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PREVALENCE OF URINARY TRACT INFECTIONS AMONG INDIVIDUALS WITH PRESUMPTIVE UTI ACCESSING HEALTHCARE IN SELECTED HEALTH FACILITIES IN ENUGU, NIGERIA

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ABSTRACT

Urinary tract infection (UTI) is infection of the bladder, ureters, kidneys and/or Urethra, symptoms of which vary depending on its severity and the characteristics of an infected individual. This study examined the prevalence of UTI among individual with presumptive UTI accessing health care services in two health facilities in Enugu metropolis. Mid-stream urine samples were collected from 384 participants and analyzed bacteriologically using standard methods. The prevalence of UTI among the study participants was 34.6%., 133 out of 384 having positive bacteria urine test. *Staphylococcus aureus* (n=19), *Escherichia coli* (n=52), *Klebsiella pneumoniae* (n=45), *Pseudomonas aeruginosa* (n=12), *Enterococcus faecalis* (n=9) and *Proteus mirabilis* (n=8) were isolated as a single or mixed culture. *Escherichia coli* was the most implicated in the study followed by *Klebsiella pneumoniae, Staphylococcus aureus, Pseudomonas aeruginosa, Enterococcus faecalis and Proteus mirabilis.* Prevalence of UTI in females was 63.9% and 36.1% in males. The married (56.8%) and the singles (34.1%) recorded higher prevalence of UTI compared with the widow/widower (6.0%) and the divorced (3.1%). UTI was comparatively high (33.1%) among the age group 25 – 34 years and low (27.1%) in those >64 years. Civil servants and participants with tertiary level of education had UTI prevalence of 41.4% and 38.3% respectively. There was a significant difference in UTI based on sex (p=0.001) and age (p=0.02), but no significant difference based on marital status, occupation and educational level (p? 0.05). The prevalence of UTI in the study was high with both gram-positive and gram-negative bacteria implicated. Sex and age seem to play a significant role in UTI unlike marital status, educational level and occupation. Antibiotic susceptibility pattern of the UTI bacteria uropathogens should be investigated.

Keywords: Prevalence; urinary tract infection; Enugu.

INTRODUCTION

Urinary tract infections have been described since ancient times with the first documented description in the Ebers Papyrus dated 1550 BC (Al-Achi, 2008). Urinary tract is made up of the bladder, ureters, urethra and kidneys (*Abraham and Miao, 2015)*. According to *CDC (2015), u*rinary tract infection (UTI) is an infection affecting the bladder (cystitis), ureters (ureteritis), kidneys (pyelonephritis) and/or Urethra (urethritis). For bacteria mediated UTI, it is the presence of ≥ 10^3 CFU/ml of urinary bacteria pathogen in urine whether or not there are symptoms (Okonko et al. 2009; *Lane and Takhar, 2011*). Urinary tract infection may be complicated or uncomplicated. Salvatore et al. (2011) defined complicated UTI as one involving the upper urinary tract or occurring in diabetes mellitus, pregnancy, and/or immunocompromised individuals, while UTI is considered

uncomplicated in a healthy and premenopausal woman. According to *Flores-Mireles (2015) and* Oma (2014), *the risk* factors of urinary tract infection include: sexual intercourse, age, spermicide and diaphragm use, frequent use of antibiotics, reduced mobility (e.g., after surgery or prolonged bed rest), recurrent UTIs, Kidney stones, the nature of female anatomy (the distance between the anus and the urethra is short unlike in males). Other risk factors include; menopause, pregnancy, prostatitis, male uncircumcision, iatrogenesis (use of catheter, intravenous treatments), diabetes, obesity, family history,urinary abnormalities such as (vesicoureteral reflux), constipation, spinal cord injury and other underlying conditions (*Eves and Rivera, 2010; Bhat* et al. *2011; Lane and Takhar, 2011)*

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 (*Nicolle, 2008)*. In post-menopausal women, sexual activity does not affect the risk of developing a UTI (Franco, 2005). Spermicide and diaphragm use, independent of sexual frequency, increases the risk of UTIs, while condom use without spermicide or the use of birth control pills does not increase the risk of uncomplicated urinary tract infection (*Nicolle, 2008* and Franco, 2005*)*. Urinary tract infection occurs when bacteria, often from the skin or rectum, travel up the urethra and into the bladder. Advancing reasons for the higher incidence of UTI in females than males, *Dielubanza and Schaeffer (2011) implicated human anatomy as a risk factor of UTI, stating that the* urethra is much shorter in women *allowing easier access for bacteria into the bladder, and that the proximity or closeness of a woman's urethral opening to the anus and vagina, which are sources of bacteria*, put *w*omen at a greater risk of UTI than men.

