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Assessing the prevalence of Staphylococcus aureus in (UTIs) patients age groups

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تقييم انتشار المكورات العنقودية الذهبية في الفئات العمرية للمرضى المصابين بالتهابات المسالك البولية

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Abstract:
Background: *Staphylococcus aureus*, a bacterium of significant clinical importance, is recognized as the etiological agent responsible for an extensive array of infections that can affect both individuals receiving outpatient care as well as those who are admitted to hospitals for medical treatment. This particular microorganism is widely acknowledged as one of the most prevalent contributors to the incidence of nosocomial infections, which are infections acquired in hospital settings, across numerous healthcare facilities in various countries situated around the globe.
Objectives: the primary objective of the research being conducted in this study is to meticulously assess and analyze the prevalence and distribution of the bacterium *Staphylococcus aureus* within the context of urinary tract infections (UTIs) among patients of varying ages and sexes within the designated geographical area under investigation.
Methods: The present investigation was meticulously carried out at the Sabratha Central Hospital over an extensive timeframe spanning from September to November 2025., during which a comprehensive analysis was undertaken. The biological samples were systematically collected from a cohort of patients diagnosed with urinary tract infections (UTIs), comprising a total of 572 individuals, among which 377 were identified as females and 195 as males, all of whom were duly registered participants in this particular research endeavor, and both urine and semen samples were acquired under strictly aseptic conditions to ensure the integrity of the subsequent microbial culture analyses. Furthermore, the patients involved in this study were categorized into a total of 17 distinct age groups, allowing for a nuanced examination of the data across various demographic segments.
Results: A comprehensive analysis involving 572 patients, comprising 377 females and 195 males, was performed with urine samples cultured on CLED agar for microbiological assessment. In female samples, The age group 21-25 showed the highest infection rate at 19.84%, followed by 26-30 years at 16.79%, highlighting the prevalence of urinary tract infections in these demographics. In male samples, the 0-5 years age group had the highest infection rate at 37.75%, succeeded by the 6-10 years group at 7.14% of positive samples collected. A meticulous analysis of 69 male patients undergoing semen analysis involved culturing samples on CLED agar for microbiological evaluation, revealing 21 samples with positive microbial growth. The age group 36-40 demonstrated the highest infection rate at 33.33%, followed by 26-30 years at 28.57%, emphasizing significant public health implications.

Keywords: UTI- S, aureus, male, female, age groups.

الملخص

الخلفية: تُعد المكورات العنقودية الذهبية (Staphylococcus aureus) من البكتيريا ذات الأهمية السريرية البالغة، حيث تمثل العامل المسبب لمجموعة واسعة من الالتهابات التي تصيب كلًّا من المرضى المنوّمين في المستشفيات والمرضى المراجعين للعيادات الخارجية. وتُعتبر هذه البكتيريا من أكثر مسببات العدوى المكتسبة في المستشفيات شيوعًا على مستوى العالم.

الأهداف: يهدف هذا البحث إلى تقييم وتحليل مدى انتشار المكورات العنقودية الذهبية وتوزيعها ضمن التهابات المسالك البولية (UTIs) بين المرضى بمختلف الأعمار والجنسين في المنطقة الجغرافية محل الدراسة.

الطرق: أُجريت الدراسة في مستشفى صبراتة المركزي خلال الفترة من سبتمبر إلى نوفمبر 2025. جُمعت العينات البيولوجية من 572 مريضًا مصابًا بالتهابات المسالك البولية (377 إناثًا و195 ذكورًا). تم الحصول على عينات البول والسائل المنوي في ظروف معقمة، وزُرعت العينات على وسط CLED للتحليل الميكروبيولوجي. كما جرى تصنيف المرضى إلى 17 فئة عمرية لزيادة دقة التحليل الديموغرافي.

