



Hajj and Umrah Mass Gatherings and COVID-19 Infection

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Accepted: 24 October 2020 / Published online: 3 November 2020
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Abstract

Purpose of Review We discuss the risk of COVID-19 in religious mass gathering events including Hajj and Umrah pilgrimages. **Recent Findings** The risk of transmission of respiratory viruses including COVID-19 is particularly high due to the overcrowding conditions at the Hajj and Umrah. The profile of the Hajj pilgrims who tend to be older and with multiple comorbidities corresponds to that of individuals at risk for severe COVID-19. In order to avoid a COVID-19 outbreak with potential spreading to many countries through returning pilgrims, Saudi Arabia suspended the Umrah, and access to the 2020 Hajj was very limited. **Summary** A clear relation between early suspension of religious mass gatherings and lower occurrence of COVID-19 transmission in countries that took such measures promptly was noticed. There are lessons to national and international health organizations for other mass gatherings in the context of the pandemic.

Keywords Hajj · Pilgrimage · Umrah · Mass gathering · COVID-19 · SARS-CoV-2 · MERS-CoV

Introduction

The Hajj in Makkah, Kingdom of Saudi Arabia (KSA), is one of the largest annual religious mass gatherings (MGs) in the world with a strong international component. Each year, two to three million Muslims from more than 180 countries around the world flock to Makkah for the Hajj pilgrimage [1•]. This is one of the five pillars of Islam. It is compulsory, at least once in lifetime, for all responsible adult Muslims who have the physical and financial capacities necessary to accomplish it. The Hajj takes place every year between the 8th and the 13th of Dhul Hijjah, the 12th and last month of the Islamic calendar. In contrast, the Umrah is another Islamic pilgrimage to

Makkah (shorter than the Hajj) that can be undertaken at any time of the year. The Umrah is not compulsory, but is still highly recommended [2]. Umrah during Ramadan is equal to Hajj in terms of religious value, according to a statement that is attributed to the Prophet Mohammad [3]. Together, the Hajj and Umrah involve over 10 million participants each year [4•].

The presence of a large number of pilgrims from many parts of the world in congested and crowded areas greatly increases the risk of spreading infectious diseases [1•, 5]. Respiratory tract infections (RTIs) are the most frequent infections transmitted between pilgrims [1•, 5]. Most of pilgrims develop RTIs early after their arrival in Makkah with prevalence up to 90% [6].

This article is part of the Topical Collection on *Massive Gathering Events and COVID-19*

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In December 2019, an outbreak of respiratory infectious disease (COVID-19) due to a novel coronavirus (officially named SARS-CoV-2) emerged in the city of Wuhan, in the Chinese province of Hubei. The virus is easily transmitted between humans, and the outbreak was declared a Public Health Emergency of International Concern on January 30, 2020, and then a pandemic on March 12, 2020 [7]. This pandemic is posing serious risks to public health worldwide including in the KSA. All possible measures against lethal COVID-19 were applied in the country, but one of the most important questions asked in the Islamic world in the context of COVID-19 was about approaching Umrah and Hajj pilgrimages.

We review viral respiratory infections at the Hajj and Umrah mass gatherings with a focus on COVID-19.

Transmission of Respiratory Viruses During the Hajj and Umrah

Acute RTIs are a major problem of public health that affects over 5 million individuals (more than 15%) of the KSA population in 2013 [8]. Respiratory viruses are the most frequent cause of these infections [9, 10]. The epidemiology of respiratory viruses in KSA is likely affected by the gathering of more than 10 million Muslims in the holy sites of Makkah and Medina during the Umrah and Hajj seasons [11]. In pilgrims, human rhinovirus (HRV), common human coronaviruses (HCoV), and influenza virus were the respiratory viruses most frequently acquired at the Hajj [2, 5, 6, 12–16].

