

## Brief Communication

# Association between Australian Hajj Pilgrims' awareness of MERS-CoV, and their compliance with preventive measures and exposure to camels

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## Abstract

Through a prospective cohort study the relationship between travellers' awareness of MERS-CoV, and compliance with preventive measures and exposure to camels was evaluated among Australian Hajj pilgrims who attended Hajj in 2015. Only 28% of Australian Hajj pilgrims were aware of MERS-CoV in Saudi Arabia. Those who were aware of MERS-CoV were more likely to receive recommended vaccines [odds ratio (OR) 3.1, 95% confidence interval (CI): 1.5–5.9,  $P < 0.01$ ], but there was no significant difference in avoiding camels or their raw products during Hajj between those who were aware of MERS-CoV and those who were not (OR 1.2, 95% CI: 0.3–5.2,  $P = 0.7$ ). Hajj pilgrims' awareness is reflected in some of their practices but not in all.

**Key words:** Camel, Hajj, Knowledge, attitude and practice (KAP), MERS-CoV, Pilgrims, Saudi Arabia, Unpasteurized milk

As of 22 June 2016, Middle East respiratory syndrome coronavirus (MERS-CoV) infection has been identified in 1762 people in 27 countries with 36% mortality.<sup>1</sup> Recent studies have demonstrated the potential role of camels, the only known zoonotic source of MERS-CoV, in the transmission of MERS-CoV to humans.<sup>2,3</sup>

Saudi Arabia, the epicentre of MERS-CoV (with >80% of global MERS-CoV burden),<sup>1</sup> hosts the Hajj pilgrimage in Mecca, where 2–3 million people assemble annually. Millions also visit Mecca and Medina throughout the year on a minor pilgrimage called Umrah. Although no MERS-CoV cases have been reported in relation to Hajj, several imported cases have been recorded among returning Umrah pilgrims in the UK, Malaysia, Tunisia, Algeria and the Netherlands.<sup>4–6</sup> Potential sources of infection are exposure to camels or their products, other MERS patients and hospital visits.<sup>5</sup> Previous studies assessing awareness of MERS-CoV among French, Australian and Turkish Hajj pilgrims found

that between 35 and 65% pilgrims were unaware of the presence of the disease in Saudi Arabia.<sup>7–9</sup> However, no study has attempted to investigate the association between Hajj pilgrims' awareness of MERS-CoV, and their compliance with preventive measures and exposure to camels. Therefore, we conducted a prospective cohort study among Australian travelers who attended Hajj pilgrimage in 2015.

## Methods

Between September and December 2015, a prospective cohort study was conducted among Hajj pilgrims in Greater Sydney, New South Wales (NSW), Australia. NSW has the largest Muslim population (50% of all Australian Muslims reside here) in Australia, with the majority living in Greater Sydney.<sup>10</sup> Participants aged  $\geq 18$  years who planned to attend the Hajj

2015 (in last week of September) were approached. The recruited participants were then followed up during Hajj, and again after their return from Hajj.

Before Hajj, between mid-August and the first week of September 2015, the researchers attended pre-Hajj seminars run by eleven specialist Hajj travel agents in Sydney. Most prospective pilgrims attend these seminars as part of their preparations for travel to Mecca, making it an ideal place to recruit a relatively representative and generalizable sample. All pilgrims attending these seminars were approached and invited to participate in the study. Upon consent, data on socio-demographic characteristics, details of their travel itinerary and receipt of pre-travel health advice from medical (such as a general practitioner [GP]) and non-medical sources (tour operator) were collected in a self-administered questionnaire. The respondents' knowledge, attitudes and perceptions regarding MERS-CoV, their willingness to use preventive measures while at Hajj, and their understanding of the risk of MERS-CoV infection from exposure to camels, were descriptively analyzed using a three-point Likert scale.

