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Cardiovascular Diseases among Iranian Hajj Pilgrims from 2012 to 2022: Prevalence, Trends, and Economic Perspective

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Abstract

Background: Cardiovascular diseases (CVDs) represent a significant cause of mortality and morbidity globally. One of the primary objectives of medical examinations for Hajj pilgrims is disease screening, which is conducted following stringent guidelines to mitigate mortality and disability among the pilgrims. This study aimed to assess the prevalence, patterns, and associated healthcare services of CVDs among pilgrims from 2012 to 2022.

Methods: This study examined the prevalence of CVDs among Iranian Hajj pilgrims using pooled cross-sectional data, stratified by age, sex, and provinces. Logistic regression modeling was employed to evaluate the influence of various factors on the likelihood of CVDs among the pilgrims.

Results: This study incorporated data from 459,934 Hajj pilgrims. The findings revealed that the mean age of the pilgrims was 55.48 years. The prevalence of CVDs was higher in men (4.25%) compared with women (3.41%), with an overall prevalence of 3.83% among the pilgrims. The peak prevalence was observed in 2018 at 5.18%. The binary logistic regression model indicated that age (odds ratio [OR], 1.067), fasting blood sugar (OR, 1.002), male sex (OR, 0.781), chronic renal failure (OR, 2.262), high blood pressure (OR, 2.742), and diabetes (OR, 1.723) were significantly associated with the probability of having CVDs.

Conclusion: This study represents the most comprehensive investigation into the prevalence and pattern of CVDs among Iranian pilgrims over the past decade, utilizing data from approximately half a million Iranian pilgrims. The results highlight substantial differences in the prevalence of CVDs by age, sex, and their distribution across different provinces. Consequently, screening, diagnosis, and appropriate management by primary care physicians are crucial to prevent adverse disease outcomes and alleviate the economic burden.

Keywords: Prevalence, Cardiovascular Diseases, Hajj Pilgrims, Iran, Economic

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↑What is "already known" in this topic:
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→What this article adds:
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Introduction

Non-communicable diseases (NCDs) represent a significant global health challenge, responsible for 41 million fatalities annually (1), and contributing to 53% of the 1.65 million years of life lost (YLL) globally (2). The 2019 Global Burden of Disease (GBD) report identified cardiovascular diseases (CVDs) as the primary cause of mortality and disability-adjusted life years (DALYs). The report revealed that the number of individuals afflicted with CVDs escalated from 271 million in 1990 to 523 million in 2019, indicating a more than 2-fold increase over 3 decades. Furthermore, the mortality rate associated with these diseases surged from 12.1 million in 1990 to 18.1 million in 2019 (3). The 2017 report underscored that CVDs were the predominant cause of YLL in 113 countries for men and 97 countries for women (4). Over recent decades, the geographical distribution of CVDs has transitioned from developed to developing nations, prompting the World Health Organization (WHO) to prioritize CVD prevention in developing countries (5).

While developed countries have witnessed a decline in mortality and morbidity due to CVDs in recent years, attributable to preventive measures and efficacious interventions, the trend continues to ascend in developing nations. The most salient risk factors for CVDs encompass malnutrition, obesity, insufficient physical activity, tobacco use, hypertension, lipid disorders, diabetes, and aging (6).

The prevalence of CVDs exhibits considerable variation across countries. Studies have reported prevalence rates spanning from 0.5% in Jordan to 7.6% in Malaysia. European and American nations have documented prevalence rates oscillating between 1% to 5%. Among developed nations, Japan exhibits the lowest prevalence at 1%, while epidemiological data suggest the highest prevalence of CVDs in Asian countries (7). In recent years, Iran has experienced an upsurge in the prevalence of CVDs, which have become the leading cause of mortality in individuals aged >35 years. CVDs account for 44% of all deaths and 27.2% of years of life lost, thereby amplifying the importance and necessity of health policy solutions in Iran (8, 9).

