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Short Communication

Prevalence of *Staphylococcus aureus* colonization and antibiotic susceptibility: A survey among biomedical students

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Staphylococcus aureus is a major human pathogen, causing both hospital and community-acquired infections.[1,2] It is responsible for 25% of healthcare-associated infections and contributes substantially to morbidity and cost of hospital stays. The source of many of these infections is thought to be the patients' endogenous flora. The ecological niche of *S. aureus* is the anterior nostrils, and 25–30% of individuals are colonized at a given time. Numerous studies have linked nasal carriage of *S. aureus* with increased risk of infection with *S. aureus* in various settings.[3]

A study conducted in central Italy to establish the rates of nasal carriage of *S. aureus* and antibiotic susceptibility patterns in the community showed that the prevalence of nasal carriage of *S. aureus* was 30 ± 5%, with only one subject identified as a carrier of meticillin-resistant *S. aureus* (MRSA) (prevalence 0 ± 12%).[4] In another Italian study conducted in injection drug users,[5] the prevalence of nasal colonization with *S. aureus* was 8.83%, and 12.5% of isolates were found to be meticillin resistant.

Recently, concern has increased regarding the spread of MRSA in the community and schools.[6] Students with weakened immune systems may be at risk for more severe illness if they become infected with MRSA, and being a carrier of *S. aureus* is a major risk factor for transmission.[1]

In a study of Brazilian university students, 40.8% (102/250) were found to be nasal carriers of *S. aureus*, and six (5.8%) of the isolates were MRSA and carried the *mec* A gene.[7] In a study among college student athletes in East Tennessee, the prevalence of community-acquired MRSA (CA-MRSA) was found to be 1.8%, which was similar to the prevalence reported in the general population (1.5%).[8]

The prevalence of nasal carriage of *S. aureus* and the presence of CA-MRSA in Italy still appears to be rare, and no evidence exists regarding MRSA in schools. For this reason, it is important to evaluate the prevalence of *S. aureus* and MRSA colonization among students who attend courses in a university hospital setting, where the prevalence rates among inpatients and healthcare workers are nearly 15% and 19%, respectively.[9]

The aims of this study were:

- to estimate the rate of *S. aureus* colonization among biomedical students; and
- to assess antibiotic susceptibility among students testing positive for *S. aureus*, and verify the presence of MRSA-positive individuals.

In March–April 2009, the authors conducted a cross-sectional study on biomedical students attending courses at the teaching hospital of Sapienza University of Rome (medical students and undergraduate/postgraduate prevention technician students).[10] Participation was voluntary, and nasal swabs were taken for the detection of *S. aureus* colonization. In total, 106 nasal swabs were inoculated directly on mannitol salt agar (Oxoid, Cambridge, UK) for recovery of staphylococci.

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S. aureus colonies were collected and isolated in pure cultures. Biochemical identification and susceptibility to common antibiotics were determined using Vitek®2 Compact (bioMérieux spa, Florence, Italy) in accordance with the manufacturer's instructions. Antibiotic susceptibility was performed using the Vitek®2 Gram Positive Susceptibility Card (AST-P580, Duram, USA) that tests the following antibiotics: benzylpenicillin, erythromycin, clindamycin, gentamicin, tobramycin, mupirocin, tetracycline, fosfomycin, fusidic acid, levofloxacin, linezolid, moxifloxacin, nitrofurantoin, oxacillin, rifampicin, teicoplanin, trimethoprim/sulfamethoxazole and vancomycin.

Frequency and contingency tables were composed, and differences between groups were tested using Chi-squared test. Univariate and multivariate logistic regressions were conducted, and the results have been expressed as odds ratio (OR) and 95% confidence intervals (95% CI). Statistical analyses were conducted using Statistical Package for the Social Sciences Version 12.0 (SPSS Inc., Chicago, IL, USA).

In total, 106 students (68 males and 38 females) were included in the study. Thirty individuals (28.3%) with a mean age of 25 years (range 19–58 years) were found to be colonized with *S. aureus*.