Bacteria are the most common cause of urinary tract infection. According to *Flores-Mireles et al. (2015), Escherichiacoli* from the gut and *Staphylococcus saprophyticus* account for about 80–85% and 5-10% of community-acquired urinary tract infections respectively, while *E. coli* (27%), *Klebsiella* (11%), *Pseudomonas* (11%), and *Enterococcus* (7%) among others are associated with hospital acquired UTI. In a study to track the causes of urinary tract infection in pregnant women in University Hospital of Obstetrics and Gynaecology "Maichin dom" Shopova et al. *(*2004) isolated *E. coli, Proteus, Klebsiella* (gram negative) and *S. aureus* and *Enterococcus* (gram positive) bacteria. *Lane and Takhar (2011)* opined that *Chlamydia trachomatis* and *Mycoplasma genitalium* can infect the urethra but not the bladder, stating *that u*rinary tract infections due to *Staphylococcus aureus* typically occur secondary to blood-borne infections.

Concerning other groups of microorganisms, Candida albicans and Trichomonas vaginalis are the commonest fungi and parasite implicated in UTI especially in women (*Amdekar, 2011*). Viruses are rarely implicated in UTIs, however herpes virus has been found to play role in urethritis (*Amdekar, 2011*). According to *Nicolle (2008)*, the most common symptoms of lower urinary tract infection are burning sensation on urination, frequent urination and/or an urge to urinate even with an empty bladder in the absence of vaginal discharge and significant pain. There may be pain above the pubic bone or in the lower back (*Colgan and Williams, 2011*). These symptoms may vary from mild to severe lasting for an average of six days in women depending on the stage of the infection and history of an infected individual (*Lane and Takhar, 2011; Colgan and Williams, 2011*).

Diagnosis of urinary tract infection can be based on symptoms alone (*Nicolle, 2008).* However, personal experience shows that laboratory diagnosis is necessary using a number of techniques (urine analysis, microscopy, culture and molecular analysis) for empirical evidence of UTI. Urine analysis reveals the presence of nitrite, leukocyte or leukocyte esterase in UTI (CDC, 2010). The presence of red blood cell, white blood cells, or bacteria could be observed in UTI during urine microscopy, while urine culture is considered positive for urinary tract infection if it shows a bacterial colony count of greater than or equal to 10^3 colony-forming units per mL of a typical urinary tract organism (CDC, 2010).

Although a number of researches

conducted among wide range of subjects in Nigeria have revealed the prevalence of UTI, there was no documented evidence on the size of the problem among individuals with presumptive UTI especially in Enugu metropolis in the recent times. Hence, understanding the prevalence of the infection among these groups of individuals is important in improving management of the infection. Therefore, the aim of the study is to ascertain the prevalence of UTI among individuals with presumptive UTI attending clinic at ESUT Teaching Hospital and Omniscient Medical Diagnostic Centre, Enugu.

MATERIAL AND METHODS

Study Design

This is a cross-sectional and facility-based study in which participants with self-reporting urinary tract infection attending clinic in Enugu State University Teaching Hospital and Omniscient Medical Diagnostic Centre were examined for urinary tract infection.

Study Population

Individuals with presumptive urinary tract infection accessing medical care at Enugu State University Teaching Hospital and Omniscient Medical Diagnostic Centre Enugu between April and August 2019 were studied.

Inclusion and Exclusion Criteria

All adult individuals with suspected UTI whose willingness and consent were obtained were included, while those who refused to participate by not giving consent as well as female patients menstruating were excluded.

