Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 12 (2024): December 2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i12.1492
Original Article

PREVALENCE OF NASAL CARRIAGE OF METHICILLIN-RESISTANT STAPHYLOCOCCUS AUREUS IN A MEDICAL COLLEGE OF INDUSTRIAL AREA OF JHARKHAND

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Abstract

Background

Methicillin-resistant Staphylococcus aureus (MRSA) is a significant public health concern due to its ability to cause severe infections and its increasing prevalence in community and healthcare settings. This study aimed to investigate the prevalence of nasal carriage of MRSA in Jharkhand. Understanding the distribution of MRSA carriers is essential for implementing effective infection control measures.

Methods

A cross-sectional study was conducted involving 130 individuals from various healthcare and community settings in Jharkhand. Nasal swabs were collected and analyzed for the presence of MRSA using standard microbiological techniques. Participants identified as MRSA carriers were treated with 2% Mupirocin Nasal Ointment, and training programs on infection control were conducted for housekeeping and security staff.

Results

Out of 130 isolates, 6.15% were found to be carriers of Staphylococcus aureus, with 1.53% being MRSA. Among the carriers, 9.2% were doctors and 66.9% were medical students, indicating a higher prevalence in these groups. The study identified that 76.2% of participants had patient contact, highlighting significant transmission risks. The demographics revealed 42.3% male and 57.7% female carriers, with the majority aged under 25.

Conclusion

The study emphasizes the importance of regular screening and education about MRSA in both healthcare settings and the community. Enhancing awareness and implementing infection control measures are crucial in mitigating the risks associated with MRSA.

Recommendation

Hospital personnel should be trained on hospital infections, their routes of contamination, and preventive measures for the prevention and control of hospital infections.

Keywords: *MRSA, Nasal Carriage, Infection Control, Healthcare Workers, Prevalence.*
Submitted: *2024-11-20* ***Accepted:*** *2024-12-29*

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Introduction

Staphylococcus aureus is a prominent human pathogen distinguished by many virulence characteristics and the capacity to acquire resistance to most antibiotics. This flexibility is intensified by the ongoing creation of new clones, categorizing Staphylococcus aureus as a "superbug." The clinical application of methicillin has resulted in the proliferation of methicillin-resistant Staphylococcus aureus (MRSA), with recent decades observing the appearance of new MRSA clones. In contrast to conventional MRSA strains mostly located in healthcare facilities, these emerging clones can penetrate community settings and infect individuals lacking predisposing risk characteristics, hence augmenting the MRSA reservoir within the population [1].

Despite being detected over forty years ago, MRSA has swiftly changed and proliferated epidemiologically, emerging as a predominant cause of both nosocomial and community-acquired infections worldwide. MRSA infections vary from mild skin and soft tissue conditions, such as boils and abscesses, to serious systemic infections, such as pulmonary emboli and septic shock. Some persons may asymptomatically harbor MRSA in their nasal passages and on their skin. Asymptomatic carriers present a risk by potentially transmitting the virus to healthy individuals. Studies demonstrate that around 25% of individuals who harbor MRSA for more than a year may get infections, with 84% of these instances necessitating hospitalization, and some leading to mortality [3]. Moreover, persistent carriers encounter increased risks of illness and mortality [4].

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Due to the substantial consequences of MRSA colonization, it is essential to identify carriers to enact effective strategies for mitigating the risk of MRSA infections. Research indicates that as much as 50% of specific groups may asymptomatically harbor MRSA in their nasal passages, acting as reservoirs for contact transmission and endogenous infections [5-10]. This study seeks to identify nasal carriage of MRSA by collecting nose swabs from each nostril of participants, thereafter employing several laboratory techniques for identification and detection. This research will augment the comprehension of research methodologies and simultaneously help healthcare professionals, communities, and epidemiologists by increasing awareness of MRSA.

This study aims to ascertain the prevalence of nasal carriage of methicillin-resistant Staphylococcus aureus (MRSA) among students and various occupational members of the medical college in Jamshedpur, Jharkhand.

Materials and Methods

Study Design and Location

This observational cross-sectional study was conducted in the Department of Microbiology at Manipal Tata Medical College, Jamshedpur, Jharkhand.

Study Participants

Participants included college students, teaching and non-teaching staff, security personnel, cleanliness workers, and manual workers at the medical college. Before participation, the purpose of the study was thoroughly explained to all potential subjects. Those who agreed to participate were required to sign a written informed consent form.

