

# Pattern of Referral of Sick Pilgrims from Omani Medical Mission During Hajj 2019 (1440 H)

Ahmad Obaid al Mashaykhi<sup>1</sup>, Randa Nooh<sup>2</sup>, Sami Said Almudarra<sup>3</sup>, Abdulaziz Saad Almutari<sup>2</sup>, Naif Saud Albudayri<sup>4</sup>, Khalid Masoud Alghamdi<sup>4</sup>

<sup>1</sup>Directorate of Disease Surveillance and Control, Ministry of Health, North Sharqiya, Sultanate of Oman

<sup>2</sup>Field Epidemiology Training Program, Ministry of Health, Riyadh, Kingdom of Saudi Arabia

<sup>3</sup>CDC Gulf Country Council, Riyadh, Kingdom of Saudi Arabia

<sup>4</sup>Department of Communicable Disease, Ministry of Health, Riyadh, Kingdom of Saudi Arabia

## Email address:

Dr.ahmed929@hotmail.com (Ahmad Obaid al Mashaykhi)

## To cite this article:

Ahmad Obaid al Mashaykhi, Randa Nooh, Sami Said Almudarra, Abdulaziz Saad Almutari, Naif Saud Albudayri, Khalid Masoud Alghamdi. Pattern of Referral of Sick Pilgrims from Omani Medical Mission During Hajj 2019 (1440 H). *Science Journal of Public Health*. Vol. 11, No. 3, 2023, pp. 43-55. doi: 10.11648/j.sjph.20231103.11

**Received:** September 25, 2022; **Accepted:** November 11, 2022; **Published:** May 25, 2023

---

**Abstract:** Background: Annually, in the month of Dhul hijjah, over 2 million Muslims travel to Saudi Arabia to perform Hajj. Hajj is the biggest mass gathering globally, which creates a significant influence on Hajjes' health. The Omani medical mission is the official delegation from the Omani government to Saudi Arabia to serve the Omani hajjees regarding their health Sduring Hajj 1440 H. Methods: We conducted a cross-sectional study at the Omani Medical missions in Makkah, Madinah, Mina, and Arafat. Data was collected via a predesigned form. All Omani pilgrims presenting to the mission who were referred to local hospitals were included. Results: The total number of cases was 5000, of which 106 (2.1%) were referred to local hospitals (21.2 per 1000 hajjees). The most common causes of referral were cardiovascular diseases (23.6%), followed by gastrointestinal disease (17.9%) and trauma (16.9%). Males comprised 60.1%. Their mean age was 47.3 years (SD  $\pm$ 11.27), with the highest referrals in the 51-60 years age group (30%). Over half (55.7%) had co-morbidities. Patients' mean time to reach the clinic was 8.87 min (SD  $\pm$ 6.41), with 65% arriving in 5 min or less. The mean time needed to reach the hospital by ambulance was 11.39 min (SD  $\pm$ 6.6), with 36% arriving within 5 min. Of the referrals, 42% were admitted into hospital. Hospitalization was significantly higher among patients with chest pain (P-value < 0.0057), diabetics (P-value < 0.0001), and patients with Heart Disease (P-value = 0.013). Conclusions: The most common causes for referral of Hajjees from the Omani Medical Mission were cardiovascular diseases, gastrointestinal disease, and trauma. This information should assist the Omani government in planning their medical services in hajj season in future years.

**Keywords:** Hajj, Oman, Pilgrims, Referral, Omani

---

## 1. Introduction

The Kingdom of Saudi Arabia (KSA) is an Arab Islamic state and is the largest country in the Arabian peninsula situated at the strategic crossroads of three continents: Europe, Africa, and Asia. It is the home to several human civilizations and the cradle of the heavenly messages. KSA is renowned for the sacred sites of Islam; the two Holy Mosques' of Makkah Al Mukarramah and Al Madinah Al Munawwarah are the destinations of millions of Muslims annually for Hajj and Umrah.

Annually in the lunar calendar month of Dhul hijjah, almost 2.5 million Muslims travel to Makkah city in Saudi Arabia to apply the fifth pillar of Islam, the Hajj. This ritual is to be completed by any grown male or female once in an entire life if they are in shape financially and physically. In addition to Makkah Al Mukarramah, these pilgrims (hajjees) visit other significant Islam sites in the country, such as Arafat, Muzdalifa, Mina, and AlMadinah Almunawwara. The hundreds of thousands of people who attend Hajj arrive over a period of weeks and converge in a single crowded 5-day trek that covers nearly many miles, looping from the Al-Haram mosque in

Makkah, through the huge tent city of Mina, to the slopes of Mount Ararat and back. Traffic in parts of this course frequently comes to a complete standstill, to the extent that many pilgrims complete their journey on foot. The heat can be fierce, with temperatures soaring to over 50 degrees centigrade, mainly when hajj falls in the summer months. [1]

### **1.1. Common Health Problems During Hajj**

The chance of transmission of infection during Hajj is increased compared to other circumstances because of overcrowding, possible breaches of food standards and hygiene, and the extended ability to introduce vector-borne disease. [2]

While performing the Hajj rites, pilgrims are prone to certain illnesses which can be normally related to the Hajj season, inclusive of respiratory infection, gastrointestinal sicknesses, food poisoning, dermatological diseases, dry eye, sunstrokes, and heat exhaustion, in addition to the deterioration of the health condition of Hajjees with prior non-communicable disease.

Respiratory tract infections are common during Hajj. Common respiratory diseases during Hajj are the common cold, seasonal influenza, and bronchitis. Infection is transmitted via infected droplets by coughing, sneezing, or speaking. The most common purpose of hospital admission at some point of Hajj is pneumonia. The seasonal influenza vaccine, which includes H1N1, is therefore strongly advocated for all pilgrims. [3]

One survey of protective practices and respiratory illness among US travelers to the 2009 Hajj evaluated whether recommended behavioral interventions (hand hygiene, wearing a face mask, cough etiquette, social distancing, and contact avoidance) were effective at mitigating illness among travelers during the 2009 Hajj. This survey assessed demographics, knowledge, attitudes, and practices (KAP) related to influenza A (H1N1), vaccination, health-seeking behaviors, sources of health information, protective behaviors during the Hajj, and respiratory disease and immediately after the Hajj. The study showed that recommended protective behaviors were associated with less respiratory illness. [3]

Another vital respiratory disease threat that may occur during Hajj is the Middle East Respiratory Syndrome (MERS-CoV). This disease was first identified in Saudi Arabia in 2012, and is caused by a single coronavirus, is much like the virus liable for the 2003 global outbreak of Severe Acute Respiratory Syndrome (SARS). The most common symptoms include fever, cough, and shortness of breath. Myalgias, diarrhea, vomiting, abdominal ache, thrombocytopenia, and leukopenia have also been reported. The severity of illness has ranged from mild to severe, and approximately 45% of cases have been fatal. Although the virus has been isolated in camels within the kingdom, however, the role of the animal-to-human transmission is uncertain. Diagnosis may be suspected on clinical grounds and confirmed by PCR. [4]

Even though no MERS-CoV infection cases have been

associated with the Hajj seasons since the discovery of the virus, MERS-CoV disease nevertheless proposes a challenge as outbreaks connected to camel contact and transmission in healthcare settings remain reported in the country. [5] Although camel contact is not likely over the duration of participation in Hajj, it has to be suspected in pilgrims admitted to health facilities during Hajj.

Tuberculosis is another infectious disease threat during Hajj. However, it is hard to evaluate the transmission of tuberculosis in the Hajj course due to its long incubation duration. Since many pilgrims come from regions where tuberculosis is endemic, there remains a chance for the occurrence and transmission of this disease, primarily due to overcrowding and the presence of co-morbidities, which makes some pilgrims vulnerable to infection or reactivation of latent tuberculosis. [2]

The crowded conditions for the duration of Hajj give the opportunity of tuberculosis transmission. Pilgrims are advised to seek health care if they experience increased symptoms of active tuberculosis, such as cough with sputum and blood at instances, chest pains, weakness, weight reduction, fever, and night sweats. [6]

Food- and waterborne illnesses are a prime health threat throughout the Hajj, with symptoms including diarrhea, constipation, nausea, and vomiting. These probably occur because of possible breaches of meal hygiene standards, shortage of safe water, the presence of mildly unwell and asymptomatic carriers of pathogenic bacteria and viruses, and the preparation of large quantities of meals that may be poorly stored.

