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Pharyngeal carriage rate of *Neisseria meningitidis* before and after the Hajj pilgrimage, in Zahedan (southeastern Iran), 2012

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Background/aim: The annual Hajj pilgrimage to Mecca, which attracts more than 3 million Muslim pilgrims from around the world, has played a role in the global spread of meningococcal infection. We aimed to compare pharyngeal carriage of *Neisseria meningitidis* in Hajj pilgrims before departure and after returning to Iran, Zahedan.

Materials and methods: This prospective and cross-sectional study was conducted among Hajj pilgrims in Zahedan (southeast Iran) in 2012. We studied all pilgrims who agreed to participate in this study and who met the inclusion criteria. Sampling was done by swabbing the posterior pharyngeal wall through the mouth with direct plating or keeping transport time to below 5 h. Specific culture, oxidase test, and carbohydrates tests were done on the positive samples.

Results: Among 422 pilgrims (42.2% male, 57.8% female; with age range 21–95 years), 6 (1.4%) were positive *for N. meningitidis* after the Hajj pilgrimage. Nobody was positive before departure. During the Hajj 58.5% of the participants received antibiotics.

Conclusion: According to the results of our study, the prevalence of pharyngeal carriage of *N. meningitidis* in pilgrims after returning to Zahedan was low (1.4%). The quadrivalent meningococcal vaccine and antibiotic therapy were effective in reducing the number of carriers among pilgrims after travel.

Key words: *Neisseria meningitidis*, Hajj pilgrim, pharyngeal carriage

1. Introduction

Neisseria meningitidis is a member of the gram-negative cocci and mostly its serogroups A, B, C, W135, and Y contribute to human diseases (1). Up to 10% of the world's population may be asymptomatic carriers with nasopharyngeal colonization, but higher rates can be seen in crowded settings such as prisons, universities, schools, immigrant camps, and military institutions (1,2). *N. meningitidis* is responsible for meningitis and sepsis, and delayed or undertreated cases are associated with mortality rates above 50%. Moreover, even with prompt treatment, meningococcal meningitis leads to death in 5% to 10% of cases (2). Transmission occurs through breathing aerosols by people who have had close or extended contact with an infected patient, such as those in the same household and shelters, roommates, and pilgrims. The development of invasive MCD is dependent upon a wide variety of bacterial, host, and environmental factors. Risk is highest among travelers who have prolonged contact with local populations in the meningitis belt during an epidemic (3). The Hajj pilgrimage to Saudi Arabia has been associated with outbreaks of meningococcal disease in returning pilgrims and those in contact with them (4). Every year, about 3 million people from over 140 countries meet in Medina and Mecca for nearly 30 days (5,6). The incidence of meningococcal disease is several times higher in the meningitis belt and Saudi Arabia than in Iran and other countries, with periodic epidemics during the dry season (December–June) (3–7).

In 1987, a *N. meningitidis* serogroup previously isolated in East Asia and Europe occurred among the pilgrims, and spread globally when the pilgrims returned to their home countries (7–9). Then an outbreak of serogroup W-135 MCD occurred in mid-March 2000 among Muslim pilgrims returning from the pilgrimage to Mecca and those in contact with them, with more than 340 cases being reported from around the world (4,10). Recent studies showed that W-135 and B were the commonest serogroups causing meningococcal meningitis (11,12). The risk of transmission increases owing to the fact that carriage may last between 5 and 15 weeks (13–15). In the study by Wilder-Smith et al., 15% of pilgrims were carriers of *N.*

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meningitidis following their return from pilgrimage, and interestingly 55% of these carriers tested positive during the next 6 months (16). Another study, by Ceyhan et al. in 2010 in Turkey, showed serogroup W135 to be responsible for most carriage cases among pilgrims, despite their being vaccinated with the quadrivalent vaccine. Moreover, the carriers transmitted the pathogen to their family members, and account for the main source of W135 in Turkey (17). As there are few studies on pharyngeal carriage among pilgrims in Iran, especially in this region (5), we decided to study and to compare the carrier status of *N. meningitidis* among pilgrims going to and pilgrims returning from the Hajj.

2. Materials and methods

This cross-sectional and prospective study included Hajj pilgrims from Zahedan in Iran in 2012. All pilgrims who agreed to participate and who had not taken antibiotics in the previous 7 days were enrolled in the study. The pilgrims were tested twice: before departure from their home country and after returning from the pilgrimage. Pharyngeal swab sampling was performed in each pilgrim at the waiting hall of the airport, and the swab was maintained in Stuart Transport Medium until transmission to the laboratory. The specimen was cultured on modified Thayer-Martin and blood agar medium for 24 h. Following Gram staining of the obtained colonies, gram-negative diplococci were identified by oxidase and carbohydrate consumption tests. The carrier status for *N. meningitidis* was defined as a positive culture of the pharyngeal swab sample for the organism. Then carrier rate was compared in Hajj pilgrims before departure and after returning to Zahedan, Iran.

2.1. Statistical analysis

The results were analyzed using SPSS 22.0 for Windows to calculate significant differences and $P \leq 0.05$ was considered statistically significant.

