



Burden of Urinary Tract Infection (UTI) among Female Students: South Eastern Nigeria Side of the Story

Ani Ogonna Christiana^{1*}, Odeta Nwamaka Perpetua² and Onwe Sunday Obasi¹

¹*Department of Biological Sciences, Ebonyi State University, Abakaliki, Nigeria.*

²*Department of Applied Microbiology, Ebonyi State University, Abakaliki, Nigeria.*

Authors' contributions

This work was carried out in collaboration between all authors. Author AOC designed the work, coordinated and served as the principal supervisor. Author ONP wrote the protocol and author OSO searched the literatures. All the authors participated in the laboratory investigation, read and approved the final manuscript.

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ABSTRACT

Aims: This study investigated the prevalence of infection, implicated bacteria species and antibiotics for better treatment of Urinary Tract Infection (UTI) among undergraduate female students of the Ebonyi State University Abakaliki, South East Nigeria.

Study Design: The study was a laboratory - based investigation.

Place and Duration of the Study: The investigation was carried out at the Applied Microbiology Laboratory, Ebonyi State University, Abakaliki, Nigeria between April and August 2014.

Methodology: Microscopy and culture of 150 urine samples of female undergraduates were carried out using standard methods to isolate bacteria causing UTI. Sensitivity tests were also conducted to identify susceptibility of the isolates to selected antibiotics.

Results: The results obtained showed that 117 (78%) out of the 150 females students screened were positive for significant (UTI). The micro-organisms isolated in order of prevalence included;

*Corresponding author: Email: ogonna_ani@yahoo.com;

E. coli (35.9%), *Staphylococcus* Spp (29.9%), *Streptococcus* spp (12.8%), *Proteus* spp (11.1%) and *Pseudomonas aeruginosa* (10.3%). Among the different antibiotics used against the isolates, ciprofloxacin was the most effective, followed by augumentin and gentamicin while the isolates were resistant to ampicillin and tetracycline.

Conclusion: The prevalence of UTI is high in the study population and females at the peak of their sexually active years are more prone to infection than the younger ones. Bacteriuria is therefore still an issue of serious public health importance in Nigeria. *E. coli* was implicated as the greatest causative agent of bacteriuria and ciprofloxacin was the most sensitive antibiotic against the bacteria isolates. To successfully control the transmission and menace caused by UTIs, improvement of both personal and environmental hygiene and health education on the transmission and causes of this infection are recommended. Proper diagnosis and treatment of infected individuals with highly sensitive antibiotics such as ciprofloxacin, augumentin and gentamicin are also encouraged.

Keywords: Urinary; tract; infection; students; isolates; antibiotics; females.

1. INTRODUCTION

Urinary Tract Infection (UTI) is an infection of the urinary tract comprising kidney, ureters, bladder and urethra. (UTIs) are of global public health importance and contribute significantly to the cost of providing health care in both economically developed and underdeveloped countries. Urethritis, cystitis, haematuria and pyelonephritis are the infections of the urinary tract caused by bacteria such as *Staphylococcus saprophyticus*, *Schistosoma haematobium*, *Escherichia coli*, *Enterococcus* spp, *Proteus* spp, *Streptococcus* spp, *Klebsiella* spp and *Pseudomonas* spp [1]. Kunin defined (UTI) as the microbial invasion of any of the tissues of the urinary tract extending from the renal cortex to the urethra meatus [2]. The two types of UTI are lower UTI which is an infection of the lower part of the urinary tract (the bladder and Urethra) and upper UTI which is an infection of the upper part of urinary tract (the kidneys and ureters). The upper UTI is potentially more serious than the lower one because there is a possibility of kidney damage [3].

In man, the urinary tract is the second commonest site, after the respiratory tract for bacterial infection [4]. It consists of the kidneys (in the upper urinary tract) and the bladder (in the lower urinary tract) and accessory structures. The kidneys act as a specialized filtering system to cleanse the blood of many waste materials while selectively absorbing other substances that can be utilized. The urinary tract is an anatomical unit and infection of one part could generally spread to other parts [5].

