


Hand hygiene knowledge and practices, and rates of respiratory tract infections between Hajj and Umrah pilgrims: a comparative study

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ABSTRACT

Background: Hajj and Umrah mass gatherings (MGs) in the Kingdom of Saudi Arabia amplify the risk of viral respiratory tract infections (RTIs), but there is a lack of comparative data from these two MGs. This study aims to compare pilgrims' hand hygiene knowledge, practices, and rates of RTIs during the peak periods of Umrah and Hajj in 2021.

Materials and methods: The datasets of this comparative study were obtained from two previously conducted studies that used similar study tools and identical syndromic definitions. The binary logistic regression was applied to compare the categorical variables and, a t-test was used to compare the continuous variables.

Results: A total of 510 Hajj pilgrims and 507 Umrah pilgrims were recruited. The majority of Hajj pilgrims (68%) were ≥ 40 years old, while most Umrah pilgrims (63%) were < 40 years old. The mean total knowledge scores of hand hygiene between the Hajj and Umrah pilgrims differed significantly (4.1 vs. 3.7, respectively, $p < 0.001$) so did their compliance with frequent use of alcohol-based hand rubs (53.0% vs. 36.3%, respectively, $p < 0.001$) and the rates of RTIs (4.7% vs. 2.2%, respectively, $p = 0.05$).

Conclusions: These differences could be attributable to the distinctive characteristics of Hajj and Umrah pilgrimages, and the unique differences in risks posed by those MGs.

(Int Marit Health 2023; 74, 2: 92–97)

Key words: Hajj, Umrah, hand hygiene, mass gathering, pilgrim, respiratory tract infection

INTRODUCTION

The Kingdom of Saudi Arabia (KSA) hosts two major types of religious mass gatherings (MGs): Hajj and Umrah. Hajj is an annual Islamic pilgrimage that attracts up to

three million pilgrims between the 8th and the 13th of Dhul Hijjah, the last month of the Islamic calendar, while Umrah is a minor pilgrimage that can be completed within a short period of time at any time throughout the year,

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Received: 24.01.2023 Accepted: 17.04.2023

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although the fasting month of Ramadan is the peak time for Umrah as it holds almost similar spiritual significance to the devotees as Hajj [1]. The common rituals of these pilgrimages include assembly at the Holy Mosque in Makkah City, where pilgrims make circumambulations around the monolith known as the “Kaaba” and march between two hillocks called Safa and Marwa, and Hajj pilgrimage has additional rituals, such as spending the designated Hajj days in tents on the outskirts of Makkah, including Arafat, Mina, and Muzdalifah [2].

During such MGs, the congregation of participants at particular sites for a specific period of rites poses a greater risk of acquiring and transmitting infectious diseases, mainly viral respiratory tract infections (RTIs) [3, 4]. In a survey conducted in 2010, approximately 50% of Hajj pilgrims from the capital city of KSA (Riyadh) developed RTIs [5]. Also, in a surveillance study conducted among returning Hajj and Umrah pilgrims from India in 2014 and 2015, about 11% reported symptoms of RTI [6]. Furthermore, the overall prevalence of influenza-like illnesses (ILI) among Hajj pilgrims is high. For instance, 30% of Egyptian pilgrims studied between 2012 and 2015 [7] and about 80% of French pilgrims studied between 2014 and 2017 had ILI [8].

The practice of proper and frequent hand hygiene (HH), alongside other non-pharmacological interventions, is strongly recommended to control and prevent RTIs during MG events. In the recent Hajj and Umrah seasons, the government of KSA imposed a set of public health measures to prevent the spread of the coronavirus disease 2019 (COVID-19) in the midst of the global pandemic [9]. These measures included the mandatory use of face masks, advice on practising frequent HH, providing necessary hygienic products to pilgrims, and maintaining physical distance [10].

