**Prevalence of extended-spectrum β-lactamase producing isolates from asymptomatic bacteriuria among students in a tertiary institution in ibadan, Nigeria**.

Alabi O. S.1, Onyenwe N. E.2, Satoye K. A.3 and Adeleke O. E.4

1-4 Department of Pharmaceutical Microbiology, Faculty of Pharmacy, University of Ibadan, Nigeria.

[o\_nathejik@yahoo.com](mailto:o_nathejik@yahoo.com), [mailpharmmuyiwa@yahoo.com](mailto:mailpharmmuyiwa@yahoo.com)

**Abstract:** Indiscriminate use of antibiotics, particularly the extended-spectrum antibiotics in Nigeria has assisted the principle of selection pressure for the highly resistant strains of bacteria. The aim of this study is to investigate the prevalence of asyptomatic bacteriuria as well as antibiotic susceptibility and extended-spectrum beta-lactamase production among bacterial isolates from healthy students in a tertiary institution in southwest Nigeria. The results of the mid-stream urine catch that was collected and analysed in a total of 100 students , all within the age range 17 to 26 years, were found to contain bacterial isolates of *Staphylococcus aureus* (5%), *Escherichia coli* (3%), *Citrobacter frundii* (4%), *Proteus* spp. (26%), *Klebsiella* spp. (40%), *Moganella* *morganni* (4%) and *Providencia stuartii* (4%). Visible bacterial growth occurred in 86% of the urine samples with 41% from males and 45% from females. Antibiotics such as penicillin, cephalosporin, quinolone, aminoglycoside, macrolide and nitrofuran were used for antibiotic susceptibility test against the isolates. Extended-spectrum beta-lactamase production was determined among cephalosporin resistant Gram-negative isolates. This study showed high prevalence of asymptomatic bacteriuria associated with multidrug resistance and some ESBL-producing bacteria among healthy students of University of Ibadan. Thus concerted effort in the control of the use of extended-spectrum antibiotics should be made, so as to avoid high prevalence of human reservoirs of multidrug resistant and ESBL-producing bacteria. <http://www.sciencepub.net/nature>.

**[**Alabi O. S., Onyenwe N. E., Satoye K. A.and Adeleke O. E. **Prevalence of extended-spectrum β-lactamase producing isolates from asymptomatic bacteriuria among students in a tertiary institution in ibadan, Nigeria.** *Nat Sci* 2014;12(4):111-114]. (ISSN: 1545-0740). <http://www.sciencepub.net/nature>. 15

**Keywords:** Bacteriuria, ESBL, multidrug-resistant, asymptomatic bacteriuria, antibiotic.

**Introduction**

Asymptomatic bacteriuria is defined as a significant bacterial isolate count greater than or equal to 10×103 colony-forming units per milliliter (≥105 cfu/mL) of urine in two consecutive fresh (clean catch) urine specimens (Nicolle, 2003). Significant asymptomatic bacteriuria is a risk factor for symptomatic urinary tract infection and septiceamia among predisposed individuals indicating an active infection of the urinary tract (Alebiosu *et al*., 2003). Asymptomatic bacteriuria occurs in small number of healthy individuals and is common among females particularly, sexually active women (Richard *et al*., 2006). Its prevalence varies with age, sex, sexual activity, and the presence of genitourinary abnormalities (Nicolle, 2003). In healthy women, the prevalence of bacteriuria increases with age, from about 1% in females of 5 to 14 years of age to more than 20% in women of at least 80 years of age (Richard *et al*., 2006). Infecting organisms are diverse and include the *Enterobacteriaceae*, *Pseudomonas aeruginosa, Enterococcus* species, *Staphylococcus aureus* and group B *Streptococcus* (Richard *et al*., 2006; Chukwu *et al*., 2011). *Escherichia coli* is the most common organism isolated from patients with asymptomatic bacteriuria (Richard *et al*., 2006; Dalal *et al*., 2009). Although certain patients having diabetes, infected kidney stones, kidney transplant, older age and pregnant women are at a higher risk of developing kidney infection if they have asymptomatic bacteriuria, most healthy patients with asymptomatic bacteriuria do not need treatment. However, in this era of abuse and irrational use of antibiotics reported in Nigeria (Tamuno *et al*., 2011), the possibility of healthy individuals with persistent asymptomatic bacteriuria becoming a reservoir of multidrug resistant and extended-spectrum beta-lactamase producing bacteria was the concern for carrying out this study. Extended-spectrum β-lactamases (ESBLs) are a rapidly evolving group of β-lactamases which also have the ability to hydrolyze third-generation cephalosporins and aztreonam yet are inhibited by clavulanic acid (Bush *et al*., 1995; Paterson and Bonomo, 2005). The incidence of extended-spectrum beta-lactamase producing bacteria has been reported in both the community and hospital settings in some parts of the world including Nigeria (Bonnet, 2004; Pitout *et al*., 2005; Paterson and Bonomo, 2005; Soge *et al*., 2006; Canton and Coque, 2006; Mendonca *et* *al*., 2007; Okesola *et al*., 2009; Tijjani *et al*., 2012) and several studies have found a relationship between the use of third-generation cephalosporins and acquisition of ESBL-producing strains (Ariffin *et al*., 2000). This study however, investigated the prevalence of multidrug resistance and ESBLs production among bacterial isolates obtained from urine of healthy students of the University of Ibadan, Nigeria.

