

“Analysis of Epidemiological Patterns and Common Injuries in Emergency Medicine During Hajj Season and Their Impact on Health Planning”

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Abstract:

The Hajj season in Saudi Arabia is one of the largest annual gatherings in the world, bringing together millions of pilgrims from diverse backgrounds and regions. This massive gathering poses unique public health challenges, particularly in the field of emergency medicine. The high population density increases the risk of transmission of infectious diseases, injuries, and other health conditions. This study aims to analyze the epidemiological patterns and most common injuries in emergency departments during the Hajj season and assess their impact on health planning. A comprehensive literature review was conducted using PubMed, Science Direct, and Cochrane databases, along with a manual search in Google Scholar. All relevant studies were included in the review without restrictions on age, publication type, or publication date. The results indicate that infectious diseases have historically been the leading cause of illness and death during Hajj, including respiratory and gastrointestinal infections, with an increasing contribution from non-communicable diseases such as heart disease, diabetes, and hypertension. Thermal injuries, stampede injuries, and falls are also major challenges, along with environmental conditions such as high temperatures and high population density.

Keywords: Epidemiological Patterns, Common Injuries, Emergency Medicine, Hajj Season, Health Planning.

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Introduction:

The Hajj season in Saudi Arabia is one of the largest annual gatherings in the world, bringing together millions of pilgrims from diverse backgrounds and regions. This mass congregation presents unique public health challenges, particularly in emergency medicine. With such a high density of people, the risk of infectious disease transmission, injuries, and other health-related incidents escalates significantly [1]. Addressing these risks effectively requires a thorough understanding of epidemiological patterns and the types of injuries most frequently encountered during Hajj.

The purpose of this analysis is to examine the common injuries and diseases treated in emergency departments during the Hajj season and to assess their implications for health planning [2]. By identifying prevalent health issues and understanding the epidemiological trends, health planners can better allocate resources, anticipate patient load, and optimize emergency response strategies [3]. This study not only aims to provide a foundation for enhancing medical readiness but also seeks to contribute to the ongoing improvement of health services for pilgrims, ultimately supporting a safer and more efficient Hajj experience.

Previous studies that have examined injury patterns have largely focused on specific injuries, such as falls and fractures or specific age groups, like the elderly. However, little is known about the wider spectrum of adult injury patterns.

Methods:

A comprehensive literature search was conducted in PubMed, Science Direct, and Cochrane databases using Medical Subject Headings (MeSH) and relevant keywords. All relevant peer-reviewed articles involving human subjects and available in English were included. Using the reference lists of the previously mentioned studies as a starting point, a manual search of the literature was conducted through Google Scholar to avoid missing any potential studies. There were no restrictions on date, publication type, or participant age.

Discussion

Saudi Arabia is the only country in the Islamic world that hosts Hajj and hence it is given exceptional attention by the people. Providing proper health facilities to these guests of Allah is our highest priority and moral obligation [4]. Every year, millions of Muslims embark on the Hajj pilgrimage to Mecca, Saudi Arabia. The mass migration during the Hajj season is unprecedented in scale, and pilgrims face numerous health risks. The heavy crowding of people and vehicles during this time amplifies health risks, such as those from infectious diseases, which vary from year to year. Because the Hajj is based on the lunar calendar, which is shorter than the Gregorian calendar, it presents public health policymakers with a moving target, requiring constant preparation. With global travel on the rise, preventing disease transmission has become critical to avoiding the spread of infectious diseases, including severe acute respiratory syndrome (SARS), avian influenza, and hemorrhagic fevers [5].

Historically, communicable diseases have been the primary cause of illness and death during Hajj, exacerbated by emerging viruses such as COVID-19, H1N1 influenza, SARS-CoV, and MERS-CoV. However, in recent years, non-communicable diseases (NCDs) have become significant contributors to adverse health outcomes. Cardiovascular diseases, for example, now account for up to 64% of ICU admissions and 46-66% of deaths among pilgrims. Conditions like diabetes, hypertension, and hypercholesterolemia are prevalent, particularly among older pilgrims aged 65-75, with high rates of these comorbidities. Despite the rising impact of NCDs, Hajj entry health requirements remain focused solely on communicable disease prevention, reflecting a public health emphasis on the global threat of infectious diseases over non-communicable ones [6].

Table 1: Major disease outbreaks of novel viruses and the affected Hajj seasons.

Major disease outbreaks of novel viruses and the affected Hajj seasons.