النتائج: أظهرت النتائج أن الفئة العمرية (21–25 سنة) لدى الإناث سجّلت أعلى معدل إصابة بالتهابات المسالك البولية بنسبة 19.84%، تلتها الفئة (26–30 سنة) بنسبة 16.79%. أما لدى الذكور، فقد سُجّلت أعلى نسبة إصابة في الفئة العمرية (0–5 سنوات) بنسبة 37.75%، تلتها الفئة (6–10 سنوات) بنسبة 7.14%. كما كشف تحليل عينات السائل المنوي لدى 69 مريضًا عن نمو ميكروبي إيجابي في 21 عينة، حيث سُجّلت أعلى نسبة إصابة في الفئة (36–40 سنة) بنسبة 33.33%، تلتها الفئة (26–30 سنة) بنسبة 28.57%.

الكلمات المفتاحية: المكورات العنقودية، التهاب المسالك، الذكور، الإناث، الفئات العمرية.

Introduction

Uren contamination: Urinary tract infections, commonly referred to as UTIs, represent one of the most frequently occurring bacterial infections that afflict individuals across various demographics and can lead to significant health complications if left untreated. Research has indicated that symptomatic urinary tract infections contribute to an astonishingly high number of medical consultations, resulting in approximately 7 million visits to outpatient clinics, an additional 1 million visits to emergency departments, and a concerning 100,000 hospitalizations on an annual basis (**Schappert 1999)**. These infections have escalated to the status of being the predominant type of infection acquired within hospital settings, comprising a staggering 35% of all nosocomial infections reported, while also standing as the second most prevalent cause of bacteremia among patients who are hospitalized, (**Stamm , 2002 and Weinstein *et al.* ,1990)**. The financial burden imposed on the healthcare system of the United States due to community-acquired urinary tract infections alone is estimated to be a remarkable $1.6 billion annually **(Foxman 2002).** Urinary tract infection (UTI) can be comprehensively defined as the complex pathological process characterized by the active proliferation and subsequent colonization of various microorganisms, including bacteria, fungi, and viruses, within the intricate structures and functional compartments of the urinary tract, which consists of the kidneys, ureters, bladder, and urethra, ultimately leading to a spectrum of clinical manifestations that may range from mild discomfort to severe systemic illness (**Akter *et al.*, 2016)**. Numerous taxa of both Gram-positive and Gram-negative bacteria have been identified as significant etiological agents in the pathogenesis of urinary tract infections (UTIs). Staphylococcus aureus is regarded as the preeminent staphylococcal pathogen affecting humans and poses considerable challenges within the field of human medicine. (**Coates *et al.*, 2014)**.

Staphylococcus aureus bacteriuria, commonly referred to in the scientific literature as SABU, constitutes a relatively uncommon clinical phenomenon, with prevalence rates that range from approximately 0.8% to 4.3%, and this occurrence can be intricately linked to various underlying conditions such as asymptomatic colonization of the urinary tract, the initial onset of urinary tract infections that are associated with the use of indwelling catheters, as well as the potential for hematogenous seeding that occurs in patients who are diagnosed with Staphylococcus aureus bacteremia, often abbreviated as SAB **(Al Mohajer *et al*., 2013).**

Schuler *et al.* (2020) documented that, cumulatively, 245 individuals receiving care at the University Hospital Münster, Germany, during the period spanning from January 1, 2012, to December 31, 2019, satisfied the specified inclusion and exclusion criteria. Among the 245 subjects diagnosed with SABU, 66 individuals exhibited a concomitant occurrence of SAB, representing a prevalence of 26.9%. The presence of elevated C-reactive protein (CRP) levels was found to be significantly correlated with the incidence of SAB. Conversely, other analyzed parameters, including leukocyte counts and comorbid conditions, did not demonstrate a significant association with SAB in the context of a multivariate analytical framework. In conclusion, the observed prevalence of SAB among patients afflicted with SABU was notably elevated, thereby necessitating proactive screening for bloodstream infections in hospitalized individuals, especially in the presence of heightened CRP levels.

