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Medication Adherence Among Pilgrims with Chronic Diseases at Hajj 2024

Authors' Contribution:

Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Osama A. Samarkandi** 
ABCDEF 2 **Fahad Alamri** 
ABFG 2 **Hala Aljishi**
ABE 2 **Lamis Alabdullatif**
ABDG 2 **Ghadah S. Alsaleh**
ABCDEF 3 **Mohamad Alfrelali** 
ABE 2 **Jumanah Alhazmi**
ABDFG 1 **Waleed Alazmy**
ADEF 4 **Anas Khan** 

1 Department of Basic Science, Prince Sultan College for Medical Emergencies, King Saud University, Riyadh, Saudi Arabia
2 Global Center for Mass Gathering Medicine (GCMGM), Ministry of Health, Riyadh, Saudi Arabia
3 Department of Family and Community Medicine, Faculty of Medicine in Rabigh, King Abdulaziz University, Jeddah Saudi Arabia
4 Department of Emergency Medicine, College of Medicine, King Saud University, Riyadh, Saudi Arabia

Corresponding Author: Fahad Alamri, e-mail: fahadalamri518@gmail.com
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Background: Data on the pattern of medication use among pilgrims during the Hajj can help pilgrims make informed decisions regarding safe and effective medication use. This study aimed to evaluate medication adherence and identify barriers among pilgrims with chronic diseases during Hajj 2024.

Material/Methods: A cross-sectional study was conducted over 1 month preceding the conclusion of the 2024 Hajj. Data collection was undertaken at departure terminals in Jeddah and Madina airports, using a structured, pre-validated questionnaire to gather information on demographics, disease prevalence and complications, medication adherence, regimen details, and barriers to medication use. Statistical analysis was performed using SPSS version 27, with a significance threshold set at $P < 0.05$.

Results: The chronic disease prevalence was 40.1% and polypharmacy was observed among 4.9% of the pilgrims. The study revealed that 61.8% of pilgrims take at least 1 medication for chronic conditions. Adherence rates varied, with 48.9% taking medications consistently, 21.1% never adhering, and 14.7% ($n=100$) taking them intermittently. Insufficient medication supply (25.7%) and forgetfulness (13.8%) were the primary reasons for non-adherence. Significant associations were found between age and medication usage, with younger pilgrims more likely to use single medications, and those aged 40 to 60 years more likely to use multiple medications ($P=0.001$). Education level was also linked to medication adherence ($P=0.012$).

Conclusions: The study identified a significant burden of chronic diseases and polypharmacy among pilgrims and found inconsistent medication adherence. Targeted interventions, including health education, medication access, and healthcare support, are crucial to improving health outcomes during mass gatherings.

Keywords: Disease • Health • Medication Adherence • Polypharmacy

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Introduction

The Hajj pilgrimage is one of the largest and most complex annual mass gatherings worldwide, attracting millions of Muslims to Makkah, Saudi Arabia [1]. This event presents unique public health challenges, especially in managing chronic diseases, such as diabetes, hypertension, and asthma [2-4]. During Hajj, pilgrims travel from different geographic locations, which increases their risk of contracting infections and developing acute and chronic illnesses [5,6]. Pilgrims need to follow the Ministry of Health Hajj guidelines [6-8]. The physical demands of the pilgrimage, such as crowded conditions, hot temperatures, and long walking distances under direct sun exposure, can further increase the risk of health hazards [5]. Pilgrims with chronic illnesses are especially vulnerable, as their conditions can worsen [8,9]; in addition, high temperatures cause drug deterioration, and crowded environments interfere with the medication time [5,8,9]. Therefore, proper medication management can mitigate complications [5,9]. Understanding these health risks is critical in developing effective strategies to enhance healthcare delivery and ensure the safety of participants during Hajj [10,11].