When the infection is localized at such single sites as the kidneys, it is referred to as pyelonephritis, to the urethra as urethritis or

restricted to the bladder as cystitis and to the prostate as prostatitis. It affects both old and young leading to a number of deaths either from acute infection or from chronic renal failure [6]. The incidence of urinary tract infections is greatly influenced by age and sex and by other predisposing factors that impair the defence mechanism that maintain the sterility of the normal urinary tract [3]. The incidence of the infections is high in women (20-50%) of whom will suffer a clinical episode during their life time. This high incidence is because of the anatomical nature of their reproductive organ [6]. Host factors such as changes in normal vaginal flora may also increase the risk of UTI. In young sexually active women, sexual activity is the cause of 75-90% of bladder infections, with the risk of infection related to the frequency of sex [3]. The term "honeymoon cystitis" has been applied to this phenomenon of frequent UTIs during early marriage. Genetic factors, including expression of HLA-A₃ and Lewis blood group Le(a-b-) or Le (a+b-), may also put women at higher risk for recurrent UTI. Post-menopausal women are at higher risk for UTI than younger women are, because they lack estrogen, which is essential to maintain the normal acidity of vaginal fluid. This acidity is critical to permitting the growth of *Lactobacillus* in the normal vaginal flora, which acts as a natural host defence mechanism [7].

Most UTIs are caused by bacteria that can live in the digestive tract, the vagina or around the urethra. Infections occur when such bacteria enter the normally sterile urinary system and multiply there. They produce enzymes which help them feed on tissues of the host and thus damage them [8]. Bacteria can enter the urinary system through the urethra or more rarely

through the blood stream [9]. Poor toilet habits, pregnancy in women and prostate enlargement in men can predispose one to infection.

The etiological and clinical presentation of UTI is similar in both industrialized and developing nations but the range of infections varies from place to place [10]. The symptoms range from low grade fever, frequent and urgent micturition, painful micturition to being very ill with shaking chills and temperature hikes to 42°C, or 43°C and excruciating pain in one or both flanks [11]. These symptoms can also be for other ailments, thus the need for a definitive diagnosis before the commencement of treatment.

Urine culture is traditionally the gold standard for diagnosing UTI, and though a culture showing no growth essentially rules out UTI caused by the most common organisms, sensitivity and specificity will vary depending on the threshold colony count used and whether a specimen is obtained by catheterization or other methods [12]. Requests for determining significant bacteria through culture and sensitivity far outstrip any other laboratory requests. It, however, takes 48 hrs to get a result and a lot of samples turn out to have significant bacteriuria. Another test, urine microscopy, looks for the presence of red blood cells, white blood cells, bacteria or components. In complicated or questionable cases, it may be useful to confirm the diagnosis via urinalysis, looking for the presence of urinary nitrites. The increased prevalence of drug resistant bacteria has made susceptibility testing particularly important. Antibiotic sensitivity can be tested with these cultures, making them useful in the selection of antibiotic treatment.

UTIs can be prevented by having adequate fluid intake, especially water, not resisting the urge to urinate, taking showers not bath, practicing good hygiene, cleaning genital area prior to and after sexual intercourse, voiding before and after sexual intercourse and wiping from anterior to posterior. In those with frequent urinary tract infections who use spermicide or a diaphragm as a method of contraception, use of alternative methods is advised. Cranberry (Juice or capsules) may decrease the incidence in those with frequent infections, but long-term tolerance is an issue with gastrointestinal upset.

Studies of this kind have been carried with different groups at different locations but not much has been done in this zone and virtually non has been done with this group of individuals. The purpose of this study is therefore to

determine the rate of occurrence of UTI among female undergraduate students, determine the particular bacteria that are implicated in these infections and the antimicrobial susceptibility pattern of the isolates.

2. MATERIALS AND METHODS

2.1 Study Area

This research was conducted in Ebonyi State, South-East Nigeria. The State is bounded to the west by Enugu State, north by Benue State and south by Abia State. The vegetation is characteristic of the mosaic of the savannah that is dense and remains evergreen throughout the rainy season. It has high rainfall intensity, high run-off volumes, high relative humidity and an average rainfall of about 1600 mm-2000 mm per annum. The mean daily maximum and minimum temperatures are 32°C and 25°C respectively. It is densely populated and relatively developed with such basic amenities as pipe borne - water, electricity, state and federal government owned hospitals, transport and communication services.

2.2 Study Population

The study population was drawn from female students of Ebonyi State University, Abakaliki, Ebonyi State, South-Eastern Nigeria. One hundred and fifty (150) female students not clinically diagnosed as having UTI were involved in the study. Those students who had taken antibiotics two weeks before or were currently on antibiotics medication and pregnant women were excluded from the study.

2.3 Ethical Consideration

Ethical clearance was obtained from the Research and Ethics Committee of the Department of Applied Biology, Ebonyi State University, Abakaliki, Nigeria. Informed consent of the students was also sought and obtained before the commencement of the study. Information/results of the study were handled confidentially.

