



**THE PREVALENCE OF *STAPHYLOCOCCAL* NASAL CARRIAGE AMONG
YOUNG HEALTHY MEDICAL, NURSING AND BIOMEDICAL SCIENCE
STUDENTS ATTENDING SULTAN QABOOS UNIVERSITY**

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ABSTRACT

Methicillin resistant *Staphylococcus aureus* (MRSA) is *S. aureus* that has become resistant to different antibiotics and is more hazardous. The aim of this prospective study was to determine *S. aureus* and MRSA prevalence in nasal samples obtained from young, healthy Omani medical, nursing, and biomedical science students attending Sultan Qaboos University. A total of 100 nasal samples were collected randomly from young, healthy adult Omani volunteers aged between 18 and 30 years. Volunteers were recruited among biomedical, medical, and nursing students studying at Sultan Qaboos University. Samples were collected from October 4, 2019, to December 29, 2019. The data collected from each volunteer included name, age, gender, and the department in which the volunteer was studying. A nasal swab was analyzed microbiologically for the presence of MRSA. The total number of *S. aureus* nasal carriers detected among young, healthy adult Omani volunteers was 18 (18%). Three out of the eighteen volunteers with *S. aureus*-positive were nasal carriers of MRSA. The three MRSA-positive nasal samples were detected in biomedical student volunteers. The prevalence of MRSA nasal carriers was higher among biomedical students than among medical and nursing students. The prevalence of MRSA nasal carriers among biomedical students was 3%. MRSA was not detected in the medical and nursing students.

Keywords: *Staphylococcus aureus*, MRSA, Young healthy adults volunteers, Sultan Qaboos University, Oman

INTRODUCTION

Staphylococcus aureus (*S. aureus*) is considered one of the most common human pathogens that causes many infections in vulnerable humans in communities and hospitals [1, 2]. *S. aureus* is found on the skin, mucus membranes of the upper respiratory tract, ocular conjunctivae, urogenital tract, and gastrointestinal tract as normal flora [2]. This organism is mainly located in the anterior nares, where endogenous infections are most likely to occur [3].

Carriers of asymptomatic *S. aureus* can transfer the organism to community members or to immunodeficient individuals, such as the elderly [3].

Methicillin resistant *Staphylococcus aureus* (MRSA) is *S. aureus* that has become resistant to many of the antibiotics used to treat *S. aureus* infections [1-4].

S. aureus live in the nose and on the skin as normal flora [4]. However, MRSA infection can occur when these bacteria starts to colonize and multiply uncontrollably [5]. Because MRSA strains have penicillin-binding protein 2a (PBP2a), which encodes the *mecA* gene, these strains are resistant to several antimicrobials [6]. Therefore, infections caused by MRSA are often complicated [7].

There are two types of MRSA: community-acquired MRSA (CA-MRSA) and hospital-acquired MRSA (HA-MRSA) [8].

A MRSA infection that occurs in a hospital or nursing home is referred to as HA-MRSA, while an infection that is transmitted through direct contact or through personal contact is referred to as CA-MRSA [8].

Worldwide, the prevalence of MRSA in recent years has substantially increased. However, there are massive differences among countries. The prevalence of MRSA in Japan, southern European countries, and the USA is high, between 20% and 60% [9], while the prevalence in Scandinavia and the Netherlands is less than 3% [9].

Previous studies in Gulf Cooperation Council (GCC) countries, such as Kuwait, have reported an increase in the prevalence of MRSA among hospitalized patients [10]. A previous study in the Kingdom of Saudi Arabia (KSA) demonstrated that the prevalence of MRSA in the KSA was 35.6% from a pooled estimation of 22,793 *S. aureus* strains isolated from 2002 to 2012 [11]. The MRSA prevalence in Jordan, Iran, Oman, and Egypt was found to be greater than 50% [9].

The aim of the present prospective study was to determine the prevalence and incidence of MRSA in young, healthy medical, nursing, and biomedical Omani students at Sultan Qaboos University (SQU) and to determine antibiotic

susceptibility patterns of clinical *S. aureus* isolates in nasal carriers.