SAB was characterized as the identification of *S. aureus* in a minimum of one blood culture. The duration between SABU and SAB was defined as the interval from the sample collection date of the initial SABU to the first SAB documented during the course of hospitalization. Cefazolin or Flucloxacillin administered intravenously for the management of methicillin-susceptible S. aureus, as well as vancomycin, linezolid, or Daptomycin for the treatment of methicillin-resistant S. aureus (MRSA), were regarded as efficacious antimicrobial interventions. **(Holland *et al.*, 2014)**

The preponderance of urinary tract infections, commonly referred to as UTIs, can be attributed primarily to the presence of *Escherichia coli*, a specific strain of bacteria, which is subsequently followed in frequency by other bacterial species such as *Proteus spp., Staphylococcus saprophyticus, Klebsiella spp.,* along with various other members of the *Enterobacteriaceae* family **(Kahlmeter 2000)**. It is noteworthy to mention, however, that when considering the spectrum of bacteria that are implicated in the etiology of urinary tract infections, *E. coli* is unequivocally recognized as the most significant and prevalent causative agent, playing a central role in both community-acquired and healthcare-associated infections, commonly referred to as nosocomial UTIs. The array of antibiotics that are frequently endorsed for the effective treatment of UTIs encompasses a range of options, including but not limited to co-trimoxazole, ciprofloxacin, and ampicillin **(Foxman 2014).** Nonetheless, it is imperative to highlight the alarming global trend of increasing antibiotic resistance that has been observed among pathogens responsible for urinary tract infections, a concerning pattern of resistance that has also been documented within the context of Saudi Arabia, as evidenced by the research conducted by) Al **Yousef *et al.*, 2016).**

Muder *et al.*, (2006) conducted a study involving 102 patients and discovered that 82% had recently undergone urinary catheterization. At the time of the initial isolation of Staphylococcus aureus, 33% of patients presented with symptomatic urinary tract infections, and 13% exhibited bacteremia. The authors also concluded that Staphylococcus aureus serves as a contributory factor in urinary tract infections among individuals with urinary catheters. The predominant isolates identified were methicillin-resistant Staphylococcus aureus. Furthermore, Staphylococcus aureus bacteriuria has the potential to result in subsequent invasive infections. The effectiveness of antistaphylococcal therapy in mitigating the risk of late-onset staphylococcal infections in patients exhibiting persistent staphylococcal bacteriuria warrants investigation through controlled clinical trials.

The predominant instances of *S. aureus* bacteriuria lack correlation with manifestations indicative of urinary tract infection **(Demuth *et al.*, 1979)**. Given that bacteriuria almost invariably occurs concurrently with prolonged urinary catheterization **(Warren *et al.*, 1987)**, the clinical implications of isolating *S. aureus* from urine in these patients remain ambiguous. The distinction between asymptomatic bacteriuria and clinically significant urinary tract infection poses considerable challenges within the geriatric population **(Nicole *et al.*, 1988).**

Semen contamination:

Staphylococcus aureus was identified as one of the bacterial species causing semen infections in male infertility patients. However, the study found that the overall rate of bacterial infections in semen was low, at 1.38%. While Staphylococcus aureus isolates were resistant to penicillin, the research primarily highlighted Escherichia coli as the most common pathogen. The presence of bacterial infection, including Staphylococcus aureus, negatively impacted sperm motility and density, affecting the fertilization process **(Yin *et al.*, 2018).**

Semen infection by Staphylococcus aureus can significantly deteriorate semen quality. In a study involving 48 semen ejaculates from healthy bucks, 52.08% tested positive for *Staphylococcus spp*., including *S. aureus*. The presence of this bacterium, along with others, was confirmed through Gram staining, growth on Mannitol salt agar, and multiplex PCR. The findings highlight the importance of maintaining the health and hygiene of bucks to prevent contamination and ensure quality semen for artificial insemination **(Gangwar *et al.*, 2022).** On the other hand, Staphylococcus aureus was identified in 61.9% of the infected semen samples from infertile males. The presence of *S. aureus* significantly decreased sperm concentration and motility, indicating its detrimental effect on sperm quality. This bacterium, being coagulase positive, is considered pathogenic and can lead to reduced sperm function, potentially contributing to male infertility. The findings highlight the importance of evaluating and treating bacterial infections in semen to improve reproductive outcomes **(Berjis *et al.*, 2018).** Infections of Staphylococcus aureus in the male reproductive system can lead to decreased sperm motility, as demonstrated in a study involving 60 strains isolated from the semen of 589 infertile men. The research found that 17 of these strains significantly reduced sperm motility ($P < 0.05$). The study suggests a potential association between the virulence gene scn, which encodes a complement inhibitor, and the spermatozoal immobilization effect caused by Staphylococcus aureus infections **(Li *et al.*, 2015).**

Materials and Methods

Study area: The current research endeavor was meticulously carried out at the Sabratha Central Hospital, a prominent medical facility, during the specific timeframe extending from the month of September to the month of November in the year 2025.