Ethical Considerations

Ethical permission for the research was obtained from Enugu State University Teaching Hospital Ethical Committee. The three ethical principles namely; safety, privacy and confidentiality of participant's information were maintained. The guidelines on the conduct of biomedical research by the Council of International Organization of Medical Sciences (CIOMS) and that of the International Conference on Harmonization – Good Clinical Practice (ICH-GCP) were followed on the course of the research.

Sample size

A total of 385 patients were studied. The sample size was determined using Cochran's sample size formula by Bartlett et al. (2001).

Sampling Strategy

Convenient sampling strategy was used to select participants in the study. Urine specimen collection was scheduled for Mondays and Wednesdays in the month of April – August 2019 until the sample size of 385 was reached. The two days were selected conveniently to make for enough time for urine specimen analysis and for space management in the incubator.

Urine sample collection

The participants were advised on how to collect a 'Clean catch' mid-stream urine. The specimens were coded to ensure anonymity and confidentiality with demographic details of the patients regarding age and gender properly recorded before transported to Omniscient Medical Diagnostic Centre, Enugu, Enugu State for further processing.

Urine culture

The urine specimens were cultured on Blood agar, MacConkey agar and Cysteine, Lactose, and Electrolyte Deficient (CLED) agar using streaking method (Ochei and Kolhatkar, 2000). The culture was incubated at 37^{o}C for 24 hours and the plate read. UTI isolates were subjected to gram staining and biochemical tests for identification.

Identification of Isolates

Gram staining and a combination of conventional biochemical testing techniques including Catalase and coagulase tests for *S. aureus*, indole test for suspected *E. coli*, citrate and malonate utilization tests for suspected *K. pneumoniae*, and oxidase test for suspected *P. aeruginosa*, Bile Resistance test for *E. faecalis*, and motility test for *P. mirabilis* were carried out following the method described by Ochei and Kolhatkar (2000).

3.8 Statistical Analysis

The data were analysed by SPSS 23

software. To compare qualitative variables, chi-square test was applied. Level of significance was $P < 0.05$.

RESULTS

A total of 384 participants were involved in the study. One hundred and thirty-three participants showed positive bacteria urine test, accounting for UTI prevalence rate of 34.6%, with six different bacteria uropathogens being implicated.

Isolated bacteria

Six (6) different species of bacteria uropathogens were isolated from 133 participants, some occurring either singly or as a mixed growth. Bacteria species isolated include; *Staphylococcus aureus (*18), *Escherichia coli (*42*), Klebsiella pneumonia (33), Pseudomonas aeruginosa (11), Enterococcus faecalis* (9) and *Proteus mirabilis (8)* which occurred as single isolates, as well as *Klebsiella pneumoniae + Escherichia coli (10), Staphylococcus aureus + Escherichia coli(1)* and *Pseudomonas aeruginosa + Klebsiella pneumoniae (1)* that occurred as mixed growths.

Therefore, a total of 145 bacterial pathogens belonging to the 6 genera listed above were isolated from 133 participants with UTI. One hundred and twenty-one (121) isolates were from 121 (91.0%) participants who had UTI due to a single bacteria species and 24 isolates from 12 (9.0%) participants with UTI due to mixed infection caused by two different bacteria species. Table 1 shows the isolates disaggregated into single and mixed bacteria isolates

Bacterial isolates	No of participants
Single Bacterial Isolates	
S. aureus	18
E. coli	42
K. pneumoniae	33
P. aeruginosa	11
E. faecalis	9
P. mirabilis	8
Mixed Bacterial Isolates	
K. pneumoniae+ E. coli	10
S. aureus + E. coli	1
P. aeruginosa + K. pneumoniae	1
Total	**133**

Sex distribution of UTI among the participants

Out of 190 males and 194 females that participated in the study, 48 (36.1%) males and 85 (63.9%) females had a positive bacteria urine test respectively. Figure 1 shows the percentage sex distribution of UTI