The Hajj represents an annual mass gathering convened in Mecca, Saudi Arabia, attracting 2 to 3 million pilgrims globally, a figure projected to rise in the future (10, 11). These pilgrims originate from approximately 180 countries, with nearly two-thirds hailing from low- and middle-income countries. Most of these individuals are elderly (>65 years old) and possess underlying health conditions (12). The physical and environmental stressors associated with this gathering, coupled with dietary changes and inadequate sleep, can exacerbate diseases among pilgrims (13-17). Underlying conditions such as CVDs, respiratory, mental, and musculoskeletal disorders, as well as aging, present health challenges during the Hajj, resulting in physical disability for participants. These diseases may impose substantial financial burdens on pilgrims, their families, and the involved organizations due to the requirement for specialized treatments.

Screening for diseases constitutes a primary objective of medical evaluations for Hajj pilgrims, conducted in accordance with stringent guidelines aimed at reducing mortality and disability among this population. These evaluations are designed to assess the physical and mental capacities of pilgrims, identify individuals at high risk, and acquaint caravan leaders with the physical and mental needs of pilgrims to facilitate the provision of more effective medical services throughout the journey. Upon registration with the caravan, each individual is required to consult the caravan physician within 24 hours. During the initial consultation, a series of general tests and examinations are conducted, and within a 7-day timeframe, the physician delivers an assessment of the individual's overall health status, subsequently approving or rejecting their participation in the Hajj. The health status assessment checklist for pilgrims encompasses various categories, including skin diseases, ear, nose, and throat conditions, respiratory diseases, cardiovascular diseases, gastrointestinal diseases, internal diseases, blood disorders, neurological conditions, women's health, and musculoskeletal diseases.

Despite the Hajj being one of the most ancient religious ceremonies globally, attracting annual attendance from pilgrims from various countries, particularly Muslim nations, there has been a paucity of recent research investigating the epidemiological pattern of CVDs, as well as the cardiac care required and provided to pilgrims by the Iranian Red Crescent Society—a principal organizer of the Hajj. The present study was conducted to evaluate the prevalence and pattern of CVDs and the requisite services provided to pilgrims during the years 2012-22. Given the substantial population of pilgrims (approximately 500,000) encompassed in the study, the results can be utilized to formulate preventive and health protocols, offering a comprehensive overview of the cardiovascular status of pilgrims over a decade.

Methods

Research Methodology

This study was conducted in 2023 and scrutinized the prevalence of CVDs, stratified by sex, province, and year, spanning from 2012 to 2022. Comprehensive demographic information, risk factors, and CVD data were extracted from the databases of the Hajj and Pilgrimage Medical Center via file perusal. The study encompassed an examination of the age distribution of pilgrims, the prevalence of CVDs by age and sex among pilgrims within each age bracket, and the prevalence of CVDs among pilgrims by province and year.

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Sampling and Inclusion and Exclusion Criteria

This study did not employ sampling, and all Hajj pilgrims during the study period (from 2012 to 2022) were incorporated into the analysis. Those pilgrims with >40% of registered information missing in the databases were excluded from the study.

Age Category

In this study, pilgrims were categorized into 4 age categories: <15 years, 15-44 years, 45-69 years, and >70 years.

Data Analysis and Statistical Tests

The extracted data were analyzed by Excel 2019 and Stata17 software. The R software version 4.3.1 was used to draw the map. In the descriptive part of the study, frequencies and percentages were used for qualitative variables, and the mean and standard deviation were used for quantitative variables. To investigate the effect of risk factors on the odds of CVD, a binary logistic regression model was used. Given that the prevalence of CVD among pilgrims differs by province and that pilgrims from the same province tend to be more similar to each other, the province was used as a clustering variable. Robust standard errors were employed to adjust for the correlation among pilgrims within the same province, thereby accounting for intracluster correlation. The significance level for the statistical test was considered at 5% ($\alpha = 0.05$).

Ethical Considerations

This study is derived from the research project with the ethics code of IR.RCS.REC.1401.019 from the Iranian Red Crescent Society, which was conducted at the Research Center for Emergency and Disaster Resilience, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran.

Results

The study included data on 459,934 hajj pilgrims with a mean age of 55.48 years, including nearly 50% women and 50% men. Of the total pilgrims, 21.02% were hypertensive, and 13.62% had diabetes. In addition, 3.71% of pilgrims were affected by ischemic heart disease. The highest number of pilgrims (n = 89,000) belonged to the year 2019, and 73.32% were in the 45-70 years group (Table 1).