Inclusion and Exclusion Criteria

For this study, the inclusion criteria comprise healthy individuals aged over 18 years, including students, teaching staff, non-teaching staff, security guards, cleanliness workers, and manual workers who are willing to provide consent. Conversely, the exclusion criteria consist of individuals with a history of upper respiratory tract infections or fever, those who have undergone recent nasal surgery or are using nasal medications, and individuals currently receiving antimicrobial therapy.

Sample Size

The estimated sample size for this study is 130 participants.

Study Technique

The study began only after obtaining approval from the Indian Council of Medical Research (ICMR) and the Institutional Ethics Committee (IEC). Participants were informed about the study's objectives before providing consent, and their involvement was entirely voluntary. Written informed consent was obtained from all subjects before the commencement of the study.

Data Collection Method

The study utilized a standard nasal swab-based screening technique for data collection. Swabs were collected from the anterior nares of participants, as this area is known to be a natural habitat for Staphylococcus aureus and provides consistent isolation of the organism [16, 17]. The procedure and study objectives were explained to participants before obtaining their consent. Each participant had one nasal swab collected from each nostril, ensuring proper hand hygiene and precautions were followed before and after the procedure. The collected swabs were placed in sterile tubes and sent to the laboratory for analysis.

Laboratory Procedures

The swabs were cultured on Mannitol Salt Agar and 5% Blood Agar, incubated at 37°C for 18-24 hours (Figure 1). After incubation, the organisms' growth on the culture plates was assessed. Colonies that ferment mannitol and display yellow or golden-yellow pigmentation were chosen for additional analysis, which will encompass Gramme staining, catalase testing, and coagulase testing (including both slide and tube methods). Gram-positive cocci that are catalase-positive and coagulase-positive will be classified as Staphylococcus aureus. Antibiotic susceptibility testing was performed on all isolates utilizing the modified Kirby-Bauer disc diffusion method by CLSI standards.

Upon identification of Staphylococcus aureus by laboratory testing, an additional assessment was conducted to distinguish between Methicillin-Sensitive Staphylococcus aureus (MSSA) and MRSA. All isolates underwent testing for methicillin resistance utilizing a Cefoxitin 30 µg disc, by CLSI standards (susceptibility: >22 mm; resistance: <21 mm).

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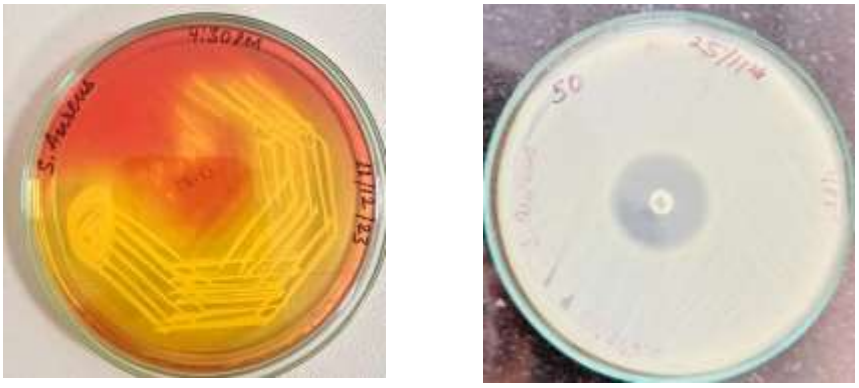

Figure 1: Mannitol Salt Agar and 5% Blood Agar plates for incubation of the nasal swabs.

Data Analysis Plan

The data obtained from the study were analyzed using SPSS software to ensure accurate statistical evaluation of the findings.

Ethical Clearance

The study protocol was initially reviewed and approved by the Institutional Scientific Committee to validate the methodology. Following this, the proposal was submitted to the Institutional Ethics Committee, which granted ethical clearance on October 4, 2023.

Results

Table 1: Growth on Mannitol Salt Agar by Age and Gender:

Age Category	N	Growth on Mannitol Salt Agar	Chi-Square	P Value
<=25 years	87	Negative (N=79, 64.8%) Positive (N=8, 100%)	4.213	0.04
>25 years	43	Negative (N=43, 35.2%) Positive (N=0, 0%)		
Gender				
Female (F)	75	Negative (N=69, 56.6%) Positive (N=6, 75%)	1.046	0.306
Male (M)	55	Negative (N=53, 43.4%) Positive (N=2, 25%)		

The findings of the Chi-square test analyzing growth on Mannitol salt agar across various age categories, gender, occupation, linked workplaces, patient interaction, and infection control training are summarised. Individuals aged 25 years or under exhibited a significant prevalence of positive growth (100%), but those older than 25 years demonstrated no good findings (0%). The result was statistically significant, indicated by a Chi-square value of 4.213 and a p-value of 0.04. Other demographic characteristics, including gender and occupation, exhibited no significant differences (p-values > 0.05) (Table 1).