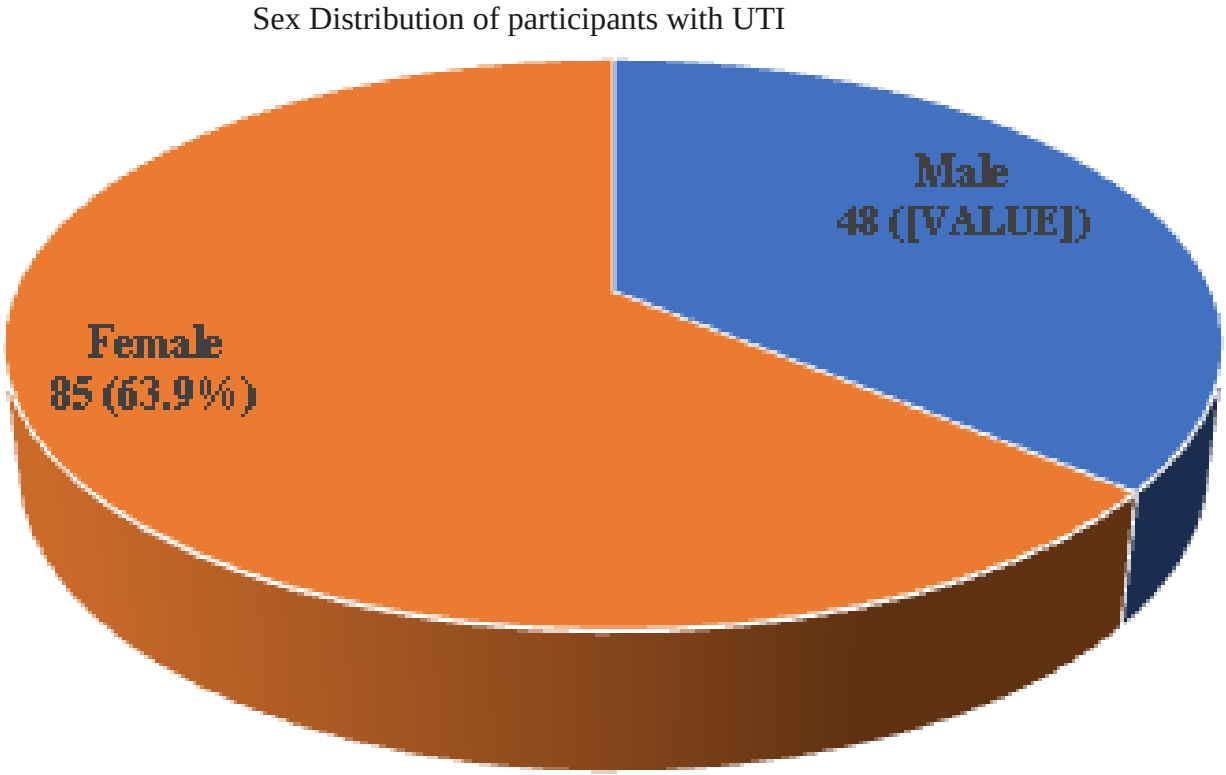


Figure 1: Sex distribution of UTI among the participants

Age distribution of UTI among the participants

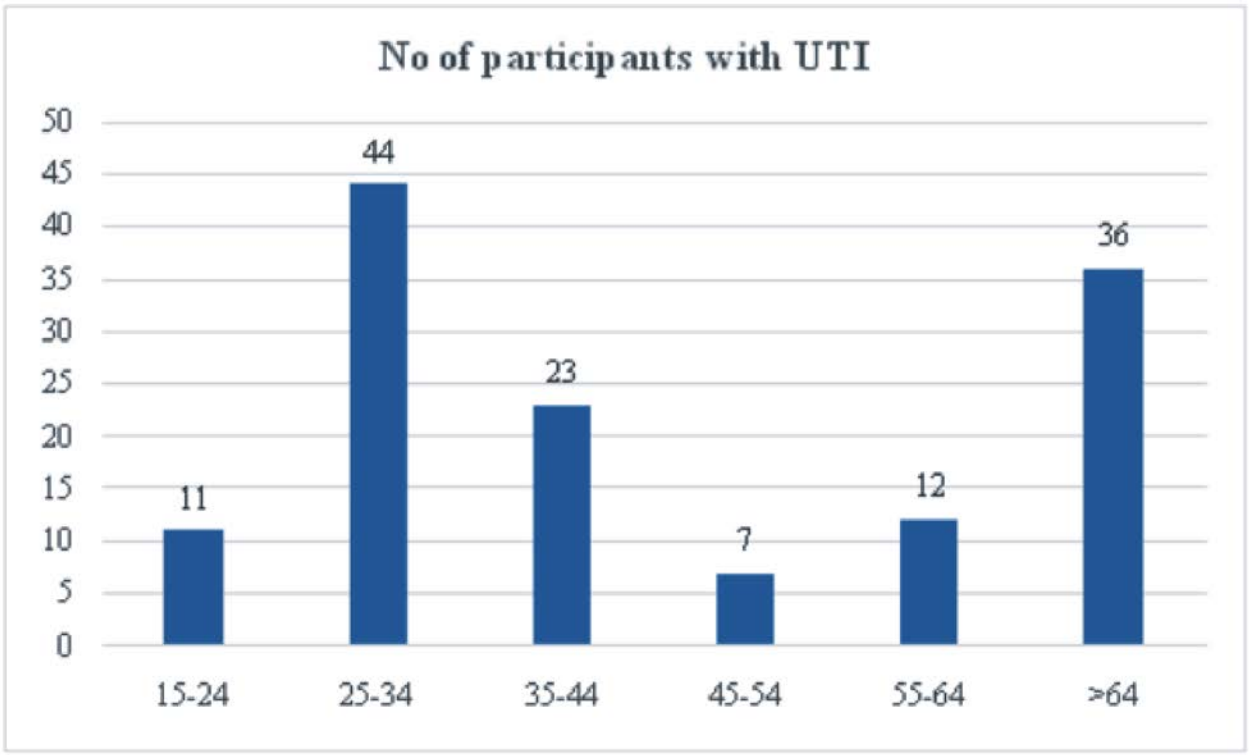


Figure 2: Age distribution of UTI among the participants

The age group 25-34 years recorded the highest (44) no of positive bacteria urine test unlike the age group 45-54 years with the least (7). Figure 2 shows the age distribution of UTI in the study.

Distribution of UTI among the participants based on Marital Status

Table 2: Distribution of UTI among the participants based on Marital Status

Marital status	Number of participants with positive bacteria urine test (%)
Single	131(34.1)
Married	218(56.8)
Divorced	12(3.1)
Widow/widower	23(6.0)

UTI was high among the married (56.8%), followed by the single (34.1%). Table 2 presents the distribution of the infection in the study according to the marital status of participants.

Distribution of UTI among the participants based on Occupation

On the basis of occupation of the participants, UTI was found to be higher among the civil servants (40.6%), followed by the business people (27.1%), Farmers (12.8%), Students (12.8%) and the unemployed (6.8%) as shown in figure 3.