HRV is a highly contagious respiratory virus. It is a frequent cause of RTIs in humans of all age range. Immunosuppressed individuals or persons with congenital heart disease and bronchopulmonary dysplasia are exposed to severe HRV infection [17]. In cohorts of pilgrims sampled after participation in the Hajj, carriage of HRV ranged from 8.4 to 34.4% and was significantly higher before the Hajj [16]. As an example, a paired survey realized among 692 international Hajj pilgrims showed that over 34% pilgrims acquired HRV after the 2013 Hajj season [12]. More recently (2014 to 2017), in a 4-year cohort of 485 French pilgrims, 26.9% participants acquired HRV after their pilgrimage [18]. The dynamic of HRV acquisition during the pilgrimage was recently described in French pilgrims [6]. The authors showed an early increase in HRV carriage during the first days of the pilgrimage with a prevalence 24 times higher than that of pre-travel samples. Then, HRV carriage decreased progressively in subsequent samples but was still eight times higher in post-Hajj samples compared to pre-Hajj [6].

In November 2002, a pandemic due to the novel HCoV named SARS-CoV started in Guangdong, China. The virus

spread to several countries with 8096 confirmed cases reported, and the mortality was nearly 10.0% [19]. Ten years later, a SARS-like CoV identified as MERS-CoV was isolated from a Saudi patient. An outbreak quickly spread to neighboring countries, followed by a wider spread to geographically distant countries [20]. As of September 2019, it involved 27 countries with 2494 laboratory-confirmed cases and 858 deaths (mortality rate was 34.4%). The majority of cases occurred in the KSA with 2102 cases reported and 780 deaths (37.1% case fatality rate) [21]. The largest numbers of MERS-CoV cases were reported in 2014 and 2015 with 523 and 452 cases, respectively [11]. However, no cases of SARS coronavirus and MERS coronavirus were documented in Hajj pilgrims until now [22], and only a few cases of MERS have been reported among Umrah pilgrims [16]. By contrast, other common HCoVs were acquired by pilgrims during their pilgrimage. Acquisition rate of HCoV 229E calculated from a large paired cohort survey (692 international pilgrims) in 2013 was 14.6% [12]. In paired cohorts of French pilgrim ($n = 485$) investigated during the Hajj 2014–2017, the overall HCoV acquisition rate was 8.3% (with HCoV 229E the most frequent (6.2%)) [18] with a marked peak during the 2016 Hajj season with a 19.8% HCoV 229E acquisition rate [2, 13–16, 23•].

In April 2009, an outbreak due to a novel H1N1 influenza virus (influenza A(H1N1)pdm09) was first identified in Mexico and became rapidly pandemic with more than 22 million cases reported in with USA [9]. The KSA was one of the countries affected by the virus, with 15,850 laboratory-confirmed cases, including 124 deaths on December 30, 2009 [24]. The first 100 cases in KSA involved travelers at four airports during June 2009 [24]. The 2009 Hajj took place in the last week of November, during the outbreak that had been declared as a global pandemic by the World Health Organization on June 11, 2009 [25]. The acquisition rate of influenza A(H1N1)pdm09 among 305 returning Iranian pilgrims after the 2009 Hajj season was 1.6% [26]. Koul et al. conducted a study among 300 Indian pilgrims returning from the Hajj and Umrah in 2014–2015. Their qPCR result showed that 11% were positive for influenza virus, including 9 cases of influenza A(H1N1)pdm09, 13 cases of influenza A/H3N2, and 11 cases of influenza B [27]. In another study realized among 1600 international pilgrims after the 2010 Hajj season, a total of 7.5% participants were positive for influenza A by qPCR. Of whom, 9 cases were positive for influenza A(H1N1)pdm09 [28].

Overall, these results show that acquisition of respiratory viruses following the Hajj is very frequent with high carriage rates on leaving KSA and a potential for further transmission on returning to home country. This strongly suggests that the Hajj and possibly the Umrah may contribute to the globalization of common respiratory viruses.

