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Nasal Carriage of *Staphylococcus Aureus* and Methicillin-Resistant *S. Aureus* among Female University Employees in Ila-Orangun, Nigeria

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ABSTRACT

Staphylococcus aureus, including methicillin-resistant *S. aureus* (MRSA), represents a significant public health concern due to escalating antimicrobial resistance and potential for community transmission. A cross-sectional study was conducted among 127 workers at a tertiary institution. Participants comprised married women (n = 69) and single women (n = 58). Nasal swab specimens were collected using sterile techniques and processed using standard microbiological methods. *S. aureus* identification was performed through Gram staining, catalase testing, and coagulase testing. Antimicrobial susceptibility testing was conducted using the Kirby-Bauer method for disk diffusion. Colonization rates showed a non-significant trend toward difference by marital status, with married women demonstrating higher but non-statistically-significant prevalence (56.5%) compared to single women (39.7%, $\chi^2 = 3.58$, $p = 0.058$). *S. aureus* was identified in 62 (48.8%) participants and 27 of 62 (43.5%) were methicillin-resistant, with comparable proportions between married (41.0%) and single women (47.8%). Antimicrobial resistance analysis revealed alarmingly high resistance rates to third-generation cephalosporins: cefuroxime (93.5%), cefotaxime (93.5%), and ceftazidime (90.3%). MRSA isolates showed high resistance rates to clindamycin (55.6%), sparfloxacin (37.0%), and gentamicin (29.6%). Conversely, relatively preserved susceptibility was observed for ceftriaxone (88.9%), ofloxacin (81.5%), and erythromycin (81.5%). This study reveals a high prevalence of *S. aureus* and MRSA nasal colonization among tertiary institution workers in a single cross-sectional survey, with high resistance rates to beta-lactam antibiotics. These findings highlight the need for targeted infection prevention and surveillance measures in non-healthcare occupational settings.

Keywords: *Staphylococcus aureus*, MRSA, Nasal Colonization, Antimicrobial Resistance, Occupational Health, Tertiary Institution Workers, Multidrug Resistance

INTRODUCTION

Staphylococcus aureus remains one of the most clinically significant bacterial pathogens worldwide, responsible for a diverse spectrum of infections ranging from superficial skin and soft tissue infections to life-threatening invasive diseases including bacteremia, endocarditis, pneumonia, and osteomyelitis (Ibrahim *et al.,* 2024). The organism's remarkable adaptability and propensity for acquiring antimicrobial resistance mechanisms have positioned it as a priority pathogen in global antimicrobial resistance surveillance programs. The emergence and dissemination of methicillin-resistant *S. aureus* (MRSA) since the 1960s has fundamentally transformed clinical management paradigms and infection control strategies across healthcare and community settings (Bawankar *et al.,* 2025).

The global epidemiology of *S. aureus* nasal colonization demonstrates substantial geographic and population-specific variation. Systematic reviews indicate that approximately 20–30% of the general population harbors *S. aureus* in the anterior nares, with colonization serving as a well-established risk factor for subsequent infection (Ribeiro, 2021). Among healthcare workers, colonization rates exhibit considerable heterogeneity, ranging from 5.2% to 36% for MRSA across different settings and geographic regions (Giri *et al.,* 2021, Bawankar *et al.,* 2025). Recent studies from tertiary care hospitals have documented MRSA colonization rates of 5.0% in Ecuador (Baroja *et al.,* 2021), 6.0% in long-term care facilities (Shih *et al.,* 2021), 6.33% in India (Subba *et al.,* 2025), 11.2% in Ethiopia (Mitiku *et al.,* 2023), and 23.5% in Indonesia (Rohmah *et al.,* 2023), underscoring the substantial burden in low- and middle-income countries.