METHODS

Nasal swab samples:

This study was performed at SQU, where a total of 100 nasal swab samples were collected from young, healthy adult student volunteers aged between 18 and 30 years. Volunteers were studying at Sultan Qaboos University from October 4, 2019, to December 29, 2019. Samples were collected from both anterior nares using sterile red top culture swabs with a standard rotating technique. Forty-five out of the one hundred volunteers were medical students; seventeen of the volunteers were nursing students; and thirty-eight of the volunteers were biomedical students. The data collected from each volunteer included name, age, gender, and college type (i.e., medical, biomedical, or nursing) in which the volunteer was studying. Ethical approval for this research was obtained from the Research Ethics Committee of the College of Medicine and Health Science at SQU in Muscat, Oman (MREC # 1551).

Bacteriological analysis:

The identification of *S. aureus* was performed in accordance with standard laboratory identification protocols. Nasal swab samples were directly plated on blood agar and on mannitol salt agar after collection. On blood agar, colonies of *S. aureus* appear golden and are frequently surrounded by zones of clear beta

hemolysis. On mannitol salt agar, colonies of *S. aureus* are typically yellow, which indicates mannitol fermentation. In addition, gram stains of the isolates revealed gram-positive cocci in clusters and were positive for catalase, coagulase, and DNase, were identified as *S. aureus*.

Screening for antibiotic susceptibility:

Antibiotic sensitivity tests were performed on Mueller-Hinton agar using the Kirby-Bauer disc diffusion method. The results were interpreted according to Clinical Laboratory Standard Institute (CLSI) guidelines. The following antibiotics were used in order to determine the sensitivity of all *S. aureus* isolates: oxacillin (1µg), cefoxitin (30µg), erythromycin (15µg), clindamycin (2µg), rifampicin (5 µg), doxycycline(30µg), and vancomycin (30µg).

Criteria for the detection of MRSA:

Results were interpreted according to CLSI guidelines.

PBP-II) confirmatory test:

The *mecA* product (PBP2a) was detected using the MASTALEX™ MRSA kit (Mast Group Ltd., UK) in accordance with the manufacturer's instructions. A negative and a positive control were included in each experiment.

Data analysis:

All patients' data were collected in Excel (2013) and tabulated using Statistical Package for Social Science (SPSS)

software. The mean, median, and proportion for categorical variables were analyzed by SPSS.

RESULTS

The prevalence of *S.aureus* among adult healthy Omani volunteers:

During the data collection period, a total of 100 nasal samples were collected from young, healthy adult Omani volunteers who were recruited for this study. All volunteers were students studying at SQU (Table 1). The total number of *S. aureus* nasal carriers detected among the volunteers was 18(18%). Three (3%) out of the eighteen volunteers that had *S. aureus*-positive nasal swabs were nasal carriers of MRSA (Table 2).

Antibiotic susceptibility testing:

MRSA isolates were sensitive to clindamycin, rifampicin, doxycycline, and vancomycin, while non-MRSA isolates were sensitive to all antibiotics used.

PBP2 tests in MRSA detection:

All 3 MRSA isolates detected by the disc diffusion test were positive for the *mecA* product (PBP2a) by the confirmatory MASTALEX™ PBP-II test.

The distribution of MRSA in association with sex:

The total number of females recruited for the present study was 78 (78%). Twelve (15.38%) out of the seventy-eight nasal swab samples obtained from these female volunteers were *S. aureus*-positive. Three

(25%) out of these twelve positive nasal swabs were MRSA-positive. The total number of male volunteers was 22. Six (27.27%) out of the twenty-two male volunteers were *S. aureus*-positive. No MRSA isolates were detected among male volunteers.

The prevalence of *S. aureus* and MRSA among medical, nursing, and biomedical students:

Forty-five (45%) out of the one hundred volunteers were medical students. Nine (20%) out of the forty-five medical student volunteers were *S. aureus*-positive (Table 2). Eight out of these nine *S. aureus*-positive medical students were preclinical students (i.e., did not attend the hospital), and one out of these nine medical students was a clinical student (i.e., attended the hospital) (Table 2). The total number of nursing volunteers was seventeen (17%). Three (17.64%) out of the seventeen nursing student volunteers were *S. aureus*-positive (Table 2). One out of these three was a preclinical student (i.e., did not attend the hospital), and two out of these three *S. aureus*-positive students were clinical students (i.e., attended the hospital). No MRSA isolates were detected among all medical and nursing volunteers (Table 2). The total number of biomedical student volunteers was thirty-eight (38%). Six (15.78%) out of the thirty-eight biomedical volunteers were *S. aureus*-

positive, and three (7.89%) out of these six were MRSA-positive (Table 2). The prevalence of *S. aureus* and MRSA among

medical, nursing, and biomedical students is summarized in Table 2.