2.4 Urine Collection

Early morning mid- stream urine samples were collected under aseptic conditions into sterile wide - mouthed universal container with screwed cap tops and correctly labelled. The samples were taken to the Department of Microbiology Laboratory, Ebonyi State University for analysis

using the methods of Stamm et al. [13]. Boric acid was added to the samples that were not screened immediately and stored in the refrigerator for preservation.

2.5 Urine Analysis and Microscopy

The samples were examined within 6 hours of collection. The colour and turbidity of each urine sample was checked macroscopically. Then impregnated combi-9 urine analysis strip was dipped into each sample for 2 seconds and colour development within 30 seconds was noted, compared and matched to the standard colours on the containers as provided. Indications of (UTI) such as the presence of protein in urine, high pH and nitrate were also recorded for each sample.

For urine microscopy, the urine samples were mixed and centrifuged at 3500 rpm for 5 min and the supernatant decanted. The sediments of each sample were transferred to clean grease-free microscope slides, covered with cover slips and examined under x10 and x40 objective lens for the presence of epithelial cells, pus cells, yeasts, granular cast, white blood cells, red blood cells and motility of any bacteria among other characteristics of the samples.

2.5.1 Urine culture

Each urine sample was well shaken to allow for homogeneity. Then using a standard sterile platinum wire loop, a loopful of the urine was aseptically and uniformly inoculated into duplicate plates of Blood and Mac-Conkey agar. The plates were labelled and incubated aerobically at 37°C for 24 hours. The plates were then examined macroscopically and microscopically for bacterial growth according to [14]. Bacterial colonies were counted and multiplied by 100 to give an estimate of the number of bacteria present per milliliter of urine [15]. The morphological characteristics of the colonies of the pure culture growing on the media were examined with reference to their sizes, pattern of their edge, margin, surface texture elevation, consistency and colour as described by [16].

2.5.2 Gram staining and identification of isolates

After 24 hours of incubation of the cultured specimens, the plates were examined for the presence or absence of growth and colonies were counted for plates with growth to determine significant growth. Plates which had growth were

further examined for their cultural characteristics; gram staining of discrete colonies was also done using cloth crystal violet (primary stain), Lugol's iodine (mordant), acetone (differentiator) and carbon fusin (counter stain) and examined to determine the gram reaction and morphology of the isolates. The colonies were sub-cultured into nutrient agar plates and incubated for 24 hours at 37°C for purification of the isolates.

2.6 Antibiotic Susceptibility Testing

This was done using agar diffusion method with standardization of the inoculums' sizes as described by [17] and adopted by [18]. Interpretation of results was done using the zone sizes. Zones of inhibition of ≥ 18 mm was considered sensitive, 13-17 mm immediate and < 13 mm resistant. The standard single-disc diffusion method was employed as described by [19].

3. RESULTS AND DISCUSSION

Out of the one hundred and fifty (150) samples screened for this study, 117 (78%) were positive. A total of five (5) bacterial species were identified. This agreed with [20] who recorded 77.9% among Prison inmates in Nigeria, [4] who recorded 60% bacturaria among female residents of a rural community in Ebonyi State, Nigeria and [18] who also recorded 60% rate in their study among patients attending Dalhatu Araf Specialist Hospital, Lafia, Asarawa State, Nigeria. It is however, higher than the prevalent rate of 40% recoded by [3] among sexually active women in Abakaliki, Ebonyi State and 35.5% by [21] in Rukuba Military Cantonment, Jos, Plateau State, Nigeria. The high prevalence in the present study may be associated with high sexual promiscuity and peer group influence among university undergraduates and the low level of hygiene usually prevalent within and around students' hostels. The high rate of bacteriuria in the current study is of great public health concern as not only does it pose a threat to health but also poses economic and social burden on the populace.

Escherichia coli (35.9%) was the most predominant followed by *Staphylococcus* spp (29.9%), *Streptococcus* spp (12.8%), *Proteus* spp (11.1%) while *Pseudomonas aeruginosa* (10.3%) was the least (Table 1). This observation corroborates that of [4] who recorded *Escherichia coli* (51.74%), *Staphylococcus aureus* (20%), *Pseudomonas aeruginosa* (10%) and *Klebsiella* spp (12%). This supports the assertion that gram

negative bacteria especially *E. coli* is the commonest pathogen implicated in UTI [22,23]. High incidence of *E. coli* when compared to the other isolates contains its importance and other members of Enterobacteriaceae in UTI. The Predominance of *E. coli* could be attributed to the fact that it is a commensal of the bowel and that infection is mostly by faecal contamination due to poor hygiene [22].