Prevalence of CVDs by Age and Sex

According to the findings, the prevalence of CVDs among pilgrims increases with age, thus, the highest prevalence of the disease was observed in pilgrims aged ≥70 years (Table 2). The prevalence of CVDs was estimated at 4.25% in men and 3.41% in women. Overall, the prevalence of these diseases among pilgrims during the study period was 3.83%. The prevalence was zero in 2017 and reached its highest level in 2018, with 5.18%.

According to the data in Figure 1, the lowest and highest prevalence rates of CVDs among pilgrims were observed in Lorestan and Ilam provinces, respectively (Table 3).

Table 1. Characteristics of Iranian Hajj Pilgrims

Variable	N (%)
Sex	
Male	230,136 (50.04%)
Female	229,798 (49.96%)
Total Number	459,934
Age (years)	
<15	129 (0.03%)
15-44	73,292 (15.94%)
45-69	337,229 (73.32%)
≤70	49,284 (10.72%)
Mean	55,48
Year	
2012	60,922 (13.25%)
2013	60,837 (13.23%)
2014	61,248 (13.32%)
2016	64,123 (13.94%)
2017	84,993 (18.48%)
2019	89,000 (19.35%)
2022	38,811 (8.44%)
Diabetes Mellitus (18)	
Yes	62,630 (13.62%)
No	397,304 (86.38%)
Hypertension	
Yes	96,691 (21.02%)
No	363,243 (78.98%)
Ischemic Heart Disease (IHD)	
Yes	17,042 (3.71%)
No	442,892 (96.29%)
Chronic Renal Failure (CRF)	
Yes	700 (0.15%)
No	459,234 (99.85%)

Table 2. Prevalence of CVDs in Hajj Pilgrims by Age and Sex

Age (years)	CVDs	
	No	Yes
<15	129(100%)	0(0.0%)
15≤age<45	73,126 (99.77%)	166 (0.23%)
45≤age<70	324,897 (96.34%)	12,332 (3.66%)
70≤	44,176 (89.64%)	5,108 (10.36%)
Sex		
Male	220,357 (95.75%)	9,779 (4.25%)
Female	221,971 (96.59%)	7,827 (3.41%)
Total	442,328 (96.17%)	17,606 (3.83%)

Factors Influencing the Prevalence of CVDs

To evaluate the impact of demographic variables and certain risk factors on CVDs, a logistic regression model was employed. Given the binary nature of CVDs (CVDs = 0, CVDs = 1) and the clustered structure of the data (individuals within a province may exhibit similarities in certain environmental and genetic characteristics), robust standard errors were utilized to adjust for clustering correlation. The outcomes of fitting the logistic regression model, incorporating the robust standard error, are described in Table 4.

The overall significance of the model was computed to be 5008.075, as determined by the Wald statistic, and the P value for this test was <0.05 ($P < 0.001$). Consequently, the model is deemed significant, implying that the null hypothesis (the insignificance of all independent variables in the model on the probability of having CVDs) is rejected, and at least one of the independent variables in the model exerts a significant influence on the probability of developing CVDs. Given that the P value for all independent variables in the model, except for systolic blood pressure, diastolic blood pressure, and blood creatinine levels, was <0.05 ($P <$

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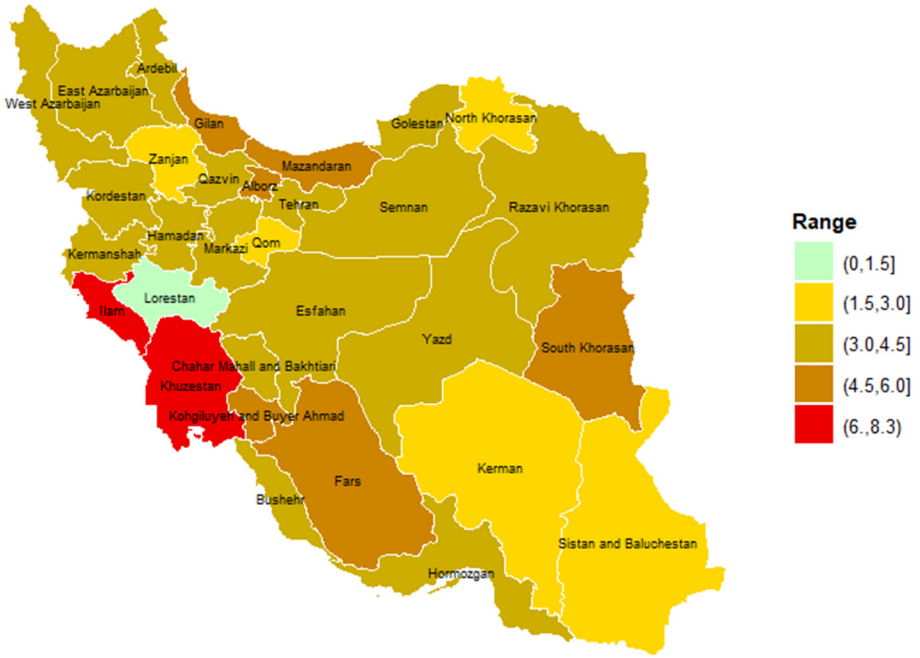