The clinical and economic implications of *S. aureus* colonization and infection are profound. MRSA infections are associated with increased morbidity, mortality, healthcare costs, and length of hospital stay compared to methicillin-susceptible *S. aureus* (MSSA) infections (Baroja *et al.,* 2021). Furthermore, the progressive accumulation of resistance determinants has resulted in the emergence of strains with reduced susceptibility to last-resort antimicrobials, including vancomycin-intermediate *S. aureus* (VISA), vancomycin-resistant *S. aureus* (VRSA), and linezolid-resistant MRSA, representing a silent but escalating public health threat (Rohmah *et al.,* 2023; Bawankar *et al.,* 2025).

Occupational exposure represents a critical determinant of *S. aureus* and MRSA colonization risk. Healthcare workers, particularly those in intensive care units, surgical departments, and long-term care facilities, face elevated colonization rates due to frequent patient contact, exposure to antimicrobial-resistant organisms, and environmental contamination (Shih *et al.,* 2021, Ishore *et al.,* 2022), (Subba

et al., 2025). Studies have consistently demonstrated that healthcare personnel working in critical care settings exhibit MRSA colonization rates ranging from 11.33% to 36%, significantly exceeding rates observed in the general population (Ishore *et al.,* 2022, Bawankar *et al.,* 2025).

Beyond traditional healthcare settings, emerging evidence suggests that workers in educational institutions, particularly tertiary institutions with diverse occupational roles, may also face elevated colonization risks. Factors contributing to increased risk in these settings include crowded working conditions, shared facilities, inadequate hand hygiene infrastructure, and limited access to infection prevention resources. However, systematic surveillance data from non-healthcare occupational populations remain scarce, particularly in resource-limited settings where the burden of antimicrobial resistance is disproportionately high.

Gender-specific factors may further modulate colonization risk. Physiological differences, behavioral patterns related to hygiene practices, occupational roles, and social determinants of health may contribute to differential colonization rates between male and female workers. Additionally, marital status has been hypothesized to influence colonization through household transmission dynamics, shared living spaces, and caregiving responsibilities, though empirical evidence remains limited (Giri *et al.,* 2021).

Despite the well-documented burden of *S. aureus* and MRSA colonization among healthcare workers, significant knowledge gaps persist regarding colonization patterns in non-healthcare occupational settings, particularly tertiary educational institutions. workers in these settings may face unique risk profiles due to occupational roles, social interactions, and potential household transmission dynamics. Furthermore, the antimicrobial resistance profiles of *S. aureus* isolate from these populations remain poorly characterized, limiting evidence-based approaches to infection prevention and antimicrobial stewardship.

The paucity of data from low- and middle-income countries, where antimicrobial resistance rates are often higher and surveillance infrastructure is limited, further compounds this knowledge gap. Understanding the prevalence, risk factors, and antimicrobial resistance patterns in these populations is essential for developing targeted interventions, informing occupational health policies, and preventing community dissemination of resistant strains.

This study aimed to determine the prevalence of nasal *S. aureus* and MRSA colonization, characterize the antimicrobial resistance profiles of isolates, and explore the association of marital status with colonization risk among tertiary institution workers in Ila-Orangun, Nigeria

MATERIALS AND METHODS

Study Design

This cross-sectional observational study was conducted among pioneer staff of the Federal University of Health Ila-Orangun Sciences, Ila-Orangun, Nigeria. The study was designed to assess the point prevalence of nasal *S. aureus* and MRSA colonization among female workers and to characterize the antimicrobial resistance profiles of isolated strains. The tertiary institution setting was selected due to the diverse occupational roles and potential for pathogen transmission within the institutional environment.

Study Population

The study population comprised 127 pioneer employees of the Federal University of Health Sciences in Ila-Orangun, South West Nigeria including administrative staff, academic personnel and supporting staff. Participants were stratified by marital status into two groups: married women (n = 69) and single women (n = 58). This stratification was implemented to explore potential associations between marital status and colonization risk, as household dynamics and caregiving responsibilities may influence exposure patterns.

Inclusion Criteria

workers employed at the tertiary institution, willingness to provide informed consent and staff not on antimicrobial therapy in the preceding two weeks

Exclusion Criteria

Staff currently on antimicrobial therapy or antimicrobial use within 14 days prior to sample collection, those with active nasal infection or recent nasal surgery as well as those that refuse to participate or provide informed consent.

