

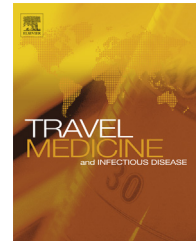


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REVIEW

Hajj-associated viral respiratory infections: A systematic review



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Summary Respiratory tract infections (RTI) are the most common infections transmitted between Hajj pilgrims. The aim of this systematic review was to determine the prevalence of virus carriage potentially responsible for RTI among pilgrims before and after participating in the Hajj. A systematic search for relevant literature was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. 31 studies were identified. Severe Acute Respiratory Syndrome coronavirus and Middle East Respiratory Syndrome coronavirus (MERS) were never isolated in Hajj pilgrims. The viruses most commonly isolated from symptomatic patients during the Hajj by PCR were rhinovirus (5.9–48.8% prevalence), followed by influenza virus (4.5–13.9%) and non-MERS coronaviruses (2.7–13.2%) with most infections due to coronavirus 229E; other viruses were less frequently isolated. Several viruses including influenza A, rhinovirus, and non-MERS coronaviruses had low carriage rates among arriving pilgrims and a statistically significant increase in their carriage rate was observed, following participation in the Hajj. Further research is needed to assess the role of viruses in the pathogenesis of respiratory symptoms and their potential role in the severity of the symptoms.

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1. Introduction

Every year, more than 10 million pilgrims from over 180 countries arrive in the Kingdom of Saudi Arabia for a pilgrimage to the holy places of Islam [1]. Around 2–3 million Muslims will perform the Hajj at fixed dates over a 6-day period, while the remaining pilgrims will participate in the Umrah, a shorter pilgrimage that can be done at anytime, although most pilgrims perform this activity during the month of Ramadan. The number of pilgrims undertaking the Hajj has increased by a factor 5 from 1920 to 2012 [1].

The crowded conditions within a confined area and the close contact with others, particularly during the circumambulation of the Kaaba (Tawaf) inside the Grand Mosque in Makkah, lead to increased risk of pilgrims acquiring and spreading infectious diseases [2]. Respiratory tract infections are the most common infections transmitted between pilgrims, and the majority of pilgrims will develop one form of respiratory tract infection or another during their few weeks in Makkah and Madinah [3,4]. Cough attack rates over 90% have been recorded among pilgrims from various nationalities [5–7]. Among ill pilgrims consulting at Mina primary health structures, 60% present with respiratory tract infection symptoms [8]. Respiratory tract infection is the leading cause of hospitalization in Saudi Hospitals during the Hajj, with a level as high as 57% in one study [9]. Pneumonia accounts for 20–40% of hospitalization in tertiary care structures [9,10] and for 55–67% of admissions to intensive care units [11,12].

Several transmissible viral respiratory infections have been reported to cause upper respiratory tract infections in Hajj pilgrims [3,13]. Published studies over recent years and including large panels of viruses tested by multiplex PCR provided new insights in the epidemiology of viral respiratory tract infections at the Hajj.

The objective of this paper is to summarize available data about the prevalence of virus carriage potentially responsible for respiratory tract infections among Hajj pilgrims as well as data about carriage acquisition and circulation of respiratory viruses among pilgrims before and after participating in the Hajj.

2. Methods

2.1. Search strategy and selection criteria

The systematic review was conducted according to Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (<http://www.prisma-statement.org>). The following databases were searched, attempting to identify all relevant studies published from January 1980 to April 2015: Scopus (<http://www.scopus.com/>), PubMed (<http://www.ncbi.nlm.nih.gov/pubmed>) and Google Scholar (<http://scholar.google.fr/>). The latest search was conducted on May 1, 2015. The topic search terms used for searching the databases were as follows:

#1: "hajj" OR "hajj" OR "pilgrimage";
#2: "respiratory";

#3: "viral" OR "virus" OR "viruses" OR "pathogens" OR "infection" OR "infections";
#4: #1 AND #2 AND #3.

The Saudi Epidemiological Bulletin (<http://seb.drupalgardens.com/>) issues were systematically reviewed for relevant papers.

Only articles published in English were included based on common language charred by the authors.

For inclusion the article needed to fulfill the following criteria [1]: It needed to be related to the Hajj pilgrimage [2], report on screening in asymptomatic or symptomatic participants [3], present virological data and [4] report on virus carriage prevalence. We excluded case reports. The reference lists of reviews were screened to identify studies possibly missed by the search.

Two researchers (P.G. and S.B.) independently performed the screening of the abstracts. Any discordant result was discussed in consensus meetings. After screening the abstracts, the full text of the articles was assessed for eligibility by the same two researchers and selected or rejected for inclusion in the systematic review.

2.2. Data collection process

The following data (if available) were extracted from each article: year, study design, study population, type of sample, microbiological methods, pathogens investigated and their prevalence, influenza vaccination rates and its effect on influenza virus carriage prevalence. We made a distinction between surveys conducted among symptomatic patients only, most of whom were included when consulting for respiratory symptoms at medical structures or were included in other settings on the basis of suffering respiratory symptoms at the time of sampling and, broader surveys conducted among cohorts of pilgrims independently of their clinical status (i.e. symptomatic and asymptomatic individuals). In this latter group sampling in pilgrims presenting respiratory symptoms was not necessarily done at the time of symptoms.

2.3. Data synthesis and analysis

As a result of the design of the studies (cross-sectional studies and cohort studies) and the heterogeneity in patient populations and diagnosis methods, a formal meta-analysis was not possible. Therefore, the study results were summarized to describe the main outcomes of interest (i.e. the prevalence of respiratory viruses before and/or after participation to the Hajj). If possible, percentages not presented in the articles were calculated from the available data.

3. Results

3.1. Study selection

A total of 95 articles were found from the search, eleven additional references were found through manual search. After screening of titles and summaries, 32 articles were

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