Table 1. Frequency of isolated organisms among the female students of Ebonyi State University, Abakaliki, Nigeria

Name of isolate	Number of occurrence	Percentage occurrence (%)
<i>Escherichia coli</i>	42	35.9
<i>Staphylococcus</i> spp	35	29.9
<i>Streptococcus</i> spp	15	12.8
<i>Proteus</i> spp	13	11.1
<i>Pseudomonas aeruginosa</i>	12	10.3
Total	117	100

The microscopic examination of the samples also revealed the presence of pus cells, yeast cells, casts and epithelial cells (Table 2). The presence of these characteristics is an indication of abnormality. Pus cells are usually present in the urine due to direct inflammation while the

presence of epithelia cells may be due to wear and tear of the kidney tubules.

Among the age groups, bacteriuria was highest within the age range of 31 years and above (87.3%), followed by 26-30 years 33 (82.5) while the least was within 15-20 (48%) (Table 3). This could be due to the fact that younger females are less sexually active than the older ones and are less exposed to activities that predispose them to conditions that increase susceptibility to UTI.

Table 2. Results of the microscopic analysis of the urine samples

Sediments	Number of occurrence	Percentage of occurrence
Pus cells	10	9.26%
Yeast cells	28	25.93%
Casts	40	37.04%
Epithelial cells	30	27.78%

Table 3. Prevalence of urinary tract infection in relation to age

Age group (years)	Number examined	Number positive (%)
15 - 20	25	12 (48)
21 - 25	30	24 (80)
26 - 30	40	33 (82.5)
31 and above	55	48 (87.3)
Total	150	117 (78)

Table 4. Antibiotic susceptibility pattern of bacterial isolates among female students of Ebonyi State University, Abakaliki

Antibiotic tested	<i>E. coli</i>	<i>Staph. spp</i>	<i>Strep. spp</i>	<i>Proteus spp</i>	<i>P. aeruginosa</i>
Ampicillin	R	R	R	R	R
Augmentin	100	100	33.3	R	R
Chloramphenicol	R	R	66.7	R	R
Ciprofloxacin	100	100	100	100	66.7
Gentamicin	66.7	66.7	R	66.7	33.3
Nalidixin acid	R	R	66.7	R	R
Ofloxacin	66.7	100	R	66.7	R
Amoxycilin	R	R	R	R	R
Cefuroxime	R	R	R	R	R
Tetracycline	33.3	R	R	R	R
Nitrofurantoin	R	R	R	R	R
Tarivid	100	100	66.7	66.7	33.3
Septtrin	66.7	R	33.3	R	R
Peflacin	100	66.7	66.7	100	66.7
Streptomycin	R	100	R	66.7	66.7

Key: R = Resistance to antibiotic

The susceptibility profile of the bacterial isolates showed that ciprofloxacin was the most active antibacterial agent followed by peflacin, tarivid and gentamicin while augumentine, ofloxacin, septrin and streptomycin were poorly active against the bacterial isolates. The isolates were resistant to ampicillin, amoxycilin, cefluroxin, nitrofurantin, tetracycline, nalidixin and chloramphenicol (Table 4). The most sensitive antibiotics in this study were ciprofloxacin, pefloxacin, tarivid and gentamycin. These drugs are relatively expensive, rarely used and consequently rarely abused by the populace when compared to other antibiotics which are cheaper and are frequently used. The isolates were therefore more sensitive to those drugs that are rarely abused. This is similar to reports of [21,19]. Septrin, streptomycin, ofloxacin and augumentine performed poorly against the isolates in this study. The reason may as well be that these drugs are commonly used and frequently abused. This, however, contrasts the reports of [21,24], who in their separate studies in different locations in Nigeria reported that the isolates were highly susceptible to septrin. The reason for the difference may not be far from the practice of self medication and abuse among the students.

4. CONCLUSION

The prevalence of UTI is high in the study population and females at the peak of their sexually active years are more prone to infection than the younger ones. This reveals the fact that bacterial infection is still an issue of serious public health importance in Nigeria.

E. coli was also implicated as the greatest causative agent of bacteriuria and ciprofloxacin was the most sensitive antibiotic against the bacteria isolates.

5. RECOMMENDATIONS

There is therefore need for education of the students on the importance of personal hygiene as most of the implicated isolates are commensals of perianal and vaginal regions. Adequate health facilities should be provided for the university community and its environs in order to tackle the menace of UTIs among female populations. The study population should be discouraged from the abuse of antibiotics as this leads to drug resistance by bacteria. Periodic screening of women in both rural and urban areas for UTIs is highly recommended. There is also need to constantly monitor the susceptibility

of these pathogens to commonly used antibiotics as this will assist health practitioners in the use of these drugs in the treatment of UTIs and other related infections.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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