Sample Collection

Nasal swab specimens were collected from the anterior nares of all participants using sterile cotton swabs. The collection procedure followed standardized protocols to ensure specimen quality and minimize contamination risk. Specifically, sterile swabs were moistened with sterile normal saline and gently rotated in both anterior nares for approximately 5 seconds per nostril. Swabs were immediately placed in sterile transport media (Stuart's transport medium) and transported to the microbiology laboratory within 2 hours of collection under ambient temperature conditions (Baron, 2015; Qian *et al.,* 2020).

Isolation and Identification of S. Aureus

Upon receipt in the laboratory, nasal swabs were inoculated onto mannitol salt agar (MSA), a selective and differential medium for staphylococci. Plates were incubated aerobically at 37°C for 24–48 hours. Colonies demonstrating characteristic morphology (golden-yellow pigmentation and mannitol fermentation, indicated by yellow coloration of the medium) were subjected to confirmatory identification procedures (Nocera *et al.,* 2021).

MRSA Detection

Methicillin resistance was determined using the cefoxitin disk diffusion method, which serves as a surrogate marker for *mecA* gene-mediated methicillin resistance. Cefoxitin (30 µg) disks were applied to Mueller-Hinton agar plates inoculated with bacterial suspensions adjusted to 0.5 McFarland standard (Saenhom *et al.,* 2022).

Antimicrobial Susceptibility Testing

Antimicrobial susceptibility testing was performed using the Kirby-Bauer disk diffusion method on Mueller-Hinton agar, following CLSI guidelines. Bacterial suspensions were prepared to match 0.5 McFarland turbidity standard (approximately 1.5×10^8 CFU/mL) and inoculated onto agar plates using sterile swabs to achieve confluent growth. Antimicrobial disks were applied to the inoculated plates, which were then incubated at 35°C for 16–18 hours (Salam *et al.,* 2023).

Antimicrobial Agents Tested

The following antimicrobial agents were evaluated, representing major antibiotic classes relevant to staphylococcal infections: cefuroxime (30 µg), cefotaxime (30 µg), ceftazidime (30 µg), ceftriaxone (30 µg), sparfloxacin (5 µg), ofloxacin (5 µg), erythromycin (15 µg), clindamycin (2 µg), gentamicin (10 µg). Inhibition zone diameters were measured to the nearest millimeter and

interpreted as susceptible, intermediate, or resistant according to CLSI breakpoints. Quality control was performed using *S. aureus* ATCC 25923 to ensure accuracy and reproducibility of susceptibility testing.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using appropriate statistical software. Descriptive statistics were calculated for all variables, including frequencies, percentages, and 95% confidence intervals (CI) for prevalence estimates.

Chi-square (χ^2) tests were employed to assess associations between categorical variables, specifically: - Comparison of *S. aureus* prevalence between married and single women - Comparison of MRSA distribution between marital status groups - Assessment of antimicrobial resistance patterns across demographic groups. Statistical significance was defined as $p < 0.05$ for all analyses.

RESULTS AND DISCUSSION

Among the 127 tertiary institution workers enrolled in this study, *Staphylococcus aureus* was isolated from 62 participants, yielding an overall nasal colonization prevalence of 48.8% (95% CI: 39.9–57.7%). This prevalence substantially exceeds rates typically reported in the general population and approaches levels observed in high-risk healthcare settings.

Stratification by marital status revealed notable differences in colonization rates (Table 1). Married women demonstrated a higher prevalence of *S. aureus* colonization (56.5%, 39/69; 95% CI: 44.0–68.4%) compared to single women (39.7%, 23/58; 95% CI: 27.0–53.4%). Chi-square analysis indicated a trend toward statistical significance ($\chi^2 = 3.58$, $p = 0.058$), suggesting that marital status may be associated with increased colonization risk, potentially reflecting household transmission dynamics or differential exposure patterns.