3. Results

A total of 422 individuals were included in this study (42.2% male, 57.8% female). The mean ± SD age of subjects was 50.18 ± 11.09 years. Of these, 268 (63.5%) mentioned a previous pilgrimage and 247 (58.5%) reported a history of antibiotic use during the Hajj pilgrimage. Before-trip sampling revealed 2 cases of *Neisseria sicca* (0.5%) and 11 cases of *Moraxella catarrhalis* (2.6%). However, no *N. meningitidis* colony was grown on the culture. Post-trip sampling showed 49 cases of *N. sicca* (11.6%), 15 cases of *M. catarrhalis* (3.6%), and 6 cases of *N. meningitidis* (1.4%) (Table). Among the patients with positive culture of *N. meningitides*, 2 (33.3%) were aged < 40 years, 3 were (50%) aged between 40 and 60 years, and one (16.7%) was aged > 60 years. According to the chi-square test, there was no significant relationship between age and carrier status ($P = 0.664$). Most of the carriers were female (5 females, 83.3% vs. 1 male, 16.7%; $P = 0.199$). However, there was no significant difference among carriers in terms of sex distribution. Of the carrier patients, 3 individuals had been on a previous pilgrimage (50%), which did not reveal a statistically significant difference. On the other hand, 4 carriers (66.7%) reported a history of antibiotic use, which did not show a significant relationship with carrier status. Overall, of the 247 who reported previous antibiotic use, 17% were carriers of *N. meningitidis*, *N. sicca*, and *M. catarrhalis*, while of the 175 without previous use of antibiotics, 28 (16%) were carriers of these organisms.

4. Discussion

Our study showed that, among 422, only 6 individuals (1.4%) were positive for *N. meningitidis* after the Hajj pilgrimage. Nobody was positive before departure. Meningococcal meningitis is an endemic disease in eastern Mediterranean countries, especially the sub-Saharan meningitis belt. Sudden outbreaks of meningitis have been observed in this region in the past. The annual incidence rate of meningococcal meningitis has been reported between 1 and 5 in every 100,000 people in the eastern Mediterranean region. Nevertheless, the weaknesses of the current health surveillance system of some countries and underreporting to the World Health Organization should be noted (4). Meningococcal meningitis is considered a huge problem for the domestic health care system of Saudi Arabia too, especially during the Hajj ceremony and afterwards. The Hajj is an annual religious event that

Table. Prevalence of pharyngeal carriage of *Neisseria meningitidis* in pilgrims before and after Hajj pilgrimage.

Pharyngeal carriage	*Neisseria meningitidis*		*Moraxella catarrhalis*		*Neisseria sicca*	
Before travel	N	%	N	%	N	%
	0	0	11	2.6	2	0.5
After travel	N	%	N	%	N	%
	6	1.4	15	3.6	49	11.6

attracts a large number of pilgrims (over 2 million Muslims from all over the world) to Saudi Arabia. This mass gathering increases the risk of infectious disease outbreaks, facilitated by large numbers of individuals staying in confined areas for a short period of time. Following the pilgrimages of 1987 and 1988, a large meningitis epidemic occurred in some eastern Mediterranean countries. Saudi Arabia experienced the first outbreak of the disease due to the W135 serogroup during the Hajj ceremony in 2000, which repeated in 2001. Since then, the country has mandated the quadrivalent vaccine (ACWY135) for all pilgrims (11,12). Among the pilgrims in our study who agreed to participate in sampling, none were carriers before the pilgrimage, while 6 tested positive for *N. meningitidis* after the pilgrimage. Such a carrier rate is remarkably lower in relation to the carrier rate in society and compared to previous studies. We did not find any significant relationship between the carrier status and age, sex, and previous history of pilgrimage, while 58% of the pilgrims reported a previous history of antibiotic use. On the other hand, *N. sicca* was the cause of postpilgrimage carrier status in 11.6% of the pilgrims, followed by 3.6% *M. catarrhalis*, and 1.4% *N. meningitidis*. In the study by Alborzi et al. in Shiraz, which was conducted in 2008, the carrier status of pilgrims was evaluated by nasopharyngeal sampling before and after the pilgrimage. That study revealed that administration of ciprofloxacin 500 mg, 24 h before the trip, could decrease the carrier status from 8.2% to zero (5). Another study by Husain et al., in 2010, was conducted in 177 Hajj pilgrims. They found that there was no throat colonization with *N. meningitidis* in any of the throat swabs. Of the 177 pilgrims, 92% were vaccinated with meningococcal quadrivalent vaccine and 83% of the pilgrims had received one dose of ciprofloxacin before leaving Mecca (8). Wilder-Smith et al. reported that 15% of pilgrims were carriers of *N. meningitidis* following their return from the pilgrimage (16). A study conducted by the WHO in 2005 among pilgrims and their family contacts in Morocco, 3 to 12 months after the Hajj, reported that 2.7% of the specimens showed pharyngeal carriage of serogroup W135 *N. meningitidis* (18). In our study, all 422 subjects who underwent sampling had received the quadrivalent meningococcal vaccine prior to the trip. Of these, 247 reported previous antibiotic usage during pilgrimage (58.5%). The lower carrier status rate of our pilgrims is probably due to previous antibiotic use. However, nobody had received ciprofloxacin prophylaxis before leaving Mecca in our study.

It is necessary that all the pilgrims receive the quadrivalent meningococcal vaccine 10–14 days prior to their trip to prevent infection with *N. meningitidis*.

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