Table 2: Growth on Mannitol Salt Agar by Occupation:

Occupation	N	Growth on Mannitol Salt Agar	Chi-Square	P Value
Doctor	12	Negative (N=12, 9.8%) Positive (N=0, 0%)	4.213	0.519
Housekeeping Staff	15	Negative (N=15, 12.3%) Positive (N=0, 0%)		
Lab Technician	3	Negative (N=3, 2.5%) Positive (N=0, 0%)		
Non-Teaching Staff	6	Negative (N=6, 4.9%) Positive (N=0, 0%)		
Security Personnel	7	Negative (N=7, 5.7%) Positive (N=0, 0%)		
Student	87	Negative (N=79, 64.8%) Positive (N=8, 100%)		

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The prevalence of Staphylococcus aureus with identical demographic characteristics is likewise emphasized. Consistent with the prior study, individuals aged 25 years or under had a substantial correlation, with a 100% positivity rate in this demographic, but none in the over 25 years category tested positive (Chi-square = 4.213, p = 0.04). No notable differences were detected concerning gender and occupation (p-values > 0.05), consistent with prior findings (Table 2).

Table 3: Growth on Mannitol Salt Agar by Associated Workplace and Patient Contact:

Associated Workplace	N	Growth on Mannitol Salt Agar	Chi-Square	P Value
Hospital	99	Negative (N=91, 74.6%) Positive (N=8, 100%)	2.669	0.263
Laboratory	3	Negative (N=3, 2.5%) Positive (N=0, 0%)		
Medical College	28	Negative (N=28, 23%) Positive (N=0, 0%)		
Patient Contact				
No	31	Negative (N=31, 25.4%) Positive (N=0, 0%)	2.669	0.102
Yes	99	Negative (N=91, 74.6%) Positive (N=8, 100%)		

The data on MSSA were evaluated based on age groups, gender, occupation, workplace affiliation, patient interaction, and infection control training. The younger age group exhibited a prevalence of MSSA at 100%, although the differences were not statistically significant (Chi-square = 3.109, p = 0.078). Moreover, gender and occupation exhibited no significant differences (p-values > 0.05) (Table 3).

Table 4: Staphylococcus aureus Detection:

Categories	N	Organism	Chi-Square	P Value
Age Categories				
<=25 years	87	Negative (N=79, 64.8%) Staphylococcus aureus (N=8, 100%)	4.213	0.04
>25 years	43	Negative (N=43, 35.2%) Staphylococcus aureus (N=0, 0%)		
Gender				
Female (F)	75	Negative (N=69, 56.6%) Staphylococcus aureus (N=6, 75%)	1.046	0.306
Male (M)	55	Negative (N=53, 43.4%) Staphylococcus aureus (N=2, 25%)		

The findings regarding methicillin-resistant Staphylococcus aureus (MRSA) reveal that all participants aged 25 years or younger tested negative for MRSA, with a Chi-square value of 1.004 and a p-value of 0.316, suggesting no significant correlation with age or other demographic factors. Comparable patterns were seen for gender and occupation, which did not yield significant results (p-values > 0.05) (Table 4).

Table 5: Methicillin Resistance in Staphylococcus aureus:

Categories	N	Methicillin Resistance	Chi-Square	P Value
Age Categories				
<=25 years	87	Methicillin Sensitive (N=81, 65.3%) Methicillin Resistant (N=2, 100%)	1.004	0.316
>25 years	43	Methicillin Sensitive (N=43, 34.7%) Methicillin Resistant (N=0, 0%)		
Gender				
Female (F)	75	Methicillin Sensitive (N=71, 57.3%) Methicillin Resistant (N=2, 100%)	1.49	0.222
Male (M)	55	Methicillin Sensitive (N=53, 42.7%) Methicillin Resistant (N=0, 0%)		

The average age of participants was 25.82 years, with a standard deviation of 5.853, and the predominant demographic was students (66.9%). The data revealed a substantial negative growth rate on Mannitol salt agar

(93.8%) and a considerable percentage of individuals who underwent infection control training (80.8%) (Table 5).