Figure 1. Prevalence (%) of CVDs by province

0.001), it can be inferred that, based on the data and evidence at a 5% error level, aside from the 3 variables (systolic blood pressure, diastolic blood pressure, and blood creatinine), the other variables were significantly correlated with the probability of developing CVDs. For instance, for each unit increment in the age of the pilgrims, while holding other variables in the model constant, the probability of developing CVD will augment by .067%. Similarly, for the sex variable, the probability of developing CV among women is 0.781 times that of men—alternatively, the probability of developing CVDs in men is 1.28 (1/0.78) times

Table 3. Prevalence of CVDs among Hajj Pilgrims by Province

Province	CVDs		
	0	1	Total
Chahar Mahaal and Bakhtiari	2,359 (96.13%)	95 (3.87%)	2,454 (100.00)
Kohgiluyeh and Boyer-Ahmad	785 (94.01%)	50 (5.99 %)	835 (100.00)
Alborz	7,440 (94.78%)	410 (5.22 %)	7,850 100.00
Ardabil	3,821 (96.01%)	159 (3.99%)	3,980 (100.00)
Bushehr	5,053 (96.84 %)	165 (3.16%)	5,218 (100.00)
East Azarbayjan	14,336 (95.65 %)	652 (4.35 %)	14,988 (100.00)
Fars	20,546 (95%)	1,081 (5%)	21,627 (100.00)
Gilan	3,476 (94.18%)	215 (5.82%)	30691 (100.00)
Golestan	20,316 (96.85%)	661 (3.15%)	20,977 (100.00)
Hamadan	12,393 (96.84%)	405 (3.16%)	12,798 (100.00)
Hormozgan	5,276 (96.88%)	170 (3.12%)	5,446 (100.00)
Ilam	644 (91.74 %)	58 (8.26%)	702 (100.00)
Isfahan	41,809 (96.61%)	1,466 (3.39 %)	43,275 (100.00)
Kerman	16,714 (97.01%)	515 (2.99%)	17,229 (100.00)
Kermanshah	5,148 (96.51 %)	186 (3.49%)	5,334 (100.00)

Table 3. Continued

Province	CVDs		
	0	1	Total
Khuzestan	22,280 (93.72%)	1,492 (6.28%)	23,772 (100.00)
Kurdistan	8,465 (96.02%)	351 (3.98%)	8,816 100.00
Lorestan	6,881 (98.53%)	103 (1.47%)	6,984 100.00
Markazi	8,610 (96.39%)	322 (3.61%)	8,932 (100.00)
Mazandaran	19,879 (95.19 %)	1,005 (4.81%)	20,884 (100.00)
North Khorasan	6,903 (97.71%)	162 (2.2 %)	7,065 (100.00)
Qazvin	6,033 (95.66 %)	274 (4.34%)	6,307 (100.00)
Qom	12,814 (97.54%)	323 (2.46%)	13,137 (100.00)
Razavi Khorasan	54,223 (95.70%)	2,436 (4.30%)	56,659 (100.00)
Semnan	6,233 (96.67%)	215 (3.33%)	6,448 (100.00)
Sistan and Baluchistan	8,831 (97.96%)	184 (2.04%)	9,015 100.00
South Khorasan	9,587 (95.27 %)	476 (4.73 %)	10,063 (100.00)
Tehran	68,298 (96.50%)	2,478 (3.50%)	70,776 100.00
West Azarbayjan	19,476 (95.93%)	826 (4.07%)	20,302 (100.00)
Yazd	15,760 (96.81%)	519 (3.19 %)	16,279 (100.00)
Zanjan	7,939 (98.12%)	152 (1.88%)	8,091 (100.00)
Total	442,328 (96.17%)	17,606 (3.83%)	459,934 (100.00)

