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Nasal Colonization of Staphylococcus Aureus Among Volunteered Students: A Prevalence Study

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Abstract: Staphylococcus aureus (S. aureus) nasal carriage may spread and cause future illnesses. The present study examined Staphylococcus aureus nasal colonization in medical laboratory students at the Federal School of Medical Laboratory Sciences and Technology Jos, Plateau State, Nigeria, who had completed their posting. One hundred nasal swabs were taken from randomly selected school kids. Swabs were plated on Mannitol salt agar (MSA) and incubated at 37ºC for 24 hours. After incubation, S. aureus isolates were recognized by their yellowish MSA colony, Gramme response, catalase, and coagulase test. This study found 37.0% nasal colonization of Staphylococcus aureus. It was higher among students aged 26 and older (55.6%), followed by 18 and under (40.0%) and 19-25 (34.9%). However, age-pattern incidence variation was not significant ($p > 0.05$). The sex-related incidence rate was significantly greater ($p < 0.001$) in female students (52.0%) compared to male students (22.0%). In conclusion, the high prevalence of Staphylococcus aureus nasal colonization in our study, especially in women, is concerning. Thus, public awareness campaigns, health education, and cleanliness and sanitation should be prioritized in the study area.

Keywords: Staphylococcus Aureus Nasal Colonization; Resistant Bacteria; Prevalence of Staphylococcus; Gram-Positive Bacteria; B-Lactam Antibiotics; Systemic Illnesses; Nasal Abnormalities.

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1. Introduction

1.1. Background of the Study

Staphylococci are Gram-positive bacteria characterized by individual cocci that form grape-like clusters. The genus Staphylococcus comprises 32 species and eight sub-species, with particular emphasis on Staphylococcus aureus and Staphylococcus epidermidis [17]. These non-motile, non-spores-forming bacteria are catalase-positive and oxidase-negative. They exhibit tolerance to high salt concentrations and heat resistance. They are distinguished by their ability to produce coagulase, which induces blood clotting and is a key marker for identifying pathogenic strains [38]. This characteristic

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distinguishes coagulase-positive strains, such as S. aureus (a human pathogen), S. intermedius, and S. hyicus (which are animal pathogens), from other staphylococcal species like S. epidermidis, which are coagulase-negative [28]. Staphylococci aureus is part of the normal flora of human skin and nasal passages [20]. Unfortunately, it is an opportunistic organism that may cause infection under favourable circumstances and easily spread through direct contact. The anterior nares are the primary niche of S. aureus, and it is reported that about 20% of the human population is persistently colonized with S. aureus in the anterior nares [42]. S. aureus is a major causative agent of superficial and systemic infections [35].

Methicillin-resistant Staphylococci aureus (MRSA) is a term given to S. aureus strains of medical importance uniquely characterized by high virulent factors and methicillin-resistant mechanism [10]. Any species of Staphylococcus aureus that has evolved resistance to many beta-lactam antibiotics, either via horizontal gene transfer or natural selection, is considered to be MRSA [2]. Some penams-penicillin derivatives, like methicillin and oxacillin, and cephems, like cephalosporins, are part of the β-lactam antibiotics broad spectrum group [24]. S. aureus strains that are responsive to methicillin and other drugs are known as methicillin-susceptible S. aureus (MSS) [45]. Staphylococci aureus colonisation may be affected by specific demographic factors. Some factors that have been associated with the nasal carriage of S. aureus include: sex, occupation, age, ethnicity, nasal abnormalities, and risk factors such as genetic makeup, immunological status, hormonal status in women, recent hospitalisation, hemodialysis, HIV status, S. aureus skin infections, nose picking, and multiple antibiotics administration [5].

1.2. Statement of the Problem

Many different infectious disorders, from minor skin infections to serious systemic illnesses, can be caused by Staphylococcus aureus, a common pathogen in both the population and hospitals. The prevalence of S. aureus is demonstrated by the fact that an estimated 20-30% of the world's population has this bacteria permanently colonised in their anterior nares [42]. There is a substantial risk of transmission in these harmful bacteria, since research has revealed that 10–40% of those examined as outpatients or upon admission to healthcare institutions are nasal carriers of S. aureus [40]. Carriers of S. aureus in the nose are at increased risk of infection and also operate as reservoirs for the bacterium, making it easier for it to spread in the community, healthcare settings, and schools. This makes them a significant risk factor for future infections.