Pilgrims with chronic diseases need comprehensive healthcare support, meticulous medical care, and uninterrupted access to medications and ancillary healthcare services [5,12,13]. The sheer volume of pilgrims and the resultant surge in healthcare demands pose significant challenges to the timely identification and effective management of disease complications [5,12,13]. Furthermore, the physically demanding nature of the rituals, coupled with environmental stressors and logistical hurdles, can profoundly impact pilgrims' adherence to medication regimens and overall health status [4,5,13,14]. Earlier studies have assessed pilgrims' disease status and medication management during mass gatherings [4,5,13,14]. It has been suggested that, despite chronic diseases, respiratory, musculoskeletal, and skin diseases were more prevalent among pilgrims [13]. Furthermore, according to 2019 Hajj statistics, 223 964 medications were prescribed to pilgrims: mostly analgesics, oral antibiotics, anti-inflammatory products, and flu medications [13]. On the other hand, earlier literature on medication errors during Hajj suggest that the highest medication errors occurred during the prescribing phase, and most medication errors were classified as near misses [13]. Lack of drug information was the leading cause of reported medication errors, followed by environmental, personnel, and workload issues and look-alike/sound-alike medication issues [15]. Currently, no studies have examined medication-taking behavior and its characteristics among pilgrims.

Medication adherence plays a crucial role in ensuring optimal health outcomes during mass gatherings, such as the Hajj pilgrimage [12-14]. Adhering to medications helps prevent complications associated with chronic diseases, reducing the risk of hospitalizations and emergency medical interventions [12-14].

In addition, consistent medication use ensures that pilgrims' health conditions remain stable, enabling the pilgrims to fully participate in religious activities without undue health risks [12-14]. Furthermore, adherence can decrease the demand for healthcare services during mass gatherings. By managing their conditions effectively, pilgrims can enjoy a better quality of life during the gathering, fostering a more meaningful and spiritually fulfilling experience [12-14].

The 2024 Hajj, attended by a large number of pilgrims, underscores the need for effective healthcare strategies to manage chronic diseases and medication adherence [16]. In this study, we investigate medication adherence and barriers among pilgrims with chronic conditions, aiming to inform evidence-based interventions and improve health outcomes. Understanding patterns of medication consumption, including the number and frequency of medications used, can empower pilgrims to make informed decisions about safe and effective medication use under healthcare guidance. Moreover, this information can inform health authorities' planning, enabling them to address barriers to safe medication use, optimize resource allocation, and enhance service delivery. Previous studies have examined disease patterns and medication use among hospitalized pilgrims, highlighting the importance of targeted healthcare interventions [4,9,17]. Therefore, this study aimed to evaluate medication adherence and barriers among pilgrims with chronic diseases at religious mass gatherings in 2024.

Material and Methods

Design, Setting, and Population

A cross-sectional study was conducted for 1 month toward the end of Hajj 2024 at the departure terminals at King Abdulaziz International Airport in Jeddah and Prince Mohammed bin Abdulaziz International Airport in Madina. The data were collected from the participants using convenience sampling, ensuring representation of both sexes. The study population included adult pilgrims with the presence of at least 1 chronic disease and pilgrims from different countries who performed Hajj. Female pilgrims who were pregnant or in a postpartum period were excluded from the study. Before starting data collection, ethical approval for the study was obtained from the Ministry of Health Headquarters in Riyadh (IRB-24-289E) on June 5, 2024. All study procedures adhered to the Declaration of Helsinki guidelines for human research, ensuring participant confidentiality and voluntary participation. Also, informed consent was obtained from the pilgrims.