Several research studies have investigated and reported tourist's diarrhea during the Hajj. Al-Joudi and co-workers investigated an outbreak of food-borne diarrheal illness among soldiers in Mina during hajj and the role of consumer food handling behaviors. The study was conducted to identify the outbreak's source, the number of cases of gastroenteritis reported, to assess its extent, and make recommendations to prevent similar attacks in the future. Sixteen patients were recorded; all of them complained of diarrhea. The rice item served during the lunch meal showed a statistically significant association with an illness ( $p=0.023$ ). Other likely organisms were *Bacillus cereus* and *Clostridium perfringens*. Consuming food kept at an unsafe temperature without being reheated was the most probable important factor leading to this outbreak. [7]

Food contamination can occur through the negligence of cleansing vegetables before ingestion, failure of washing hands before preparing or consuming meals, oversight of cooking meat well, drinking unpasteurized milk, eating some meals uncooked (which includes eggs), or foods which contain raw eggs (such as mayonnaise), when stored in incorrect temperature. Eating contaminated "shawarma" has been proved to be the cause of many outbreaks of food-borne disease. [8]

Salmonella food poisoning has also been reported during Hajj, resulting in acute gastrointestinal infection, and produces signs of stomach ache, headache, high temperature, diarrhea,

and vomiting. A previous study that investigated diarrhea and gastroenteritis during hajj confirmed that 82.9% of the positive samples from hajjees with enteric infection resulted from infection by a bacterial agent, 6.1% were due to viruses, and 5.3% had been parasitic. The most common bacterial pathogens were *Salmonella* spp., *Shigella*, enteroinvasive *Escherichia coli*, and enterotoxigenic *E. coli*. [9]

Amongst infectious threats through Hajj is Meningococcal disease. The transmission of Meningococcal meningitis is facilitated with the aid of crowded environments. An international outbreak of Meningococcal disease serogroup W-135 occurred in the year 2000 Hajj season in Saudi Arabia. [10] This outbreak resulted in ninety instances of meningococcal disease in nine European Union (EU) countries, including the United Kingdom (UK) and France. [11]

Malaria is another infectious disease that may occur during Hajj. Malaria is an essential parasitic infection in tropical areas. Many pilgrims may host the parasite, considering that malaria outbreaks have occurred during the Hajj. [12, 13] Saudi Arabia is currently at the pre-elimination phase of malaria, and nearby malaria transmission has been limited to villages along the border with Yemen. Consequently, the threat of transmission of malaria during the Hajj is shallow. [12]

Arboviruses *Aedes aegypti* mosquitoes have no longer been detected within the Hajj areas. However, *Aedes aegypti* is present in surrounding towns, including Jeddah. [14] The latest literature review has discussed dengue outbreaks that have regularly occurred in Saudi Arabia in the 1990s [15, 16], which increases the possibility of a plague of dengue fever taking place at some stage in the Hajj.

Alkhurma hemorrhagic fever (AHF) is a tick-borne ailment observed in Saudi Arabia and Egypt. In Saudi Arabia, outbreaks of AHF have occurred in Jeddah and Makkah. Ticks transmit the virus following contact with farm animals, including sheep. The danger of infection with AHF at some stage in Hajj is probably low. Still, it should be considered as a differential prognosis for viral hemorrhagic fevers that occur during Hajj. [17, 21]

Another source of infection during Hajj is a blood-borne disease. Muslim men are required to shave their heads on the completion of Hajj. The use of unclean blades by way of unlicensed barbers can transmit blood-borne pathogens, including hepatitis B, hepatitis C, and HIV. The Saudi government recruits certified barbers tested for these blood-borne pathogens and are further required to apply disposable, single-use blades in their work. Unfortunately, unlicensed barbers perform illegally during Hajj, where they may use non-sterile blades on numerous male hajjees. [18]

Dermatological conditions that may occur during Hajj are exfoliation & chaffing of the skin, especially in male pilgrims' thighs. There has been a high incidence of dermatological complaints amongst hajjes. Dermatitis of various etiologies (23.6%) was determined to be the most common, followed by pyoderma and intertrigo. [18]

Regarding the non-Communicable diseases (NCD), affected pilgrims can easily perform the Hajj rituals if they are assessed by their medical doctor before travel, to examine

their health situation, and prescribe the appropriate medications. Hajjees have to bring with them enough amounts of their prescribed drugs and should be advised to store them in the right way, take them on time and adhere to their doctor's advice, specifically concerning their diet. It is a well-known problem that pilgrims who are caught up with Hajj's religious activities can forget to take their prescribed medications or not take them on time. [18]

Typically the non-communicable disease admission rate increases during the Hajj season. Hajjees age, transportation, and crowding are taken into consideration as the main risk factors for deterioration of the health condition of Hajjees with non-communicable diseases. [20]

Cardiovascular disease constitutes the highest proportion of NCD among hajjees. It has been reported that 60% of admission at Intensive care units during hajj are myocardial infarction and left ventricle failure. In previous hajj seasons, the highest cause of death reported was due to cardiovascular reasons. In the Hajj season of 2015, the incidence rate of stroke between hajjees was 8.9/100,000. The main risk factors noted were hypertension (57%) and diabetes (40.9%). [20]

Diabetes is another common NCD among older hajjes. Its prevalence has increased globally, and most Gulf countries are in the top 10 countries of high incidence. About 220,000 pilgrims will have a diagnosis of diabetes out of 2.5 million Muslim pilgrims if we consider the 8.8 % international prevalence of the disease. Furthermore, during hajj, there is an increased chance of complications of DM among diabetic patients. [21]

A cross-sectional study was conducted among patients admitted to 1487 beds in four hospitals in Mina (793 beds) and three hospitals in Arafat (694 beds) from the seventh to the thirteenth day of the Hajj season of the Islamic year 1423. The objective was to investigate the pattern of diseases, complications, and outcomes of pilgrims who require hospitalization during the Hajj period. The study showed that the highest age group admitted during hajj season was older than 40 years. 70 % of patients were admitted to the medical ward, 13% to the surgical ward, and 10% to the intensive care unit. The most common diagnoses were pneumonia, ischemic heart disease, and trauma. [22]

In 2013, a study was done at two medical health centers in Makkah. This study's objective was to determine the pattern of diseases among pilgrims seeking medical services in Mina primary health care centers during the Hajj season. The study showed that 83.5% of patients were treated and discharged, and only 16.5% were referred to tertiary hospitals to continue management. The most common diagnoses were Respiratory problems (17.6%), followed by skin disease (15.7%) and gastrointestinal tract infections (13.2%). [5]

In Malaysia, one systemic review of studies among hajj pilgrims showed that respiratory diseases (76.2%) were the main health problem, followed by skin problems (7.4%), meningococcal disease (3.7%) and heat stroke (3.7%). [23]

Heat illnesses are essential reasons for admission to hospitals during hajj. In 2016, a study conducted at eight hospitals in Almashaer confirmed that heatstroke occurred in

29% of hajjees presenting to the hospitals, of which 67.7% deteriorated to heat exhaustion. [24]

Trauma is an important reason for morbidity and mortality during Hajj. Pilgrims may walk long distances through or close to dense traffic, and motor vehicle accidents may arise. The maximum feared trauma threat, however, is occurrence of a stampede. In such thick crowds, little can be performed to keep away from or escape a charge once it has begun. In 2006, the Hajj stampede began when some pilgrims tripped over fallen baggage, ending in masses of accidents and deaths. Death typically results from asphyxiation or head trauma, and supplying prompt treatment is almost impossible in huge crowds. [25]

### **1.2. Background of the Omani Hajj Delegation Mission**

Oman is a Muslim Arab country located on the southeastern coast of the Arabian Peninsula. About 14000 pilgrims from Oman complete the hajj each year, organized through agencies authorized by the Omani government. Omanis planning for hajj must register their application at [www.hajj.om](http://www.hajj.om) or through the Sanad office and Departments of Endowment and Religious Affairs in all Governorates.

The system selects those who are entitled to Hajj as per the criteria defined, and as per the quota specified for each governorate according to that governorate's population. Priorities are given for those performing hajj for the first time and those accompanying their female relatives (mother, sister, wife, or daughter). Even those going for the first time may be filtered by age if the number of hajj applications exceeds 14000, with the priority given to older people. [26]

Because vaccination is mandatory, according to both Saudi authorities and the Ministry of Health in Oman, Meningococcal meningitis and seasonal Influenzas Vaccine are provided for all pilgrims coming from Oman. [27]

The Omani government sends a hajj delegation led by the Ministry of Endowments and Religious Affairs. This delegation is composed of members from several ministries, including the Omani Ministry of Health. This team consists of approximately 50 health professionals, including doctors, nurses, pharmacists, and public health inspectors.

All Omani pilgrims requiring medical assistance during the hajj receive full first aid management and stabilization of the case. Patients who need advanced management are referred to the nearest hospital in Makkah, Mina, and Arafat by an ambulance accompanied by both a doctor and nurse. Patients are transferred with a referral form that documents full medical information about the case.