COVID-19 Pandemic in the Kingdom Saudi Arabia and the Main Countries That Usually Send Pilgrims

The first COVID-19 case in KSA was detected on March 02, 2020, in the Qatif region among an individual who had traveled to an endemic region in Iran [29•]. The outbreak then began to spread throughout the country in early April 2020. As of August 11, 2020, a total of 3199 death out of 288,947 confirmed cases COVID-19 (8315 cases/1 M population) were reported in KSA [30]. A dynamic epidemiological model estimated that the 2020 Hajj season could coincide with the peak or deceleration leg of the COVID-19 pandemic curve [31]. Interestingly, the COVID-19 epidemic in KSA was partly related to another pilgrimage (Shiite pilgrimage) with Saudi pilgrims returned from pilgrimage sites in Iraq and Iran being an early source of community seeding of SARS-CoV-2 in KSA contributing to global total cases.

The annual number of pilgrims in the last 10 years varied between 1,862,909 and 3,161,573 (Fig. 1) [32]. The incidence of confirmed cases of COVID-19 in top 10 countries which send Hajj pilgrims in 2018 varied from 227/1 M population to 3910/1 M population [30] (Table 1). Thus, it was expected that the Hajj and Umrah will be suspended [33].

The Risk for COVID-19 Among Hajj and Umrah Pilgrims

During the Hajj and Umrah pilgrimages, the risk of transmission of respiratory viruses including COVID-19 is particularly high due to the overcrowding as pilgrims gather in sacred crowded places where rituals take place such as during tawaaf

(circumambulating the Ka’ba) or within the housing structures. By example, these is up to 8 persons per m² at the Grand Mosque in Makkah during rituals, and 50–100 pilgrims are housed per tent at Mina encampment [34, 35]. Even when the reproduction rate of an outbreak is low, the over density during the Hajj tends to amplify the spread of transmission [36]. The Sri Petaling MG, a Muslim missionary movement with 19,000 participants, including 1500 foreigners from 30 countries, in the suburb of Kuala Lumpur, Malaysia, that took place from February 27 to March 1, 2020, accounted for > 35% of the COVID-19 cases in the country [37••]. In February 2020, 19.2% (712/3711) of the ship’s population on the Diamond Princess Cruise Ship were infected by SARS-CoV-2 [38]. The Shincheonji Christian religious group with approximately 200,000 participants gathering in the city of Daegu, South Korea, took an important role in the COVID-19 epidemic in the country. On March 03, 2020, nearly 3000 related cases were reported out of 5621 cases in whole South Korea [39]. A high attack rate of SARS-CoV-2 was observed during a large wedding in Jordan with a total of 76/350 (21.7%) participants tested positive [40]. In February 2020, 8000 pilgrims had returned to different cities of Pakistan from Qom city in Iran where a pilgrimage of Shia Muslims took place. At the end of March 2020, a total of 990 confirmed cases were reported in Pakistan, of whom, 60% were pilgrims returning from Iran [41•]. In early March 2020, a cluster of 48/53 (90.5%) COVID-19 cases was documented in Greek pilgrims after a Christian pilgrimage in Jerusalem, Israel [42]. In late March 2020, six pilgrims who attended a pilgrimage at a masjid in Pakistan were detected positive for SARS-CoV-2 in China. During their 6-month stay, they had close contact with thousands of masjid pilgrims without face mask [43]. Finally, in March 2020, the COVID-19 outbreak started in Arkansas, USA, with two index cases who participated to a Christian event in a rural county [44•]. A total of 35/92 (38%) attendees were confirmed for the SARS-CoV-2, including 3 deaths. In addition, at least 26 additional patients who had contact with these participants were likely infected by them.

Several risk factors for COVID-19 infection and critical COVID-19 cases were described [45•]. Persons with organ transplant, cancers, severe lung condition, and serious heart condition or pregnant woman are at high risk. Older persons, having lung condition that is not severe, heart disease, diabetes, chronic kidney or liver disease, or obesity are at moderate risk [46]. In a meta-analysis of 3027 patients from 13 studies showed multiple factors to be associated with SARS-CoV-2 infection [45•]. Being male and smoking were associated with a twofold increased risk of severe disease. Age older than 65 years was associated with a sixfold increased risk of disease progression in patients with COVID-19 [45•]. In addition, the proportion of chronic diseases was significantly higher in critical and among those who died compared to others, including hypertension (odds ratio (OR) = 2.72),