Sample Size Estimation

Similar to previous studies [18-20], the required sample size for this study was calculated using the Raosoft sample size

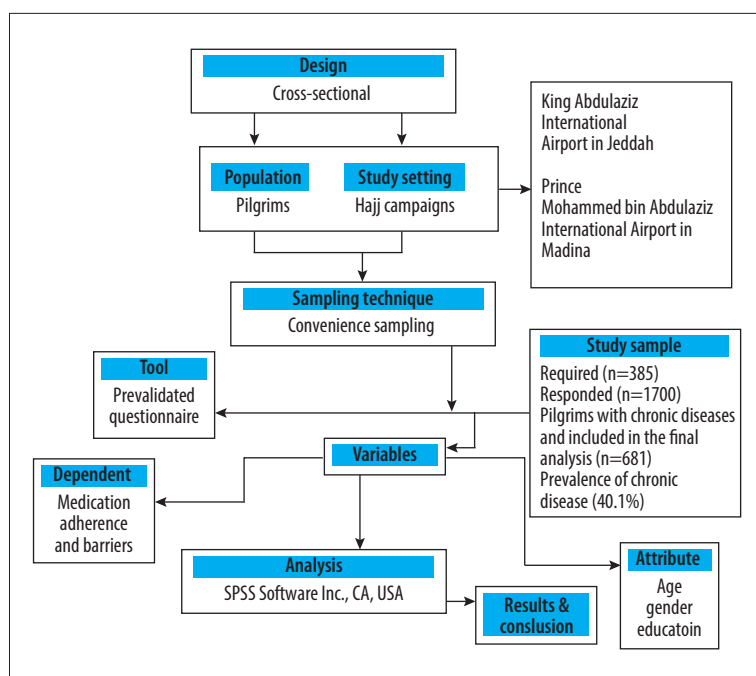


Figure 1. Outline of research design.

calculator (<http://www.raosoft.com/samplesize.html>) with a 95% confidence interval and a predetermined margin of error of 5%, assuming a response distribution of 50%. Therefore, the required sample size was determined to be 385 pilgrims. To improve the study's statistical power, accuracy of estimates, and ability to detect significant differences, as well as to minimize sampling bias and error, we sought cooperation from participants in the pilgrimage to participate in the research. As a result, we were able to collect a total of 1700 completed questionnaires. However, only 681 pilgrims with chronic diseases were included in the final analysis (Figure 1).

Questionnaires

Data were collected using a structured, pre-validated questionnaire that was adopted from earlier literature, to capture medication-taking behavior and related factors among pilgrims from various countries [1,7,11,17,21]. The questionnaire consisted of 3 parts. The first part focused on demographic information, including age, sex, education, and country of origin and residence. The second part gathered data on medication-taking behavior, including frequency (eg, "How frequently are you taking the medication for your chronic disease?") and number of medications (eg, "How many medications currently taking?"). The last part collected barriers toward medication adherence. All these questions were open-ended.

After the initial questionnaire draft, a team of experts, including a researcher and a professor from the Department of Basic Science and Emergency Medicine who have experience in questionnaire design and validation, provided independent

feedback on the content, flow, and suitability. The questionnaires were then pilot-tested among randomly selected pilgrims early in the season, which took approximately 10 min to complete per individual. The reliability of the questionnaire was found to be 0.79, indicating validity and reliability for the study. Data collection used convenience sampling, with the English version of the questionnaires used for interviews. Translators were available to assist pilgrims speaking different languages, including non-Arabic and non-English speakers, from their respective Hajj campaigns. Data collection continued until the required sample size was achieved. In this study, we defined polypharmacy as taking ≥ 5 medications at a time [22,23]. Multiple medication refers to a therapeutic approach that involves using multiple drugs together to enhance efficacy, improve safety profiles, and delay resistance in the treatment of chronic conditions [23,24].

Statistical Analysis

The data analyses were conducted using Statistical Package for the Social Sciences (SPSS) software, version 27. Descriptive statistical methods were used to summarize data on socio-demographic characteristics. Continuous variables, such as age, were summarized using mean, median, and standard deviation. Categorical variables, such as sex and medication-taking behavior, were presented as frequencies and percentages. Chi-square or Fisher exact tests were conducted to determine associations between variables, with a P value of <0.05 considered statistically significant.

Table 1. Participant demographics.