**Materials and Methods**

**Collection of urine samples**

One hundred students (50 males and 50 females) between the ages 17 and 26 years, from the University of Ibadan, voluntarily participated in the study. After filling a questionnaire, mid-stream urine clean catch sample was collected aseptically in sterile wide mouth sample bottles and were immediately sent to the laboratory as soon as it was produced by the participating students. The samples were screened for the presence of bacteria within 24 hours of collection. Students currently on antibiotic treatment or that have been treated for urinary tract infection as far as two months before this study were excluded from the research. The participating students were taught how to collect their urine samples without contaminating the samples with their hands and external genital.

**Bacteria Isolation and Identification**

A loop-full of urine was streaked on Nutrient agar, Mannitol salt agar, cetrimide agar and MacConkey agar media. The culture plates were incubated at 370C for 24 hours. Plates that showed growth were observed and the colonies were further characterized by Gram stain and standard biochemical tests. The identified isolates were streaked on agar slants and stored in a refrigerator for later use.

**Antibiotic susceptibility test**

The bacterial isolates were subjected to antibiotic susceptibility testing against ten antibiotics belonging to the penicillin, cephalosporin, aminoglycoside, quinolone, macrolide and nitrofuran classes using the disc diffusion method on Mueller Hinton agar according to the Clinical Laboratory Standards Institute guidelines (CLSI, 2011). The antibiotics included: amoxicillin-clavulanic acid (20/10 µg), cefuroxime (30 µg), cefixime (5 µg), ceftazidime (30 µg), ceftriaxone (30 µg), gentamicin (10 µg), ciprofloxacin (5 µg), ofloxacin (5 µg), erythromycin (5 µg) and nitrofurantoin (300 µg).

**Detection of Extended-Spectrum Beta-Lactamase (ESBL) Production**

ESBL production was determined among the Gram negative bacteria resistant to third generation cephalosporins by double-disc synergy test with ceftazidime (30 µg) and cefotaxime (30 µg) discs placed 20mm centre-to-centre around amoxicillin-clavulanic acid (20/10 µg) disc. This was done on the surface of Mueller Hinton agar plate inoculated with the isolates suspension equivalent to 0.5 McFarland standard by surface spreading using sterile swab sticks. After incubation at 37oC for 24 hours, ESBL production was inferred when the zone of inhibition around the cephalosporin discs was expanded by ≥5mm by the presence of clavulanic acid.