Sampling: The samples were collected from UTIs patients (*n*= 572): (377) females and (195) males, who were registered in this research and the urine samples were taken aseptically for microbial culture. The sterile containers were properly labelled with the name, age and sex of the patients. The samples were cultured immediately after collection.

Uren samples: Patients were meticulously identified through the comprehensive analysis of microbiology laboratory reports, a process conducted by trained infection-control practitioners during their routine surveillance activities aimed at monitoring and evaluating infection trends. All individuals for whom Staphylococcus aureus was successfully isolated from urine cultures that had been ordered by the physicians of these patients for specific clinical indications were systematically entered into a carefully designed prospective, observational study intended to investigate various aspects of this pathogen. At the time of entry into the study, nares cultures were meticulously obtained to facilitate further analysis and understanding of the nasal colonization status of the participants involved. The clinical isolates of Staphylococcus aureus were precisely identified utilizing the advanced Vitek system developed by bioMérieux, which employs standard criteria to ensure accurate detection and characterization of this significant microorganism.

semen samples: Semen specimens were procured following a period of sexual abstinence lasting between three to five days. Participants were instructed to void and cleanse their hands, penis, and scrotum prior to ejaculation in order to mitigate the risk of contamination from urine or external genitalia. The samples underwent examination subsequent to a liquefaction period of thirty minutes at 37°C, during which parameters such as volume, pH, concentration, morphology, and motility were evaluated in accordance with the guidelines established by the World Health Organization (WHO) (14). Specimens were inoculated onto agar and EMB plates utilizing a calibrated loop, and the plates were incubated overnight at 37°C in an atmosphere of normal air supplemented with 5% CO2. The identification of microorganisms was conducted through Gram staining, as well as catalase and coagulase assays.

Results

A comprehensive analysis involving a total cohort of patients, specifically numbering 572 individuals, was conducted, which included a subset of 377 female participants whose urine samples were meticulously cultured on CLED agar medium for the purposes of microbiological evaluation. Among these examined urine samples, it was determined that 131 females exhibited positive microbial growth on the CLED agar, indicating a significant presence of urinary pathogens in this population.

The data that has been systematically presented in Table 1 elucidates that the age group categorized as 21-25 years demonstrated the highest recorded infection rate, which was quantified at an alarming 19.84% of the total number of positive samples collected; this was closely followed by the subsequent age group of 26-30 years, which revealed a slightly lower, yet still concerning, percentage of infection at 16.79%, thereby underscoring the prevalence of urinary tract infections within these specific demographic brackets.

Table 1: The prevalence rate of urinary tract infections (UTIs) attributable to Staphylococcus aureus expressed in percentage terms among the female population.

Age Range	Negative	positive	Total	% from the total prevalence
0 - 5	62	9	71	6.87
6 – 10	38	10	48	7.63
11 – 15	12	10	22	7.63
16 – 20	6	8	14	6.10
21 – 25	30	26	56	19.84
26 – 30	24	22	46	16.79
31 – 35	19	14	33	10.68
36 – 40	19	8	27	6.10
41 – 45	11	4	15	3.05
46 - 50	4	4	8	3.05
51 – 55	7	3	10	2.29
56 – 60	7	5	12	3.81
61- 65	3	0	3	0
66 - 70	3	3	6	2.29
71 – 75	1	2	3	1.52
76 – 80	0	2	2	1.52
81 -85	0	1	1	0.76
Total	246	131	377	34.74

