



Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



## Letter to the Editor

**Mass gathering-related mask use during 2009 pandemic influenza A (H1N1) and Middle East respiratory syndrome coronavirus**


Mass gatherings (MG) of people are a challenge to global emerging disease surveillance, research, and prevention. The Hajj is the world's largest and most diverse annual mass gathering of religious and political significance; approximately two to three million pilgrims arrive in the Kingdom of Saudi Arabia (KSA) from about 180 countries, some of them with suboptimal disease surveillance and preparedness capacities, and this has highlighted the global significance of MG.<sup>1,2</sup> Historically, respiratory diseases have been the most common public health condition associated with MG.<sup>3</sup> In recent years, the emergence of new respiratory diseases and the potential of MG to act as venues for the global spread of such conditions, has raised additional challenges for public health preparedness with regard to MG.<sup>1,2</sup> No pharmaceutical interventions to prevent all respiratory diseases during a MG are available. Of the non-pharmaceutical measures, only a few are feasible during MG and have been recommended, such as the use of face masks.<sup>4</sup> Two recent respiratory conditions of global significance, pandemic influenza A (H1N1) in 2009 and Middle

East respiratory syndrome coronavirus (MERS-CoV) in 2013, have offered opportunities to assess and contrast Hajj pilgrim compliance with the use of face masks.

Although the use of a face mask during the Hajj may be controversial due to religious beliefs, face mask use was a highly visible and targeted intervention during both the 2009 and 2013 Hajj. The interventions targeted nearly all pilgrims passing through the Jeddah Airport Hajj Terminal as part of public health orientation on arrival. Facemasks were provided as part of a welcome kit to each arriving pilgrim by non-governmental entities in 2009 and by the Ministry of Health of KSA in 2013.

Because individual surveys or assessments are not practical during a MG, we assessed the prevalence of face mask use during the Hajj using a relatively unused method: the photo survey. We took photos of the moving crowd from elevated areas to obtain face views of people at three time periods of the day (morning, noon, and evening) during the 5-day period of Hajj (Figure 1). We reviewed the photo frames and counted pilgrims whose full face views were visible. We excluded pilgrims not covering their nose with the face mask and uniformed service personnel. We re-counted 10% of the frames to check for consistency.



**Figure 1.** Photograph of the moving Hajj crowd 2013 from elevated area to obtain face views and calculate mask wearing percentage.

Overall, 131 photo frames were reviewed for 2009 and 137 for 2013; full face views were recognized and counted for 1607 pilgrims (23% women) in 2009 and 1724 pilgrims (16% women) in 2013. The percentage of pilgrims who used a facemask was significantly higher during the 2009 influenza A (H1N1) outbreak (8.4%) than during the 2013 MERS-CoV outbreak (0.02%) ( $p = 0.002$ ). The difference in percentage of pilgrims who used a face mask in 2009 and 2013 remained when analyzed separately by gender: male 8.8% vs. 0.02%, and female 7.5% vs. 0.05% ( $p = 0.05$ ). An additional 15% of the women wore a traditional face veil. We were unable to ascertain if women were wearing face masks under their face veil.

Although the optimal population level coverage rate of mask use to achieve a reduction in respiratory disease transmission is unknown, we found that pilgrim compliance with the recommendation to use a face mask during the Hajj was extremely low, too low to have any effect on disease transmission. However, the finding that significantly more pilgrims used one during the declared pandemic in 2009 could imply that with more targeted and innovative interventions, the rate of face mask use by pilgrims could be increased. Not much is known about pre-departure disease prevention counseling in the home countries of Hajj pilgrims, and such opportunities need to be pursued.

Despite the fact that KSA carried the major burden of documented MERS-CoV cases reported globally (130 of 160 cases), the very low level of face mask use by pilgrims during the 2013 Hajj did not result in a single Hajj-related MERS-CoV transmission in KSA or abroad among the 1 943 995 total pilgrims performing the Hajj in 2013. This finding suggests very low person-to-person transmissibility of the virus.<sup>5,6</sup>

The use of aerial photographs has been suggested as a research tool in the field of MG planning.<sup>7</sup> To our knowledge, this is the first report on the use of photography for surveillance of disease mitigation strategies and highlights the relevance of photo surveys in the emerging field of MG medicine. Given the absence of other disease control tools for emerging respiratory diseases, renewed attention is needed to increase face mask use so that many more pilgrims may be protected from endemic and emerging respiratory illnesses during the Hajj.

## Acknowledgement

We thank Dr Shahul H. Ebrahim who conceived the study and reviewed the manuscript.

*Conflict of interest:* No conflict of interest to declare.

## References

1. Ebrahim SH, Memish ZA, Uyeki TM, Khoja TAM, Marano N, McNabb SJN. Pandemic H1N1 and the 2009 Hajj. *Science* 2009;**326**:938–40.
2. Memish ZA, Al-Rabeeh AA. Public health management of mass gatherings: the Saudi Arabian experience with MERS-CoV. *Bull World Health Organ* 2013;**91**: 899–899A.
3. Alzahrani AG, Choudhry AJ, Al Mazrooa MA, Turkistani AH, Noumanc GS, Memish ZA. Pattern of diseases among visitors to Mina health centers during the Hajj season, 1429 H (2008 G). *J Infect Public Health* 2012;**5**:22–34.
4. Qanta A, Balaban V. Saudi Arabia: Hajj pilgrimage. In: Brunette GW, editor. *Travelers' health, Yellow book*. Atlanta, GA: Centers for Disease Control and Prevention; 2013 Chapter 4; Available at: <http://wwwnc.cdc.gov/travel/yellow-book/2014/chapter-4-select-destinations/saudi-arabia-hajj-pilgrimage> (accessed December 4).
5. Raoult D, Charrel R, Gautret P, Parola P. From the Hajj: it's the flu, idiot. *Clin Microbiol Infect* 2014 Jan;**20**(1):O1.
6. Rashid H, Azeem MI, Heron L, Haworth E, Booy R, Memish ZA. Has Hajj-associated MERS-CoV transmission occurred? The case for effective post-Hajj surveillance for infection. *Clin Microbiol Infect* 2013; in press.
7. Hariri MM. Aerial photographs: their use in guiding pilgrims and pointers for developing countries. *J Environ Planning Management* 1984;**27**:27–33.

Habida Elachola  
Abdullah M. Assiri  
Ziad A. Memish\*

Global Center for Mass Gathering Medicine, Ministry of Health, Riyadh,  
Kingdom of Saudi Arabia

**Corresponding Editor:** Eskild Petersen, Aarhus, Denmark

\*Corresponding author.

E-mail address: [Zmemish@yahoo.com](mailto:Zmemish@yahoo.com) (Z.A. Memish).

Received 9 December 2013

Accepted 9 December 2013