Table 1: Distribution of *Staphylococcus Aureus* and MRSA Colonization by Marital Status

Marital Status	Number of Participants	*S. aureus* Positive n (%)	MRSA Positive n (%)	MRSA Among *S. aureus* (%)
Single	58	23 (39.7%)	11 (19.0%)	11/23 (47.8%)
Married	69	39 (56.5%)	16 (23.2%)	16/39 (41.0%)
Total	127	62 (48.8%)	27 (21.3%)	27/62 (43.5%)

$\chi^2 = 3.58$, p = 0.058 for S. aureus prevalence comparison between married and single women

Of the 62 *S. aureus* isolates, 27 (43.5%; 95% CI: 30.9–56.7%) were identified as methicillin-resistant based on cefoxitin disk diffusion testing. This MRSA proportion is substantially elevated compared to global averages and indicates a significant burden of antimicrobial resistance within this occupational population.

The overall MRSA colonization prevalence among all study participants was 21.3% (27/127; 95% CI: 14.5–29.4%). When stratified by marital status, MRSA colonization rates were 23.2% (16/69) among married women and 19.0% (11/58) among single women ($\chi^2 = 0.35$, $p = 0.55$), indicating no statistically significant difference in MRSA prevalence by marital status.

Interestingly, among *S. aureus*-positive participants, the proportion of MRSA was slightly higher in single women (47.8%, 11/23) compared to married women (41.0%, 16/39), though this difference was not statistically significant ($\chi^2 = 0.28$, $p = 0.60$). This finding suggests that while married women may have higher overall *S. aureus* colonization rates, the likelihood of methicillin resistance among colonizing strains is comparable across marital status groups.

Antimicrobial susceptibility testing of all 62 *S. aureus* isolates revealed concerning resistance patterns, particularly to beta-lactam antibiotics (Table 3). The most striking finding was the exceptionally high resistance to second- and third-generation cephalosporins, with only 6.5% (4/62) of isolates susceptible to cefuroxime and cefotaxime, and 9.7% (6/62) susceptible to ceftazidime. These resistance rates (93.5% for cefuroxime and cefotaxime, 90.3% for ceftazidime) substantially exceed those reported in most contemporary studies and suggest widespread dissemination of beta-lactamase-producing strains or strains with altered penicillin-binding proteins.

In contrast, ceftriaxone demonstrated markedly better activity, with 95.2% (59/62) of isolates remaining susceptible. This discordance in cephalosporin susceptibility patterns is noteworthy and may reflect differential selective pressures or distinct resistance mechanisms.

Fluoroquinolone susceptibility was moderate, with 75.8% (47/62) of isolates susceptible to sparfloxacin and 91.9% (57/62) susceptible to ofloxacin. Erythromycin retained activity against 90.3% (56/62) of isolates, while clindamycin susceptibility was observed in 75.8% (47/62) of isolates. Gentamicin demonstrated good activity, with 82.3% (51/62) of isolates susceptible.

Table 2: Antimicrobial Susceptibility Profile of All S. Aureus Isolates

Antimicrobial Agent	Susceptible n (%)	Intermediate n (%)	Resistant n (%)	Resistance Rate (%)
Cefuroxime	4 (6.5%)	0 (0.0%)	58 (93.5%)	93.5%
Cefotaxime	4 (6.5%)	0 (0.0%)	58 (93.5%)	93.5%
Ceftazidime	6 (9.7%)	0 (0.0%)	56 (90.3%)	90.3%
Ceftriaxone	59 (95.2%)	0 (0.0%)	3 (4.8%)	4.8%
Sparfloxacin	47 (75.8%)	3 (4.8%)	12 (19.4%)	19.4%
Ofloxacin	57 (91.9%)	1 (1.6%)	4 (6.5%)	6.5%
Erythromycin	56 (90.3%)	0 (0.0%)	6 (9.7%)	9.7%
Clindamycin	47 (75.8%)	1 (1.6%)	14 (22.6%)	22.6%
Gentamicin	51 (82.3%)	0 (0.0%)	11 (17.7%)	17.7%

MRSA isolates (n = 27) demonstrated elevated resistance rates across multiple antimicrobial classes compared to the overall *S. aureus* population (Table 4). Universal resistance to cefuroxime, cefotaxime, and ceftazidime was observed

(100%, 27/27), consistent with the methicillin-resistant phenotype and associated beta-lactam cross-resistance. However, ceftriaxone retained activity against 88.9% (24/27) of MRSA isolates, suggesting potential therapeutic utility in selected cases, though this finding requires cautious interpretation given the inherent limitations of disk diffusion testing for MRSA.