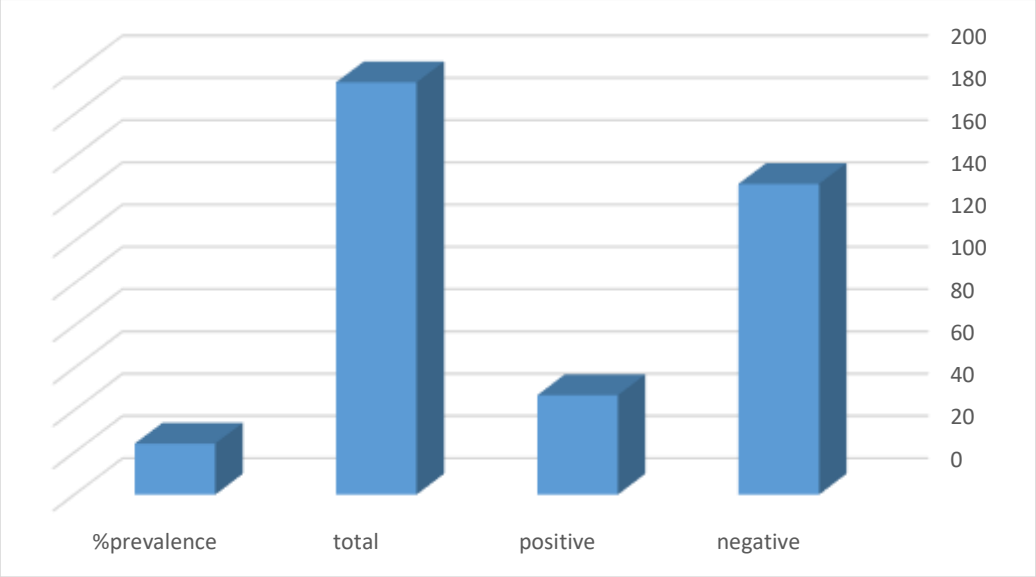

Figure (1): the proportion of male prevalence, cumulative total, as well as the counts of both negative and positive specimens in male samples.

A thorough and extensive examination that encompassed a total population of patients, specifically amounting to 572 individuals, was meticulously executed, which notably included a defined subset of 195 male participants whose urine samples were rigorously cultivated on CLED agar medium for the explicit purpose of microbiological assessment and evaluation. Among the multitude of urine samples that were scrutinized during this comprehensive investigation, it was conclusively determined that 47 of these samples exhibited positive microbial growth on the CLED agar, thereby indicating a significant prevalence of urinary pathogens within this particular demographic cohort.

The data that has been systematically organized and presented in Table 2 serves to elucidate the findings that reveal the age group classified as 0-5 years exhibiting the highest recorded rate of infection, a figure that was quantified at an alarmingly high percentage of 37.75%, which was subsequently followed by the age group categorized as 6-10 years, demonstrating an infection percentage of 7.14% of the total number of positive samples that were collected during the course of this analysis.

Table 2: The prevalence rate of urinary tract infections (UTIs) attributable to Staphylococcus aureus expressed in percentage terms among the male population.

Age Range	Negative	positive	Total	%from the total prevalence
0 - 5	38	12	50	37.75
6 – 10	32	8	40	7.14
11 – 15	6	5	11	3.06
16 – 20	1	1	2	2.04
21 – 25	9	1	10	3.06
26 – 30	7	3	10	2.04
31 – 35	6	2	8	4.08
36 – 40	15	1	16	5.10
41 – 45	10	3	13	0
46 -50	5	3	8	4.08
51 – 55	5	3	8	2.04
56 – 60	4	0	4	2.04
61- 65	3	1	4	2.04
66 - 70	3	0	3	2.04
71 – 75	1	1	2	3.06
76 – 80	2	1	3	6.12
81 -85	0	1	1	4.08
86 – 90	0	1	1	4.08
91 – 95	0	12	1	4.08
Total	147	47	195	24.1