A study about the disease among Omanis during hajj was done in 1996 when around 10800 Omanis achieved hajj. The objectives were to identify the socio-demographic characteristics, the diabetes profile, and the knowledge about complications of diabetes among Omani hajjees. Baomar *et al.* reported 169 diabetic patients tested in Oman medical mission clinic over the three days in Mina, giving a prevalence rate of diabetes of 16 per 1000. Their median age was 54 years, 89% were on oral hypoglycemic treatment, 7% were on dietary control, and 4% were on insulin injection.

Around 28% of diabetic patients had other co-morbidities, either coronary heart diseases or hypertension or both. 4% of them lost their way during Hajj, 4% suffered from heat exhaustion, 3% had cut wounds, 1.2% had pneumonia, and 2% got into a coma. [27]

Another study conducted by AlTobi and co-workers with the objectives to identify the main health education messages, with their sources, imparted to Omani hajjis performing Hajj during 1433 H, to assess the adherence of Omani hajjis to health education advice on major health hazards during hajj 1433 H. A total of 397 Hajjis were included in this study, out of the 69.0% were male, most 45.6% were in the age group 30-44 years with mean age and standard deviation of  $37.87 \pm 10.93$  years. 65.7% of Hajjis received health education about health hazards in hajj in Oman, 53.9% received it during the hajj journey, and 43.1% received it in Saudi Arabia. About 67.0% of Omani hajjis received educational messages about the importance of meningitis and influenza vaccines, 33.0% about the precaution that should be taken during head shaving, 16.9% about food precautions, 61.2% about avoidance of heat exposure, and finally 64.2% about avoiding crowded places, especially over Jamarat. [28]

In the 2011 hajj season, a study was conducted by AlBosaidi and co-workers. Their objectives were to estimate the health-related behavioral risk factors, their relationship with specific demographic characteristics, and investigate self-reported health problems among Omani hajjis. Out of 500 respondents, 73.6% were male, the mean age was 39.05 years, and 59.2% were performing Hajj for the first time. Of all the Hajjis, the proportions suffering from acute or chronic problems were 66% and 17.2%. Among hajjis with chronic diseases, 72.1% brought their needed medication with them. However, the study showed some results that should attract more attention like a low proportion of hajjis who have valid influenza vaccinations and had their hair cut by professional barbers. [29]

### **1.3. Rationale**

This study plans to investigate the referral rate, pattern, and frequencies of diseases among sick Omanis referred by the Omani medical mission. By finding out cases pattern and the prevalence of the disease among Omani hajjes, the Omani government will be better informed to provide appropriate services, medications, medical devices, and focused health education to Omanis before traveling hajj.

### **1.4. Objectives**

- 1) To investigate the rate of referral of sick pilgrims presenting to the Omani Hajj Medical Mission to local hospitals.
- 2) To obtain primary data about the pattern of diseases among patient pilgrims referred from the Omani medical mission.
- 3) To investigate the outcome of referral of these cases, and investigate which diseases required hospitalization.
- 4) To provide recommendations for future health services to be provided by the Omani Hajj mission.

## 2. Methodology

### 2.1. Place of Study

The study was conducted in Mecca, Mina, Arafat, and AlMadinah Omani hajj health missions during the Hajj season of the year 1440 H.

### 2.2. Study Duration

The study was conducted over 13 days, eight days of which were in Makkah and AlMadinah (from 1<sup>st</sup> to 7<sup>th</sup> of Dhulhijjah), before going to Mina for four days (8<sup>th</sup>, 10<sup>th</sup>, 11<sup>th</sup>, and 12<sup>th</sup> of Dhulhijjah), and one day in Arafat (9<sup>th</sup> of Dhulhijjah).

### 2.3. Study Design

It was a cross-sectional study. The principal investigator collected data via a predesigned data collection form.

### 2.4. Sampling

- 1) *Study population*: All Omani pilgrims who were registered in the Omani Ministry of endowments for hajj 2019 were potential participants.
- 2) *Sampling technique*: All Omani pilgrims presenting to the Omani medical mission and referred to local hospitals were included in the study.

### 2.5. Data Collection

- 1) *Data collection tool*: A predesigned tool based on the referral datasheet used to refer Omani pilgrims from the Omani medical mission to local hospitals was used.
- 2) *Data collection technique*: Data was collected from referral paper daily. All related information at the Omani medical mission clinic in Makkah, AlMadinah, and the Omani camp in Mina and Arafat weir. The feedback of cases and final diagnosis were taken from the referral hospitals daily by the researcher.

### 2.6. Analysis

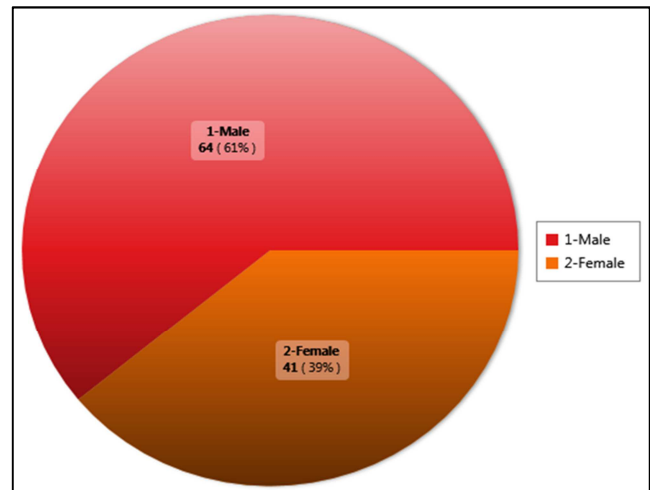
Epi info 7 and Microsoft Excel were used for data entry and analysis. Descriptive statistics, including frequencies, means, standard deviations, and cross-tabulations, were performed as appropriate. Chi-square or Fisher's exact test was compared to compare categorical variables as appropriate.

Ethical considerations: Approval was obtained from both the Saudi Field Epidemiology Training Program and the Omani Hajj Delegation before fieldwork. Also, Ethical permission was obtained from the Ministry of Health Institutional Review Board. Data collected was confidential and was used only for the study purpose.

## 3. Results

The total number of Omani hajjes arriving to hajj this year was 14,000. Among those, 5000 hajjes presented at Oman Medical Mission clinic, 4894 (97.88%) cases were seen, examined, and discharged after receiving treatment, and 106 (2.12%) cases were referred to local hospitals in Makkah, Mina, Arafat, and AlMadinah. The referral rate among Omani Hajjes attended the Oman Medical Mission was 21.2 per 1000 hajjees.

The demographic characteristics of patients are shown in table 1. Of the total, 64 (60.1%) were males, and 41 (39.9%) were females, as shown in figure 1.



**Figure 1.** Distribution of gender of patients referred from Oman Medical Mission during hajj 1440 H.

Regarding nationality, 103 (97.2%) patients were Omanis, 1 (0.9%) was Saudi, and 2 (1.9%) were from other Muslim countries.

The mean age for the referred cases was 47.27 years (standard deviation (SD)  $\pm 11.27$ ). The highest age group was the "50-61" with 32 cases (30.48%), followed by the "40-51" age group with 30 cases (28.58%), then the "30-41" by age group with 23 cases (21.90%). The youngest group '21-30', was the lowest group referred to local hospitals 5 cases (4.76%). (Figure 2).

Referred cases came from different areas of Oman. Those from Dakhiliyah Governorate were the highest 17 cases (16.35%), followed by those from North Batinah Governorate and South Batinah Governorate 16 cases each (15.38%), South Sharqiyah Governorate 14 (13.46%), Muscat Governorate 12 (11.54%), North Sharqiyah Governorate 9 (8.65%), and Governorate of Dhofar 6 (5.77%). The lowest came from Dhahirah Governorate, Governorate of Buraymi, ALWusta Governorate, and Governorate of Musandam. (Figure 3).