Fluoroquinolone resistance was notably elevated among MRSA isolates, with 37.0% (10/27) resistant to sparfloxacin and 14.8% (4/27) resistant to ofloxacin. Clindamycin resistance was particularly concerning at 55.6% (15/27), substantially higher than the 22.6% observed in the overall *S. aureus* population. This elevated clindamycin resistance may reflect co-selection of resistance determinants or clonal expansion of resistant lineages.

Erythromycin and gentamicin resistance rates among MRSA isolates were 18.5% (5/27) and 29.6% (8/27), respectively, both elevated compared to the overall population but indicating that a substantial proportion of MRSA isolates retain susceptibility to these agents.

Table 3: Antimicrobial Susceptibility Profile of MRSA Isolates (N = 27)

Antimicrobial Agent	Susceptible n (%)	Intermediate n (%)	Resistant n (%)	Resistance Rate (%)
Cefuroxime	0 (0.0%)	0 (0.0%)	27(100.0%)	100.0%
Cefotaxime	0 (0.0%)	0 (0.0%)	27(100.0%)	100.0%
Ceftazidime	0 (0.0%)	0 (0.0%)	27(100.0%)	100.0%
Ceftriaxone	24 (88.9%)	0 (0.0%)	3 (11.1%)	11.1%
Sparfloxacin	16 (59.3%)	1 (3.7%)	10 (37.0%)	37.0%
Ofloxacin	22 (81.5%)	1 (3.7%)	4 (14.8%)	14.8%
Erythromycin	22 (81.5%)	0 (0.0%)	5 (18.5%)	18.5%
Clindamycin	11 (40.7%)	1 (3.7%)	15 (55.6%)	55.6%
Gentamicin	19 (70.4%)	0 (0.0%)	8 (29.6%)	29.6%

Multidrug resistance (MDR), defined as non-susceptibility to at least three antimicrobial classes, was highly prevalent among both *S. aureus* and MRSA isolates. Among all 62 *S. aureus* isolates, 58 (93.5%) demonstrated resistance to at least three cephalosporins (cefuroxime, cefotaxime, ceftazidime), automatically classifying them as MDR. When considering resistance across diverse antimicrobial classes (beta-lactams, fluoroquinolones, macrolides, lincosamides, aminoglycosides), 45 isolates (72.6%) exhibited resistance to three or more distinct classes.

Among MRSA isolates, all 27 (100%) were resistant to beta-lactams; however, Specifically, 22 MRSA isolates (81.5%) demonstrated resistance to four or more antimicrobial classes, and 8 isolates (29.6%) exhibited resistance to five or more classes, indicating extensive drug resistance.

Discussion

The overall *S. aureus* nasal colonization prevalence of 48.8% observed in this study is substantially elevated compared to most contemporary reports from occupational populations. Recent studies among healthcare workers have documented *S. aureus* colonization rates ranging from 10.26% in Iran (Abdullahi *et al.,* 2022), 12.5% in Iran (Moazen *et al.,* 2023), 14.7% in Nepal (Giri *et al.,* 2021), 15.6% in Ethiopia (Mitiku *et al.,* 2023), 20% in Somaliland (Mohamoud *et al.,* 2023), 20.67% in India (Ishore *et al.,* 2022), to 25.2% in Ethiopia (Ibrahim *et al.,* 2024). The prevalence observed in our study is however lower than 61.8% Staphylococcus carrier rate documented among healthcare workers in Central India (Bawankar *et al.,* 2025).