1.3. Justification of the Study

Staphylococcus aureus colonization presents a significant global health concern, particularly for healthcare workers. S. aureus can colonize healthcare workers, especially in the anterior nares, and failure to adhere to infection control measures can lead to the transmission of S. aureus to patients. Medical students are also at risk of S. aureus colonization, particularly during their clinical training in hospital settings where they come into close contact with infected patients, samples, and healthcare workers. This, therefore, underscores its widespread transmission within the medical school environments due to the potential risks associated with clinical training, which forms the basis for this study.

1.4. Aim of the Study

This study aimed to determine the prevalence of Staphylococcus aureus nasal colonization among Federal School of Medical Laboratory Sciences and Technology Jos students, Plateau State, Nigeria.

1.5. Objectives of the Study

The general objectives of this study include:

- To determine the prevalence of prevalence of Staphylococcus aureus nasal colonization among students of Federal School of Medical Laboratory Sciences and Technology Jos, Plateau State, Nigeria.
- To determine the age pattern of Staphylococcus aureus nasal colonization among the students.
- To determine the sex pattern of Staphylococcus aureus nasal colonization among the students.

1.6. Significance of the Study

The study's findings will greatly add to what we already know about Staphylococcus aureus nasal colonization, especially among medical students. These findings could give us important information about the spread of Staphylococcus aureus among medical students in the Jos North Local Government Area. The results could influence the decisions made and the measures taken by medical students during their clinical training. Additionally, the findings could help us develop better ways to prevent and control Staphylococcus aureus.

1.7. Research Hypotheses

- H0 - There is no significant age pattern of Staphylococcus aureus nasal colonization among the students.
- Ha - There is a significant age pattern of Staphylococcus aureus nasal colonization among the students.

- H0 - There is no significant sex pattern of Staphylococcus aureus nasal colonization among the students.
- Ha - There is a significant sex pattern of Staphylococcus aureus nasal colonization among the students.

2. Literature Review

2.1. Overview of Staphylococcus aureus

There are multiple species and subspecies of Staphylococcus. Staphylococcus aureus is a member of the Micrococcaceae family of facultative anaerobic coccus that is Gram-positive, catalase-positive, coagulase-positive, and typically oxidase-negative [1]. A non-motile bacterium is what it is. The cells are round, singular, and frequently cluster into structures resembling grapes. Differentiating S. aureus from other staphylococcal species, it produces coagulase, ferments mannitol and trehalose, and produces heat-stable thermonuclear [44]. Temperatures ranging from 7 to 48 degrees Celsius (with an optimal range of 30 to 37 degrees Celsius), pH levels from 4.2 to 9.3 (with an optimal range of 7.0 to 7.5), and concentrations of sodium chloride reaching up to fifteen percent NaCl are all within the organisms' growth parameters [36]. Because of these traits, the bacteria are able to thrive in a wide range of foods, particularly those that go through processing, such as fermented goods like cheese [9].

2.2. Growth Requirement and Survival of Staphylococcus aureus

Staphylococcus aureus is a bacterium that can survive in dry and stressful environments, such as the human nose and skin, as well as on surfaces like clothing. It is able to adapt to different environmental conditions and can grow in a wide range of temperatures and pH levels. Staphylococcus aureus can even survive and multiply in low temperatures and high salt concentrations [3]. The bacteria resist high salt levels, detergents, and alcohol due to their strong cell structure but can be easily killed through pasteurization or cooking. However, the exact processes underlying its ability to adapt to different environments are still not fully understood.

2.3. Epidemiology of Staphylococcus aureus Infection

This microbe's epidemiology in animals has recently attracted a lot of attention due to its significance in veterinary medicine, the rise in infectious processes caused by it (particularly Methicillin-resistant Staphylococcus aureus, or MRSA strains), and the emergence of certain clonal lineages linked to animals and zoonotic potential evidence [26]. Intoxications caused by germs in food are common, and S. aureus is a major culprit. It ranks high among the reasons Americans become sick from eating contaminated food [15]. Raw milk from mastitic cows is a major source of S. aureus, and approximately half of healthy persons have the germs in their nasal passages, throats, and skin [43]. In addition to humans, it can be found in a wide variety of animals that are used for food, including pigs, cows, goats, chickens, and ducks [46].

2.4. Staphylococcus aureus as a Human Commensal and Pathogen

The bacterium S. aureus usually lives in the front part of the nose. About 20% of people always have S. aureus in their noses, while another 20% never do. The remaining 60% are sometimes carriers of the bacterium [42]. It's unclear why some people are always colonized by S. aureus. Men and women who use hormonal birth control are more likely to have S. aureus. Also, people with diabetes, those who are in the hospital, and patients on dialysis are more often colonized. S. aureus is also more common in children than in adults. Smoking appears to be linked to a lower chance of having S. aureus. Changes in seasons, temperature, and levels of pollen or dust in the air can affect the types of bacteria in the nose. Genetics seem to have a small effect on this [5].