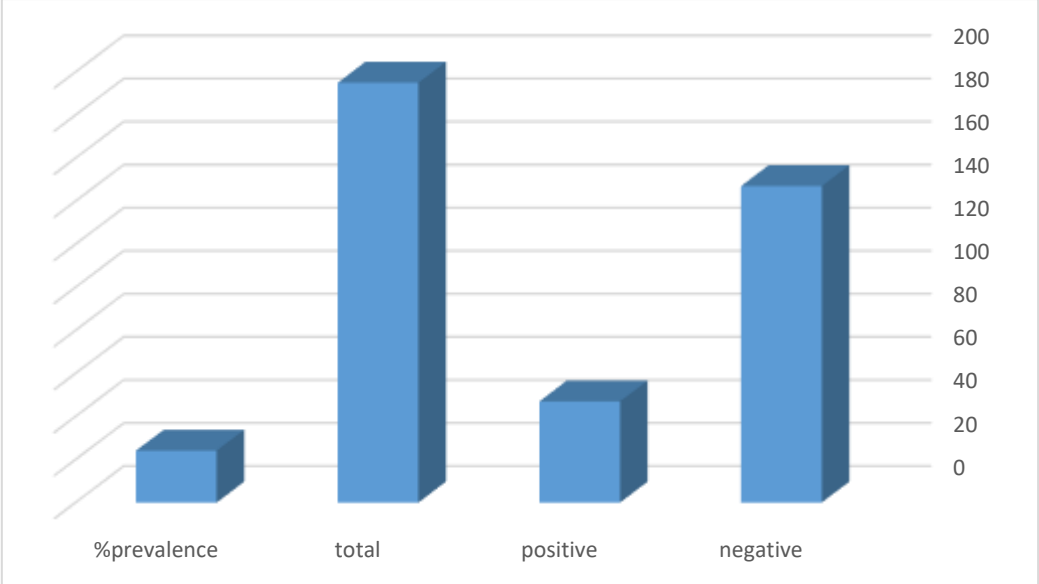

Figure (2): the proportion of male prevalence, cumulative total, as well as the counts of both negative and positive specimens in female samples.

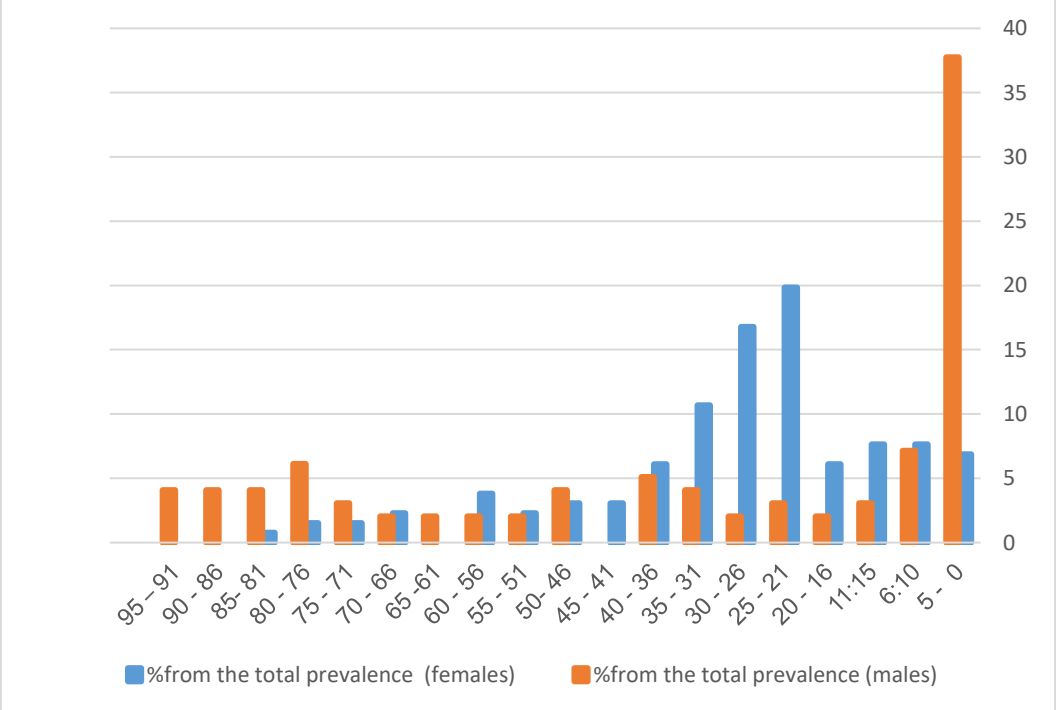

Figure (3): percentage of male and female prevalence for all age groups.