Several factors may contribute to this elevated prevalence. First, the tertiary institution setting may present unique transmission dynamics, including crowded working conditions, shared facilities, and potentially suboptimal hand hygiene infrastructure compared to healthcare settings where infection control measures are more rigorously implemented. Second, the study population comprised exclusively workers, and gender-specific factors including physiological differences, occupational roles, and behavioral patterns may influence colonization risk. Third, geographic and regional variations in *S. aureus* epidemiology, influenced by climate, population density, and antimicrobial usage patterns, may contribute to higher baseline colonization rates in the study setting.

The MRSA prevalence of 21.3% among all participants and 43.5% among *S. aureus* carriers is alarmingly high and exceeds most contemporary reports from occupational populations. Recent studies have documented MRSA colonization rates of 5.0% in Ecuador (Baroja *et al.,* 2021), 5.2% in Nepal (Giri *et al.,* 2021), 6.0% in long-term care facilities (Shih *et al.,* 2021), 6.33% in India (Subba *et al.,* 2025), 7.5% in Ethiopia (Ibrahim *et al.,* 2024), 11.2% in Ethiopia (Mitiku *et al.,* 2023), and 23.5% in Indonesia (Rohmah *et al.,* 2023). The proportion of MRSA among *S. aureus* isolates in our study (43.5%) is comparable to the 36% reported among healthcare workers in Central India (Bawankar *et al.,* 2025) and the 35.3% reported in Nepal (Giri *et al.,* 2021), but lower than 39.1% reported in Benin City (Beshiru and Uwhuba, 2023).

The observed trend toward higher *S. aureus* colonization among married women (56.5%) compared to single women (39.7%) represents a novel finding with potential implications for understanding transmission dynamics. While this difference approached but did not reach conventional statistical significance ($p = 0.058$), the 16.8 percentage point difference suggests a potentially meaningful association warranting further investigation.

Several mechanisms may explain this association. First, married individuals typically have more household contacts, including spouses and children, potentially increasing exposure to *S. aureus* through household transmission. Studies have documented substantial *S. aureus* sharing among household members, with concordance rates exceeding 50% in some populations. Second, married women may have differential caregiving responsibilities, including care for children or elderly family members, which could increase exposure risk. Third, socioeconomic factors associated with marital status, including household size, living conditions, and access to hygiene resources, may modulate colonization risk.

Interestingly, while married women demonstrated higher overall *S. aureus* colonization, the proportion of MRSA among *S. aureus* isolates was comparable between married (41.0%) and single women (47.8%), suggesting that marital status may influence colonization risk but not necessarily the

likelihood of acquiring methicillin-resistant strains. This finding implies that MRSA acquisition may be driven more by occupational or community exposures than by household transmission dynamics.

The substantial MRSA burden observed in this study underscores the importance of surveillance and infection prevention measures in non-healthcare occupational settings. While healthcare workers have traditionally been recognized as high-risk populations for MRSA colonization due to patient contact and exposure to antimicrobial-resistant organisms (Shih *et al.,* 2021; Ishore *et al.,* 2022; Subba *et al.,* 2025), our findings suggest that workers in tertiary educational institutions may also face elevated risk.

The mechanisms underlying elevated MRSA colonization in this population likely differ from those in healthcare settings. Rather than direct patient contact, transmission in educational institutions may be driven by environmental contamination, shared facilities, crowded conditions, and person-to-person transmission through social interactions. Studies have documented *S. aureus* contamination of frequently touched surfaces, mobile phones, and shared equipment, which may serve as reservoirs for transmission (Karunarathna *et al.,* 2020).

The public health implications of high MRSA colonization in non-healthcare occupational populations are significant. Colonized individuals serve as potential reservoirs for community transmission, and occupational settings may function as amplification sites for resistant strains. Furthermore, colonized workers who subsequently require medical care face increased risk of endogenous MRSA infection, which is associated with worse clinical outcomes and higher healthcare costs compared to MSSA infections.