S. aureus has many ways to make people sick. It can cause mild skin and tissue infections or very serious illnesses like pneumonia, bone infections, heart infections, and blood poisoning [35]. Even though having S. aureus in the nose usually doesn't cause symptoms, it raises the risk of serious infections, especially in people with weak immune systems and those in the hospital. Studies have shown that the strain of S. aureus in the nose is usually the one that causes infections [40]. So, removing S. aureus from the nose is a very effective way to prevent these infections. When S. aureus is eliminated from the nose, it usually goes away from other body parts because it's mostly spread through the hands [30].

People who have S. aureus in their noses are at high risk of getting sick, so a common treatment is to use mupirocin to get rid of the bacterium from the nose. Mupirocin works by stopping bacteria from making proteins. Putting mupirocin ointment in the nose twice a day for 5 days usually gets rid of S. aureus and lowers the risk of serious infections [29]. Mupirocin works about 90% of the time, but in some parts of the United States, resistance to it increases to 30% [41]. This means new drugs to get rid of S. aureus are really needed because they often come back after mupirocin treatment.

S. aureus has become more resistant to common antibiotics in the past decades. One common type of S. aureus that is resistant to lots of antibiotics, including methicillin, is called MRSA. MRSA used to be mostly picked up in hospitals, but now it's being spread in communities. These community-associated MRSA strains are often more dangerous and easier to spread than hospital-associated ones [21].

2.5. Nasal Microbiota and Their Interaction

The bacteria in the adult nose vary between people, but Corynebacterium, Propionibacterium, and Staphylococcus are the most common. In a study of 178 adults, most people had these bacteria in their noses [25]. The nasal microbiota can change depending on whether a person is healthy or in the hospital. Healthy people often have more Actinobacteria (mainly Propionibacterium and Corynebacterium spp.), while hospitalized people have more S. aureus and S. epidermidis [18]. Some bacteria can stop others from growing. This might be because they activate or stop each other. Some bacteria make molecules that can change how much S. aureus there is. For example, Streptococcus pneumoniae makes H2O2, which kills S. aureus [49]. Also, Staphylococcus lugdunensis makes a molecule called lugdunin that stops S. aureus from growing in the nose [14]. Figure 1, according to Sakr et al. [40], presents bacterial interactions with Nasal S. aureus.