Variable	Frequency (n)	Percent (%)
Sex		
Male	330	48.5%
Female	351	51.5%
Age		
Mean	44.86	
Median	44	
Standard deviation	13.803	
IQR	20	
Educational level		
Illiterate	97	14.2%
Able to read and write	154	22.6%
Intermediate or secondary	73	10.7%
University	357	52.4%
Chronic diseases		
Diabetes	209	30.7%
Cardiovascular disease	168	24.7%
Hypertension	155	22.8%
Others	149	21.8%

Results

A total of 1700 pilgrims responded; however, only 681 pilgrims reported the presence of at least 1 chronic disease. The prevalence of disease status among pilgrims was 40.1%. **Table 1** presents an overview of the demographic details of the participants who reported chronic conditions. The sex distribution was almost equal, with 48.5% male and 51.5% female participants. The average age of participants was 44.8 years, with

a standard deviation of 13.803 years, indicating a broad age range. Regarding education, most participants had a university degree (52.4%), while 22.6% could read and write but did not finish formal schooling. Interestingly, 14.2% of participants were illiterate. In this study, diabetes was the most commonly reported disease, affecting 30.7% of the population, followed by cardiovascular disease, at 24.7%, and hypertension, which affected 22.8% of participants, as shown in **Table 1**.

In terms of the nationality of the pilgrims, 77.5% (n=528) were from the Eastern Mediterranean Region, while 17.6% (n=120) were from the South-East Asian Region, 2.6% (n=18) were from the African Region, and 2.2% (n=15) were from the European Region, as shown in **Figure 2**.

Table 2 highlights medication usage among participants. According to findings, 16.6% (n=113) of the pilgrims took no medication, while 9% (n=61) took 2 medications. Most (61.8%) reported taking at least 1 medication for their chronic conditions during Hajj. The prevalence of polypharmacy among pilgrims was 4.9% (n=33). Among the users of medications, 48.9% of the pilgrims reported taking medication always, while 21.1% reported never taking their medications, and 14.7% (n=100) reported taking it sometimes.

The primary reason for non-adherence to medication was insufficient medication availability (25.7%), followed by forgetfulness (13.8%) and a belief that daily medication was unnecessary (13. 2%). **Figure 3** shows the detailed frequencies of medication-taking among pilgrims.

The findings revealed that the frequency of using 1 medication was significantly higher among young pilgrims, while the frequency of using 5 and 6 medications was higher among pilgrims aged between 40 and 60 years old ($P=0.001$). Therefore, the age of the pilgrims was significantly associated with the number of medications used. There was no significant relationship between the pilgrims' number of medications used and sex ($P>0.005$) or education ($P>0.005$) (**Table 3**).

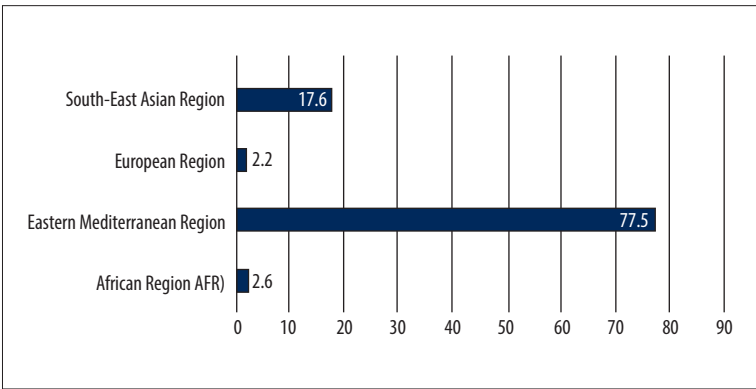


Figure 2. Nationality of the pilgrims in the sample.

Table 2. Medication-taking behavior among participant pilgrims (n=681).

