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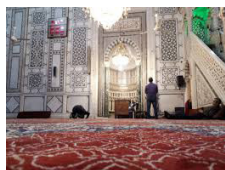
Isolation and Identification of Bacteria in Mosque Carpets: A Cross-Sectional Study in Riyadh, Saudi Arabia

Fahad Alsaif¹, Ali Somily², Ghadah Alhammad³,
Abdullah Almousa³, Abdulrahman Albasseet³,
Afnan Almutawa³, Amjad Albatli³,
Latifah Albatly³, Raya Alsuhaihani³,
Ziyad Alajlan³, Mojahed Otayf³

¹Department of Dermatology, King Saud University, Riyadh, Saudi Arabia

²Department of Pathology and Laboratory Medicine, College of Medicine, King Khalid University Hospital and King Saud University, Riyadh, Saudi Arabia

³College of Medicine, King Saud University, Riyadh, Saudi Arabia



Muslims tend to spend a lot of time inside mosques, special indoor environments for human gatherings, open to all age groups during prayer times, particularly elderly people who have a high prevalence of chronic diseases and associated risks.^{1,2} Many studies have so far shown a significant association between the area per occupant and the concentration of bacteria, which may increase the risk of infections in such enclosed spaces.³ However, limited information is available on the type of the isolated pathogenic bacteria from carpets of mosques globally.⁴ We conducted this study to investigate the types of the bacterial contamination, if any, in prayer carpets in mosques in Riyadh, the capital city of Saudi Arabia. We also attempted to compare the contamination levels between male and female prayer halls.

Using a cross-sectional design, 100 mosques representing most areas of Riyadh, were studied. Using a cluster random sampling, mosques where all the five daily prayers are performed and which have an ablution area were selected from the five re-

gions of Riyadh—middle, northern, southern, eastern, and western areas. Twenty mosques were selected randomly from each of the five regions. Samples were obtained from selected areas of carpets in the main entrance and the first row, as these areas have the highest load of worshipers in both men and women praying sections by a trained research assistant in August and September 2017, using sterile cotton swabs. The swabs were moistened with sterile gel (Medical Disposable Manufacturing Co., Riyadh, Kingdom of Saudi Arabia) and transported immediately in Stuart transport medium to the microbiology lab. Separate cotton swabs and transport media were used for each area. Samples were inoculated on three media—blood agar for 24–48 hrs, MacConkey agar for 24–48 hrs, and Sabouraud dextrose agar (Saudi Prepared Media Laboratory Co. Ltd., Riyadh, Kingdom of Saudi Arabia) for 24–72 hrs. Any growth on blood agar was only identified by Gram stain, catalase, and coagulase. Catalase-positive coagulase-negative Gram-positive cocci were considered “coagulase-negative staphylococci.” Catalase-

Correspondence to
Ghadah Alhammad,
College of Medicine,
King Saud University,
Riyadh, Saudi Arabia
E-mail: ghadah.alhammad@gmail.com

