestyle factors such as higher smoking rates in men may contribute (6). This study also found that a higher prevalence of CKD was observed in men (0.30%).

Estrogen, through estradiol, can reduce kidney damage. In contrast, testosterone inhibits the formation of antioxidant enzymes, exacerbating oxidative stress in the kidneys (22,23).

Age is significantly associated with CKD (p-value <0.001). With an adjusted POR of 1.93 (95% CI 1.48–2.52), indicating that pilgrims aged ≥60 years are 1.93 times more likely to develop CKD compared to those aged <60 years. This finding is consistent with studies by Poudyal et al. and Muiru et al., which report that individuals aged ≥60 years have 2.60 times (95% CI: 1.90–3.60) and 3.52 times (95% CI: 1.89–6.54) higher risk of developing CKD compared to those aged <60 years (16,24).

The risk of kidney function decline increases with age due to anatomical, physiological, and cytological changes in the kidneys. Kidney mass decreases by 10% per decade, leading to a reduction in functional nephrons. In addition, aging causes immune system dysfunction, enhancing inflammation and accelerating the deterioration of renal function (25–27). By 2050, global life expectancy is projected to rise, resulting in individuals aged 60 and older comprising 16% of the global population. Furthermore, an estimated 66.67% of this aging population will reside in low- and middle-income countries, where limited healthcare resources and a higher prevalence of comorbidities may further increase the risk of developing CKD (28).

Prospective Hajj pilgrims with hypertension are 1.90 times more likely to develop CKD compared to those without hypertension, as indicated by an adjusted POR of 1.90 (95% CI 1.48–2.44). This finding aligns with studies by Flammia et al., Saminathan et al., Poudyal et al., and Ko et al., which report that individuals with hypertension have 1.67 times (95% CI: 1.06–2.63), 3.72 times (95% CI: 2.08–6.66), 2.40 times (95% CI: 2.00–3.00), and 2.05 times (95% CI: 1.91–2.19) higher risk of CKD, respectively (15–17,29).

Changes in dietary patterns, such as the adoption of a Western-style diet high in protein and fat, as well as increased consumption of packaged food and beverages, contribute to the rise in hypertension among Indonesians. The high fat and sodium content in packaged foods may increase the risk of hypertension, subsequently raising the risk of CKD. Hypertension leads to oxidative stress and inflammation in the kidneys, narrowing blood vessels and reducing blood flow, which weakens kidney vessels over time. This results in a progressive decline in kidney function as functional glomeruli decrease, eventually exacerbating kidney damage (30).

Research Limitations

This study had several limitations, including biases related to temporal ambiguity and differential misclassification. Temporal ambiguity arose from the cross-sectional study design, which prevents the establishment of causal relationships and does not allow for a precise determination of whether the disease occurred after exposure, as data collection was conducted simultaneously. Differential misclassification bias could have occurred due to the non-standardized methods used for diagnosing CKD, which may have led to either overestimating or underestimating due to differences in diagnostic accuracy among prospective Hajj pilgrims. Furthermore, the data availability from the 2024 Siskohatkes limited the research variables analyzed to assess CKD risk factors. As a result, other factors such as smoking habits, salt consumption, and cadmium exposure could not be analyzed.

CONCLUSION

The prevalence of CKD among Indonesian prospective Hajj pilgrims in 2024 is 0.20%. Multiple logistic regression in this study identified family history of CKD, diabetes mellitus, sex, age, and hypertension as risk factors for CKD, with family history of CKD being the most dominant risk factor. It is recommended that the Indonesian Hajj Health Center implement a standardized diagnostic method for CKD to assess the health eligibility (*istithaah*) of prospective Hajj pilgrims. Furthermore, the Indonesia Hajj Health Center is advised to integrate health information systems to record comprehensive and accurate health data, including medical history, treatments, and laboratory results. Additional studies are suggested to focus on high-risk age groups, particularly individuals aged ≥60 years, due to the interaction between hypertension and age in the occurrence of CKD.

CONFLICT OF INTEREST

The authors declare there is no conflict of interest associated with this study.

AUTHOR CONTRIBUTIONS

IKK: analysis, visualizing and interpreting data, writing the original draft, and editing. CS: guiding research flow, analysis, and interpreting data. LH: providing revisions on the discussion section. HB: data collection.

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