Variable	Frequency (n)	Percent (%)
How many medications do you take for chronic diseases?		
No medication	113	16.6%
One medication	421	61.8%
Two	61	9.0%
Three	35	5.1%
Four	18	2.6%
Five	19	2.8%
Six and above	14	2.1%
If you take medications, how regularly have you been taking them?		
Always	333	48.9%
Often	76	11.2%
Sometimes	100	14.7%
Rarely	28	4.1%
Never	144	21.1%

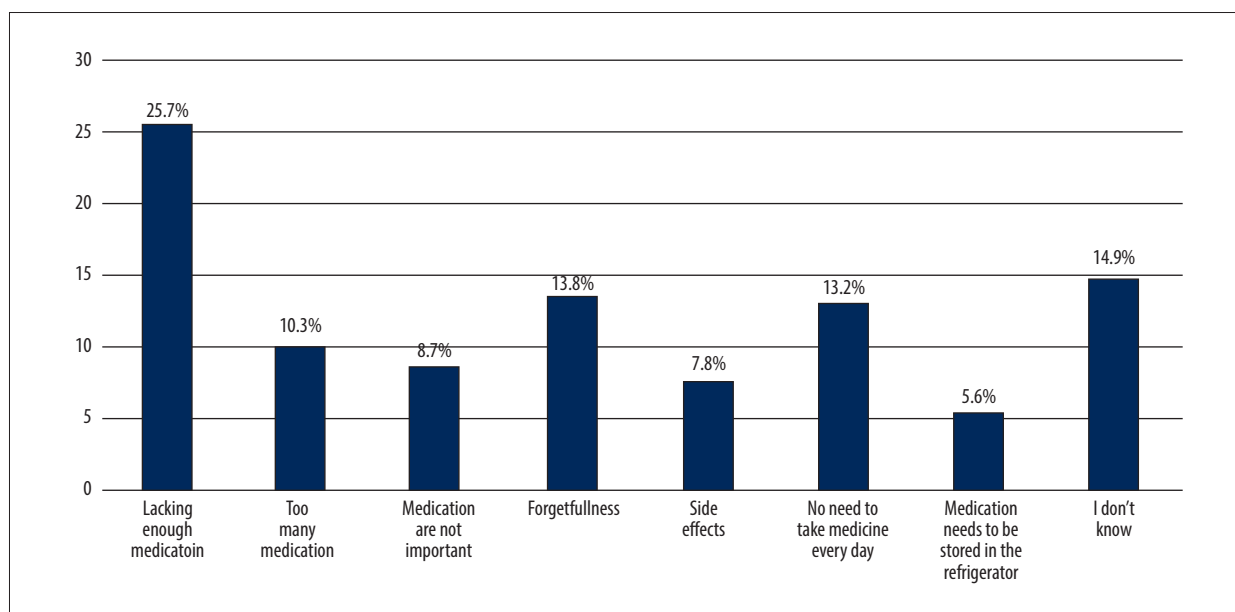


Figure 3. Barriers to medication-taking.

Regarding the adherence to medication among pilgrims, the findings showed that individuals aged 31 to 40 years were the most consistent in taking their medication, compared with younger and older pilgrims. Conversely, those aged 40 to 60 years were the most likely to miss or never adhere to their medication regimen. However, there was no significant association between age and medication adherence ($P=0.873$). Participant sex was also not found to be a significant factor in medication regularity ($P=0.385$). Interestingly, the education level of the pilgrims was significantly linked to their consistency in

taking medication. Pilgrims who were able to read and write and those with university educations were more consistent in taking medication, compared with pilgrims with other education levels ($P=0.012$), as depicted in **Table 4**.

Discussion

A limited number of studies evaluated medication-taking behavior, disease complications, and factors among international

Table 3. Association between number of medication taking and participants demographic characters.