The antimicrobial resistance patterns observed in this study are particularly concerning and have important clinical and public health implications. The exceptionally high resistance rates to second- and third-generation cephalosporins (cefuroxime, cefotaxime, ceftazidime: 90.3–93.5%) substantially exceed those reported in most contemporary studies and suggest widespread dissemination of beta-lactamase-producing strains or strains with altered penicillin-binding proteins.

In contrast, studies from Ethiopia reported substantially lower cephalosporin resistance rates, with cefoxitin resistance (a marker for methicillin resistance) at 71.7% (Mitiku *et al.,* 2023). Studies from Iran documented 100% susceptibility to cefoxitin and oxacillin among *S. aureus* isolates, though 75% harbored the *mecA* gene, representing oxacillin-susceptible MRSA (OS-MRSA) (Abdullahi *et al.,* 2022). The discordance between our findings and these reports may reflect regional differences in antimicrobial usage patterns, infection control practices, and circulating strain types.

The preserved activity of ceftriaxone (95.2% susceptibility overall, 88.9% among MRSA) is noteworthy and contrasts sharply with the high resistance to other cephalosporins. This finding may reflect differential selective pressures, as ceftriaxone is often reserved for more severe infections and may be less frequently used in the community compared to other cephalosporins. However, this apparent susceptibility should be interpreted cautiously, as MRSA is considered intrinsically resistant to all beta-lactams regardless of in vitro susceptibility results, and ceftriaxone should not be used for MRSA infections.

Fluoroquinolone resistance, particularly to sparfloxacin (19.4% overall, 37.0% among MRSA), is concerning given the importance of this class for treating staphylococcal infections. Studies from Nepal reported even higher fluoroquinolone resistance among MRSA, with only 25% susceptibility to ofloxacin and ciprofloxacin (Giri *et al.,* 2021). The elevated fluoroquinolone resistance likely reflects widespread use of these agents in the community and healthcare settings, leading to selection of resistant strains.

The high clindamycin resistance among MRSA isolates (55.6%) is particularly problematic, as clindamycin is often used as an alternative agent for MRSA infections, particularly skin and soft tissue infections. Studies from Nepal reported 83.3% clindamycin susceptibility among MRSA (Giri *et al.,* 2021), substantially higher than our findings. The elevated clindamycin resistance in our study may reflect co-selection with macrolide resistance through the *erm* gene, which confers cross-resistance to macrolides, lincosamides, and streptogramin B antibiotics (MLSB phenotype).

The high antimicrobial resistance rates observed among *S. aureus* and MRSA isolates represent a significant public health concern; however, MDR proportions require recalculation from isolate-level class-by-class data before definitive statements can be made. (93.5%) and universal MDR among MRSA isolates represents a critical public health concern. These findings align with recent reports documenting extensive multidrug resistance among *S. aureus* isolates from healthcare workers. Bawankar *et al.* (2025) reported that all MRSA isolates from healthcare workers were multidrug-resistant, with 12.5% demonstrating vancomycin-intermediate resistance (VISA) and 10% exhibiting linezolid resistance. Similarly, studies from Ethiopia documented high rates of resistance to multiple antimicrobial classes, including penicillin (93.3%), tetracycline (58.7%), and trimethoprim-sulfamethoxazole (52.2%) (Mitiku *et al.,* 2023; Ibrahim *et al.,* 2024).

The clinical implications of widespread MDR are profound. Multidrug-resistant *S. aureus* infections are associated with increased treatment failure rates, prolonged illness, higher healthcare costs, and increased mortality compared to infections caused by susceptible strains. Furthermore, the presence of MDR strains in colonized individuals increases the risk of treatment failure if these individuals subsequently develop infections, as empiric antimicrobial therapy may be ineffective.

From a public health perspective, the high prevalence of MDR colonization in this occupational population suggests potential for community dissemination of resistant strains. Colonized workers may transmit resistant strains to household contacts, community members, and healthcare settings if they require medical care. This bidirectional transmission between community and healthcare settings has been well-documented and contributes to the persistence and spread of antimicrobial resistance.