A meticulous and comprehensive analysis, which involved an extensive cohort composed exclusively of male patients, with a specific tally amounting to 69 individuals who were subjected to a rigorous semen analysis, resulted in the careful culturing of samples on agar medium, all aimed meticulously at achieving a thorough microbiological evaluation of the specimens. Within the array of samples that were subjected to examination, it was conclusively determined that 21 of these samples exhibited a notable presence of positive microbial growth when cultured on the CLED agar, indicating significant microbial activity.

The data that has been systematically and methodically presented in Table 3 serves to elucidate the findings, revealing that the age group specifically categorized as being between 36 and 40 years of age exhibited the highest recorded infection rate, which was quantified at a concerning rate of 33.33% of the total number of positive samples that were collected; this alarming statistic was closely followed by the subsequent age group categorized as 26 to 30 years, which recorded an infection rate of 28.57%, thereby underscoring the significant public health implications associated with these findings.

Table 3: Prevalence rate of urinary infections caused by S. aureus as a percentage in semen samples.

Age Range	Negative	Positive	Total	%from the total prevalence
21- 25	2	1	3	4.76
26 – 30	4	6	10	28.57
31- 35	8	2	10	9.52
36 -40	2	7	9	33.33
41 – 45	1	3	4	14.28
46 – 50	2	1	3	4.76
51 – 55	19	1	20	4.76
Total	38	21	69	30.43

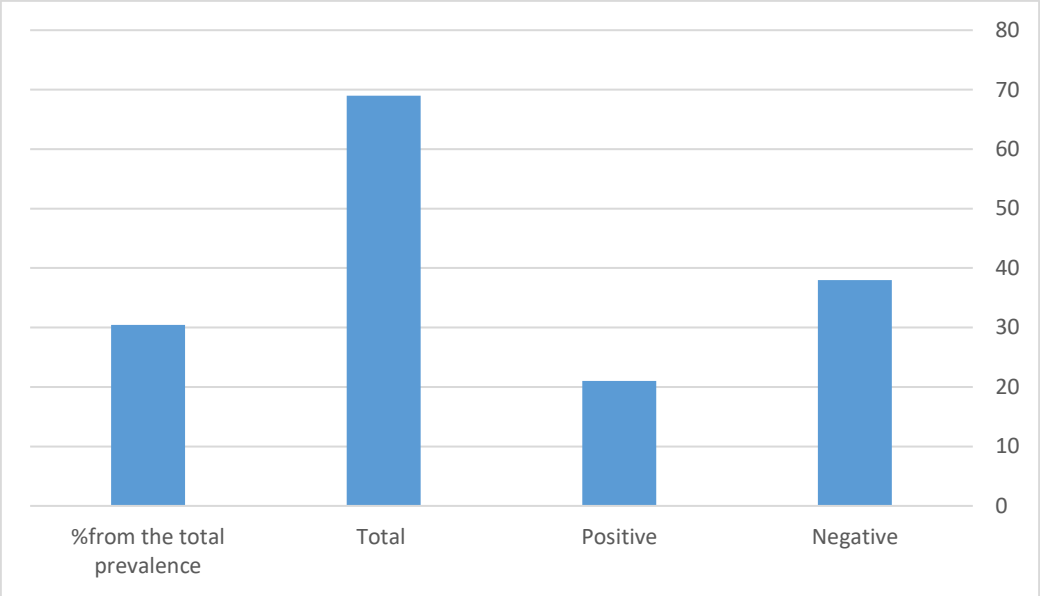

Figure (4): the proportion of semen occurrence, aggregate quantity, as well as negative and positive specimens.

Discussion

In female cohorts, the age category of 21 to 25 years exhibited the most elevated infection rate at 19.84%, succeeded by the 26 to 30 years age group at 16.79%, thereby underscoring the prominence of urinary tract infections within the sampled population. These findings are consistent with those reported by **Elkhouly *et al.* (2025)b,** who determined that the demographic segment of individuals aged 11 to 20 years presented the highest prevalence of infection at 22.03% among the total positive samples, whereas the lowest prevalence was recorded at 9.32% within the demographic exceeding 60 years of age. Within the female demographic, the peak infection prevalence was documented at 21.43% in the 0 to 10 years age range, in contrast to the minimal infection rate of 7.14% observed within the 41 to 50 years age bracket.