Variable	Number of medications							χ^2	P value
	No medication n (%)	1 n (%)	2 n (%)	3 n (%)	4 n (%)	5 n (%)	>6 n (%)		
Age (Years)									
<20	2 (16.7)	6 (50.0)	2 (16.7)	1 (8.3)	0 (0.0)	0 (0.0)	1 (8.3)	27.000	0.001*
21-30	22 (21.6)	65 (63.7)	7 (6.9)	3 (2.9)	2 (2.0)	1 (1.0)	2 (2.0)		
31-40	32 (17.1)	122 (65.2)	11 (5.9)	8 (4.3)	5 (2.7)	4 (2.1)	5 (2.7)		
41-50	28 (17.5)	97 (60.6)	15 (9.4)	9 (5.6)	5 (3.1)	3 (1.9)	3 (1.9)		
51-60	17 (13.0)	80 (61.1)	16 (12.2)	6 (4.6)	2 (1.5)	7 (5.3)	3 (2.3)		
>61	12 (13.5)	51 (57.3)	10 (11.2)	8 (9.0)	4 (4.5)	4 (4.5)	0 (0.0)		
Gender									
Male	55 (16.7)	206 (62.4)	24 (7.3)	19 (5.8)	7 (2.1)	13 (3.9)	6 (1.8)	6.412	0.382
Female	58 (16.5)	215 (61.3)	37 (10.5)	16 (4.6)	11 (3.1)	6 (1.7)	8 (2.3)		
Education									
Illiterate	14 (14.4)	65 (67.0)	7 (7.2)	5 (5.2)	2 (2.1)	2 (2.1)	2 (2.1)	24.701	0.133
Read & write	27 (17.5)	91 (59.1)	15 (9.7)	10 (6.5)	5 (3.2)	5 (3.2)	1 (0.6)		
Intermediate or secondary	16 (21.9)	41 (56.2)	7 (9.6)	1 (1.4)	2 (2.7)	0 (0.0)	6 (8.2)		
University	56 (15.7)	224 (62.7)	32 (9.0)	19 (5.3)	9 (2.5)	12 (3.4)	5 (1.4)		

χ^2 – Chi-Square; * Fisher exact test.

pilgrims during the Hajj. However, most of the literature reported on the presence of chronic diseases, medication handling, and health services practices. The present study will significantly contribute to the safety of pilgrims and the effective and safe use of medication, and serve as a reference for future studies. The findings could also be used by healthcare authorities to develop appropriate interventions to improve barriers to proper medication-taking behavior and to prevent disease-related complications among pilgrims, ultimately saving healthcare resources and reducing medical and healthcare-related costs.

In this study, 83.4% of the pilgrims used at least 1 medication to manage their diseases. A previous study conducted among Hajj pilgrims aimed to assess medication handling and storage revealed that 44.4% of the pilgrims reported using medication during Hajj, with underlying health conditions [25]. Medication-taking behavior differed in this study, as pilgrims reported taking multiple medications. Among those taking various medications, 12.6% (n=86) took more than three, 5.1% took three, 2.6% took four, 2.8% took five, and 2.1% took six or more. The prevalence of polypharmacy among pilgrims was

found to be 4.9%. However, according to the findings, 16.6% of pilgrims never took medication, while 9% took 2 medications. These findings were consistent with earlier research by Yezli et al in 2020, which revealed that pilgrims were prescribed an average of 2.6 medications per consultation, and 4.8% of pilgrims reported polypharmacy (≥ 5 medications) [12]. In another study, most pilgrims (70.4%) received medications [17]. Similarly, in another study, 13.3% of the pilgrims used several medications [26]. On average, 2.25 medications were prescribed per consultation in another study, with a low (1.3%) prevalence of polypharmacy [13]. Findings from a similar study revealed high usage of multiple medications; for instance, 91.6% of the pilgrims reported using 1 to 4 medications, while the prevalence of polypharmacy was 8.4% [25]. Additionally, earlier reports indicated that pilgrims receiving prescription-based medication during Hajj ranged between 47% and 95% [27]. However, the unnecessary overuse of medications accelerates the timeline for organisms to develop resistance [27], which can cause polypharmacy, leading to a higher risk of adverse drug reactions, including drug-drug interactions and adverse effects [27]. Additionally, polypharmacy, or the use of many medications, can result in higher healthcare costs, due to the

Table 4. Association between frequency of medication-taking and participants' demographic characters.