No significant differences were found between the two groups (carriers/non-carriers) in terms of age ($P = 0.62$) and gender ($P = 0.91$), while a significant difference was found for participation in sporting activities ($P = 0.001$) and year of study ($P = 0.045$) (Table 1). No significant differences were found between under- and postgraduate students (OR postgraduate = 1.02; 95% CI 0.35–2.93). The multivariate analysis confirmed the results of the univariate analysis (OR sporting activities = 0.23, 95% CI 0.09–0.59; OR year of study = 0.38, 95% CI 0.13–1.00).

No subjects were found to be carriers of MRSA. Resistance to benzylpenicillin was frequently observed (86.7%), followed by erythromycin (23.3%), clindamycin (23.3%), tetracycline (3.3%), gentamicin (3.3%), tobramycin (3.3%) and mupirocin (3.3%). Antimicrobial susceptibility testing showed 23.34% of multidrug–resistance profiles (≥3 antibiotics; Table 1). Benzylpenicillin/erythromycin/clindamycin (71.4%) was the most common pattern of multidrug resistance, followed by benzylpenicillin/gentamicin/tobramycin (14.3%) and benzylpenicillin/erythromycin/clindamycin/tetracycline (14.3%).

This is the first study of this type in Italy to focus on students in a hospital setting. The prevalence of nasal carriage of *S. aureus* was found to be lower among students than the general population,[4] but higher than the prevalence among healthcare workers.[9]

Distinct resistance phenotypes were found among almost all isolates, but no isolates of MRSA were detected.

In a previous study, knowledge, attitudes and practices towards MRSA skin infection were assessed among biomedical students, and most respondents were found to have poor or very poor knowledge.[10] This poor knowledge, given the prevalence of *S. aureus*, could represent a serious health risk in an environment as sensitive as a hospital setting. Although no MRSA-positive individuals were identified in this study, these results indicate that there is a need for continuous improvement of educational training of students attending teaching hospitals, particularly those studying medicine and public health.

Poor knowledge may be related to the progressive disappearance from university curricula of the focus on classical pathogens that recognize human reservoirs in favour of the study of epidemiology and prophylaxis of emerging infectious diseases. Additionally, in Italy, there is no large educational programme on CA-MRSA implemented for the general public by public health government bodies. The US Centers for Disease Control and Prevention initiative in primary and secondary schools and sporting activities[6] could be highly effective in Italy.

In conclusion, the results of this study showed that nasal colonization with *S. aureus* is common in this student community. The population was not sampled in a random way and the results cannot be generalized to the entire Italian biomedical student population, but it appears that the risk of CA-MRSA may be spreading in Italy.

Acknowledgements

Ethical approval

As requested by the Italian Ministry of Health, the local ethical committee was notified of the research protocol.

Table 1 – General characteristics of the students.

Variable	Category	*n*	*S. aureus* carrier negative (%)	*S. aureus* carrier positive (%)	*P*-value*	Crude OR (95% CI)	Adjusted OR (95% CI)	*S. aureus* MDR profile[a] No. (% SA carrier +/vi)
Gender	Female	38	27 (71.10)	11 (28.90)	0.912	1		2 (18.20)
	Male	68	49 (72.10)	19 (27.90)		0.95 (0.39–2.29)		5 (25.00)
Age (years)	≤25	50	37 (74.00)	13 (26.00)	0.619	1		4 (33.30)
	≥26	56	39 (69.60)	17 (30.40)		0.81 (0.34–1.89)		3 (15.80)
Respondent's year of study	1–3	84	64 (76.20)	20 (23.80)	0.045	1	1	5 (23.80)
	≥4	22	12 (54.50)	10 (45.50)		0.37 (0.14–0.99)	0.38 (0.13–1.00)	2 (20.00)
Participation in sporting activities	No	32	16 (50.00)	16 (50.00)	0.001	1	1	7 (29.20)
	Yes	74	60 (81.10)	14 (18.90)		0.23 (0.09–0.58)	0.23 (0.09–0.59)	0 (0.00)

*P-value of the Chi-squared test.
a MDR, multidrug resistance (≥3 antibiotics); OR, odds ratio; 95% CI, 95% confidence interval.

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Competing interests

None declared.

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