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Table 4. Results of Logistic Regression Analysis for Factors Associated With the Prevalence of CVDs

CVDs	OR	Robust. St.Err.	t-value	*P*-value	[95% Conf	Interval]	Sig
Age	1.067	.003	24.74	0	1.062	1.073	***
Sex	.781	.031	-6.21	0	.722	.844	***
Systotic	1.003	.002	1.65	.098	1	1.006	***
Diastolic	1.002	.002	1.25	.21	.999	1.005	
FBS	1.002	0	7.87	0	1.002	1.003	***
Cr	1.006	.026	0.21	.831	.956	1.058	
CRF	2.262	.263	7.01	0	1.8	2.842	***
DM	1.723	.048	19.58	0	1.632	1.82	***
HTN	2.742	.091	30.27	0	2.568	2.927	***
Constant	0	0	-47.85	0	0	0	***
Mean dependent var		0.038		SD dependent var		0.192	
Pseudo r-squared		0.129		Number of obs		459934	
Chi-square		5008.075		Prob > chi2		0.000	
Akaike crit. (AIC)		130235.608		Bayesian crit. (BIC)		130345.996	

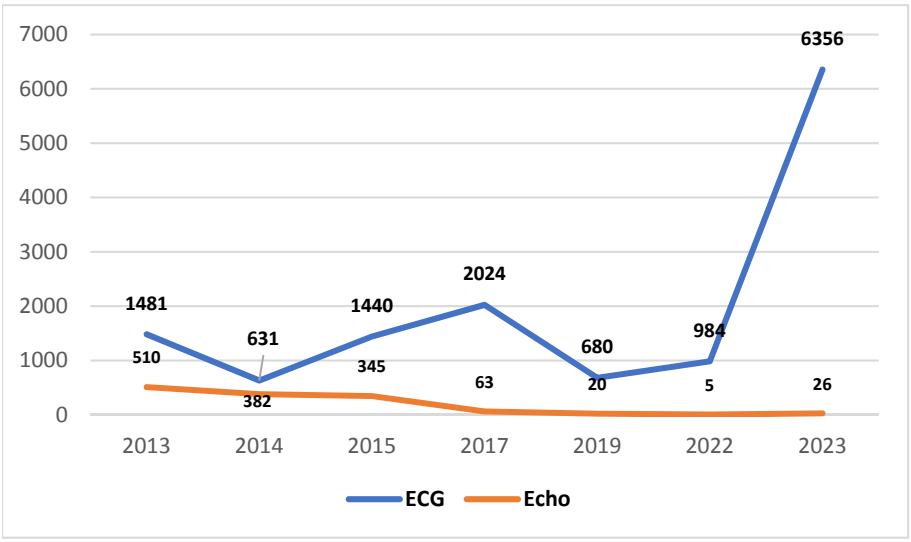

Figure 2. Echocardiography and ECG Trends During Hajj

that of women. Pertaining to the fasting blood sugar variable, the probability of developing CVDs for each unit increase in fasting blood sugar will augment by 0.002%. Additionally, the probability of developing CVDs in patients with chronic kidney disease (CKD) is 2.262 times that of healthy individuals. Similarly, it can be deduced that the probability of developing CVDs in diabetics is 1.723 times that of nondiabetic individuals. Furthermore, for those with hypertension (HTN, 1), the probability of developing CVDs is 2.742 times that of those without hypertension (HTN, 0).

Healthcare Delivery and Economic Burden

Iranian pilgrims have been receiving specialized consultations, referrals to treatment teams, echocardiography, and electrocardiography. In severe cases, hospitalization in the special care department may be necessary. The chart below illustrates the trend of specialized services, such as ECG and echocardiography, provided each year. The lowest number of electrocardiograms was conducted in 2014, while the highest was in 2023. The lowest number of echocardiograms was conducted in 2014, while the highest was in 2015 (Figure 2). In 2023, the highest rate of intensive care unit (ICU) beds for cardiovascular patients was recorded (Figure 3).