Variable	Always n (%)	Often n (%)	Sometimes n (%)	Rarely n (%)	Never n (%)	χ^2	P
Age (Years)							
<20	7 (2.1)	1 (1.3)	1 (1.0)	0 (0.0)	3 (2.1)	13.098	0.873
21-30	47 (14.1)	15 (19.7)	11 (11.0)	4 (14.3)	25 (17.4)		
31-40	86 (25.8)	21 (27.6)	34 (34.0)	9 (32.1)	37 (25.7)		
41-50	79 (23.7)	14 (18.4)	25 (25.0)	6 (21.4)	36 (25.0)		
51-60	74 (22.2)	14 (18.4)	16 (16.0)	3 (10.7)	24 (16.7)		
>61	40 (12.0)	11 (14.5)	13 (13.0)	6 (21.4)	19 (13.2)		
Sex							
Male	177 (53.2)	44 (57.9)	45 (45)	12 (42.9)	73 (50.7)	4.175	0.385
Female	156 (46.8)	32 (42.1)	55 (55)	16 (57.1)	71 (49.3)		
Education							
Illiterate	61 (18.3)	4 (5.3)	12 (12.0)	1 (3.6)	19 (13.2)	25.683	0.012
Able to read and write	82 (24.6)	13 (17.1)	14 (14.0)	7 (25.0)	38 (26.4)		
Intermediate or secondary	32 (9.6)	13 (17.1)	12 (12.0)	4 (14.3)	12 (8.3)		
University	158 (47.4)	46 (60.5)	62 (62.0)	16 (57.1)	75 (52.1)		

χ^2 – Chi-Square.

increased number of medications, potential hospitalizations, and treatment of adverse drug reactions [27]. Therefore, it is essential to regularly review and optimize medication regimens to minimize polypharmacy and reduce the risk of adverse drug reactions. Furthermore, educating patients on the safe use of medications, potential adverse effects, and adherence to their treatment plans is crucial [28].

The primary reason pilgrims did not use medications for disease management was insufficient availability of drugs (25.7%), followed by forgetfulness (13.8%), a belief that daily medication was unnecessary (13.2%), and having too many medications (10.3%). This barrier in the present study might be because a considerable proportion of respondents were taking multiple medications, which can be complex and overwhelming, leading to non-adherence and reduced effectiveness of treatment. Another reason for the pilgrims' responses toward the barriers to medication use could be a lack of awareness of medication availability. A previous study evaluating the pilgrims' preparation and uptake of preventive measures during Hajj 2017 revealed that 26% of the pilgrims were unaware of the availability of medications [29]. To improve medication adherence among pilgrims, several strategies can be suggested. First, using reminder systems, such as mobile apps or pill boxes, can assist pilgrims in following their medication schedules

[12,13,30,31]. Additionally, pilgrims should be advised to plan and pack an adequate supply of medication for the entire duration of the Hajj [12,13,16,30,31]. Moreover, it is essential to ensure access to pharmacies and healthcare facilities during the Hajj, enabling pilgrims to refill prescriptions or seek advice when necessary [12,13,16]. Lastly, offering education and counseling on proper medication management, including guidance on handling missed doses and potential adverse effects, can empower pilgrims to take charge of their health [12,13,16].