Table 1: Total number of samples

Specialties	Total number of volunteers students
Medical students	45
Biomedical students	38
Nursing students	17

Table 2: The prevalence of *S. aureus* positive and MRSA carriers among medical, nursing and biomedical students

Students		Total number of samples (n=100)	Total number of <i>S. aureus</i> Positive samples [total 18 (18%)]*	Percentage of positive <i>S. aureus</i> among medical, nursing and biomedical students #	Total number of MRSA positive samples (n=3)
Medical students	Pre clinical	35	8%	8 (22.8%)	0
	Clinical	10	1%	1 (0.1%)	0
BMS students		38	6%	6 (15.78%)	3(3%)
Nursing student	Pre clinical	7	1%	1 (14.28%)	0
	Clinical	10	2%	2 (20%)	0

* Percentage of *S. aureus* positive among the total of 100 samples

Percentage of *S. aureus* positive within medical, biomedical and nursing students

DISCUSSION

In Oman, the prevalence of MRSA colonization or nasal carriers among young, healthy adults was not fully elucidated. This study showed that the total number of *S. aureus* nasal carriers detected among 100 young, healthy adult Omani volunteers was 18 (18%). In addition, the overall prevalence of MRSA nasal carriers among young, healthy adult Omani volunteers was 3%. In the present study, the student volunteers comprised three sub-groups: medical students, biomedical students, and nursing students. MRSA was detected only in biomedical students. These results indicate that although exposure to a hospital environment led to a substantial increase in

the number of *S. aureus* nasal carriers among medical students and nursing students, it did not increase the number of MRSA nasal carriers among these students. The rate of MRSA was 3%, and it was only detected in biomedical students. This finding could be due to the fact that biomedical students handling different types of microorganisms during their studies.

In the present study, we used the disc diffusion method and the confirmatory MASTALEX™ PBP-II test for detection of MRSA, due to the recommendations of a previously published study that the combination of cefoxitin disk diffusion and latex agglutination test (MASTALEX™

PBP-II), improves the sensitivity and the specificity beyond that of Polymerase Chain Reaction (PCR) to detect MRSA isolates [12].

A cross-sectional cohort study from Oman Medical College in Sohar in 2016 demonstrated that 13% of preclinical students were MRSA carriers [13]. A Chinese study conducted in 2011 with preclinical medical students showed a MRSA nasal carrier prevalence of 9.4% among Chinese preclinical students [14]. In contrast, the current study showed that there were no MRSA isolates among our preclinical and clinical medical student volunteers. The results of the present study are similar to those from a Thai study from Srinakharinwirot University which was performed in 2013 and reported a *S. aureus* carrier prevalence of 29.7% among preclinical medical students, but there were no MRSA carriers [15].

In the present study, the prevalence of *S. aureus* was higher among male volunteers (27.27%) in comparison to female volunteers (15.38%). This finding agrees with those of previously published studies that concluded that male gender is consistently associated with increased *S. aureus* infection [16-19]. The basis for this increased risk is not understood.

In our study, MRSA was only detected in female volunteers. This finding could be due to the fact that there were more female

volunteers than male volunteers in the present study.

Antimicrobial resistance in *S. aureus* isolates has become an increasingly wide spread problem. The antimicrobial susceptibility profile of *S. aureus* has differed in several previous reports and depends on the resistance profiles in the medical field groups. In the present study, antibiotic susceptibility tests revealed that MRSA isolates were sensitive to rifampicin, doxycycline, vancomycin, and linezolid. This finding agrees with that of a previous study conducted in India [20].

In conclusion, the prevalence of *S. aureus* carriers among all healthy adult volunteers was 18%. In the present study, MRSA was only detected in biomedical students. There were no MRSA carriers among the medical and nursing students, which differed from the biomedical students. The prevalence of nasal MRSA carriers among biomedical students was 3%. The findings of the present study indicate the need for reinforcing an awareness campaign to take adequate precautions regarding the universal techniques of hand washing and hygiene among students and to minimize the risk of transmitting *S. aureus* and MRSA.

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