Limited studies have evaluated the knowledge and practices of HH measures among Hajj and Umrah pilgrims. A survey carried out by our researchers during Hajj in 2019 revealed that despite pilgrims' good HH knowledge and practices, only a minority utilised recommended HH products and the majority preferred handwashing with soap and water [11]. The majority of Umrah pilgrims (83%) who participated in a survey in 2019 at the departure lounge at King Abdul Aziz International Airport, Jeddah, KSA, reported cleaning their hands with soap and water or with sanitisers after coughing and sneezing [12].

Nevertheless, no focused study has compared participants' health behaviours and/or symptomatic RTI rates of these pilgrimages specifically amidst the COVID-19 pandemic. To this end, the primary objective of this study was to explore the differences in HH knowledge and practices along with the rates of syndromic RTIs among Hajj and Umrah pilgrims during the pandemic.

MATERIALS AND METHODS

The datasets for this comparative study were retrieved from two studies previously conducted by our team: one of the studies was a pilot randomised controlled trial (RCT) that was conducted among domestic Umrah pilgrims during the peak months of Umrah pilgrimage between 22 April and 8 July 2021 [13], and the other was a prospective cohort study conducted among domestic Hajj pilgrims during the peak week of Hajj festival from 19 to 23 July 2021 [14]. The detailed methodologies of these studies are published elsewhere [13, 14]. In brief, socio-demographic variables, medical and vaccination history, and knowledge about HH of Hajj and Umrah pilgrims were captured in a baseline questionnaire after they agreed to participate in the studies. Subsequently, the study participants were followed up for an equal period of 7 days after recruitment to record the occurrence of RTI symptoms and practices of HH through a follow-up questionnaire.

Similar assessment tools to evaluate knowledge and practice of HH and uniform definitions for RTIs were used in these studies. The level of HH knowledge was assessed based on the sum of the Likert scale of 0–6: ‘low level’ of knowledge was defined as a score of < 3, ‘moderate level’ as a score of 3–< 5, or ‘high level’ as ≥ 5 . HH practice was evaluated according to participants' daily use of soap and water as well as alcohol-based hand rubs (ABHR) to clean their hands during the study period: < 5 times/day indicating ‘less frequently’, or ≥ 5 times/day indicating ‘more frequently’. In order to estimate the rates of RTIs, we applied broad clinical criteria to define a case of RTI, in addition to syndromic definitions for ‘possible ILI’ and ‘possible COVID-19’ that were described and evaluated elsewhere [15, 16]. A case of RTI was defined as the development of at least one respiratory symptom, including cough, sore throat, rhinitis, dyspnoea, and smell or taste dysfunction.

The data recorded from both studies were exported to a single master Excel spreadsheet (Microsoft Office 356, version 2209, Redmond, WA, USA) for cleaning and assigning each line list of data to a code before being imported into Statistical Package for Social Sciences (SPSS) software (IBM SPSS Statistics for Windows, version 29.0, IBM Corp, Armonk, NY, USA) for analysis. The mean (or median with range) \pm standard deviation (SD) was used to report continuous variables, whilst frequencies and percentages were applied to summarise the categorical data. The binary logistic regression was used to test the difference between Hajj and Umrah pilgrims in terms of the reported HH practice and rates of RTIs, while the independent two-sample t-test was used to compare the means of overall HH knowledge score and other continuous variables between Hajj and Umrah pilgrims. A p value of ≤ 0.05 was considered statistically significant.