In the present study, diabetes affected one-third of the sample, followed by chronic headaches among 40% of the pilgrims. Cardiovascular disease was found among 24.7% of the pilgrims, and hypertension affected 22.8% of them. Earlier studies reported different findings. For example, a survey by Alrufaidi et al reported hypertension in 19.9% of participants, and bronchial asthma in 17.9% [32]. Additionally, 5.4% of patients had a myocardial infarction, and 3.4% had cerebrovascular accidents [32]. Furthermore, 4.4% of pilgrims reported having pneumonia [32]. Another recent study found that the most common conditions among pilgrims were cardiovascular disease, diabetes, and hypertension [1]. The most frequent problems among pilgrims in this study were foot pain (59.9%), body aches (20.4%), dizziness (20%), and blood sugar changes (10.6%) (n=72). However, a prior study discovered that 9.4% of

pilgrims had hyperglycemia, hypoglycemia, or diabetic ketoacidosis. Of the pilgrims, 4.4% had cut wounds, 3.7% had bone fractures and dislocations, and 1.4% had experienced head injuries [32]. All pilgrims should, therefore, take their medications as prescribed to control their diseases and mitigate further complications [16]. Thus, it is recommended that pilgrims receive pre-travel instructions on how to manage their diseases and use drugs [16]. Healthcare authorities should also provide adequate health services and sustainability education for better pilgrims' health during Hajj.

In this study, a statistically significant association was found between the number of medications taken and the age of pilgrims. However, sex and education level were not found to be significantly associated with the number of medications consumed. The frequency of using 1 medication was significantly higher among young pilgrims, while the frequency of using 5 and 6 medications was higher among pilgrims aged between 40 and 60 years old. This suggests that the age of the pilgrims was significantly associated with the number of medications used. On the other hand, the education level of the pilgrims was significantly associated with the consistency in taking medication. For example, pilgrims who were able to read and write and those with university educations were more consistent in taking medication than were pilgrims with other education levels. This suggests that the education and age of the pilgrims were significant factors in medication-taking behavior. Studies examining the variation in the number of medications used by pilgrims and their characteristics are currently lacking. Some studies have been conducted on medication use [29,33], and handling [25] among pilgrims, but these earlier studies did not explore the relationship between the number and frequency of medication use and the pilgrims' characteristics.

Therefore, to avoid the use of multiple medications and associated complications, it is necessary to implement various measures to improve medication management [13,16,34]. This includes providing multilingual medication guidance, which can be achieved by offering clear, translated medication instructions to pilgrims before the Hajj. Additionally, offering personalized medication plans can help create tailored medication schedules and plans for pilgrims with chronic conditions [31,32]. Healthcare providers should also be trained to counsel pilgrims on proper medication management. Pilgrims should be allowed to carry electronic medical records or medication cards. Introducing public health policy implications to reduce polypharmacy risks and implementing policies to minimize

multiple drug combinations and potential interactions is essential. Standardized health guidelines should be developed and disseminated for pilgrims with chronic conditions. Adequate healthcare infrastructure and resources should be ensured during the Hajj.

The present study included a relatively larger sample size than earlier published studies. Moreover, respondents from different socioeconomic backgrounds were included, using convenience sampling. This study provides much-needed information about pre-existing chronic diseases among the Hajj population, their complications, and medication-taking behavior, which can help direct future policymaking.

This study has several limitations that should be acknowledged. First, the cross-sectional design restricts the generalizability of our findings. Additionally, our sample focuses exclusively on pilgrims with pre-existing chronic diseases, which may not accurately represent the broader pilgrim population. Potential biases, such as selection or recall bias, may also be present. Furthermore, the interview-based data collection method may have introduced social desirability bias, where pilgrims might have provided inaccurate information about their health conditions. To build upon our research, future studies could benefit from larger, more diverse samples, including pilgrims from various geographical regions, to enhance the validity and applicability of the findings.

Conclusions

This study highlights the significant burden of chronic diseases and medication-related challenges among pilgrims, including polypharmacy and inconsistent adherence to medication regimens. To address these issues, targeted interventions are crucial, focusing on enhanced health education, improved medication availability, and healthcare support. Pre-travel health education and awareness about the risks of multiple medication use can also help mitigate these challenges. By addressing medication-related barriers and promoting safe and effective medication use, healthcare outcomes during mass gatherings can be significantly improved.

Declaration of Figures' Authenticity

All figures submitted have been created by the authors who confirm that the images are original with no duplication and have not been previously published in whole or in part.

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