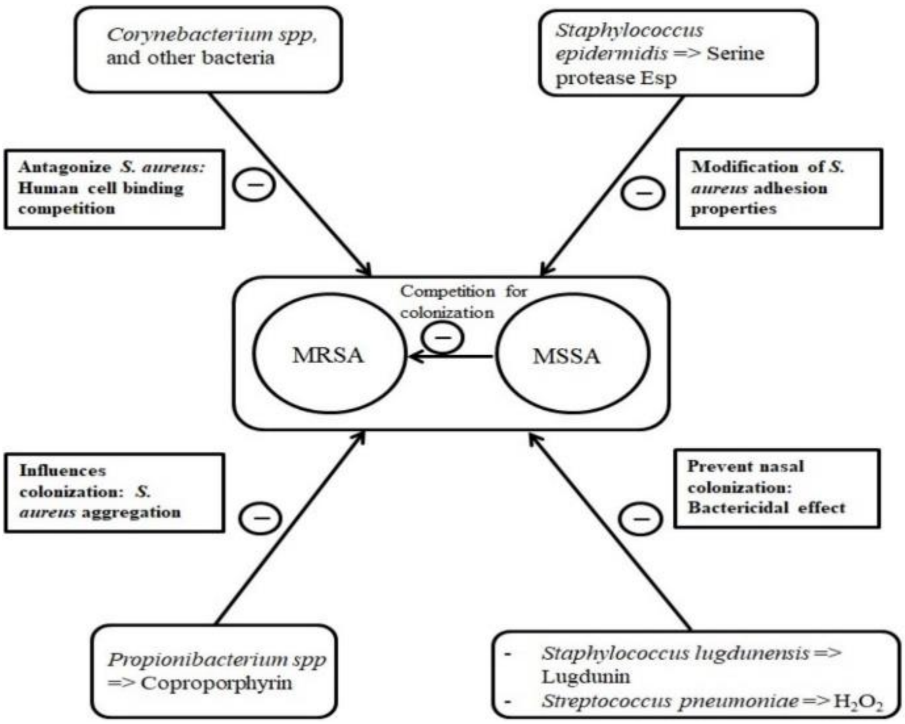

Figure 1: Main Bacterial Interactions with Nasal S. aureus

2.6. Spread and Transmission of Staphylococcus aureus Nasal Colonization

Skin, the rectum, and the vagina are among the many places Staphylococcus aureus can be discovered, but the nose is where it's most commonly found. The most common route of transmission for S. aureus from surfaces to the nose after birth is via the hands [27]. Research has revealed that people who live in close quarters with each other are more likely to have nasal polyps that share genetic material, suggesting the possibility of transmission within the home [39]. The spread of Staphylococcus aureus by air is rare, although it could contribute to epidemics in healthcare facilities.

Asymptomatic nasal carriers among healthcare professionals can occasionally cause MRSA epidemics [22]. Furthermore, a new study indicated that healthcare workers' mobile phones might harbour S. aureus, with strains on the phones being identical to those in the workers' noses. In Figure 2, the pathways of S. aureus dissemination and transmission are shown, as per Chang et al. [6]. The impact of nasal carriage on subsequent infections in clinical cases is also discussed.

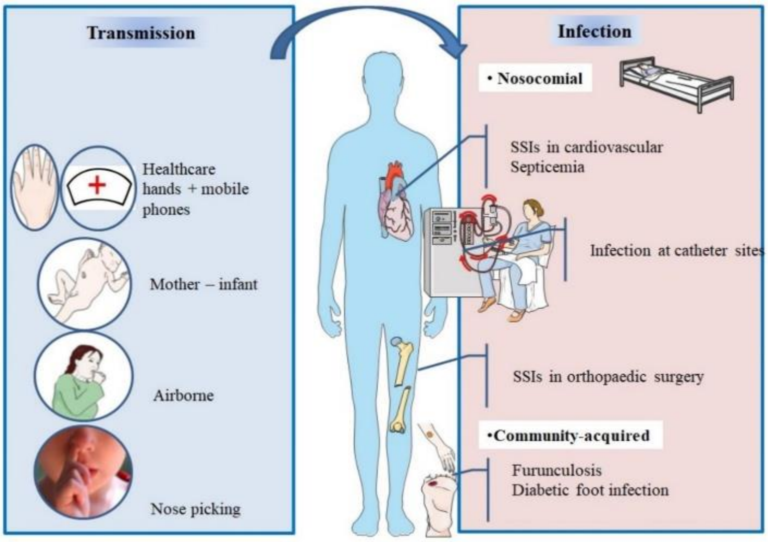

Figure 2: Main spread and transmission mechanisms of S. aureus and impact of nasal carriage on subsequent infections

2.7. Mechanisms of Staphylococcus aureus Nasal Colonization

2.7.1. Interaction Between S. aureus and the Squamous Epithelium of the Anterior Nare

Integument lines the nasal vestibule and is located at the top of the epidermis. The cornified layer, or stratum corneum, is made up of keratinocytes that express loricrin, cytokeratin 10 (K10), involucrin, and filaggrin, among other proteins [19]. Some Staphylococcal surface proteins, such ClfB and IsdA, can bind to proteins on the cornified membrane and encourage colonisation of the nasal passages [23].

2.7.2. Interaction in the Inner Nasal Cavity

Another biological niche for S. aureus is the inner section of the nasal cavity, in addition to the vestibulum nasi. One crucial component of staphylococcal colonisation is the nonprotein adhesin known as cell wall teichoic acid (WTA). An in vivo investigation shown that, in contrast to wild-type control strains, S. aureus mutants lacking WTA were unable to colonise cotton rat noses or adhere to nasal cells [48].

2.7.3. Intracellular Localization of Staphylococcus aureus

Immunohistochemistry, haematoxylin, and Eosin stains are among the methods that have been used to describe the intracellular location of Staphylococcus aureus in nasal tissue. Some of the cells that S. aureus can be found inside include epithelial cells, endothelial cells, and inflammatory cells, including mast cells (ICSA). Intracellular Staphylococcus aureus was found in the stratum spinosum, one of the epidermis layers, in skin biopsies taken from the vestibulum nasi of healthy individuals who were randomly selected [13].