**Results**

Of the 100 urine samples collected (50 males and 50 females), 86 (41 from male, 45 from female) gave visible bacterial growth after 24 hours of incubation. Table 1 shows the various bacteria isolated from the urine samples. *Klebsiella* spp. (46.5%) were found to be the most common bacteria isolated followed by *Proteus* spp. (30.2%) with *Klebsiella* more common in females (65%) than in males (35%) while *Proteus* spp was more common in males (65.4%) than females (34.6%). However, *E. coli* was found in female only. The antibiotic susceptibility test revealed that 96.5% of the isolates were resistant to amoxicillin-clavulanic acid, 95.4% to cefixime, 89.5% to cefuroxime, 80.2% to ceftazidime and 76.7% to ceftriaxone. Resistance to ciprofloxacin and ofloxacin was 33.7% and 20.9% respectively. Gentamicin had 41.9%, erythromycin 89.5% and nitrofurantoin 76.7% resistance against the isolates. *S. aureus*, *Klebsiella* spp., *M morgannii*, *P. stuartii* and *C. freundii* isolates all had 100% resistance to amoxicillin-clavulanic acid, *E coli* and *P. stuartii* had 100% resistance to ceftazidime, cefixime and cefuroxime while *M. morgannii*, *P. stuartii* and *C. freundii* were susceptible to ofloxacin (100%). *S. aureus* had 100% susceptibility to nitrofurantoin, ciprofloxacin and gentamicin (table 2). Among the 86 isolates, ESBL-production was detected in 30 (34.9%) of which 19 (22.1%) were from males and 11 (12.8%) from females. They included: *Providencia stuartii* (1.2%), *Moganella morganni* (3.5%), *Klebsiella* spp (15.1%), *Citrobacter freundii* (3.5%) and *Proteus* spp (11.6%). *C freundii* and *M* *morganni* gave the highest percentage ESBL-production (75%) compared to *Proteus* spp. (38.5%) and *Klebsiella* spp. (32.5%) as presented in table 3. Prevalence of multidrug resistance among the 86 isolates was 81.4% which was highest in *P. stuartii* (100%), followed by *Klebsiella* spp (87.5%), *Proteus* spp (84.6%), *M. morganni* (75%), *C. freundii* (75%) and *E coli* (66.7%).

Table 1: Occurrence of bacterial isolates among male and female students

|  |  |  |  |
| --- | --- | --- | --- |
| Bacteria | Total Number/  Percentage of isolates | Number /Percentage of isolates by sex | |
| Male | Female |
| *Staphylococcus aureus* | 5 (5.8%) | 3 (60%) | 2 (40%) |
| *Escherichia coli* | 3 (3.5%) | 0 (0%) | 3 (100%) |
| *Proteus* spp. | 26 (30.2%) | 17 (65.4%) | 9 (34.6%) |
| *Klebsiella* spp. | 40 (46.5%) | 14 (35%) | 26 (65%) |
| *Moganella morganni* | 4 (4.7%) | 2 (50%) | 2 (50%) |
| *Providencia stuartii* | 4 (4.7%) | 1 (25%) | 3 (75%) |
| *Citrobacter frundii* | 4 (4.7%) | 4 (100%) | 0 (0%) |
| Total number of isolates | 86 (100%) | 41 (47.7%) | 45 (52.3%) |

Table 2: Number and percentage susceptibility pattern of the isolates to selected antibiotics

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Antibiotics | *S. aureus*  *n = 5* | *E. coli*  *n = 3* | *Proteus* spp.  n =26 | *Klebsiella* spp.  n = 40 | *M. morgannii*  *n = 4* | *P. stuartii*  *n = 4* | *C. freundii*  *n = 4* |
| AMC | 5(100%) | 1(33.3%) | 25(96.2%) | 40(100%) | 4(100%) | 4(100%) | 4(100%) |
| CRX | 3 (60%) | 3 (100%) | 23(88.5%) | 38(95%) | 3(75%) | 4(100%) | 3(75%) |
| CXM | 5(100%) | 3(100%) | 24(92.3%) | 39(97.5%) | 4(100%) | 4(100%) | 3(75%) |
| CAZ | 2 (40%) | 3(100%) | 22(84.6%) | 33(82.5%) | 3(75%) | 4(100%) | 2(50%) |
| CTR | 2 (40%) | 2(66.7%) | 22(84.6%) | 32(80%) | 2(50%) | 4(100%) | 2(50%) |
| GEN | 0 (0%) | 2(66.7%) | 12(46.2%) | 17(42.5%) | 2(50%) | 2(50%) | 1(25%) |
| CPR | 0 (0%) | 1(33.3%) | 9(34.6%) | 14(35%) | 3(75%) | 1(25%) | 1(25%) |
| OFL | 1(20%) | 1(33.3%) | 7(26.9%) | 9(22.5%) | 0(0%) | 0(0%) | 0(0%) |
| ERY | 1 (20%) | 3(100%) | 23(88.5%) | 38(95%) | 4(100%) | 4(100%) | 4(100%) |
| NIT | 0 (0%) | 1(33.3%) | 21(80.8%) | 35(87.5%) | 3(75%) | 4(100%) | 2(50%) |