Limitation

Several limitations of this study warrant consideration. First, the cross-sectional design provides only a snapshot of colonization prevalence at a single time point and cannot assess colonization dynamics, persistence, or acquisition risk factors. Longitudinal studies would provide more comprehensive insights into colonization patterns and transmission dynamics.

The findings of this study have important implications for occupational health policy, infection prevention strategies, and antimicrobial stewardship programs. First, the high prevalence of *S. aureus* and MRSA colonization among tertiary institution workers suggests the need for routine surveillance programs to monitor colonization rates and antimicrobial resistance trends in non-healthcare occupational settings. Such surveillance would enable early

detection of emerging resistance patterns and inform targeted interventions.

Also, implementation of evidence-based infection prevention measures is essential. These should include enhanced hand hygiene programs with adequate infrastructure (handwashing facilities, alcohol-based hand sanitizers), environmental cleaning protocols for shared facilities and frequently touched surfaces, and education programs to raise awareness of transmission risks and prevention strategies. Studies have demonstrated that comprehensive infection control programs can significantly reduce *S. aureus* transmission in institutional settings (Shih *et al.,* 2021).

Furthermore, consideration should be given to targeted screening and decolonization programs for high-risk individuals or during outbreak situations. While universal screening and decolonization in non-healthcare settings is not generally recommended, targeted approaches may be appropriate in specific circumstances. Studies have demonstrated the effectiveness of decolonization regimens using mupirocin nasal ointment and chlorhexidine body washes in reducing MRSA colonization and infection risk (Premanand *et al.,* 2023). However, concerns regarding mupirocin resistance emergence necessitate judicious use of decolonization protocols (Bawankar *et al.,* 2025).

Conclusion

This study reveals a high prevalence of *S. aureus* (48.8%) and MRSA (21.3%) nasal colonization among tertiary institution workers, with married women demonstrating higher colonization rates than single women, though this difference did not reach statistical significance ($p = 0.058$). The proportion of MRSA among *S. aureus* isolates (43.5%) is alarmingly elevated and exceeds most contemporary reports from occupational populations. Antimicrobial resistance patterns are particularly concerning, with exceptionally high resistance to second- and third-generation cephalosporins (90.3–93.5%) and substantial multidrug resistance among both *S. aureus* (93.5%) and MRSA (100%) isolates.

These findings underscore the substantial burden of antimicrobial-resistant *S. aureus* in non-healthcare occupational settings and highlight the potential for these populations to serve as reservoirs for community transmission of resistant strains. The elevated resistance rates observed in this study reflect the broader global crisis of antimicrobial resistance and emphasize the urgent need for coordinated action across multiple sectors. The study contributes important epidemiological data from an understudied population and geographic setting, filling critical knowledge gaps regarding *S. aureus* colonization in tertiary educational institutions. The findings have important implications for occupational health policy, infection prevention strategies, and antimicrobial stewardship programs, and should inform the development of evidence-based interventions to reduce colonization rates and prevent transmission of resistant strains.

Recommendations

Based on the findings of this study implementation routine surveillance programs for *S. aureus* and MRSA colonization in tertiary institutions and other non-healthcare occupational settings to monitor prevalence trends and antimicrobial resistance patterns. Also, there is a need to strengthen infection prevention and control measures, including enhanced hand hygiene programs with adequate infrastructure and supplies; regular environmental cleaning and disinfection of shared facilities and frequently touched surfaces and education programs for workers regarding transmission risks and prevention strategies.

There is also a need to establish antimicrobial stewardship programs to promote rational antimicrobial use, minimize selective pressure for resistance, and preserve the effectiveness of existing antimicrobial agents.

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Ethical Approval

The study protocol was reviewed and approved by the Federal University of Health Sciences Ila-Orangun ethics committee. All participants provided written informed consent prior to enrollment. Participation was voluntary, and participants were informed of their right to withdraw at any time without consequences. Confidentiality was maintained throughout the study, with participant identifiers replaced by unique study codes. Participants found to be colonized with MRSA were counseled regarding infection prevention measures and referred for appropriate medical evaluation if clinically indicated.

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