Discussion

CVDs, encompassing coronary artery disease, heart failure, stroke, peripheral vascular disease, and numerous other cardiovascular conditions are the foremost cause of mortality and diminished quality of life globally. In 2019, CVDs were the principal cause of death for 9.6 million men and 8.9 million women, constituting nearly one-third of global deaths. Among these fatalities, 6.1 million transpired in those aged 30 to 70 years. The greatest number of CVD-related deaths occurred in China, India, the Russian Federation, the United States, and Indonesia. Despite a 30-year decline in the global mortality rate of CVDs, the Global Burden of Disease study in 2019 unveiled an increase in CVD-related mortality in numerous regions since 2010, with the global decline trend transitioning to a flat trend over the past 5 years (19). The standardized prevalence of CVDs in women globally is estimated at 6403 cases per 100,000 individuals. North Africa, the Middle East, high-income North America, Eastern Europe, and Central Asia exhibit the highest prevalence of CVDs (20). Over the past

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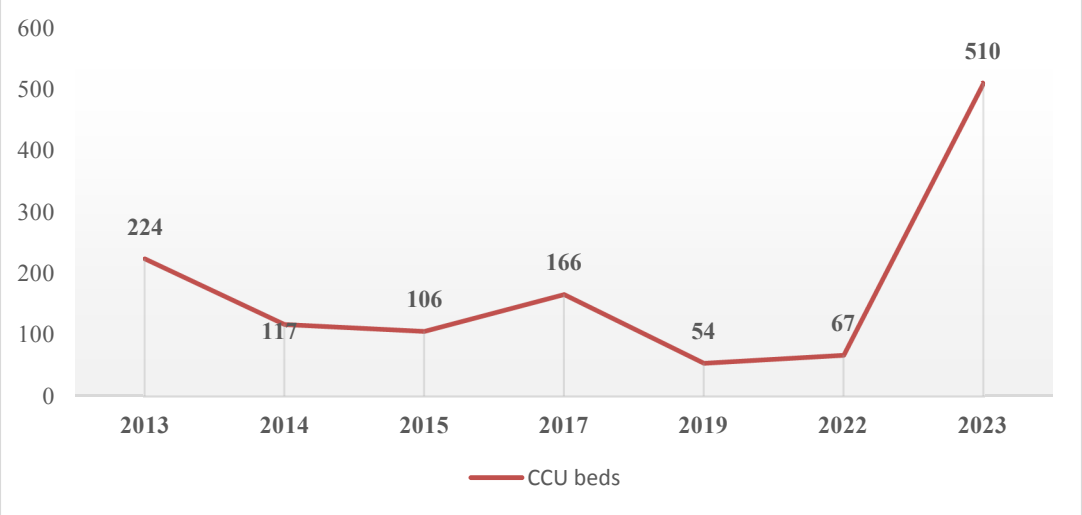

Figure 3. CCU hospitalization trends during Hajj

decade, the prevalence of CVDs among women has been reported at 4%, and among men at 7.8% (21). The annual direct and indirect costs of CVDs in the United States reached $378 billion in 2017-2018. The estimated direct costs of CVDs in the United States escalated from $103.5 billion in 1996-97 to $226.2 billion in 2017-18 (22).

According to evidence from the Global Burden of Disease study, CVDs are the leading cause of mortality and DALYs in Iran, accounting for 46% of all deaths and 20% to 23% of the disease burdens. With 9000 CVD-related deaths per 100,000 individuals, Iran is considered among the countries with the highest prevalence of CVDs (8). Among Hajj pilgrims, CVDs is a major cause of mortality during the pilgrimage, with 25% of hospital admissions and 64% of ICU admissions attributed to CVDs (23, 24). In a study conducted on pilgrims, 32.81% had high blood pressure, 13.36% had diabetes, and 6.41% of pilgrims had cardiovascular diseases (CVDs) (25).