**Table 1.** Demographic characteristics of patients referred from Oman Medical Mission during hajj 1440 H.

Demographic Characteristic		No	%
Age	21-31	5	4.7
	30-41	23	21.9
	40-51	30	28.6
	50-61	32	30.5
	60-81	15	14.3

Demographic Characteristic		No	%
Gender	Males	64	60.1
	Females	41	39.9
Nationality	Omani	103	97.2
	Saudi	1	0.9
	Other	2	1.9
	Muscat Governorate	12	11.5
	Governorate of Dhofar	6	5.8
Region in Oman	Governorate of Musandam	2	1.9
	Governorate of Buraymi	4	3.8
	Dakhiliyah Governorate	17	16.4
	North Batinah Governorate	16	15.4
	South Batinah Governorate	16	15.4
	South Sharqiyah Governorate	14	13.5
	North Sharqiyah Governorate	9	8.6
	Dhahirah Governorate	5	4.8
	Wusta Governorate	3	2.9
	Uneducated	19	17.9
Education level	Primary school	22	20.8
	High school	39	36.8
	Degree / Post Graduate/ Professional	26	24.5
	Single	7	6.6
Marital status	Married	92	86.8
	others	7	6.6

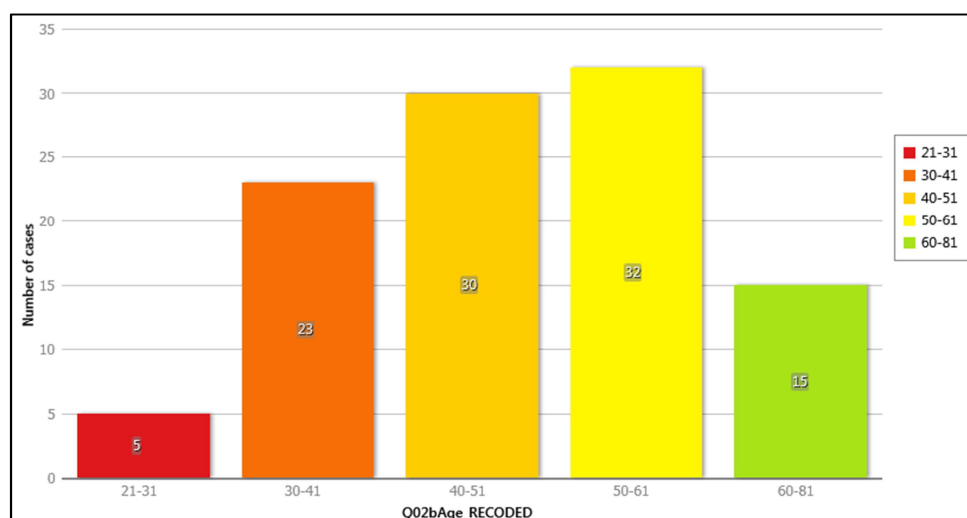


Figure 2. Distribution of age groups of patients referred from Oman Medical Mission during hajj 1440 H.

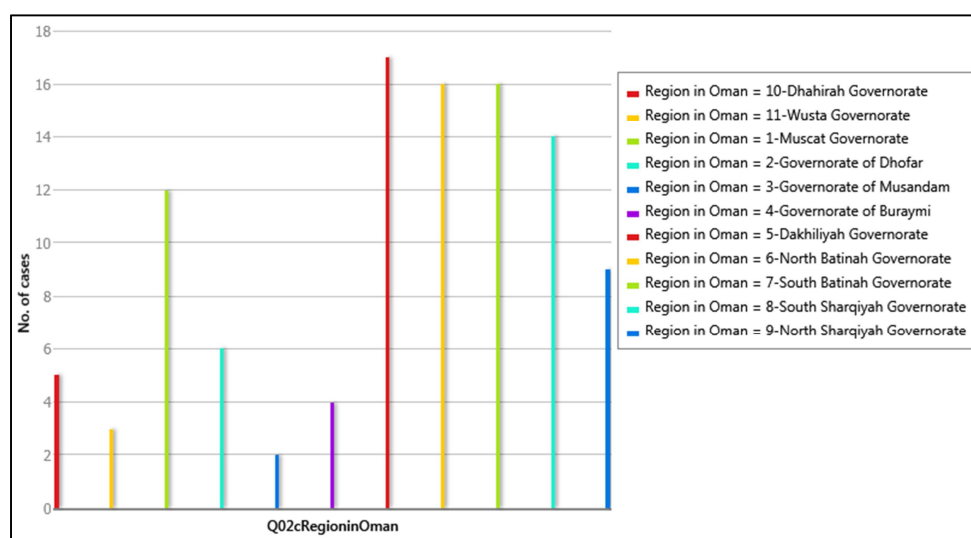


Figure 3. Distribution of region of residence of patients referred from Oman Medical Mission during hajj 1440 H.

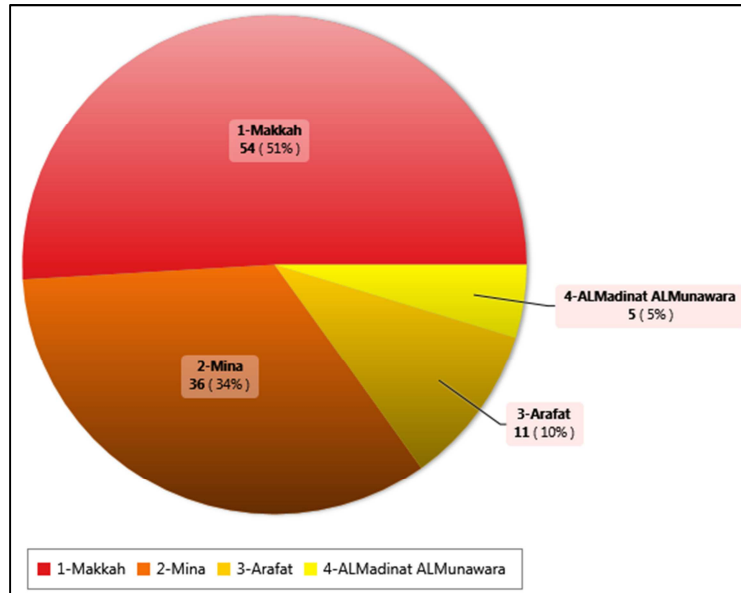


Regarding their level of education, 39 (36.79%) had a high school certificate, followed by 26 (24.53%) had a Degree or Post Graduate or Professional certificate, 22 (20.75%) had a primary school certificate, and only 19 (17.92%) were uneducated.

Regarding marital status, 92 (86.79%) were married, 7

(6.6%) were single, and 7 (6.6%) were divorced or widowed.

A total of 54 (50.94%) patients were referred to Mecca hospitals, 36 (33.96%) were referred to Mina hospitals, 11 (10.38%) to Arafat hospital, and 5 (4.72%) to AlMadinah hospitals as shown in (figure 4).



**Figure 4.** Distribution of referral hospitals for patients referred from Omani Medical Mission during hajj 1440 H.

Symptoms of referred patients are demonstrated in table 3. The highest presenting symptom was abdominal pain 32 cases (30.2%), followed by fever 25 (23.6%), Chest pain 21 (19.8%), Cough 20 (18.9%), Vomiting 19 (17.9%), Headache 15 (14.1%), Dizziness 13 (12.3%), and Diarrhea 9 (8.5%).

The medical history of the referred patients is demonstrated in table 2; 59 (55.7%) cases had past medical history or comorbidity, and 47 (44.3%) did not. There were 34 (32.08%) hypertensive patients, 24 (22.64%) had diabetes mellitus, 5 women cases (4.72%) were pregnant, 4 (3.77%) had heart disease, 2 (1.89%) cancer patients, 1 (0.94%) with Renal failure and 1 (0.94%) with hyperlipidemia. Among those, 11 cases complained of diabetes mellitus and hypertension, one case had both DM and renal failure, and another two cases had heart disease, DM, and hypertension.

**Table 2.** Distribution of Medical Conditions of referred patients from Oman Medical Mission during hajj 1440 H.

Medical condition	Number	%
Hypertension	34	32.1
Diabetes mellitus	24	22.6
Pregnancy	5	4.72
Heart disease	4	3.8
Cancer	2	1.9
Renal failure	1	0.9
Hyperlipidemia	1	0.9

Figure 5 shows the referral provisional diagnoses. Cardiovascular disease accounted for 25 patients (23.58%), followed by GIT related disease 19 (17.92%), trauma 16 (16.98%), respiratory tract infection 12 (11.32%), Diabetes

mellitus 9 (8.49%), fever of unknown Cause 4 (1.2%), Neurological disease 4 (3.81%) and foreign body swallowing 2 (1.89%). In addition to 5 women cases who suffered from pregnancy-related complications, 5 (4.72%). Regarding the trauma cases (n=16), 3 had fractures of upper limbs, 4 had fractures of lower limbs, and 1 had a rib fracture. There were also 3 cases of open wounds and 4 limb swelling, and 3 cases of back pain, including disc prolapse and muscle spasm.

The distribution of referral rate over the hajj days is demonstrated in Figure 6. The referral of patients differed over different days. The highest was on the 7<sup>th</sup> of Dhull hijjah (8<sup>th</sup> August) with 19 patients (17.92%). On the 8<sup>th</sup> of Dhull hijjah (9<sup>th</sup> of AUG) 18 patients (16.98%) were referred, 12 (11.32%) were referred on 5 Dhull hijjah (6<sup>th</sup> AUG), 11 (10.38%) were referred on both 6 Dhull hijjah (7<sup>th</sup> AUG) and 9 Dhull hijjah (10<sup>th</sup> AUG), 10 (9.43%) were referred on 10<sup>th</sup> Dhull hijjah (11<sup>th</sup> AUG), 7 (6.6%) were referred on both 4 & 11 Dhull hijjah (5<sup>th</sup> and 12<sup>th</sup> of AUG), and the rest scattered between 29<sup>th</sup> of July to 13<sup>th</sup> of August.