Table 1 COVID-19 data [30] until August 11, 2020, in top 10 countries which have highest numbers of Hajj pilgrims in 2018

Nº	Country	Population total	Number of Hajj pilgrims in 2018	Number of confirmed cases of COVID-19	Number of confirmed cases by 1 million persons
1	Indonesia	273,839,956	210,984	127,083	464
2	Pakistan	221,342,804	200,969	285,191	1288
3	India	1,381,493,158	183,040	2,269,052	1642
4	Bangladesh	164,869,319	133,157	260,507	1580
5	Turkey	84,438,244	116,551	241,997	2866
6	Egypt	102,537,651	98,143	95,666	933
7	Iran	84,109,372	86,452	328,844	3910
8	Nigeria	206,662,307	59,253	46,867	227
9	Iraq	40,323,330	43,075	164,277	4074
10	Sudan	36,958,139	39,714	12,162	277

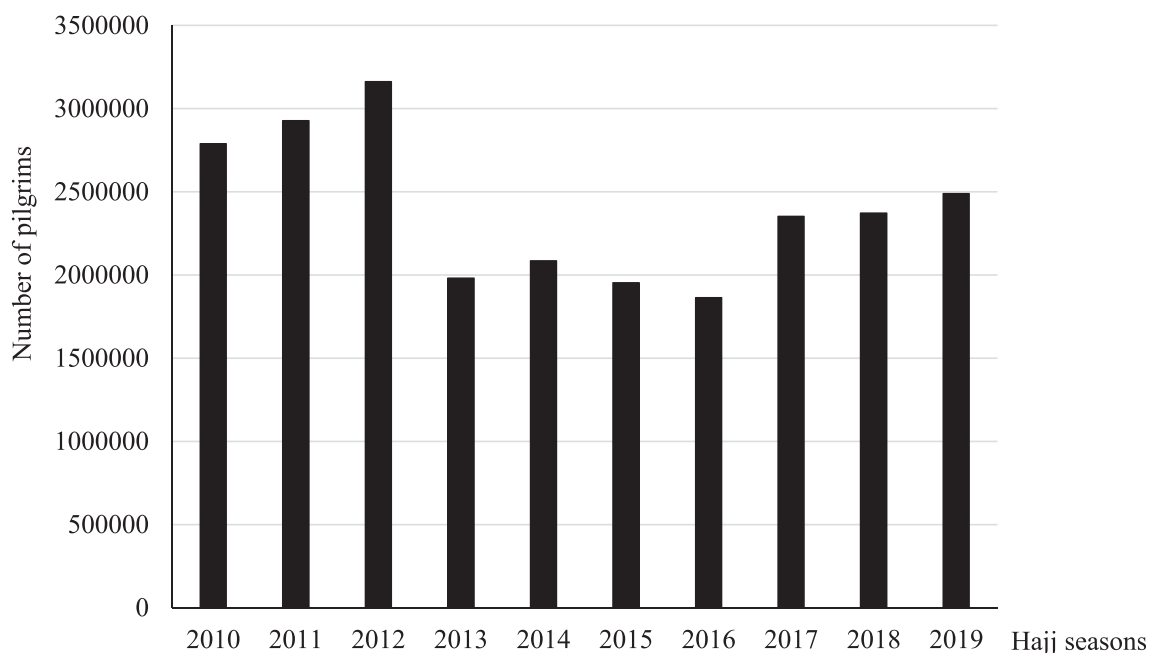


Fig. 1 Number of annual pilgrims to Makkah, Saudi Arabia, in the years 2010–2019 [32]

diabetes (OR) = 3.68), respiratory disease (OR = 5.15), and cardiovascular disease (OR = 5.19) [45•]. The profile of the Hajj pilgrims corresponds to that of individuals at risk for severe COVID. The majority of Hajj pilgrims are elderly and have a high prevalence of chronic diseases [47•, 48]. In a large study on 783 French pilgrims from 2012 to 2017, the median of age of participants was 62 years, and more than 50% have comorbidities. Diabetes and hypertension were the most frequent chronic diseases with prevalence of 29.4% and 28.0% [47•]. In 2013, 87% of Indonesian Hajj pilgrims were aged over 65 years, and 83% met criteria for high risk of health problems [48].