	H1N1	MERS-CoV	COVID-19
Pandemic Identification	April 2009	September 2012	December 2019
Hajj Season	2009	2012	2020
Hajj Dates	25–30 November	23–28 October	28 July–2 August
Vaccine Approval	September 2009	No vaccine	December 2020
Estimated Value of R_0	1.4–1.6	0.8–1.3	2.4–3.58
Incubation Period	2.7 days	5.2–6.0	2–14 days
Infectious Period	3.8 days	7.6 days	3–6 days
Confirmed Cases	482,000	132	24,854,140
Deaths	By November 2009 6000	By September 2013 58	By August 2020 838,924
	By November 2009	By September 2013	By August 2020

Table (1) summarizes the most recent epidemics of novel viruses and the dates of the immediate affected Hajj season. The table also includes the basic epidemiology of the listed epidemics: the basic reproduction number (R_0) and incubation and infectious periods. R_0 represents the average number of secondary cases caused by an infected individual. The incubation period of an infectious disease is the time interval from infection or the exposure to an infectious agent to the onset of the clinical symptoms of the disease [7]. The period between the initial exposure and infectiousness is called the latent period. During the infectious period, the infected individual can transmit the disease to other susceptible individuals.

The complex health challenges faced during the Hajj pilgrimage are compounded by the diverse demographic and health profiles of pilgrims. Pilgrims come from over 180 countries, bringing with them various endemic diseases, healthcare behaviors, and levels of health literacy [6]. This diversity not only influences the types of conditions seen in emergency settings but also affects the efficacy of public health interventions and patient outcomes.

Common Injury Patterns During Hajj

Non-communicable diseases aside, injuries are a significant concern during Hajj. Common injuries include [7], [8]:

1. **Traumatic Injuries:** Stampedes and overcrowding in highly congested areas can lead to crush injuries, fractures, and lacerations. Pilgrims often sustain musculoskeletal injuries due to long walking distances, uneven surfaces, or falls, particularly among the elderly.
2. **Thermal Injuries:** Heat-related illnesses, including heat exhaustion and heatstroke, are common due to the high temperatures during the Hajj season. Pilgrims may also suffer burns from close contact with hot surfaces or cooking mishaps in temporary accommodations.
3. **Respiratory Conditions:** The combination of extreme crowding, exposure to dust, and prolonged physical exertion often results in exacerbations of asthma or chronic obstructive pulmonary disease (COPD) and increases the risk of acute respiratory infections.

4. **Minor Injuries:** Blisters, abrasions, and minor sprains are frequently reported, especially among pilgrims who are not accustomed to extended walking or physical exertion.

Impact of Infectious Diseases

Infectious diseases remain a significant threat during Hajj, with respiratory infections being the most common, including viral illnesses like influenza and bacterial infections such as pneumonia. Gastrointestinal illnesses caused by foodborne or waterborne pathogens are also prevalent. Emerging and re-emerging diseases, such as COVID-19, have highlighted the need for robust surveillance systems and vaccination policies to mitigate risks [9].

Non-Communicable Diseases (NCDs) in the Spotlight

As noted earlier, NCDs are increasingly contributing to morbidity and mortality during Hajj. Cardiovascular events, such as myocardial infarction and stroke, often necessitate intensive care, particularly in elderly pilgrims with pre-existing conditions. This underscores the need for health planning that includes adequate facilities for managing chronic diseases alongside emergency and infectious disease care [10].

Public Health and Emergency Preparedness

The unique challenges of Hajj necessitate a multifaceted approach to health planning, encompassing [11]:

- **Pre-Hajj Screening:** Enhanced focus on NCDs during pre-travel health checks and the introduction of requirements for managing chronic conditions effectively before arrival.
- **Vaccination Programs:** Expanding vaccination mandates beyond infectious diseases to include conditions like seasonal influenza for high-risk groups.
- **Emergency Services:** Deployment of mobile health clinics and well-equipped ambulances throughout pilgrimage sites to reduce response times during emergencies.
- **Education and Awareness:** Providing pilgrims with health education on injury prevention, heat mitigation strategies, and managing pre-existing conditions.
- **Health Workforce Training:** Ensuring medical teams are trained to handle both the volume and complexity of health conditions encountered during Hajj.

The Role of Technology

Advancements in technology, including the use of AI and data analytics, can enhance health planning during Hajj. For instance, predictive modeling could help anticipate patient load, while digital health tools like wearable devices could monitor pilgrims' vital signs in real-time, flagging early signs of distress. Telemedicine can also extend the reach of specialized care to remote or overwhelmed areas [12].

Recommendations for Future Health Planning

1. **Integrated Health Policies:** Establishing a unified health policy that addresses both communicable and non-communicable diseases during Hajj.
2. **Resource Optimization:** Allocating resources based on epidemiological data to ensure the availability of critical care services, medications, and medical personnel.
3. **Post-Hajj Surveillance:** Strengthening follow-up systems to monitor and address delayed health consequences among pilgrims.
4. **International Collaboration:** Coordinating with global health authorities to implement best practices and share data for continuous improvement in Hajj health services.