During Hajj, we endeavored to meet all the same participants in Mina, Saudi Arabia and followed them daily throughout the peak days of Hajj (from 21 to 26th of September 2015). A separate questionnaire, in the form of diary card, was administered to determine their actual use of preventive measures such as facemask and hand hygiene, and document development of symptoms suggestive of acute respiratory infection retrospectively for three days before arriving in Mina, then daily for seven consecutive days.

After Hajj, the participants took part in a computer aided telephone interview (CATI) 7 to 10 days after their return to Australia (until 26th of December, 2015). Pilgrims were asked about the history of their contact with camels and consumption of camel products (e.g. milk and meat) at Hajj and development of respiratory symptoms after their return from Hajj.

Data collected before, during and after Hajj were linked by a unique barcode.

A non-random sampling plan was used to gather a sample which was representative of pilgrims residing in NSW. The sample size calculation was based on a previous study<sup>11</sup> where a sample of 10% of the target population (~3500 Australian pilgrims in 2015) was deemed sufficient. We estimated that about 35% Australian pilgrims would be aware of MERS-CoV,<sup>7</sup> and considering an error margin of 2.5%, a sample of 350 was deemed to be sufficient for this study; with compliance adjustment of 20% a total of 420 participants were approached.

Statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) v.23.0 (SPSS, Inc., Chicago, IL, USA). Pearson correlation coefficient and chi-square test were used to assess variables and determine associations and correlations. Univariate factors with *P* values < 0.25 were entered into multivariate regression models. Two-tailed *P* values < 0.05 were considered statistically significant in multivariate analyses.

This study was reviewed and approved by the Human Research Ethics Committee (HREC) at The University of Sydney (Project No: 2014/599).

## Results

A total of 421 pilgrims were enrolled in the study; their demographics are described in Table 1. Their median duration of stay

**Table 1.** Participants' demographic characteristics and knowledge about MERS-CoV

	Number (%)	Had knowledge about MERS-CoV <i>n</i> (%)	<i>P</i> value
<b>Age (years)</b>			
≤ 40	209 (50)	57 (27)	0.5
> 40	212 (50)	60 (28)	
<b>Gender</b>			
Male	229 (54)	68 (30)	0.3
Female	192 (46)	49 (38)	
<b>Education level</b>			
≤ High school certificate	199 (47)	53 (27)	0.5
> High school certificate	222 (53)	64 (29)	
<b>Employment status</b>			
Not employed	141 (33)	38 (26)	0.6
Employed	280 (67)	79 (29)	
<b>Chronic conditions</b>			
No	303 (72)	86 (29)	0.6
Yes	118 (28)	31 (26)	
<b>Hajj times</b>			
First time	341 (81)	97 (28)	0.5
> One time	80 (19)	19 (24)	
<b>Received professional pre-travel health advice</b>			
Special travel clinic	25 (6)	5 (20)	0.1
GP	203 (49)	70 (34)	0.3
Smarttraveller website <sup>a</sup>	2 (1)	2 (100)	0.6
MoH website	10 (2)	4 (40)	0.7
<b>Other sources of pre-travel health advice</b>			
Group Hajj leader	242 (58)	77 (32)	0.04
Family and friends	180 (43)	42 (23)	0.07
Internet	25 (6)	7 (28)	0.9

asmarttraveller.gov.au; bold values indicate a significant difference (*P* < 0.05).

in Saudi Arabia was 25 (range: 10–45) days. The majority (78%) of participants received one or more recommended vaccines: 76% (319/421) received influenza vaccine and 25% (106/421) additionally received pneumococcal vaccine. Fifty eight percent (245/421) of pilgrims received pre-travel medical advice before Hajj; many consulted other sources as shown in Table 1. Of the 421 participants enrolled, 391 (93%) were followed during Hajj, and 300 (71%) could be reached by CATI after their return home.