Table 1. Baseline characteristics by Hajj and Umrah pilgrims

Variable	Hajj pilgrims	Umrah pilgrims	P-value
Age [years]:			
Median (range)	50 (18–69)	34 (18–75)	
18–25	55 (10.8%)	119 (23.5%)	< 0.001*
26–39	109 (21.4%)	201 (39.6%)	< 0.001*
40–55	209 (41%)	153 (30.2%)	< 0.001*
≥ 56	137 (26.9%)	34 (6.7%)	< 0.001*
Male : Female	230 (45.1%) : 280 (54.9%)	231 (45.5%) : 276 (54.5%)	0.88
Nationality:			0.37
Saudi	437 (85.7%)	444 (87.6%)	
Non-Saudi	73 (14.3%)	63 (12.4%)	
Education:			
University-level and higher	390 (76.5%)	326 (64.3%)	< 0.001*
Diploma	27 (5.3%)	47 (9.3%)	0.016*
High school certificate	64 (12.5%)	103 (20.3%)	< 0.001*
Primary/elementary school certificate or no education	29 (5.7%)	31 (6.1%)	0.77
Presence of chronic medical conditions	167 (32.7%)	128 (25.2%)	0.009*
Received influenza vaccine	297 (58.2%)	117 (23.1%)	< 0.001*
Received at least one dose of COVID-19 vaccine	509 (99.8%)	456 (89.9%)	< 0.001*

*These values are statistically significant; COVID-19 – coronavirus disease 2019

Table 2. Comparison of hand hygiene knowledge and practices between Hajj and Umrah pilgrims

Variable	Hajj pilgrims	Umrah pilgrims	P-value
Mean ± SD total knowledge scores	4.1 ± 1.2	3.7 ± 1.3	< 0.001*
Frequency of using soap and water:			
Less frequently (< 5 times/day)	134 (30.1%)	147 (33%)	0.36
More frequently (≥ 5 times/day)	311 (69.9%)	299 (67%)	
Frequency of using ABHR:			
Less frequently (< 5 times/day)	209 (47.0%)	284 (63.7%)	< 0.001*
More frequently (≥ 5 times/day)	236 (53.0%)	162 (36.3%)	

*These values are statistically significant; SD – standard deviation; ABHR – alcohol-based hand rubs

RESULTS

A total of 510 Hajj pilgrims and 507 Umrah pilgrims were enrolled in the studies, of whom 445 participants in the Hajj study and 446 participants in the Umrah study completed the follow-up phase until the end. Table 1 summarises the baseline characteristics of Hajj and Umrah pilgrims and demonstrates significant differences between certain characteristics, including age, pre-existing medical conditions, and receipt of influenza and COVID-19 vaccinations.

Table 2 shows the differences between HH knowledge and practices among Hajj versus Umrah pilgrims. Hajj pilgrims had higher knowledge scores, and significantly more of them used ABHR to clean their hands more frequently compared to Umrah pilgrims. The logistic regression analysis found that there was a statistically significant difference between the rates of RTIs, with Hajj pilgrims having higher RTI rates than Umrah pilgrims; sore throat was the only symptom that significantly varied between participants of the two studies and affected Hajj pilgrims to a greater extent (Table 3).

Table 3. Comparison of respiratory tract infections (RTIs) rates between Hajj and Umrah pilgrims

Variable	Hajj pilgrims	Umrah pilgrims	P-value
Rate of RTI	21 (4.7%)	10 (2.2%)	0.05*
Rate of 'possible ILI'	5 (1.1%)	3 (0.7%)	0.48
Rate of 'possible COVID-19'	4 (0.9%)	2 (0.4%)	0.42
Reported respiratory symptoms:			
Sore throat	16 (3.6%)	6 (1.3%)	0.04*
Cough	9 (2%)	5 (1.1%)	0.29
Rhinitis	8 (1.8%)	5 (1.1%)	0.40
Smell/taste dysfunction	4 (0.9%)	1 (0.2%)	0.21
Shortness of breath (dyspnoea)	3 (0.7%)	1 (0.2%)	0.34

*These values are statistically significant; ILI – influenza-like illnesses; COVID-19 – coronavirus disease 2019

DISCUSSION

This is the first published study to compare health behaviours and rates of symptomatic RTIs among participants from the two largest annual religious MGs in KSA, and its findings indicated that although Hajj pilgrims demonstrated better knowledge and practices of HH than Umrah pilgrims, they reported a higher rate of symptomatic RTIs amidst the COVID-19 pandemic in 2021.