In conclusion, the epidemiological patterns and injury trends observed during the Hajj season provide crucial insights for improving health planning. A proactive and comprehensive approach can mitigate health risks, ensuring a safer pilgrimage for millions of individuals while reinforcing Saudi Arabia's commitment to global health leadership.

Health Risks During Hajj

The religious pilgrimage of Hajj is one of the largest annual gatherings in the world [2]. The Hajj pilgrimage involves numerous health risks due to the scale, diversity, and environmental conditions of the event. These risks can be broadly categorized into communicable diseases, non-communicable diseases, injuries, and environmental health challenges.

1. Communicable Diseases

- **Respiratory Infections:** Close contact among millions of pilgrims increases the risk of airborne diseases such as influenza, pneumonia, tuberculosis, and emerging respiratory viruses like COVID-19 and MERS-CoV.
- **Gastrointestinal Infections:** Poor food and water hygiene can lead to outbreaks of foodborne illnesses, including cholera and salmonella.
- **Vector-Borne Diseases:** Pilgrims from endemic regions may bring vector-borne illnesses like dengue or malaria, which could spread in suitable climatic conditions.
- **Vaccine-Preventable Diseases:** Measles, meningitis, and polio remain concerns due to the global diversity of attendees [13].

2. Non-Communicable Diseases (NCDs)

- **Cardiovascular Events:** The physical exertion required during Hajj can trigger cardiac events, particularly in elderly pilgrims or those with underlying conditions.
- **Chronic Disease Exacerbation:** Diabetes, hypertension, and asthma can worsen due to stress, dehydration, and poor medication management.
- **Mental Health Strain:** The intense environment can lead to stress-related disorders, anxiety, or exacerbation of pre-existing mental health conditions.

3. Injuries

- **Traumatic Injuries:** Stampedes, falls, and crowd-related accidents are significant risks, particularly in high-density areas.
- **Heat-Related Illnesses:** High temperatures and prolonged sun exposure increase the likelihood of heat exhaustion, dehydration, and heatstroke.
- **Minor Injuries:** Blisters, sprains, and cuts are common due to extensive walking and physical strain.

4. Environmental Risks

- **Extreme Weather Conditions:** Intense heat and sudden sandstorms can exacerbate health issues like respiratory conditions and heat-related illnesses.
- **Overcrowding:** High population density in confined spaces facilitates disease spread and hampers effective medical responses.
- **Waste and Sanitation:** Inadequate waste management and sanitation systems increase the risk of waterborne and zoonotic diseases [5].

Managing health risks during Hajj

Managing health risks during Hajj poses numerous challenges that require careful planning and coordination. Logistical hurdles are significant, with healthcare services having to accommodate more than two million pilgrims within a limited timeframe and geographic area, requiring careful coordination and ensuring adequate staff, facilities and medical supplies during peak times. The diverse health profiles of pilgrims from more than 180 countries add complexity, with differing medical conditions, vaccination status and levels of healthcare knowledge. Language and cultural barriers further complicate communication and health education efforts. Healthcare infrastructure, including hospitals, mobile clinics and emergency services, often overwhelms systems, while transporting patients across crowded areas poses additional challenges [10].

The global movement of pilgrims increases the risk of introducing and spreading emerging and re-emerging diseases, requiring strong surveillance and international collaboration to effectively contain outbreaks. Environmental and climatic factors, such as extreme heat, exacerbate health risks, intensifying heat-related illnesses and changing patterns of vector-borne diseases. Waste management and ensuring access to clean water remain critical but challenging tasks. Although preventive measures, such as vaccination requirements, exist, gaps in global health systems leave some pilgrims vulnerable, while limited access to education and pre-Hajj medical screenings limit their overall effectiveness. Finally, the absence of real-time health monitoring systems delays responses to emerging health threats, underscoring the need for technological advances and proactive strategies to protect pilgrims' health.

Conclusion

The religious pilgrimage of Hajj is one of the largest annual gatherings in the world. Event-specific conditions and patient comorbidities are common causes of serious illness during large gatherings. With the ability to provide temporary but full-service intensive care, morbidity and mortality from serious illness can be low, even among older patients and those with difficult care conditions. Effective management of health risks during Hajj requires comprehensive planning, resource allocation, and international cooperation. Addressing these challenges involves strengthening surveillance systems, optimizing healthcare infrastructure, enhancing pre-Hajj preparedness, and leveraging technology to improve real-time response capabilities. Preventive and mitigation measures, such as vaccination, isolation of infected individuals, public closures, and travel restrictions are applied at different scales to control and slow down the disease transmission in the affected regions and populations.

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