2.7.4. Immune System and Staphylococcus aureus colonization

In a recent review, Mulcahy and McLoughlin [32] examined the link between the host immune system and S. aureus nasal carriage. It appears that both the innate and adaptive immune systems are activated when S. aureus is present in the nose. If not, S. aureus can circumvent host defences. Bacterial adaptability to the immune system and the colonisation process may be influenced by the exoprotein staphylokinase and the staphylococcal protein A (SpA) [7].

2.8. Risk Factors for Staphylococcus aureus Nasal Colonization

In terms of demographics and risk factors, Staphylococcus aureus colonisation can be influenced in various ways. Factors such as sex, occupation, age, ethnicity, nasal abnormalities, genetics, immunological status, hormonal status in women, recent hospitalisation, hemodialysis, HIV status, skin infections caused by Staphylococcus aureus, multiple antibiotic administrations, and repeated needle injections are included in this list [5].

2.9. Clinical Manifestations of Staphylococcus aureus Nasal Colonization

Klebsiella pneumoniae Nasal colonisation can lead to a wide range of symptoms and illnesses, from common skin infections to critical infections such septicemia, toxic shock syndrome, necrotizing pneumonia, infective endocarditis, necrotizing fasciitis, and infective endocarditis [12]. Signs of the sickness typically manifest between two and four hours following food consumption, indicating a short incubation period. Symptoms include a lack of fever, nausea, vomiting, chills, headache, and stomach cramps (with or without diarrhoea). The majority of people experience nausea, vomiting, and abdominal cramps [33]. Diseases such as toxic shock syndrome, endocarditis, osteomyelitis, life-threatening pneumonia, necrotizing fasciitis, toxic sepsis, and severe sepsis can be caused by nosocomial infections caused by MRSA strains of Staphylococcus aureus, which are resistant to many drugs [11].

2.10. Microbiology Laboratory-Based Classification of Staphylococcus aureus Nasal Carriers

There is no statistically significant difference between the two approaches for identifying S. aureus carriage in the nose, which typically entails collecting samples using commercially available dry or moistened sterile swabs [47]. The standardisation of the sampling protocol is lacking, but generally speaking, it comprises using around four rotating motions to rub the swab in the anterior nares of each nostril [16]. Following this, the swabs are examined for the existence of S. aureus. Polymerase chain reaction and chromogenic solid media culture are the two most used laboratory procedures for Staphylococcus aureus identification. The former is a more budget-friendly choice, while the latter is considered to be the best [37].

The culture rule for predicting the carrier state of Staphylococcus aureus in healthy volunteers is based on the quantitative and qualitative results of two nasal culture swabs collected about one week apart. When there are more than 103 CFU positive in both cultures, the individual is considered a persistent carrier (cfu). One is said to be an intermittent carrier when none of the cultures is positive, or when both cultures are positive but the cfu is low [40]. A look at the Bench for Staphylococcus aureus morphologically is shown in Figures 3 and 4.

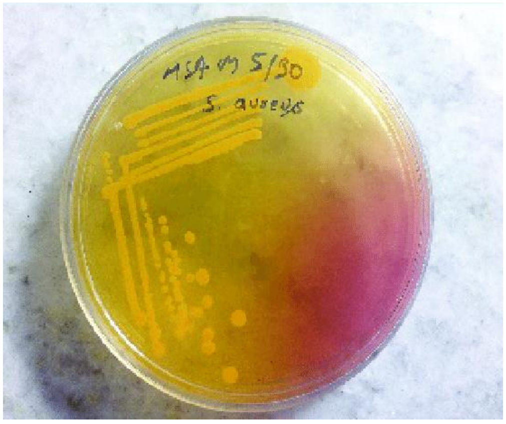

Figure 3: Staphylococcus aureus Colonies on Mannitol Salt Agar

Figure 4: Staphylococcus aureus Colonies on Blood Agar

2.11. Treatment of Staphylococcus aureus Nasal Colonization

Infections acquired outside hospitals are usually treated with pennicillinase resistant Beta-lactams. Antibiotic resistance stains often cause hospital-acquired infection and can only be treated with vancomycin.

2.12. Prevention and Control of Staphylococcus aureus Nasal Colonization

Staphylococcus aureus infection can be prevented and controlled by:

- Practicing good hand hygiene
- Personal and environmental hygiene
- Hygiene conditions for medical procedures and appropriate use of antimicrobial drugs

- Proper environmental control methods, including the regular monitoring of air, water, and surfaces.
- Stringent cleaning and disinfection of environments and equipment
- In clinical environments, isolating patients when appropriate
- Close monitoring of at-risk patients and populations.