**Table 3.** Distribution of Presenting Symptoms of referred patients from Oman Medical Mission during hajj 1440 H.

Presenting Symptom	Number	%
Abdominal pain	32	30.2%
Fever	25	23.6%
Chest pain	21	19.8%
Cough	20	18.9%
Vomiting	19	17.9%
Headache	15	14.1%
Dizziness	13	12.3%
Diarrhea	9	8.5%

The final diagnosis for the cases referred from the Omani medical mission made by local hospitals. They were close to the provisional diagnoses with minor differences. Cardiovascular related diseases still comprised the highest diagnosis, 22 cases (20.78%), followed by GIT related diseases 20 (18.87%) cases. Trauma was the third most common diagnosis 18 cases (16.98%), followed by Respiratory disease 16 (15.09%), diabetes mellitus and

complication 9 (8.49%), pregnancy complication 5 (4.72%), neurological related disease 4 (3.77%), foreign body swallowing 2 (1.89%), depression 1 (0.94%), renal stone 3 (2.83%), left thigh abscess 1 (0.94%), cancer for follow up investigation 1 (0.94%), facial skin infection 1 (0.94%), teeth extraction 1 (0.94%), Urinary tract infection 1 (0.94%) and Sick cell disease 1 (0.94%), as shown in figure 7.

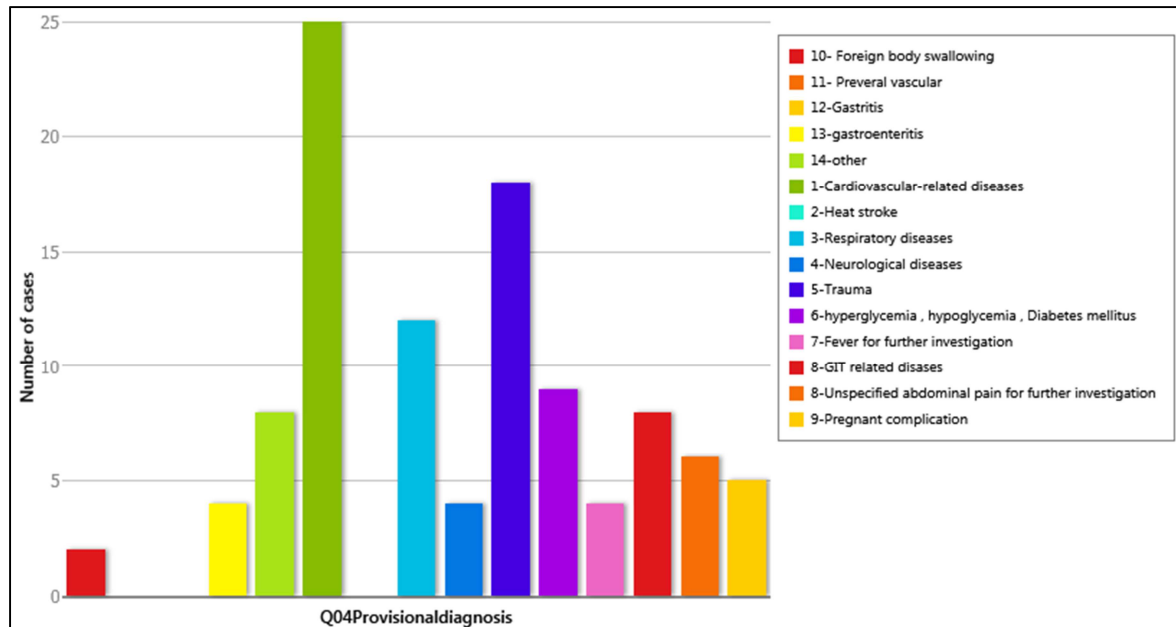


Figure 5. Distribution of provisional diagnosis of patients referred from Oman Medical Mission during hajj 1440 H.

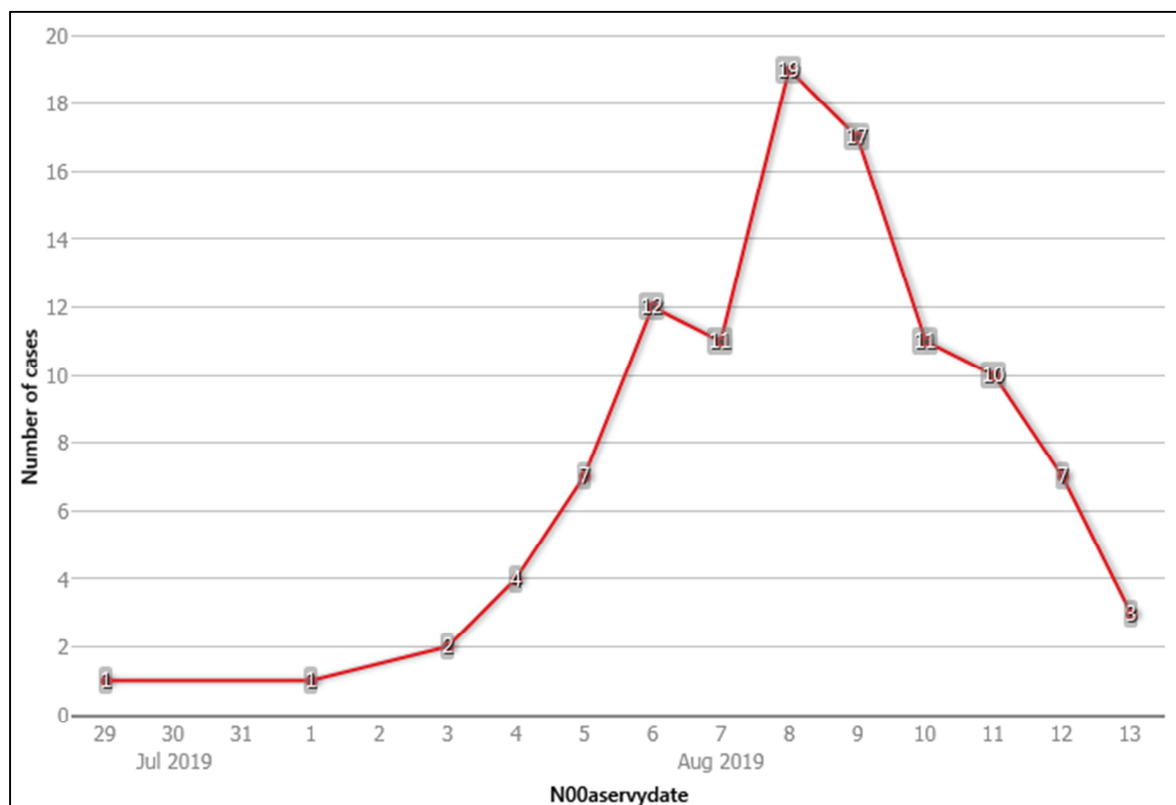
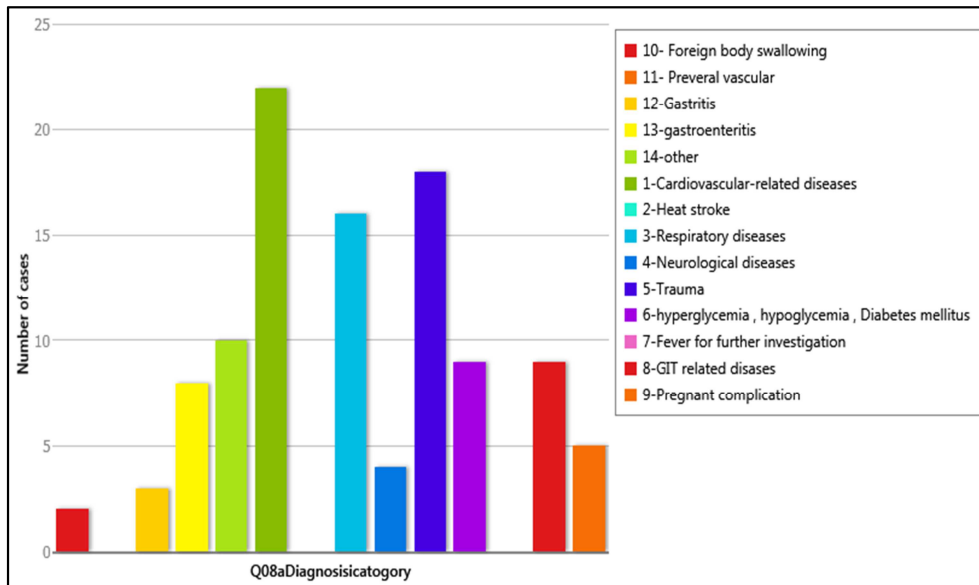
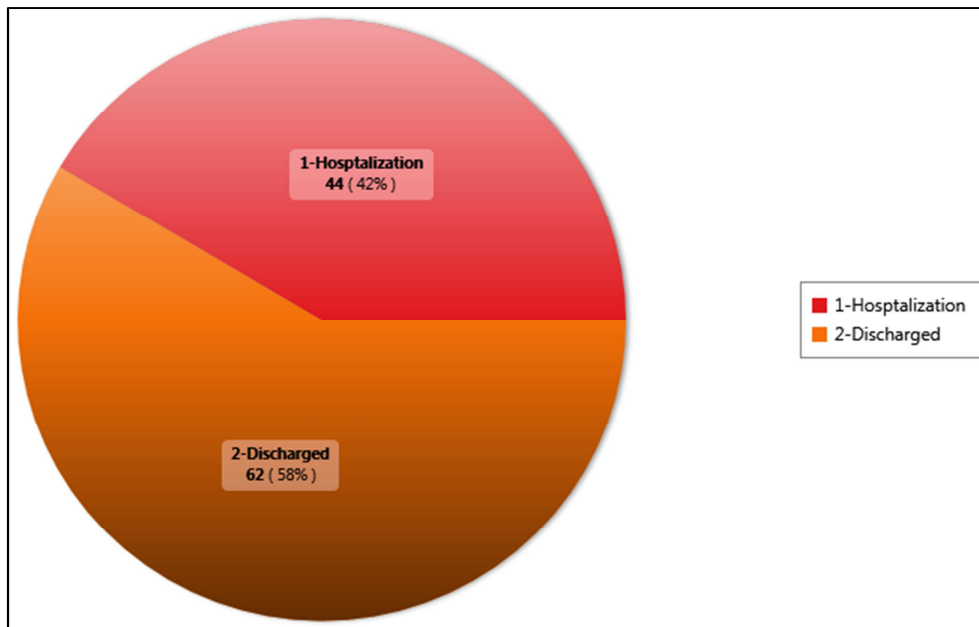