Twenty eight percent (117/421) of respondents were aware of MERS-CoV before travelling to Saudi Arabia. Of those who were aware, 44% (51/117) answered correctly that the virus affects the respiratory tract, and 26% (31/117) were 'very concerned' of contracting MERS-CoV at Hajj (Table 2). None of the demographic factors were associated with MERS-CoV awareness. Pilgrims who were aware of MERS-CoV were more likely to receive recommended vaccines than those who were not [odds ratio (OR) 3.1, 95% confidence interval (CI): 1.5–5.9, *P* < 0.01].

Overall, 39% (165/421) believed that there was a moderate to high risk of contracting disease from consumption of raw camel milk, 12% (50/421) thought the risk was low or nil, while about 49% (207/421) did not know of the risk. Pilgrims who were aware of MERS-CoV were significantly more likely to

**Table 2.** Participants' knowledge, attitude and practices regarding MERS-CoV

Traits	Number (%)
<b>Aware of MERS-CoV</b>	
Yes	117 (28)
No <sup>a</sup>	304 (72)
<b>Source of knowledge<sup>b</sup></b>	
Mass media	82 (70)
Friends and family	21 (18)
GPs	15 (13)
Internet	14 (12)
Saudi MoH <sup>c</sup>	8 (7)
Travel agents	4 (3)
Smart traveller <sup>d</sup>	4 (3)
<b>Perception about the severity of MERS-CoV</b>	
<i>People aged ≥ 65 years</i>	
Not serious	15 (13)
Moderately serious	40 (34)
Very serious	62 (53)
<i>People who have chronic diseases</i>	
Not serious	16 (14)
Moderately serious	44 (38)
Very serious	57 (49)
<i>People aged between (18–64) years</i>	
Not serious	27 (24)
Moderately serious	55 (47)
Very serious	35 (30)
<b>Concern of contracting MERS-CoV during Hajj</b>	
Not concerned	36 (31)
Slightly to moderately concerned	50 (43)
Very concerned	31 (26)
<b>Knowledge about the parts of body affected by MERS-CoV</b>	
Respiratory system	51 (44)
Digestive system	7 (6)
Brain	4 (3)
Kidneys	1 (1)
Do not Know	54 (46)
<b>Acceptability of using preventive measures during Hajj</b>	
Facemask	67 (57)
Hand washing with sanitizer	107 (92)
Hand washing after touching a patient	100 (86)
Use of disposable handkerchief	100 (86)
Avoiding contact with camel	103 (90)
Avoiding consumption of raw camel product	102 (87)
<b>Actual use of preventive measures during Hajj</b>	
Recommended vaccinations	106 (91)
Facemask use	35 (31)
Hand washing with sanitizer	99 (88)
Hand washing after touching a patient	17 (15)
Use of disposable handkerchief	53 (47)
Avoiding contact with camel or consumption of its raw product	115 (98)

<sup>a</sup>Excluded from the analysis.

<sup>b</sup>Some pilgrims obtained the information from more than one sources, so the percentages would add >100.

<sup>c</sup>Saudi Arabian Ministry of Health website.

<sup>d</sup>smartraveller.gov.au.

consider it a risk to drink unpasteurized camel milk as high than those who were unaware (74% vs 39%,  $P < 0.01$ ).

The acceptability of preventive measures, and participant's actual compliance are presented in Table 2. Those who were

aware of MERS-CoV were more likely to intend to avoid contact with camels (OR 2.1, 95% CI: 1.1–4.0,  $P = 0.01$ ) and consume their raw products (OR 2.2, 95% CI: 1.2–3.9,  $P = 0.01$ ) than those who were unaware. Moreover, participants who were concerned with catching MERS-CoV during Hajj were more likely to accept to use facemask compared with those who were not concerned (OR 3.6, 95% CI: 1.6–8.3,  $P < 0.01$ ). However, except for vaccination, no significant difference was observed in the actual uptake of preventive measures between those who were aware or concerned of MERS-CoV and those who were not.