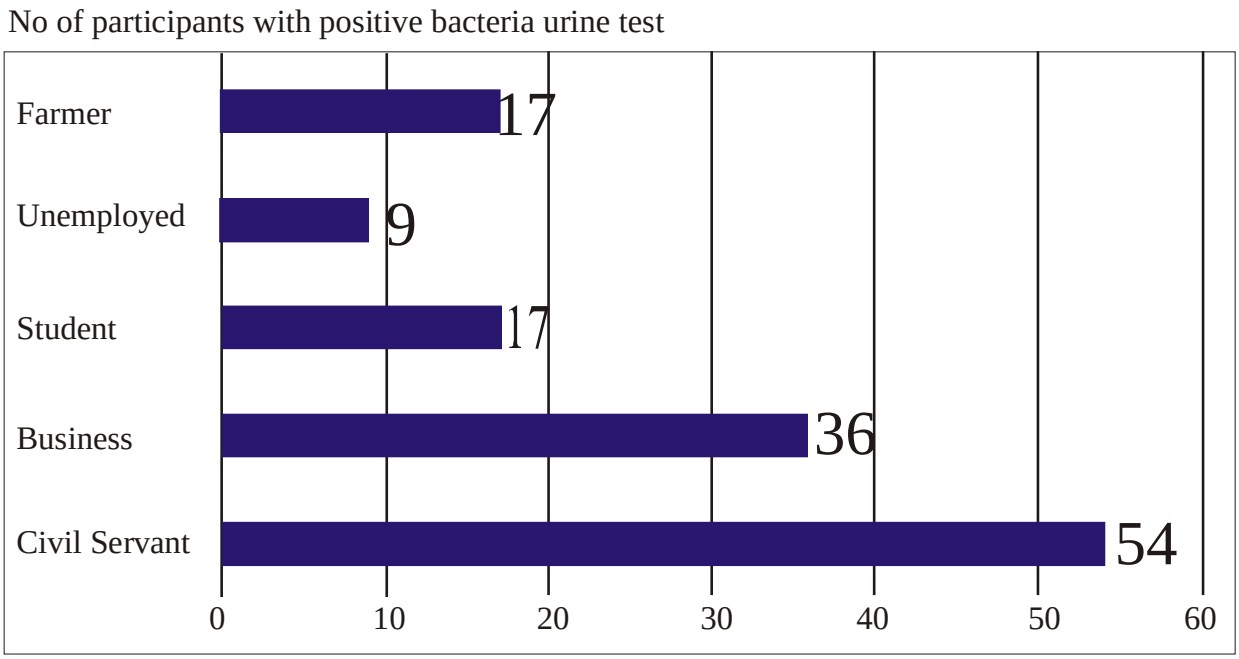
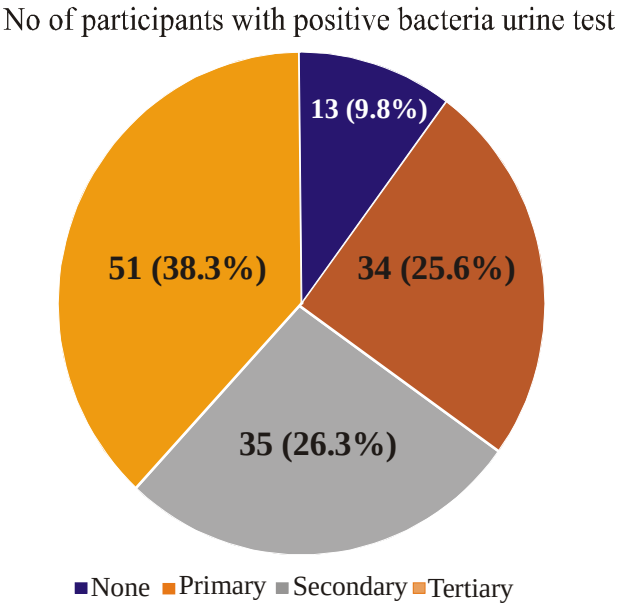


Figure 3: Distribution of UTI among participants based on Occupation.

Distribution of UTI on the basis of Educational level

Participants with tertiary education had 38.3% prevalence of UTI against 9.8% among those with no formal education. Figure 4 presents UTI prevalence on the basis of Educational level of participants.



Distribution of bacteria isolates based on sex and age

The prevalence of UTI was more in females (63.9%) than males (36.1%) with *E. faecalis* and *K. pneumoniae* + *E. coli* being the most implicated single and mixed isolate in females and males respectively. The participants in the age group 25 – 34 years recorded the highest UTI prevalence of 34.6% followed by those >64 years with 27.1%. *E. faecalis* occurring singly occurred more among participants in 25 – 34 years age group. Table 3 shows the age and sex distribution of bacteria uropathogens in the study.