Figure 6. Distribution by date of referral for patients referred from Oman Medical Mission during hajj 1440 H.





**Figure 7.** Distribution of final diagnosis for patients referred from Oman Medical Mission during hajj 1440 H.



**Figure 8.** Outcome of patients referred from Oman Medical Mission during hajj 1440 H.

The outcome of the referred cases, as received from local hospitals, showed that 62 (58.49%) cases were discharged, and 44 (41.51%) were admitted into the hospital, as shown in figure 8.

The mean time for patients to reach the Omani Medical Mission was 8.87 min (SD  $\pm$ 6.41). The shortest time of 5 min. or less was reported by 65 (61.31%) patients, 10 min. was reported by 19 (17.92%), and 9 (8.49%) patients reported 15 min. The longest time of 20 min or more to reach the clinic was reported by 13 (12.26%) patients.

The mean time to reach the local hospitals by ambulance was 11.39 min. (SD  $\pm$ 6.62). The shortest time to reach the hospital was 5 min or less, reported by 37 (34.9%) patients, and the longest time was 20 min or more, reported by 23 (21.7%) patients.

Regarding hospitalization of referred patients by different presenting symptoms. hospitalization was significantly higher among patients with chest pain (66.7% vs. 33.3%; P-value < 0.0057), but significantly lower among patients with fever (20% vs.80%; P-value <0.006). Also, patients with dizziness had higher odds of requiring hospitalization, but the difference was not statistically significant.

Regarding hospitalization of referred patients by different co-morbidities (Table 2). Hospitalization was significantly higher among diabetics (79.2% vs. 20.8%; P-value < 0.0001), and patients with Heart Disease (P-value = 0.013). Also, patients with hypertension, cancer, and pregnant women had higher odds of requiring hospitalization, but the difference was not statistically significant. There was no difference in hospitalization rates among patients with other co-morbidities

such as hyperlipidemia, bronchial asthma, and renal failure.

## 4. Discussion

Saudi Arabia is unique in the Islamic world, where the world's largest mass gathering occurs every year. The Ministry of Health of Saudi Arabia endeavors to deliver the best possible healthcare services to pilgrims arriving for Hajj each year. Sultanate of Oman sends each year an official governmental mission responsible for providing medical services for Omani pilgrims, equal to primary health care services. Patients who need more advanced management are referred to the nearest local hospitals in Makkah, Mina, Arafat, and Madinah. The present study investigates those referred patients from Omani Medical Mission to local hospitals during Hajj of 1440 H.

Out of 5000 patients presenting to the Oman Medical Mission clinics, 106 (2.12%) cases were referred to local hospitals in Makkah, Mina, Arafat, and AlMadinah after initial management. The referral rate among Omani Hajjes, who attended the Omani Medical Mission during hajj 1440 H, was 21.2 per 1000 hajjees.

Omani patients were referred to Mecca hospitals, Mina hospitals, Arafat hospital, and AlMadinah hospitals.

In a cross-sectional study where data was collected from 2 primary care medical centers located at the Holy Mosque in Makkah city, among 1008 cases, 166 (16.5%) were referred to tertiary care centers. [30] This study is similar to our study since we were both applied at the primary health care level. Still, their result is much higher probably due to the location of these two centers at Alharam, where a much higher number of cases are expected to present, with a wider variety of health and other backgrounds, and possibly being more serious.

The percentage of both genders in our study showed a clear difference; male (60.95%) and females (39.05%); a ratio of 2:1. The male: female ratio in our study was similar to other studies. [5, 15, 23, 30, 31, 32] This is expected during hajj since men are usually responsible for taking care of their families, and a woman cannot go to the Hajj without being accompanied by a male relative (usually her husband or an eternally mahram relative whom she can never marry),

In this study, the majority (73.35%) referred patients were older than 40 years, and (14.29%) were older than 60 years. It is known that many pilgrims become financially capable of performing Hajj only at an older age after decades of saving money for that purpose. The likelihood of falling ill, developing more serious medical complications and death is understandably high in elderly pilgrims. The risk of complications and death increases with age, the highest risk being noticed among pilgrims older than 80. Our findings are similar to those of a previous study that found 38.1% of hajjees admitted to the ICU were in the group age of 41-60 years. The same study also reported that 92% of ICU admitted patients were older than 40 years [33].

Khan et al. also described that most of the patients admitted into the hospital during Hajj were older, and they observed that it was one of the risk factors linked with a high

death rate [15].

On the other hand, in our study, 26.65% of referred cases were under 40 years old. This may be due to the fact that some of them travel with their older or female relatives as attendants during the hajj, or had come to perform the hajj as they are financially and physically fit to achieve it.

Most of the patients (58.49%) were discharged from the emergency departments of the referral hospitals. This short hospitalization was mainly undertaken to stabilize patients discharged as soon as possible after investigations and management that was not available at the Oman medical mission.

We found that the leading cause for patients' referral was related cardiovascular disease followed by GIT related disease, trauma, respiratory diseases, Diabetes mellitus disease, pregnancy complications, Neurological disease, foreign body swallowing, and other causes. These results are in contrast with several other studies that have investigated the pattern of admission into hospitals during hajj season. In a systematic review study done with the objective to determine the patterns of common health problems encountered by pilgrims during Hajj, respiratory diseases (76.2%) were found to be the leading health problems, followed by skin disease (7.4%), meningococcal disease (3.7%) and heat stroke (3.7%). [23]

Another study was done to determine the epidemiological pattern of diseases and risk behaviors of pilgrim patients during the Hajj of 1427 H, at two randomly chosen Mina hospitals. Among a total of 248 patients selected randomly, Acute respiratory infections (29.8%), gastrointestinal illnesses (11.3%), and cardiovascular diseases (10%) were the most commonly diagnosed. [31]

The present data is a contrast to a previous study conducted by Khan et al. [15], who reported that the four common reasons for admission were diabetes mellitus (31.9%), hypertension (37.2%), cardiac diseases (31.8%), and chronic lung diseases (14.9%). A discrepancy in the result is due to the different types of setups; they reported the disease pattern among admitted patients during the Hajj season in a tertiary care hospital in Makkah. Our study reported data from referred cases of Omani medical mission.