Seven pilgrims (2%) reported actually coming in contact with camels and/or consuming their products during Hajj; five (1%) were unaware of MERS-CoV before travel. The type of exposure to camels included taking photographs [1.3% (1/150)] with camels, consuming boiled [1% (3/300)] or raw milk [0.6% (2/300)] and meat [0.6% (2/300)]. Out of seven pilgrims who came in contact with camels four (1%) developed respiratory symptoms during and/or immediately after Hajj. No significant differences were found in avoiding camels or their raw products during Hajj between those who were aware (OR 1.2, 95% CI: 0.3–5.2,  $P = 0.7$ ) or concerned (OR 0.9, 95% CI: 0.1–10.9,  $P = 0.9$ ) of MERS-CoV and those who were not.

## Discussion

This study shows that only 28% of Australian pilgrims were aware of MERS-CoV before attending the Hajj 2015, with some engaging in high risk behaviours such as exposure to camels (2%), and non-compliance with preventive measures. Awareness was lower compared with previous surveys of similar Australian studies showing that up to 49% of pilgrims were aware of MERS-CoV;<sup>7,12</sup> other studies have shown 45% of Turkish and 65% of French pilgrims to be aware.<sup>8,9</sup>

Importantly, this study showed that pilgrims who were aware of MERS-CoV were twice more likely to intend to avoid contact with camels and consume their raw products during Hajj than those who were unaware. Similarly, those who were concerned of catching MERS during Hajj were approximately four times more likely to intend to use facemask during Hajj. This may indicate that pilgrims' awareness of infectious diseases is reflected in how acceptable they find using some preventive measures and is consistent with a previous study by our team that showed that pilgrims who were aware of MERS-CoV were also significantly more aware of its risks from drinking unpasteurized camel milk compared with those who were unaware (43% vs 23%,  $P < 0.01$ ).<sup>12</sup>

Conversely, this study highlights that while the knowledge and perceived susceptibility to the disease were associated with their intention to use preventive measures, these factors were absent in their actual use. Theoretically, the frame work of "precaution adoption model" sets forward stages of health behavior change in an individual and the factors that lead people to move from one stage to another such as awareness, perceived severity and susceptibility, and cues to action.<sup>13</sup> However, in this study we observed that perceived severity and susceptibility did not seem to play much role in motivating the pilgrims to comply with preventive measures (Figure 1). Although majority of pilgrims who were concerned with contacting MERS-CoV at Hajj