3. Materials and Methods

3.1. Study Design

The study was a descriptive study using a simple random sampling technique to determine the prevalence of Staphylococcus aureus nasal colonization among students of the Federal School of Medical Laboratory Technology (Sciences) Jos, Plateau State.

3.2. Study Area

This study was conducted at the Federal College of Medical Laboratory Science and Technology Jos North, Plateau State of Nigeria. Jos metropolis is the administrative capital plateau state and the largest city of the state, comprising three local government areas – Jos-North, Jos-South, and Jos-East. Plateau State is the twelfth largest state in Nigeria and is roughly located in the centre of the country, with 17 local government areas and a population of about 3.5 million. Bauchi State bounds it to the northeast, Kaduna State to the northwest, Nasarawa State to the southwest, and Taraba State to the southeast. Plateau State is located in Nigeria's middle belt, with an area of 26899 square kilometres. It is located between Latitude 80°24' N and Longitude 80°32' and 100°38' E [34].

3.3. Ethical Clearance

Ethical approval was sought from the Federal College of Medical Laboratory Science & Technology ethics committee, Jos Plateau State, before the commencement of this study. Subsequently, an official letter was addressed to the relevant authorities in the selected schools to obtain permission to conduct the study in their schools.

3.4. Inclusion and Exclusion Criteria

3.4.1. Inclusion Criteria

- All students of any age and gender at the Federal School of Medical Laboratory Technology (Sciences) Jos, Plateau State.
- Only students who gave their consent were allowed to participate in the study.

3.4.2. Exclusion Criteria

- Any student not attending school at Federal School of Medical Laboratory Technology (Sciences) Jos, Plateau State.
- Students who did not consent were allowed to participate in the study.

3.5. Materials

The materials that were used for this study include Mannitol salt agar, Petri dishes, slides and cover slips, applicator sticks, a microscope, hydrogen peroxide (H_2O_2), pooled citrated plasma, test tubes, bottles, and normal saline.

3.6. Sample Size Determination

Convenient sampling size of 100 samples was used in the study.

3.7. Sampling Technique

A simple random sampling technique was used to recruit 100 students who satisfied the inclusion and exclusion criteria of this study.

3.8. Data Collection

Data such as the age and sex of the recruited students were obtained and recorded during sample collection.

3.9. Sample Collection and Transport

A sterile cotton-tipped swab was moistened in sterile normal saline, swirled inside the anterior nares and, rotated 5 times in both clockwise and anticlock, removed, and returned to their vail. After collection, samples were transported in suitable transport boxes to the bacteriology laboratory in Plateau State Specialist Hospital (PSSH) for analysis.

3.10. Bacterial Isolation

The nasal swabs were inoculated directly onto mannitol salt agar (MSA), a selective medium for the isolation of S. aureus, and the plates were incubated at 37°C for 24 hours, following the criteria of Ayepola et al. [5], with a few minor modifications. The typical β-hemolysis was checked by incubating the colonies that fermented mannitol at 37°C at night. These colonies were chosen from the MSA plates that were subcultured on blood agar. Gram staining, catalase, and coagulase tests were used for further identification.

3.10.1. Gram Staining Technique

To make smears, individual colonies of pure culture that had been incubated for 24 hours were fragmented and mixed with a drop of sterile distilled water or normal saline on a grease-free slide. The smears were first left to dry naturally before being lightly heated and passed over the flame two or three times to set them. After delicately positioning the slides on the staining rack, they were immersed in the primary stain (crystal violet) for 30-60 seconds before being washed. After 30 seconds of being added as a mordant, Gram's iodine was rinsed out. We used acetone as a decolorizer for around 5 to 10 seconds before rinsing. They were thereafter cleaned and let to air-dry after being counter-stained with neutral red for 2 minutes. Microscopists using an oil immersion objective lens with a magnification of x100 studied the smears. In contrast to Gram-negative bacteria, which were red in colour, Gram-positive bacteria were purple. The Gram-positive staphylococcus aureus bacterium has a purple colour because of its positive charge. Staphylococcus aurous Gram stain result is shown in Figure 5.