Discussion

Among the 130 isolates included in this study, the results indicate that 6.15% were carriers of Staphylococcus aureus. Of these, 4.61% were identified as MSSA, while 1.53% were MRSA. These findings are consistent with those reported by Sharon Rainy Rhongpharpi, who noted that out of 70 isolates carrying Staphylococcus aureus in their anterior nares, 11.43% were resistant to methicillin [11-18].

Given that hospitals and medical institutions are particularly vulnerable to infections, healthcare professionals, including doctors and medical students, are at an elevated risk. Our study revealed that among all carriers of S. aureus, 9.2% were doctors, while 66.9% were medical students. This aligns with the findings of Nisha Giri, who reported that 18.9% of doctors and medical students were nasal carriers of S. aureus [19]. These results underscore the urgent need for regular screening programs and heightened awareness among healthcare workers regarding the nasal carriage of S. aureus.

In comparison to the study conducted by Rajesh Sarkar, which reported that 47.8% of S. aureus carriers were male and 52.2% female, with 71.5% of isolates originating from individuals aged 20-30 years and 28.5% from those over 30 years [20], our study found that 42.3% of carriers were male and 57.7% female, with 66.9% aged less than 25 years and 31.1% aged over 25 years.

A statistically significant correlation between patient contact and nasal carriage of S. aureus was established (P = 0.425). Of the 130 participants, 76.2% indicated having patient interaction. Prior research has established that direct exposure to discharge, contaminated surfaces, wounds, or personal interaction with patients, carriers, and settings affected by MRSA constitutes the principal mode of transmission. Factors that elevate transmission risk encompass proximate skin-to-skin contact, disruptions in the skin barrier (such as from indwelling catheters or wounds), congested intensive care units, and insufficient personal hygiene [9]. These findings underscore the imperative for upholding cleanliness and hygiene in healthcare environments, enhancing personal hygiene practices, instituting infection control training programs, and elevating awareness regarding the characteristics and risks linked to S. aureus and MRSA nasal carriers.

Conclusion

This research offers significant insights into the prevalence of nasal carriage of methicillin-resistant Staphylococcus aureus (MRSA) in the industrial region of Jharkhand. The results are anticipated to guide subsequent studies and enhance awareness of the associated dangers and requisite preventive strategies in communities and healthcare environments. The study highlights MRSA's ability to remain asymptomatically in the nares for prolonged durations, presenting a danger for contact transmission and endogenous infections. It underscores the possibility of MRSA transmission to healthy individuals, regardless of risk factors, potentially resulting in heightened infection rates. The collected data identified MRSA carriers and educated healthcare staff and the community on the need for frequent screenings and preventive measures. Participants identified as MRSA carriers in the trial received treatment with 2% Mupirocin Nasal Ointment to avert subsequent infections. An Infection Control Training program was instituted for housekeeping staff and security personnel, emphasizing hygiene practices and hand hygiene techniques.

Limitations

The limitations of this study include a small sample population who were included in this study. Furthermore, the lack of a comparison group also poses a limitation for this study's findings.

Recommendations

Hospital personnel should be trained on hospital infections, their routes of contamination, and preventive measures for the prevention and control of hospital infections.

Acknowledgment

The authors acknowledge and extend their gratitude to all the participants for their support and cooperation in this study.

Data Availability

Data is available upon request.

Author contributions

All authors contributed to the design of the research. RD, OC collected and analyzed the data. SM wrote the manuscript. RD, CD and OC edited the paper. All authors read and approved the paper.

List of abbreviations

MRSA- Methicillin-resistant Staphylococcus aureus
ICMR- Indian Council of Medical Research
IEC- Institutional Ethics Committee
MSSA- Methicillin-Sensitive Staphylococcus aureus

Source of funding

No funding received.

Conflict of interest

The authors have no conflicting interests to declare.

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PUBLISHER DETAILS

Student's Journal of Health Research (SJHR)
(ISSN 2709-9997) Online
(ISSN 3006-1059) Print
Category: Non-Governmental & Non-profit Organization
Email: studentsjournal2020@gmail.com
WhatsApp: +256 775 434 261
Location: Scholar's Summit Nakigalala, P. O. Box 701432, Entebbe Uganda, East Africa