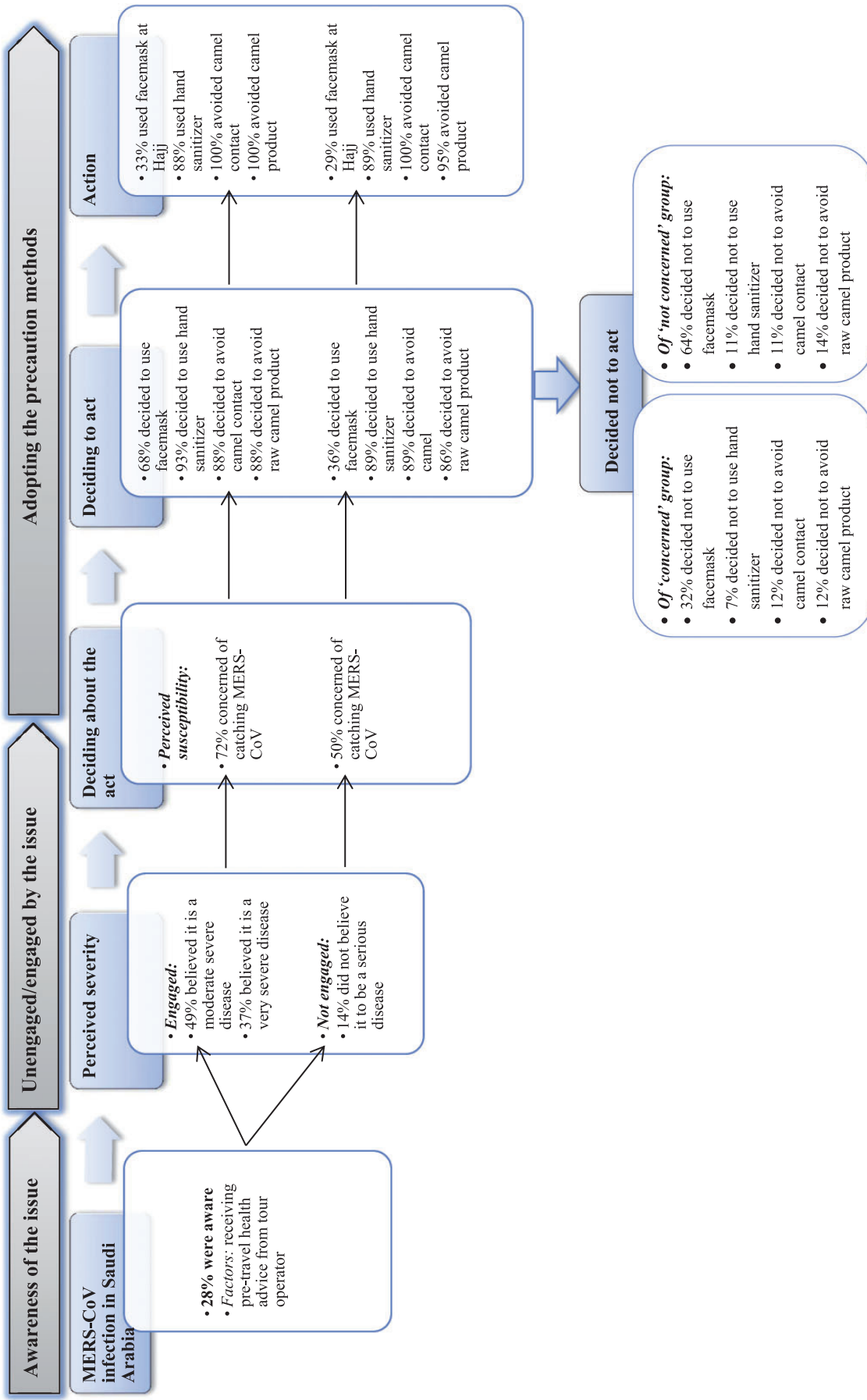


Figure 1. Applied precaution adoption model on pilgrims' behavioral change in applying MERS-CoV preventive measures

planned to use preventive measures, in practice few applied the measures and no significant difference was observed between those who were concerned and those who were not. This may indicate that among Hajj pilgrims, there may be unique factors and barriers that affect their compliance with preventive measures against the infectious diseases which needs further investigation. Other studies have documented the pilgrims' willingness to comply with MERS-CoV preventive measures,<sup>8,9</sup> in practice many participants might not have adhered to those as seen in this study.

Two percent ( $n=7$ ) of pilgrims actually came into contact with camels or consumed their products during their pilgrimage, which is an improvement compared with the previous year when between 7 and 16% pilgrims were reported to be exposed to camels.<sup>12,14</sup> This apparent decline may be attributed to the Saudi Arabian authorities' banning of bringing and sacrificing camels into Hajj sites in 2015.<sup>15</sup>

To our knowledge, this is the first cohort study which has assessed pilgrims' awareness about MERS-CoV and their actual practice of risk avoidance, especially their contact with camels at Hajj; however, the study findings have limited generalizability outside of Australia. Additionally, the pilgrims' participation in the pre-travel survey may have increased their awareness of the recommended preventive health measures, leading to higher reported usage (known as 'the Hawthorne effect'). Although this is certainly a theoretical consideration, research into the Hawthorne effect on practice-based research suggests that its impact is minimal.<sup>16</sup> Moreover, the exact site and time of camel exposure were not explored, and data collection relied on self-report.

In conclusion, this study showed that many Australian pilgrims are unaware of the risk of MERS-CoV in Saudi Arabia; and some engaged in high-risk practices such as coming in contact with camels. Pilgrims' awareness of the risk is reflected in their vaccine uptake but not in their avoidance of camel exposure.

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