Table 3: Sex and Age distribution of bacteria uropathogens in the study

Bacterial isolates (n)	Sex		Age group in Years (%)					
	M	F	15 – 24	25 – 34	35 – 44	45 – 54	55 – 64	>64
Single Bacterial Isolates								
S. aureus (18)	7(38.9)	11(61.1)	3(16.7)	7(38.9)	5(27.8)	1(5.6)	0	2(11.1)
E. coli (42)	12(28.6)	30(71.4)	4(9.5)	13(31.0)	5(11.9)	2(4.8)	6(14.3)	12(28.6)
K. pneumoniae (33)	15(45.5)	18(54.5)	1(3.0)	10(30.3)	6(18.2)	2(6.1)	3(9.1)	11(33.3)
P. aeruginosa (11)	4(36.4)	7(63.6)	1(9.1)	5(45.5)	2(18.2)	0	1(9.1)	2(18.2)
E. faecalis (9)	2(22.2)	7(77.8)	0	6(66.7)	1(11.1)	0	0	2(22.2)
P. mirabilis (8)	2(25)	6(75)	0	2(25.0)	4(50.0)	0	0	2(25.0)
Mixed Bacterial Isolates								
K. pneumoniae + *E. coli* (10)	6(60.0)	5(40.0)	1(10.0)	3(30.0)	0	1(10.0)	1(10.0)	4(40.0)
S. aureus + *E. coli* (1)	0	1(100)	0	0	0	0	0	1(100.0)
P. aeruginosa + *K. pneumoniae* (1)	0	1(100)	0	0	0	1(100.0)	0	0
Total	**48(36.1)**	**85(63.9)**	**10(7.5)**	**46(34.6)**	**23(17.3)**	**7(5.3)**	**11(8.3)**	**36(27.1)**

DISCUSSION

Urinary tract infections (UTIs) are one of the most common microbial diseases encountered in medical practice which affect people of all ages (Kunin, 1994). The prevalence of UTI in this study was 34.6%. One hundred and thirty-three (133) out of 384 participants had positive urine culture implying UTI. This prevalence is nearly similar to 39.69% and 32.2% prevalence reported in Nigeria and Uganda respectively (Oladeinde et al. 2011 and Odoki et al. 2019) and varies from 11% and 5.8% reported among febrile children less than five years of age, the elderly and HIV patients in separate studies in Nigeria (Ibeneme et al. 2014; Omeregie et al. 2010; Sheyin et al. 2018). The reason for the lower prevalence of 11% and 5.8% could be attributed to such factors as age, sexual intercourse, cerebral palsy, use of antibiotics in management of opportunistic infections in HIV/AIDS among others which are determinants of urinary tract infection (Anigilaje and Bitto, 2013; Omeregie et al. 2010; Sheyin et al. 2018). A higher prevalence of 56% was obtained in another study among pregnant women (Nwachukwu et al. 2018). Hormonal changes in pregnancy were attributed to the observed high prevalence in addition to other determinants of UTI such as sexual intercourse and douching among others (Nwachukwu et al. 2018; Brusch, 2020).

Six different species of bacteria (gram negatives and gram positives)were isolated. They include: *S. aureus, E. coli,* K. *pneumoniae, P. aeruginosa*, *E. faecalis* and *P. mirabilis*. This was consistent with the report of other studies but with little difference in species

diversity. S. *aureus, E. coli, K. pneumoniae, P. aeruginosa, E. faecalis* and *S.saprophyticus* were isolated among patients with UTI (Mitu et al. 2019).

There were differences in the frequency at which the organisms were isolated. For instance, 52(35.9%) of *E. coli*, 45(31.0%) of *K. pneumoniae*, 19(13%) of S. *aureus*, 12(8.3%) of *P. aeruginosa*, 9(6.2%) of *E.* f*aecalis* and 8(5.5%) of *P. mirabilis* were isolated. *E. coli* was the leading cause of UTI in the study followed by *Klebsiella* spp and *Staphylococcus* spp and others. This correlates with the findings of other studies which implicated *E. coli*as the major cause of UTI (Rizyi et al. 2011; Omeregie et al. 2010; Anigilaje and Bitto, 2013; Mitu et al. 2019, Odoki et al. 2019). Contrary to the findings of this study, *Klebsiella* sp was the highest occurring urinary tract bacteria pathogen followed by *E. coli* (Agbagwa and Ifeanacho, 2015). Two recent studies in Benin City Nigeria among urban settlers showed that *Staphylococcus aureus* was the most predominant isolate (Omeregie et al. 2010). It is possible that the preponderance of the agents of UTI may differ from one location to another and that the characteristics of individuals studied may be important in determining which uropathogen would be implicated in UTI. Hence, further investigations should be carried out to verify the role of location and characteristics of individual in the preponderance of uropathogens in UTI.