Other previous studies reported that upper respiratory tract infections (URTIs) were the most common disease pilgrims during the hajj. [5, 30, 34, 35, 36] Al-Tawfiq & Memish described that the most frequent diseases during Hajj are the URTIs. [37] Many factors contribute for the higher incidence of URTIs during hajj, mainly as a result of close contact with affected hajjees, climate change, and limited and overcrowded spaces. [36]

A cohort study of all critically ill Hajj patients of over 40 nationalities, admitted to 15 hospitals in 2 cities in 2009 and 2010, was conducted, where demographic, clinical, and laboratory data were collected. The researchers reported that in 2 successive Hajj seasons, pneumonia was the most common cause of admission to the intensive care unit (ICU) in 27% critically ill patients. [34]

Cardiovascular related diseases were the main cause of

referral in our study. Other studies also show the same result that it was one of the top reasons for hospital admission in the hajj season. Over the past few years, cardiovascular disease is an important cause of ICU admission and mortality rate, particularly during Hajj. [23]

Madani et al. reported that Infections (36.4%) and cardiovascular diseases (24.9%) were the most common admitting diagnoses during hajj. More specifically, pneumonia (19.7%) was the most common admitting diagnosis, followed by the various clinical presentations of ischemic heart disease (12.3%). [22]

In this study, no patients presented to the Omani medical mission with heat stroke, in spite of the fact that Hajj occurred in the middle of the summer that year. The Saudi government plays a good role in reducing the effect of heat and sun by applying a powerful cooling system in all areas during the hajj season. Also, the health education and advice given to Omani pilgrims by Oman medical mission instructs the hajjees to avoid the heat. Similar results were described by other studies that were conducted in the winter season. [22, 31, 33]

Trauma was the third cause of referral in our study, which is similar to the findings of other studies during Hajj. A study was done during hajj season to highlight the incidence, type, and early surgical management of trauma estimated that 65 % of trauma was minor and discharged from the emergency department, while limb fractures accounted for 53% of total trauma admissions. [38]

The extra physical effort expended during the performance of rituals (long-distance walking, uncomfortable sleeping conditions, and carrying heavy weights) may explain the high percentage of musculoskeletal diseases. Similar studies have shown that musculoskeletal diseases may comprise 17.6% of all illnesses in the hajj season. [39]

The movement of pilgrims on day 9, followed by the rush for stoning Jamarat on day 10, increases the likelihood of injuries on day 10 (45% of injury cases were presented on day 10). Other studies have shown that both the elderly and younger age groups are more prone to injury than the age groups in between, which are likely composed of more physically fit people. [5, 40]

In our study, gastritis and abdominal pain were the most common causes of GIT related diseases recorded. In a survey conducted during the 1413 (1993) Hajj pilgrimage to investigate the surgical and medical cases that presented to the Emergency Department during Hajj, the most common surgical problem reported was abdominal pain (30%). [41]

Another study was conducted to evaluate the pattern of general surgical admissions in 2 major hospitals in the Holy places over two consecutive Hajj years 1423, 1424 (2003, 2004). Acute appendicitis and diabetic foot were the most common causes of admission. [40]

In our study, there were 3 (2.9%) cases referred from Oman medical mission, which final diagnosis was a neurological disease. Almekhlafi et al. reported 186 cases of stroke during the 2015 Hajj season, an incidence of 8.9/100,000. The peak incidence was particularly noted on the day after Arafat. [42]

In this study, 9 (8.7%) cases with diabetic Mellitus and its complication were referred from the Omani mission. This agrees with the results of Al Turki et al., who reported diabetes as a leading cause of morbidity and mortality during Hajj. [43]

In another study to document the pattern of medical diseases necessitating admission in a tertiary care hospital during Hajj in 1425 H, at Al-Noor Specialist Hospital, in Makkah, Saudi Arabia. The results showed that 31.9% of 689 patients admitted as an emergency had diabetes mellitus. [15]

In our study, there were about 99% cases referred from Oman medical mission who had co-morbidities and who had brought their medication with them from Oman. This result shows improvement in Oman hajjes practices regarding forgetting to bring their medication compared with a previous study. In 2011 hajj season a study was conducted by AlBosaidi and co-workers which objectives were to estimate the health-related behavioral risk factors among Omani hajjis. Among hajjis with chronic diseases, only 72.1% had brought their needed medications with them. [29].

In our study, there were 5 cases of pregnancy complications, loss of pregnancy (abortion) being the main reason. This agrees with the results of Khan et al.'s study who reported that pregnant pilgrims had a high risk of abortion during Hajj, where 32 abortions (28.07%) occurred among 114 pregnant women [44].

## 5. Conclusion

This study provides information on the rate of referral and pattern of diseases among patients referred from the Omani Medical Mission to local hospitals during hajj 1440 H. The referral rate was 2.12%. Most of the patients were suffering from cardiovascular-related disease, followed by GIT related disease and trauma.

The highest age group to be referred to was 51-60 years of age. Organizational and educational interventions can be planned in future years to target this age group to improve older Omani hajjis' care during hajj.

Women who perform Hajj pilgrimages while pregnant have a high risk of abortion. Therefore, practitioners should educate patients about these risks and advise them to postpone the pilgrimage until after the pregnancy.

It is hoped that the present data can be used by the Omani policymakers and health care providers to improve health care provision to Omani hajjis.

## 6. Recommendations

Organizational and educational interventions should be planned in future years to target older age groups in order to improve older Omani hajjis' care during hajj.

To increase Omani authorities' efforts towards hajjees with NCD, and prevention activities to be directed towards at-risk patients before Hajj. Potential Hajj pilgrims should undertake an official medical evaluation before they leave for the hajj. Omani pilgrims arriving at KSA should carry a formal medical report that lists their underlying medical issues and

treatment plans, to provide them with the appropriate treatment in KSA if required.

Omani authorities should not allow high-risk patients, particularly cardiac patients, to proceed for Hajj unless they obtain acceptable vital certification from their treating physicians regarding their medical and physical ability to perform Hajj. The same should be applied for pregnant females wishing to perform Hajj.

Intensifying health education activities before Hajj to raise awareness of Omani pilgrims about appropriate Hajj health-related behaviors, particularly among those with NCD.

The accompanying health teams' role as first responders needs to be reviewed and intensified to reduce pilgrim morbidity best.

It is recommended for the Omani government to provide an expert team directed towards cardiovascular diseases, trauma cases, and other common diseases that occur in the hajj season.

More research is needed to improve the health services provided to hajjes during the hajj season.

## Acknowledgements

First of all, my deep and sincere thankfulness to my family for their continuous and unparalleled love, help, and support. I am full respect to my wife for always being there for me as a friend. I am forever indebted to my mother for giving me the chance and experiences that have made me who I am. They selflessly encouraged me to explore new way in life and seek my own destiny. I sincerely thank my brothers and my sisters for their encouragement, moral support, personal attention, and care.

This research would not have been possible if not for them, and I dedicate this milestone to them.

Foremost, I would like to show my honest gratitude to my supervisor Dr. Randa Nooh, for her continuous support during this study, for her interest, motivation, patience, and immense knowledge. Her guidance helped me all the time while writing this investigation report.

I would like to thank my colleagues in Omani Medical Mission, for their valuable help and assistance.

My sincere thanks also go to the Saudi FETP Director, Dr. Sami Almudarra, and my colleague residents their unlimited help and corporation.