Our analysis also indicated an increase in the prevalence of CVDs with age, reaching 10.36% in those aged >70 years old. Aging processes may facilitate metabolic pathways leading to undesirable metabolic profiles, high blood pressure, and lipid metabolism disorders, while metabolic conditions, especially obesity, diabetes, and insulin resistance are associated with cardiovascular and vascular aging. These aspects highlight the relationship between aging, metabolism, and CVDs (26).

A study on Indonesian Hajj pilgrims reported a 29.2% prevalence of cardiovascular risk factors and found that 13.1% of hospitalized patients were initially diagnosed with CVDs (27). In a study by Meysamie et al, the prevalence of CVDs among Iranian pilgrims in 2004 and 2005 was reported at 2.88% and 1.42%, respectively (28). Other results showed that most hospitalized pilgrims with CVDs were from Asia and Africa, accounting for 45.3% and 12%, respectively. From the Middle Eastern region, 9% of patients were from Turkey, 7% from Iraq, and 3% from Iran. The highest number of pilgrims hospitalized with CVDs were from India and Pakistan, at 17% and 16%, respectively. From Southeast Asia, 10% were from Indonesia and 1% from Malaysia. From Africa, 2% were Egyptian, 3% Nigerian, 4% Tunisian, and only 1 pilgrim each from Libya and South Africa (29). One possible reason for the low prevalence of CVDs among pilgrims, especially Iranian Hajj pilgrims, is the effective pre-departure screening programs that successfully limit high-risk groups, including those with a history of CVDs. Therefore, differences in the prevalence of CVDs may be explained by the lack of pre-departure screening programs in some countries (17).

A study conducted in Saudi Arabia found that despite their advanced age, Hajj pilgrims exhibited a lower prevalence of cardiovascular risk factors compared with the general population of Saudi Arabia. This discrepancy may be ascribed to genetic, racial, environmental, and cultural differences among pilgrims originating from diverse regions (30). Our study also reported a higher prevalence of CVDs in male pilgrims compared with female pilgrims. The evidence corroborated that variables such as male sex was associated with a higher likelihood of mortality due to CVDs (27). Although CVDs are not prevalent among pilgrims, the mortality rate associated with CVDs among pilgrims is elevated (31).

While numerous risk factors for CVDs are prevalent among both men and women, the relative significance and weight of these factors diverge. Evidence suggests that factors such as age, blood pressure, total cholesterol, and low-density lipoprotein cholesterol exert a more substantial impact on men, while smoking, diabetes, high triglycerides, and high-density lipoprotein cholesterol have a more pronounced effect on women (32). Conversely, specific risk factors for women—such as polycystic ovary syndrome, primary ovarian insufficiency, pregnancy-induced hypertension, and gestational diabetes—are associated with an increased risk of CVDs (33). A study conducted in the United States demonstrated that the prevalence, treatment trends, and control of CVD risk factors are analogous between sexes, but significant differences exist in terms of

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body mass index (BMI) and total cholesterol, with women experiencing less reduction in cholesterol than men, while women's BMI increased more than men's. The study also indicated that men are less likely to control high blood pressure and diabetes, while women are less likely than men to achieve adequate control of dyslipidemia (34). However, findings from published studies on the prevention of CVDs suggest that women are more likely than men to use statins for primary prevention of CVDs, but this association is not observed in secondary prevention (35). Findings on the prevalence of smoking, alcohol consumption, and physical inactivity among men were higher than among women (36). Conversely, evidence shows that women are more likely than men to control high blood pressure, quit smoking, and use preventive medications. Therefore, it appears that the inherent burden of cardiovascular risk factors in women is less than in men, although the cause of this is unknown, and it is believed that differences in estrogen levels may play a role in cardio-protection for women (37). Estrogen affects endothelial cells, smooth muscle cells, cardiac myocytes, and fibroblasts through transcriptional and non-transcriptional mechanisms. However, external estrogen therapy for preventing pregnancy and menopause does not reduce the risk of CVDs (20).