Our findings revealed that the pilgrims who participated in Hajj were significantly older and had more underlying health conditions compared to those who attended Umrah, with *p* values of < 0.001 and 0.009, respectively. The majority of Hajj pilgrims (68%) were ≥ 40 years old, whereas most Umrah pilgrims (63%) were younger than 40 years of age. Other studies also found most Hajj pilgrims to be middle-aged or older. For example, a study conducted in 2021 involving Hajj attendees found that approximately half of the pilgrims were aged between 51 and 60 years [17]. Many Hajj pilgrims are typically elderly as this is a serious commitment considered by most devotees as a once-in-a-lifetime performance and most pilgrims save for years to prepare for the journey [18].

Our study took place between April and July 2021, and the influenza vaccination campaign in KSA was launched in September of the preceding year (2020) [19]. We asked pilgrims if they had received the vaccine in the past 1 year; it is likely that most of the surveyed received the vaccine during the campaign, and some may have received it before the pilgrimages. Nonetheless, Hajj pilgrims showed a significantly higher influenza vaccination rate in comparison to Umrah pilgrims, with respectively 58.2% vs. 23.1% being vaccinated, *p* < 0.001. Similar to our findings, Alfelali et al. [20] reported a vaccination rate of 51.3% among Saudi Hajj pilgrims over 3 years (2013–2015), while Kandeel et al. [21] reported a lower vaccination rate of 26.8% among Egyptian

Umrah pilgrims in 2022. Possible reasons for this variation in vaccination coverage could be a more stringent recommendation for influenza immunisation for Hajj pilgrims, higher rates of pre-existing comorbidities among Hajjis, and thus being medically eligible for the vaccine irrespective of travel. We also observed that Hajj pilgrims had a significantly higher COVID-19 vaccination uptake than Umrah pilgrims, with respective vaccination rates of 99.8% vs. 89.9% (*p* < 0.001). Since Hajj follows Umrah, many more Hajj pilgrims may have been able to receive the mandatory vaccine, which was launched in KSA in phases and prioritised according to occupational category and risk conditions [22].

Overall, our findings indicated that participants in both studies had a moderate level of knowledge about HH, and all of them practised HH. Nevertheless, participants in the Hajj study had better knowledge, and more of them frequently used ABHR to clean their hands than those in the Umrah study, despite the fact that the Umrah study was an RCT to explore the effect of HH on RTIs and at least half of the participants received HH solution free of charge. This discrepancy may reflect the fact that more Hajj pilgrims had a tertiary-level education than their Umrah counterparts (76% vs. 64%, *p* < 0.001). Other studies showed that having a high level of education had a positive role in improving pilgrims' compliance with HH practices [17, 23].

Health education interventions have been demonstrated to improve pilgrims' awareness of and adherence to preventive measures against RTIs [24]. Turkestani et al. [25] demonstrated through a pre-and post-intervention survey conducted during the 2011 Hajj that direct health education to pilgrims is effective in increasing short-term health knowledge as well as the compliance rate of HH (from 79.1% to 95.5%). A cross-sectional study conducted among Australian Hajj pilgrims before and after Hajj to determine what factors influenced their compliance with preventive

measures indicated that pilgrims who sought pre-travel health advice were twice as likely to be vaccinated as those who did not [23]. Additionally, an RCT conducted by Abidin et al. [26] among Hajj pilgrims from Riyadh in 2004 found that in the control group, 33.6% of pilgrims used a face mask during the pilgrimage; among the health education alone group, 51.7% used a face mask (odds ratio [OR] = 2.1; 95% confidence interval [CI] = 1.56–2.86); and among the health education with free face mask group, 81.3% used a face mask (OR = 8.6; 95% CI = 5.93–12.44) [26].