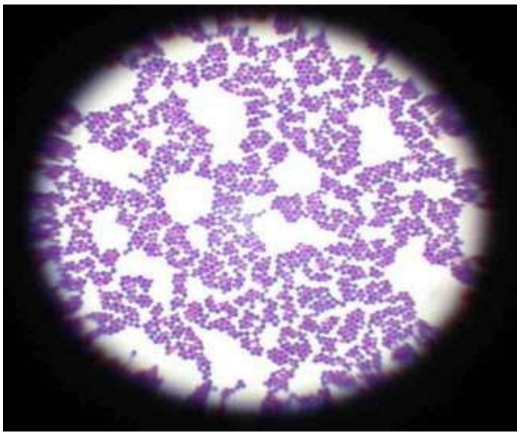

Figure 5: Staphylococcus aureus Colonies in Gram-stained film

3.10.2. Catalase Test

The slide method was used for this test with slight modification. The applicator stick was used to pick 2-3 suspected colonies from a 24-hour pure culture and emulsify them in a drop of 3% H_2O_2 placed at one end of the slide, referred to as the test. Similarly, another 2-3 suspected colonies were emulsified in a drop of normal saline as control. Immediate production of bubbles indicated a positive result, while no production of bubbles indicated a negative result. Staphylococcus aureus is a catalase-positive bacterium and, therefore, produces immediate bubbles in the hydrogen peroxide suspension.

3.10.3. Coagulase Test

The slide method was used for this test with slight modifications. A dense suspension of the suspected colonies was made by picking 2-3 pure discrete colonies from a 24-hour pure culture and emulsifying them in a clean test tube containing normal saline. Then, a clean, grease-free slide was labelled test and control. A drop of the bacteria suspension was placed on both the test and control sites, while distilled water was placed at the control site. Two drops of pooled citrated plasma followed this to the test and control sites. The contents on the slide were gently rocked and observed for agglutination within 30 to 60 seconds, indicating a positive result; otherwise, it was considered a negative result. Staphylococcus aureus is a coagulase-positive bacterium and, therefore, cross-links fibrinogens in the plasma suspension, which results in individual coccus sticking to each other, forming a visible clump or agglutination.

3.11. Statistical Analysis

The data collected in the study were sorted in Excel and analyzed using SPSS (Statistical Package for Social Science) version 27. Descriptive statistics like frequency tables and Pearson's Chi-square test were used to analyze the research objectives and hypotheses. The level of significance was set at ≤ 0.05.

4. Result Presentation

4.1. Prevalence of Prevalence of Staphylococcus aureus Nasal Colonization among the Students (Objective One)

The prevalence of Staphylococcus aureus nasal colonization was determined following positive cultures confirmed via gram staining, catalase, and coagulase test. According to Figure 6, out of the 100 pupils screened, 37.0% were S. aureus, while 63.0% did not. This indicates that the prevalence of Staphylococcus aureus nasal colonization among the students in the study was 37.0%.

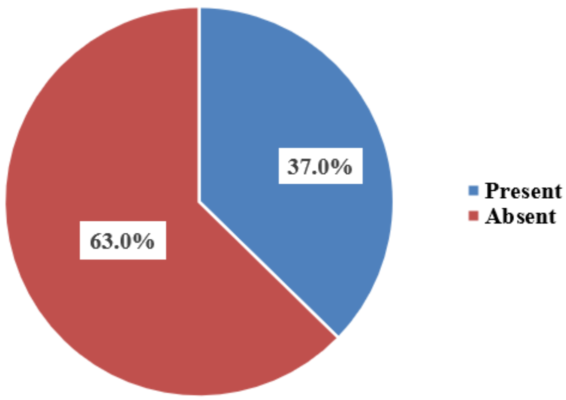

Figure 6: Prevalence of Prevalence of Staphylococcus aureus Nasal Colonization among the Students

4.2. Age-Pattern of Staphylococcus aureus Nasal Colonization Among the Students (Objective Two)

Table 1 highlights the age pattern of Staphylococcus aureus nasal colonization among the students. It indicates that Staphylococcus aureus nasal colonization was most prevalent among those aged 26 years and older (55.6%), followed by individuals aged 18 years and younger (40.0%), and then those aged 19-25 years (34.9%). However, the variance in prevalence across the age groups was found to be statistically non-significant ($p > 0.05$). Furthermore, the table reveals that urinary schistosomiasis was more prevalent in male participants (19.61%) compared to female participants (12.24%), with no statistically significant difference ($p > 0.05$) between urinary schistosomiasis and the sex of the participants.