International travel has already been shown to play a central role in the spreading of COVID-19 and international MGs like the Hajj or Umrah, if maintained may well have contributed to the globalization of SARS-CoV-2 through returned participants. [49–51]. A few cases of COVID-19 occurred in Umrah pilgrims before international travel was banned. As an example, the first patient who died of COVID-19 in Pakistan was a returned Umrah pilgrim [52]. In addition, most of Hajj and Umrah pilgrims are from countries with suboptimal disease surveillance or travel health counseling service [53].

Prevention of Respiratory Tract Infections, Including COVID-19, During the Hajj and Umrah

To date, no specific preventive measures or vaccines are available for COVID-19. Furthermore, health systems are still overloaded in many places. The overcrowding during the

Hajj and Umrah is inevitable, and it is difficult to prevent the transmission of contagious diseases in this context. The KSA Ministry of Health recommends individual preventive measures such as use of face mask and disposable handkerchiefs and hand hygiene to mitigate the risk of RTIs. However, the efficacy of these measures against RTIs is debated [35], and there have been no reliable controlled studies investigating their efficacy on the incidence of Hajj-related RTIs. The use of face masks may not provide optimal protection from infection, but that may reduce the spread of small-sized saliva droplets around when coughing or sneezing which is the main mode of transmission of most RTIs. Mandatory use of face mask in public places is considered one of the effective measures in controlling the COVID-19 pandemic [54–56], but no investigation has been conducted in the context of MGs so far. In addition, the practice of social distancing, hand hygiene, and contact avoidance was associated with reduced risk of spreading this outbreak [7, 54].

The KSA Ministry of Health annually publishes the recommendations for required immunization such as influenza vaccine and meningococcal vaccine for the Hajj. In 2012, specific individual preventive measures were also recommended against MERS [57].

On May 29, 2020, WHO published the key planning recommendations for mass gatherings in the context of COVID-19 [58]. There are several factors to consider when determining the need to cancel or postpone a mass gathering event. These factors include the number of attendees and the proportion at greater risk of COVID-19 transmission, the density of attendees within a confined place, the level of transmission in the host area, and the community to which the participants will

return [58]. WHO also recommended canceling gatherings of more than 10 persons for organizations that serve higher-risk populations or community-wide MGs with more than 250 participants [58]. If a MG is to be held, prevention supplies are needed to be provided to event staff and participants, such as hand sanitizer with at least 60% alcohol, disposable tissues, trash baskets, disposable facemasks, and surface disinfectants (Table 2) [58].

Response of the Kingdom of Saudi Arabia for Controlling the COVID-19 Pandemic at Hajj and Umrah Pilgrimage

Since the KSA has been affected by the COVID-19 pandemic, several measures were applied, including in the holy cities Makkah and Madinah, to protect people from further infection [4•]. In order to prevent the spread of COVID-19 and for avoiding super spreader events, Saudi Arabia suspended the Umrah on March 03, 2020 [59]. The government also closed the Grand Mosque and the Kaaba on March 6, 2020, for over 2 months. The shipping services and all international flights were also suspended [59]. This year, the Hajj took place from July 28, 2020, to August 02, 2020. Because the spread of infection has not been controlled worldwide and in the country, on June 22, 2020, the KSA government announced complete ban of international visitors for the 2020 annual Hajj pilgrimage to Makkah, and access for the domestic population was denied to pilgrims with chronic diseases or aged 65 years and older [60••].

The Hajj pilgrimage has not been canceled since Saudi Arabia's foundation in 1932 [61••]. In addition, the Hajj pilgrimage has faced no significant limits on attendance since the outbreaks of cholera and plague in second half of the nineteenth century [61••]. More recently, during the influenza A(H1N1)pdm09, the population groups with the highest risk of influenza complications, including pregnant women, patients with chronic diseases, and individuals under 12 years or over 65 years of age, were invited to voluntarily refrain from performing the 2009 Hajj to decrease the transmission of the virus [62].