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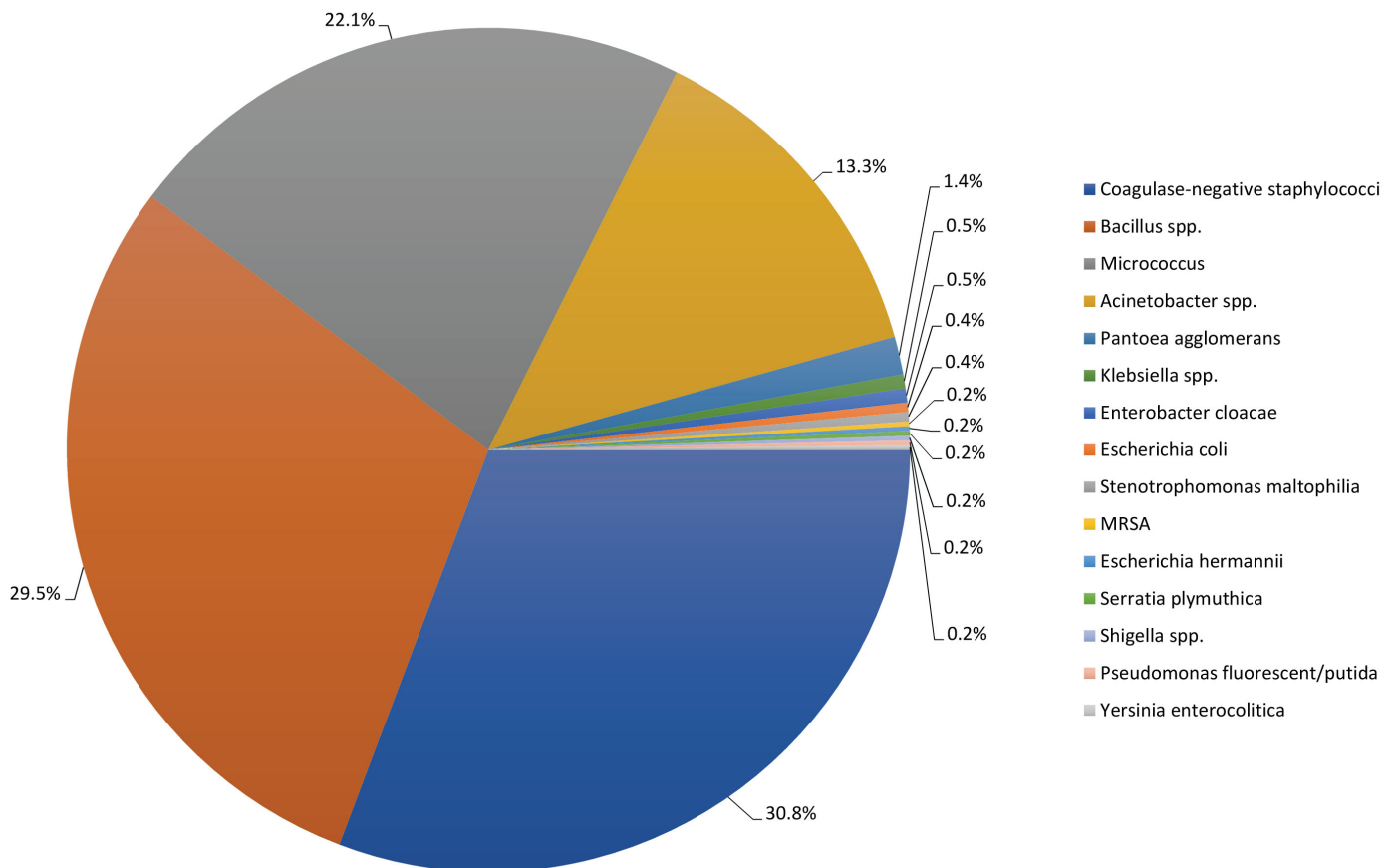


Figure 1: Types of bacteria isolated from the carpets of mosques in Riyadh, Saudi Arabia (n=288)

positive coagulase-negative Gram-positive tetrads were identified by morphology: yellow colonies on blood agar were considered “micrococci.” Catalase-positive coagulase-positive Gram-positive cocci were further processed by the MicroScan system (Abdulla Fouad Holding Co., serial number 3967402, Riyadh, Kingdom of Saudi Arabia) for full identification and sensitivity; they were reported either as *S. aureus* or methicillin-resistant *S. aureus* (MRSA). Furthermore, catalase-positive coagulase-negative Gram-positive bacilli were reported as *Bacillus* spp. However, if a Gram-positive bacteria grew on both blood agar and MacConkey agar, the bacteria were further processed by MicroScan for full identification and sensitivity and considered either *E. coli* or *Pseudomonas*.

No significant difference in the frequency or type of the isolated bacteria was found between men and women praying halls ($p=0.103$), and also between the main entrance and the first row ($p=0.803$). Of all the samples taken, 94% were positive for different bacterial organisms; 56.9% of the samples were Gram-positive cocci; 53.6% were Gram-positive bacilli. Gram-negative bacilli accounted for 31.7% of the samples. No bacterial growth was found in 5.6% of the samples taken. The most frequently isolated organisms were coagulase-negative staphylococci (59.4%), *Bacillus* spp. (56.9%), and *Micrococcus* 42.7% (Fig 1). Other potentially pathogenic bacteria like *Shigella* (0.3%), MRSA (0.3%), and *Yersinia enterocolitica* (0.3%) were isolated from the eastern, southern, and western

parts of Riyadh, respectively. *E. coli* (0.7%) and *Klebsiella* (1.0%) were cultured from the central region of Riyadh.

This high frequency of the isolated microorganisms could reflect the longstanding presence of carpets inside the studied mosques and the methods used for their cleansing.⁵ This highlights the need for establishing new programs to improve hygiene in mosques, good-quality ablution facilities, and raising awareness of worshippers about hygiene. These programs should include different strategies, for instance, setting a timetable to clean mosque carpets periodically and creating health educational material, including banners and brochures that can be distributed among the worshippers.

Conflicts of Interest: None declared.

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