In male cohorts, the age demographic of 0-5 years exhibited the highest prevalence of infection at 37.75%, followed by the 6-10 years demographic with a rate of 7.14% among the positive samples collected. **Rahman *et al.* (2001)** deduced that within the age bracket of 61-80 years, males presented a urinary tract infection rate of 17%, while females demonstrated a rate of 8%, indicating a 9% higher prevalence in males within this specific age range. The age category exceeding 80 years displayed a prevalence rate of 7%, which is comparatively lower than the rates observed across all age groups. Conversely, in a multicenter, community-based investigation conducted in Great Britain, S. aureus constituted a mere 0.5% of the isolates **(Bours *et al.*, 2010)**. Similarly, a laboratory-based study executed in France reported that S. aureus comprised only 1.3% of the isolates derived from urine specimens submitted from the community **(Goldstein, 2000)**. Previous research indicates that the isolation of S. aureus from urine is frequently a secondary consequence of staphylococcal bacteremia originating from an alternate site (e.g., in instances of endocarditis). Musher and **McKenzie (1977)** asserted that the isolation of S. aureus from urine samples in the absence of bacteremia is typically deemed to reflect colonization. Furthermore, within particular patient populations, S. aureus can emerge as a significant primary urinary pathogen. For instance, MRSA urinary tract infections manifest both in an endemic and epidemic manner among individuals undergoing urological surgical interventions **(Araki *et al.*, 2002).** MRSA bacteriuria is also observed in long-term care patients and is significantly correlated with urinary catheterization and antibiotic administration **(Coll *et al.*, 1994).**

A comprehensive examination involving 69 male subjects undergoing semen analysis was conducted through the culturing of samples on agar for the purpose of microbiological assessment, which identified 21 samples exhibiting positive microbial proliferation. The demographic cohort aged 36-40 years demonstrated the highest incidence of infection at 33.33%, succeeded by the 26-30 year age group at 28.57%, underscoring notable public health ramifications. These findings are corroborated by numerous studies that recognize the demographic segment of 30-39 years as the most adversely affected by Staphylococcus aureus infections in semen. For instance, an investigation carried out at the Mombasa Assisted Reproduction Centre discovered that the prevalence of bacteriospermia, with Staphylococcus aureus as the predominant pathogen, was most pronounced in this age cohort **(Thanki *et al.*, 2022).** Likewise, research conducted in Omara City indicated that 64% of Staphylococcus haemolyticus infections, a closely related species, were prevalent among males aged 30-39, suggesting a pattern of bacterial infections compromising fertility within this demographic **(AL-Ghizzawi and Jomaa, 2018).** Moreover, **Elkhouly *et al.* (2025)b** concluded that The antimicrobial susceptibility data reveals significant variability in antibiotic effectiveness across different bacterial species. Augmentin (AMC) consistently demonstrated high efficacy, showing notable sensitivity against *E. coli*, Klebsiella spp., and Staphylococcus aureus. In contrast, Oxacillin (OX) and Ofloxacin (OFX) frequently exhibited complete resistance, particularly against E. coli, Klebsiella spp., and S. aureus, indicating potential ineffectiveness of these agents in treating infections caused by these organisms. Ceftazidime (CAZ) and Amikacin (AK) showed strong activity against Enterobacter and Klebsiella spp., respectively, while high resistance rates were observed for commonly used antibiotics such as Cefixime (CFM), Erythromycin (E), and Ciprofloxacin (CIP) in multiple isolates, including Pseudomonas and Staphylococcus species.

Conclusion: A study of 572 patients, including 377 females and 195 males, utilized CLED agar for microbiological analysis of urine samples. The 21-25 age group exhibited the highest urinary tract infection rate at 19.84%, with the 26-30 group following at 16.79%. In male subjects, the 0-5 age cohort recorded the highest infection rate at 37.75%, with the 6-10 age group at 7.14% of positive samples. An analysis of 69 male patients undergoing semen evaluation involved CLED agar culturing, identifying 21 samples with positive microbial growth. The 36-40 age group showed the highest infection rate at 33.33%, with the 26-30 group at 28.57%, highlighting notable public health concerns.

Compliance with ethical standards

Disclosure of conflict of interest

The authors declare that they have no conflict of interest.

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