The 2020 Hajj season was successfully ended on August 3, 2020, with no major public health incident [61••]. Although the holy sites in Makkah and Medina remain open, access to the holy sites was limited for no more than 1000 persons (already resident in Saudi Arabia). Wearing of facemasks was mandatory during the pilgrimage. The participants were checked for fever and quarantined if required. Disinfectant measures were also implemented. A social distance of 1.5 m between pilgrims was applied. No pilgrims were allowed to touch the Kaaba. And after the pilgrimage, pilgrims were quarantined for 14 days.

Table 2 WHO's key planning recommendations for mass gatherings in the context of COVID-19 [57]

WHO key planning recommendations for mass gatherings in the context of COVID-19

Planning phase
✓ Establishing direct links of communication between event organizers and health authorities
✓ Ensuring alignment of the event plan with wider national emergency preparedness and response plans
✓ Making provisions for detecting and monitoring event-related cases of COVID-19
✓ Reducing the spread of the virus
✓ Treating ill persons
✓ Disseminating public health messages specific to COVID-19 in culturally appropriate ways and in languages used by participants
✓ Establishing a clear line of command and control and enabling efficient situation analysis and decision-making or developing a risk communication strategy and a community engagement plan for the event
✓ Making provisions for human resources, procurement of personal protective equipment and other medical consumables
Operational phase
• Related to the venue
✓ Hosting the event, at least partially, online/remotely/virtually
✓ Hosting the event outdoors rather than indoors
✓ Adjusting the official capacity of the venue
✓ Ensuring availability of hand washing facilities with soap and water and/or hand rub dispensers
✓ Ensuring regular and thorough cleaning and disinfection of the venue by designated staff
✓ Regulating the flow and density of people entering, attending, and departing the event
• Related to the participants
✓ Advising people to observe physical distancing, respiratory/cough etiquette, and hand hygiene practices
✓ Advising people with higher risk of transmitting COVID-19 that they should not attend the event
✓ Advising people with higher risk of developing severe illness from COVID-19 and individuals in contact with higher-risk patients that they should not attend the event, or making special arrangements for them
• Duration of event
✓ Keeping the duration of the event to a minimum to limit contact among participants
• Risk communication
✓ Ensuring coordination and consistency in crafting and delivering culturally appropriate and language specific messages to participants and the public
✓ Disseminating key messages in line with national health policies
• Surveillance of participants, aimed at detecting and managing individuals developing symptoms during the event
✓ Detection and management of event-related COVID-19 cases should be conducted in accordance with national policies and regulations, within the framework of national health systems
✓ Isolation facilities should be made available at the event site
✓ Arrangements with national and local health authorities regarding diagnosis and treatment of COVID-19 cases identified during the event
Post-event phase
Liaison between event organizers and health authorities, along the following lines:
✓ In case participants or staff develop symptoms during the event, event organizers should liaise with national and local health authorities, as well with those of the participant's home city or country, and facilitate sharing of information
✓ Individuals who develop symptoms upon returning to their home city or country should be advised to contact public health authorities about their potential exposure
✓ Liaison between event organizers and health authorities is required to ensure that systems are in place to detect cases arising

Conclusion

The level of COVID-19 outbreak had been linked to large religious MGs in several countries. A clear relation between early suspension of such events and lower occurrence of COVID-19 transmission in countries that took such measures promptly was noticed [63]. There are lessons to national and international health organizations for other MGs in the context of a pandemic.

The Saudi decision to drastically restrict the Hajj pilgrimage and to cancel the Umrah, two events with super spreader potential, offers impetus and precedence for other stakeholders and countries facing similar challenges amidst the reports of worsening COVID-19 global pandemic. As a global community, in the absence of a vaccine, the political commitment of nations and compliance of communities to effectively use known mitigation tools may help us to overcome the current pandemic. These decisions today will also offer important lessons for future generations.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflict of interest.

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