## References

- [1] MOHU. SA. Information and Data of Hajj [Available from <https://www.haj.gov.sa/ar/InternalPageCategories/Details/49>]
- [2] Al-Orainey IO. Tuberculosis infection during Hajj pilgrimage. *Saudi Med J*. 2013; 34 (7): 676-80.
- [3] Abd-alla M, Ahmed Q, Memish ZA, Saba J, Balaban V SW, Hammad A, Afgarshe M, Abd-Alla M, Ahmed Q, et al. Protective practices and respiratory illness among US travelers to the 2009 Hajj. *Journal of travel medicine*. 2012; 19 (3): 163-8.9. 2012; 19 (3): 163-8.
- [4] Assiri A, Al-Tawfiq JA, Al-Rabeeah AA, Al-Rabiah FA, Al-Hajjar S, Al-Barrak A, Flemban H, Al-Nassir WN, Balkhy HH, Al-Hakeem RF, Makhdoom HQ. Epidemiological, demographic, and clinical characteristics of 47 cases of Middle East respiratory syndrome coronavirus disease from Saudi Arabia: a descriptive study. *The Lancet infectious diseases*. 2013 Sep 1; 13 (9): 752-61.
- [5] World Health Organization. WHO MERS-CoV Global Summary and Assessment of Risk, [Internet]. Geneva: WHO; 2017 [cited 2017 26 Jul]. Available from: <http://www.who.int/emergencies/mers-cov/risk-assessment-july-2017.pdf?ua=1.19>.
- [6] Khan NA, Ishag AM, Ahmad MS, El-Sayed FM, Bachal ZA, Abbas TG. Pattern of medical diseases and determinants of prognosis of hospitalization during 2005 Muslim pilgrimage (Hajj) in a tertiary care hospital. A prospective cohort study. *Saudi medical journal*. 2006 Sep 1; 27 (9): 1373.
- [7] Al-Joudi AS. An outbreak of foodborne diarrheal illness among soldiers in mina during hajj the role of consumer food handling behaviors. *J Family Community Med*. 2007; 14 (1) 29-33. 10.
- [8] Alzahrani AG, Jamil A, Al MA, Hafiz A, Turkistani M, Nouman GS, et al. Pattern of diseases among visitors to Mina health centers during the Hajj season, 1429 H (2008 G). *J Infect Public Health*.
- [9] El Ghany MA, Alsomali M, Almasri M, Regalado EP, Naeem R, Tukestani A, Asiri A, Hill-Cawthorne GA, Pain A, Memish ZA. Enteric infections circulating during hajj seasons, 2011–2013. *Emerging infectious diseases*. 2017 Oct; 23 (10): 1640.
- [10] Lingappa JR A-RA, Hajjeh R, Mustafa T, Fatani A, Al-Bassam T, et al. Serogroup W-135 Meningococcal Disease during the Hajj, 2000. *Emerg Infect Dis* 2003; 9 (6): 665-671 2003.7.
- [11] Aguilera JF, Perrocheau A, Meffre C, Hahne S, W135 Working Group. Outbreak of serogroup W135 meningococcal disease after the Hajj pilgrimage, Europe, 2000. *Emerging infectious diseases*. 2002 Aug; 8 (8): 761.
- [12] World Health Organization. List of countries, territories and areas. Yellow fever vaccination requirements and recommendations; malaria situation; and other vaccination requirements. Geneva: WHO; 2015. Available from: <http://www.who.int/ith/2015-ith-count>.
- [13] Memish ZA, Zumla A, Alhakeem RF, Assiri A, Turkistani A, Al Harby KD, Alyemni M, Dhafar K, Gautret P, Barbeschi M, McCloskey B. Hajj: infectious disease surveillance and control. *The Lancet*. 2014 Jun 14; 383 (9934): 2073-82.
- [14] Alikhan M, Al Ghamdi K, Mahyoub JA. Aedes mosquito species in western Saudi Arabia. *Journal of insect science* (Online). 2014 May 20; 14: 69.15.
- [15] Alhaeli A, Bahkali S, Ali A, Househ MS, El-metwally AA. The epidemiology of Dengue fever in Saudi Arabia: A systematic review. *J Infect Public Health*.
- [16] Humphrey JM CN, Reusken, CBEM GM, Koopmans MPG, Abu-Raddad, LJ. Dengue in the Middle East and North Africa: A Systematic Review. *PLoS Negl Trop Dis*. 2016; 10 (12): 194.17.
- [17] CDC. Alkhurma hemorrhagic fever outbreak [Available from <https://www.cdc.gov/vhf/alkhurma/outbreaks/distribution-map.html>]

- [18] Memish ZA. The Hajj: communicable and non-communicable health hazards and current guidance for pilgrims. *Eurosurveillance*. 2010 Sep 30; 15 (39): 19671.
- [19] Fatani MI, Al-Afif KA, Hussain H. Pattern of skin diseases among pilgrims during Hajj season in Makkah, Saudi Arabia. *Int J Derm* 2000 Jul; 39 (7): 493-6.
- [20] Shimemeri A Al. Cardiovascular disease in Hajj pilgrims. *J Saudi Heart Assoc* [Internet]. 2012; 24 (2): 123–7. Available from: <http://dx.doi.org/10.1016/j.jsha.2012.02.004>
- [21] Ibrahim M, Abdelaziz SI, Almagd MA, Alarouj M, Annabi FA, Armstrong DG, Ba-Essa E, Nakhi AB, Boudjenah N, Fischl AH, Masood SN. Recommendations for management of diabetes and its complications during Hajj (Muslim pilgrimage). *BMJ Open Diabetes Research and Care*. 2018; 6 (1): e000574.
- [22] Madani TA, Ghabrah TM, Al-Hedaithy MA, Alhazmi MA, Alazraqi TA, Albarrak AM, Ishaq AH. Causes of hospitalization of pilgrims during the Hajj period of the Islamic year 1423 (2003). *Annals of Saudi medicine*. 2006 Sep; 26 (5): 346-51.
- [23] Dzaraly ND, Rahman NI, Simbak NB, Ab Wahab S, Osman O, Ismail S, Haque M. Patterns of communicable and non-communicable diseases in Pilgrims during Hajj. *Research Journal of Pharmacy and Technology*. 2014 Sep 1; 7 (9): 12.
- [24] Abdelmoety DA, El-Bakri NK, Almowallid WO, Turkistani ZA, Bugis BH, Baseif EA, Melbari MH, AlHarbi K, Abu-Shaheen A. Characteristics of heat illness during Hajj: a cross-sectional study. *BioMed research international*. 2018; 2018.
- [25] Memish ZA. Saudi Arabia has several strategies to care for pilgrims on the Hajj. *Bmj*. 2011 Dec 6; 343: d7731.
- [26] MERA. OMAN Hajj registration information. [Available from <https://hajj.om/>]
- [27] Baomer AA. Profile of diabetic Omani pilgrims to Mecca. *East African medical journal*. 1998 Apr; 75 (4): 211-4.
- [28] Atobi M. Adherence of Omani Hajjis to Health Education Advice on Major Health Hazards during Hajj, 1433H (2012G) Available at <http://fetp.edu.sa/dmu/studiesabstractresidents.php?id=584>
- [29] Albusaidi S. Behavioral Risk Factors among Omani hajjis during the hajj season 1432H/2011G. Available at <http://fetp.edu.sa/dmu/studiesabstractresidents.php?id=537>
- [30] Bakhsh AR, Sindy AI, Baljoon MJ, Dhafar KO, Gazzaz ZJ, Baig M, Deiab BA, Al Hothali FT. Diseases pattern among patients attending Holy Mosque (Haram) medical centers during Hajj 1434 (2013). *Saudi medical journal*. 2015 Aug; 36 (8): 962.
- [31] Ibrahim NK. Epidemiological pattern of diseases and risk behaviors of pilgrims attending mina hospitals, hajj 1427 h (2007 g). *J Egypt Public Health Assoc*. 2008 Jan 1; 83 (1-2): 15-33.
- [32] Al-Ghamdi SM, Akbar HO, Qari YA, Fathaldin OA, Al-Rashed RS. Pattern of admission to hospitals during muslim pilgrimage (Hajj). *SMJ*. 2003; 24 (10): 1073-6.
- [33] Madani TA, Ghabrah TM, Albarrak AM, Alhazmi MA, Alazraqi TA, Althaqafi AO, Ishaq AH. Causes of admission to intensive care units in the Hajj period of the Islamic year 1424 (2004). *Annals of Saudi medicine*. 2007 Mar; 27 (2): 101-5.
- [34] Mandourah Y, Al-Radi A, Ocheltree AH, Ocheltree SR, Fowler RA. Clinical and temporal patterns of severe pneumonia causing critical illness during Hajj. *BMC infectious diseases*. 2012 Dec; 12 (1): 117.
- [35] Memish ZA, Assiri A, Turkestani A, Yezli S, Masri M, Charrel R, et al. Mass gathering and globalization of respiratory pathogens during the 2013 Hajj. *Clin Microbiol Infect* [Internet]. 2015; 21 (6): 571.e1-571.e8. Available from: <http://dx.doi.org/10.1016/j.cmi.2015.02.008>
- [36] Al-Tawfiq JA, Zumla A, Memish ZA. Respiratory tract infections during the annual Hajj: potential risks and mitigation strategies. *Curr Opin Pulm Med* 2013; 19: 192-197.
- [37] Al-Tawfiq JA, Memish ZA. The Hajj: updated health hazards and current recommendations for 2012. *Eurosurveillance*. 2012 Oct 11; 17 (41): 20295.
- [38] Al-Harthi AS, Al-Harbi M. Accidental injuries during muslim pilgrimage. *Saudi medical journal*. 2001 Jun 1; 22 (6): 523-5.
- [39] Abodahish AA, El-Bushra HE. Utilization of primary health care services during Hajj 1998. *Saudi Med J* 1999; 20 (12): 931–8.
- [40] Al-Salamah SM. General surgical problems encountered in the Hajj pilgrims. *Saudi medical journal*. 2005 Jul; 26 (7): 1055-7.
- [41] Al-Harbi MA. Pattern of surgical and medical diseases among pilgrims attending Al-Noor hospital Makkah. *Journal of family & community medicine*. 2000 Jan; 7 (1): 21.
- [42] Almekhlafi MA, Alhazmi MA, Alsulami SS, Almorsy SA. Incidence and impact of stroke during Hajj: Results of 2015 Hajj stroke registry. *Neurosciences*. 2017 Jul; 22 (3): 181..
- [43] Al-Turki A. general guidelines for people with diabetes intending to perform Haj. *IDF Bulletin* 1998; 43: 25–70.
- [44] Khan S, Khan ID. Obstetric and Neonatal Outcomes of Pregnant Indian Pilgrims: A three-year experience at the Indian Hajj Medical Mission. *Sultan Qaboos University Medical Journal*. 2018 Aug; 18 (3): e355.