**Key:** AMC-amoxicillin-clavulanic acid (20/10 µg), CRX-cefuroxime (30 µg), CXM-cefixime (5 µg), CAZ-ceftazidime (30 µg), CTR-ceftriaxone (30 µg), GEN-gentamicin (10 µg), CPR-ciprofloxacin (5 µg), OFL-ofloxacin (5 µg), ERY-erythromycin (5 µg) and NIT-nitrofurantoin (300 µg).

Table 3: Distribution of Multidrug resistant and ESBL-producers among the isolates

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Bacteria isolates | MDR isolates | | | ESBL-producers | | |
| Total | Male | Female | Total | Male | Female |
| *Staphylococcus aureus* (n = 5) | 1 (20%) | 1 (20%) | 0 (0%) | ND | ND | ND |
| *Escherichia coli* (n = 3) | 2 (66.7%) | 0 (0%) | 2 (66.7%) | 0 (0%) | 0 (0%) | 0 (0%) |
| *Proteus* spp.  (n = 26) | 22 (84.6%) | 13 (50%) | 9 (34.6%) | 10 (38.5%) | 7 (26.9%) | 3 (11.5%) |
| *Klebsiella* spp. (n = 40) | 35 (87.5%) | 10 (25%) | 25 (62.5%) | 13 (32.5%) | 6 (15%) | 7 (17.5%) |
| *Moganella morganni*  (n = 4) | 3 (75%) | 1 (25%) | 2 (50%) | 3 (75%) | 2 (50%) | 1 (25%) |
| *Providencia stuartii* (n = 4) | 4 (100%) | 1 (25%) | 3 (75%) | 1 (25%) | 1 (25%) | 0 (0%) |
| *Citrobacter freundii* (n = 4) | 3 (75%) | 3 (75%) | 0 (0%) | 3 (75%) | 3 (75%) | 0 (0%) |
| Total number  (n = 86) | 70 (81.4%) | 29 (33.7%) | 41 (47.7%) | 30 (34.9%) | 19 (22.1%) | 11 (12.8%) |

**Key:** MDR-Multidrug resistant; ESBL-Extended-Spectrum Beta-Lactamase; ND-Not determined

**Discussion**

Although, asymptomatic bacteriuria in a healthy individual does not require treatment and may disappear within a few days but the possibility of having healthy individuals as carriers of multidrug resistant and ESBL-producing bacteria in their urine is inevitable. Several studies in Nigeria have shown that abuse and indiscriminate use of antibiotics by people practicing self-medication are partly responsible for the high prevalence of multidrug resistance and ESBL-producing bacteria in both community and hospital acquired infections (Yah *et al*., 2008; Tamuno *et al*., 2011). People tend to treat minor infections or certain ailments that may not require antibiotics with broad-spectrum or extended-spectrum antibiotics thereby aiding the principle of selection pressure for the highly resistant strains in such individuals. This study recorded high prevalence of asymptomatic bacteriuria among the students of University of Ibadan in southwest Nigeria with high level of multidrug resistant and moderate level of ESBL-producing bacteria. It is interesting to note that all the volunteers in this study have at one time or the other taken antibiotics without prescription for several ailments such as cough, sour-throat, urinary tract infections, typhoid fever, otitis media, boil and others. We suggest therefore that abuse and indiscriminate use of antibiotics among the students of the institution were crucial factors responsible for the high level of the multidrug resistance observed in this study as revealed from the questionnaires. All the volunteers have at one time taking antibiotics.

**Acknowledgement**

We are grateful to the management and staff of the University of Ibadan and the faculty of Pharmacy students, University of Ibadan, Nigeria, as well. We appreciate their effort and assistance towards this research.

**Corresponding Author:**

Onyenwe, Nathaniel, E.