In contrast to Umrah pilgrimage, Hajj is more rite-intensive, takes a longer period to conclude, and entails prolonged exposure to larger crowds, particularly during pilgrims' stays in the tents of Mina and in the plain of Arafat, which in turn poses a higher risk of RTIs; thus, this may have contributed to the higher rates of RTIs observed among Hajj pilgrims in our study. The overall rate of RTIs in both studies was lower than in the pre-pandemic studies that established diagnosis by reverse-transcription polymerase chain reaction (RT-PCR) tests. For instance, approximately one-third of nasopharyngeal and throat samples collected from 300 Indian pilgrims returning from Hajj and Umrah with respiratory infections between 2014 and 2015 were positive for a virus [27]. Although there was no significant difference in the rate of 'possible COVID-19' between Hajj and Umrah studies, the overall rate in this study was lower than that in the general Saudi population and that among attendees of other MGs [10]. A retrospective surveillance study conducted at Hajj in 2021 showed that out of 58,428 pilgrims, 41 tested positive for COVID-19 by RT-PCR conducted before, during and after Hajj [17]. From 11 July to 7 August, the adjusted incidence rate of COVID-19 in KSA ranged from 19 to 24 per 100,000 residents, while the incidence rate among Hajj pilgrims ranged from 3 to 7 per 100,000 pilgrims [17]. Moreover, a low incidence of COVID-19 and influenza was identified in a surveillance study conducted at Cairo airport using RT-PCR on nasopharyngeal swabs among Egyptian pilgrims who returned from Umrah during Ramadan of the year 2022: 67 (6.7%) of the 1003 participants tested positive for COVID-19, and 7 (0.7%) tested positive for influenza [21].

The strength of the current study is that it is the first study to compare the health behaviours and symptomatic RTIs of Hajj and Umrah pilgrims. Also, the comparison was carried out between populations from the same country in the same year amidst the pandemic. Nevertheless, the study has some limitations. We investigated only domestic pilgrims during the COVID-19 pandemic; hence, this may limit the generalisability of our findings beyond the specified population and time frame. A further limitation is the use of distinct research designs; though both studies used similar questionnaires and syndromic criteria to define

ILI and COVID-19 cases, there were differences in methodologies. Lastly, the syndromic RTIs in this study were not confirmed by laboratory tests; therefore, we considered ILI and COVID-19 cases as 'possible' rather than 'confirmed'.

Notably, there are persistent gaps in the health knowledge and behaviours of pilgrims; thus, the application of effective health education programmes and stringent recommendations prior to and during MGs should be sustained, with special consideration for Umrah pilgrims. Using smartphone applications and social media platforms (such as Twitter™, WhatsApp™, Facebook™, etc.) is an ideal medium for communicating health-related messages to a larger audience of Hajj and Umrah pilgrims. Moreover, virtual meeting platforms, such as Zoom, Webex, and Google Meet, have become a significant part of the global education system, particularly so with the unfortunate arrival of COVID-19, and can therefore be utilised by healthcare professionals and health educators to promote health messages and preventive interventions and increase awareness about the potential health risks among attendees of MGs.

CONCLUSIONS

In this comparative study, we sought to describe the differences between Hajj and Umrah pilgrims concerning their HH knowledge and practices in addition to the rates of syndromic RTIs amidst the COVID-19 pandemic. Our findings revealed that Hajj pilgrims had better knowledge about preventive measures and complied more with public health interventions yet had a higher risk of RTIs. These discrepancies could be attributable to the distinctive characteristics of Hajj and Umrah pilgrimages, and the unique differences in risks posed by those MGs.

FUNDING

The authors gratefully acknowledge Qassim University, represented by the Deanship of Scientific Research, for the financial support for this research under grant number (10333-cams1-2020-1-3-I) during the academic year 1441 AH/2020 AD. The funding source was not involved in the study design; in the collection, analysis, and interpretation of data; in the writing of the report; and in the decision to submit the article for publication.

Conflict of interest: None declared

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