An additional study scrutinized the influence of variables such as systolic blood pressure, diastolic blood pressure, blood creatinine level, fasting blood sugar level, age, sex, and the presence of CKD, diabetes mellitus, HTN, ischemic heart disease, and cerebrovascular accident (18). The results demonstrated that, except for systolic blood pressure, diastolic blood pressure, and blood creatinine, other variables exerted a significant impact on the likelihood of developing CVDs. The study discovered that in 55-year-old individuals with optimal risk factors (total cholesterol level less than 180 mg/dL, systolic blood pressure <120 mmHg, diastolic blood pressure <80 mmHg, no history of smoking, and no diabetes), the risk of mortality due to CVDs was significantly higher than in those with ≥2 risk factors, up to the age of 80 (38). In a study on 50-year-old individuals, the findings corroborated that increased blood pressure and total cholesterol were associated with an increased risk of CVDs over the lifespan and reduced survival in both men and women. The onset of diabetes at the age of 50 had the highest lifetime risk for CVDs compared with any other risk factor (39). These findings are somewhat consistent with the results of the present study.

Alongside diabetes, high blood pressure is a major risk factor for the primary cause of mortality among pilgrims with CVDs. Almekhlafi et al reported that the prevalence of stroke during the 2015 Hajj was 8.9 per 100,000 individuals. The most common risk factors were high blood pressure and diabetes, accounting for 57% and 41% of observed cases, respectively (40). In a recent similar study, the findings indicated that male sex, age > 50, high blood pressure, diabetes, overweight, and obesity were associated with a higher risk of hospitalization. Additionally, several variables, such as male sex, diabetes, and overweight, but not obesity, were associated with a higher risk of mortality (27). According to the ranking of the Global Burden of Diseases study in 2019, some risk factors such as high systolic blood pressure, dietary risks, high cholesterol levels (low-density lipoprotein), air pollution, high body mass index, tobacco consumption, and high fasting blood sugar are modifiable. Additionally, rheumatic heart disease, influenced by poverty and high-density residential conditions, and alcoholic cardiomyopathy, influenced by inappropriate alcohol use patterns, can be fully prevented (19). It is essential to note that the Hajj pilgrimage involves several activities that require significant physical activity. Walking around the Kaaba, the holiest site for Muslims, and walking between the 2 hills (Safa and Marw) at a distance of approximately 3.15 kilometers. However, these activities are only a part of the Hajj pilgrimage. Another exhausting activity is the 14.5-kilometer journey to the plains of Arafat, after which pilgrims must spend a night in Muzdalifah before proceeding to the Jamarat for the stoning ritual. Therefore, individuals participating in the Hajj pilgrimage must be in good health and capable of undertaking this journey. Diagnostic tests for some chronic diseases are mandatory for individuals participating in the Hajj pilgrimage and should be conducted 1 or 2 months before the journey. By restricting the participation of pilgrims suffering from heart failure, serious arrhythmias, uncontrolled hypertension, unstable angina, and CVDs, the burden of these diseases during the Hajj pilgrimage can be somewhat prevented.

Conclusion

Precise estimates and predictions of the prevalence of CVDs on a global, regional, and national scale are crucial for the formulation and monitoring of prevention and treatment strategies, and for assessing progress toward globally set objectives for the control of non-communicable diseases and sustainable development. Based on the findings, the present study represents the most exhaustive examination of the prevalence and patterns of CVDs among Iranian pilgrims over the preceding decade, encompassing approximately half a million Iranian pilgrims. The results of the study reveal significant disparities in the prevalence of cardiovascular diseases by age, sex, and distribution across various provinces. However, it appears that comprehensive information is deficient regarding the adaptation of pilgrims' lifestyles and the determination of behavioral factors for managing chronic diseases during the Hajj pilgrimage. Consequently, screening, accurate diagnosis, and management by primary care physicians are crucial to prevent adverse outcomes associated with diseases and mitigate the economic burden resulting from them.

Authors' Contributions

Pirhossein Kolivand: Conceptualization, project administration.

Peyman Saberian: conceptualization, writing, reviewing, and editing.

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Soheila Rajaie: data curation, visualization, data analysis.

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Ethical Considerations

This study is an extract from the research project with the Code of Ethics IR.RCS.REC.1401.019 from Iranian Red Crescent Society, which has been conducted at the Research Center for Emergency and Disaster Resilience, Red Crescent Society of the Islamic Republic of Iran, Tehran, Iran. We would like to thank all who helped us through writing the article.

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Conflict of Interests

The authors declare that they have no competing interests.

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