There was a statistically significant difference ($P < 0.05$) in sex distribution of UTI. Females recorded a higher prevalence of 63.9% than the males (36.1%). This was in agreement with higher UTI prevalences in females (83.5%, 55.1%, 77.4%, 6.6%) than males (16.5%, 34.6%, 22.6%, 4.8%) documented in other studies (Mitu et al. 2019; Omeregie et al. 2010; Ibeneme et al. 2014; Agbagwa and Ifeanacho, 2015, Sheyin et al. 2018). Finding of this study on sex distribution of UTI agreed with a study that demonstrated that female gender had statistically significant relationships with UTI (*Nicolle, 2008;* Odoki et al. 2019). The frequency of all t*he bacteria uropathogens in this study were more in females than the males with Escherichia coli* (29.0%) taking the lead and females accounting for 71.4% of infection due to this singular bacterium. This was consistent with the high prevalence of *E. coli*, but at variance with the high prevalence of *Staphylococcus aureus* in males reported in another study (Oladeinde et al. 2011). UTIs appear to be more common in females than males due to the nature of the anatomical structure and proximity of the female external urethral orifice to the anus, smaller urethra, incontinence, sexual intercourse and bad toilet (Mitu et al. 2019; Brusch, 2020; Oladeinde et al. 2011). Studies around the world showed that approximately 1 in 5 adult women experience a UTI at some point (Brusch, 2020).

The prevalence rate of UTI was 8.3%, 33.1%, 17.3%, 5.3%, 9.0% and 27.1% among participants in 15 – 24 years, 25 – 34years, 35 – 44 years, 45 – 54 years, 55 – 64 years and >64years age group respectively. The study showed that there was UTI in all age groups as opposed to UTI not reported in age group ≥ 46yrs (Sheyin et. al. 2018). Although UTI transmission was sinusoidal based on age, it did not follow a regular pattern. The prevalence of UTI increased with increase in age from 8.3% among those in 15 – 24 years age group reaching the peak of 33.1% at 25 -34 years, decreasing to 17.3% and 5.3% among participants in 45 – 54 years and 55 – 64 years and rising sharply to 27.1% in those above >64years in agreement with findings of *Salvatore et al. (2011)*. Contrary to this finding, age ≤ 19 years were demonstrated as having statistically significant relationships with UTI (Odoki et al. 2019). An inverse relationship between age and prevalence of UTI was reported in another study in Nigeria with significant decline in the prevalence of UTI with increase in age as opposed to increased prevalence with increase in age (Odoki et al. 2019; Omeregie et al. 2010, Ibeneme et al. 2014). Hence, age may be playing role together with other determinants in UTI. The age range of 21 – 30 years had the highest prevalence of UTI (44.67%). This is in agreement with the findings of Ibeneme et al. (2014). However, the prevalence of UTI did not differ significantly among the different age groups in this study ($p > 0.05$).

Married participants reported a high prevalence rate of 71.4% against 1.5% among

the divorced. This consistent with the finding of Subramaniam et al. (2016) in which there was a high prevalence of UTI among married women compared with those of individuals with other marital status. Sexual intercourse among the married may have contributed to the observed high prevalence among the group compared with the Widow/widower and the Divorced. Civil servants had 40.6% prevalence of UTI, with the unemployed recording the least prevalence of 6.8%. Participants with tertiary education had 38.3% prevalence of UTI against 9.8% among those with no formal education. Occupation and level of education were not significant factors in UTI (p? 0.05). Meanwhile, there was no report on the prevalence of UTI based on occupation and level of education among the literature reviewed for comparative analysis of this results with that of other studies. Findings of this study could therefore serve as a reference for further studies.

CONCLUSION

This study revealed that the burden of UTI among the studied participants was high with 133 out of 384 being infected. *S. aureus, E. coli*, K. *pneumoniae, P. aeruginosa, E. faecalis* and *P. mirabilis* were isolated among the participants with UTI. *E. coli* and *K. pneumoniae* occurred more frequently than the other isolates implicated in the infection. Females were more likely to have UTI than the males, while the married, the civil servants and those with tertiary level of education showed higher risk of the infection when compared with their counterparts. Prompt diagnosis and effective treatment should be instituted for individuals with presumptive UTI. Investigations should be carried out to ascertain the antibiotic susceptibility pattern of the isolates, while further studies should be conducted to access knowledge and perception of individuals about UTI.

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