Table 1: Sex-Pattern of Staphylococcus aureus Nasal Colonization Among the Students

Age group	No examined	No infected	%Infected
≤18 years	5	2	40.0%
19-25 years	86	30	34.9%
≥26	9	5	55.6%
Total	100	37	37.0%

**Chi-square Test ($\chi 2$) = 2.650; p < 0.761*

4.3. Sex- Pattern of Staphylococcus aureus Nasal Colonization Among the Students (Objective Two)

Table 2 highlights the sex pattern of Staphylococcus aureus nasal colonization among the students. It indicates that Staphylococcus aureus nasal colonization was more prevalent in female participants (52.0%) compared to male participants (22.0%), and the difference was statistically significant ($p < 0.001$).

Table 2: Sex-Pattern of Staphylococcus aureus Nasal Colonization Among the Students

Sex	No examined	No infected	%Infected
Male	50	11	22.0%
Female	50	26	52.0%
Total	100	37	37.0%

**Chi-square Test ($\chi 2$) = 8.650; $p < 0.001$*

5. Discussion

Our research uncovered that 37.0% of the students we surveyed were colonized with Staphylococcus aureus in their nasal passages (Figure 6). This prevalence differs from similar studies, which reported rates of 72.7% in Delta, South-South Nigeria, 56.3% in Owerri, southeast Nigeria, 56.7% in Ogun, Southwest Nigeria [5], and 37.3% in Plateau, North-central Nigeria [8]. We believe that the variation in prevalence can be attributed to the geographical differences between the study locations. However, the similar prevalence found in the previous study in Plateau State by Damen et al. [8] may be due to the students' similar risk of exposure. This similarity might be because both Federal School students and University of Jos students undergo clinical training in the same hospitals—Plateau Specialist Hospital (PSSH) and Jos University Teaching Hospital (JUTH).

The investigation into the age pattern of Staphylococcus aureus nasal colonization demonstrates a non-discernible related pattern. Notably, the incidence is more prevalent among the older cohort (26 years and older, 55.6%) (Table 1). This study's finding is inconsistent with Damen et al.'s previous study in Plateau state [8]; here, Staphylococcus aureus nasal colonization was more common among the younger cohort. However, both studies recorded non-significant ($p > 0.05$) variation between Staphylococcus aureus nasal colonization and age. This indicates that regardless of age, the students have a relatively similar exposure risk. In terms of gender, the prevalence rate among female students was 52.0%, while among male students it was 22.0% (Table 2). This observation aligns with the findings of Assafi et al. [4], Muhammad et al. [31], and Damen et al. [8]. The significantly ($p <0.001$) higher incidence rate in females compared to males may be associated with cultural practices in the study area and other parts of Nigeria. It is common for females to be extensively engaged in activities involving contact with various surfaces, such as fetching water, assisting with cooking, laundry, childcare, and cleaning, which results in a higher risk of exposure.

6. Conclusion

Staphylococcus aureus is one of the actively mentioned resistant bacteria. The nasal carriage is a potential source and carriage of such bacteria, especially among healthcare givers, including medical laboratory professionals. The continuous spread, as well as risk factors for subsequent infections of the bacteria, is of deep concern. The present study investigated the carriage prevalence of Staphylococcus aureus nasal colonization among students of a tertiary institution in Jos, the Federal School of Medical Laboratory Sciences and Technology Jos, Plateau State, Nigeria. The volunteers are medical laboratory technicians who have completed their medical laboratory postings in some hospitals in Jos. One hundred nasal swab specimens were obtained from randomly selected students from the school, as mentioned above. After the medical laboratory procedures for isolating the bacteria, the study established an overall Staphylococcus aureus nasal colonization prevalence of 37.0%. The incidence rate based on age showed a higher prevalence among students aged 26 years and older (55.6%), followed by those aged 18 years and younger (40.0%), and then those aged 19-25 years (34.9%). However, the variation in the incidence pattern was statistically non-significant ($p > 0.05$). Also, the sex-related incidence rate showed a statistically significant ($p < 0.001$) higher prevalence in females, 52.0%, than in male students, 22.0%. Finally, it's concerning that Staphylococcus aureus nasal colonisation was relatively common in this study, particularly among the female participants. Concerningly, this study found a rather high rate of Staphylococcus aureus nasal colonisation, particularly among the female sample. This lends credence to the idea that the anterior nares are still a major holding tank for S. aureus, and that its dangerous varieties should be eradicated as they cause the worst cases of community- and hospital-acquired infections in those who have colonised them.

6.1. Recommendations

From the study, the following recommendations are made:

- Adequate attention should be paid to public awareness campaigns, health education programs, and cleanliness and hygiene within the study area.
- Infected individuals in the study area should be identified through government-assisted house surveys and adequately treated.
- More related research is highly recommended to ascertain that the disease is not endemic in the study area.

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