Department of Pharmaceutical Microbiology

Faculty of Pharmacy,University of Ibadan

E-mail: [o\_nathejik@yahoo.com](mailto:o_nathejik@yahoo.com), [mailpharmmuyiwa@yahoo.com](mailto:mailpharmmuyiwa@yahoo.com)

**References**

1. Alebiosu CO, Osinupebi OA, Olajubu FA. Significant asymptomatic bacteriuria among Nigerian Type 2 diabetics. J. Natl Med Assoc 2003; 95: 344 – 351.
2. Ariffin H, Navaratnam P, Mohamed M, Arasu A, Abdullah WA, Lee CL, Peng LH. Ceftazidime-resistant Klebsiella pneumonia bloodstream infection in children with febrile neutropenia. Int. J. Infect. Dis 2000; 4: 21–25.
3. Bonnet R. Growing group of extended-spectrum beta-lactamases: the CTX-M enzymes. Antimicrob. Agents Chemother 2004; 48:1–14.
4. Bush K., Jacoby GA, Medeiros AA. A functional classification scheme for Beta-lactamases and its correlation with molecular structure. Antimicrob. Agents Chemother 1995; 39:1211–1233.
5. Canton R, Coque TM. The CTX-M Beta-lactamase pandemic. Curr. Opin. Microbiol 2000; 9:466–475.
6. Chukwu BF, Okafor HU, Ikefuna AN. Asyptomatic bacteriuria in children with sickle cell anemia at the University of Nigeria teaching hospital, Enugu, South East, Nigeria. Italian Journal of pediatrics. 2011; 37: 45 - 49.
7. CLSI. Clinical and Laboratory Standards Institute Guidelines. Performance standards for antimicrobial disk and dilution susceptibility tests for bacteria isolated from animals. Approved standard M31-A2. National Committee for Clinical Laboratory Standards, Wayne, Pa 2011.
8. Dalal S, Nicolle L, Marrs CF, Zhang L, Harding G, Foxman B. Long-term *Escherichia coli* Asymptomatic bacteriuria among women with diabetes mellitus. Clin Infect Dis 2009; 49: 491 – 497.
9. Mendonca N, Joana L, Vera M, Eugenia F, the Antimicrobial Resistance Surveillance Program in Portugal, Manuela C. Spread of Extended-Spectrum β-Lactamase CTX-M-Producing *Escherichia coli* Clinical Isolates in Community and Nosocomial Environments in Portugal. Antimicrob. Agents Chemother 2007; 51: 1946-1955.
10. Nicolle LE. Asymptomatic bacteriuria: when to screen and when to treat. Infect Dis Clin North Am 2003; 17:367-394.
11. Okesola AO, Makanjuola O. Resistance to third-generation cephalosporins and other antibiotics by *Enterobacteriaceae* in Western Nigeria. American Journal of Infectious Diseases 2009; 5: 17-20.
12. Paterson DL, Bonomo RA. Extended-Spectrum Beta-Lactamase: a Clinical Update. Clin. Microbiol. Rev 2005; 18(4): 657-686.
13. Pitout JD, Nordmann P, Laupland KB, Poirel L. Emergence of Enterobacteriaceae producing extended-spectrum \_-lactamases (ESBLs) in the community. J. Antimicrob. Chemother. 2005; 56**:**52–59.
14. Richard C, Lindsay EN, Andrew M, Thomas MH. 2006. Asymptomatic bacteriuria in adults. Am Fam Physician 2006; 74:985 – 990.
15. Soge OO, Adeniyi BA, Roberts MC. New antibiotic resistance genes associated with CTX-M plasmids from uropathogenic Nigerian *Klebsiella pneumonia*. J. Antimicrob.Chemother 2006; 58: 1048-1053.
16. Tamuno I, Mohammed SI. Self-medication with antibiotics amongst students of a Nigerian Tertiary Institution. J. Basic Appl. Sci. Res 2011; 1: 1319-1326.
17. Tijjani J, Arzai AH, Sadiq NM. Antimicrobial susceptibility pattern of exteneded-spectrum beta-lactamase producers in Gram negative urogenital isolates in Kano, Nigeria. Bayero Journal of Pure and Applied Sciences 2012; 5: 20-25.
18. Yah SC, Yusuf OE, Eghafona NO. Pattern of antibiotic usage by adult populations in the city of Benin, Nigeria. Scientific Research and Essay 2008; 3: 081-085.

4/11/2014