Prevalence of urinary tract infection among school going adolescent female

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ABSTRACT: Background: Urinary Tract Infection (UTI) is a serious health problem affecting millions of people especially females in developing countries like Nepal. The prevalence of UTI is higher during adolescence, a period in which hormonal changes favor vaginal colonization by nephrogenic strains of bacteria, which can migrate to the periurethral area and cause urinary tract infection. **Aim**: To determine the prevalence of UTI and to find out their antimicrobial susceptibility profile among adolescent female students of Lekhnath community. **Methods**: A cross-sectional study was conducted at two schools i.e. Brahma Rupa and Universe English Boarding School of Lekhnath community. A total 170 clean catch mid-stream urine samples were collected for routine examination, culture and sensitivity test were done from August 2018 to December 2018. A structured questionnaire was used to obtain the demographic profile, symptoms, treatment history, and hygiene practices. **Result**s: Out of 170 urine samples 7 (4.12%) were positive for pathogenic organisms. Various uropathogens, *Escherichia coli* was predominant, constituted for 42.86% followed by *Enterococcus* (28.56%), *Staphylococcus saprophyticus* (14.29%) and *Staphylococcus aureus* (14.29%). Most of the organisms isolated were sensitive to Ciprofloxacin (100%) and Gentamicin (85.71%). Poor menstrual hygiene practices were found to be one of the contributing factors for UTI. **Conclusions**: UTI is a common problem of adolescence causing much discomfort, therefore it needs careful investigations. Frequent education about hygiene and sanitation practices during menstruation in this regard will prevent asymptomatic UTI.

Keywords: Urinary tract infection; Adolescence; Female; Antibiotic sensitivity test.

1. INTRODUCTION

Infection of any part of the complex renal system and presence of actively multiplying organisms in the urinary tract is considered as Urinary Tract Infection (UTI) [1, 2]. Urine is a sterile ultra-filtrate of blood. In absence of urinary tract infection (UTI), it emerges from kidney and bladder free of microbes. A very few quantities of bacteria may pass in through distal urethra during passage as contaminants. Some species of bacteria may be found in distal urethra as transient microflora which is derived from fecal flora [3].

The World Health Organization had defined adolescence as the age group of 10-19 years. It is a transitional period from dependent childhood to independent adulthood. This is the earliest age to prevent

morbidity in later life by means of any health intervention. UTI is a well-known entity among females, occurring more than that in males [1].

UTI can be asymptomatic or symptomatic characterized by a wide range of presentations from mild voiding irritation to bacteremia, sepsis or even death. UTI accounts for 25% of all most common bacterial infections. It is predicted that one half of all women will experience a UTI in their lifetime, and one in three women will receive antimicrobial therapy for a UTI [3].

About 152 million people are diagnosed worldwide with urinary tract infections per year with morbidity of about 196,500. The presence of $>10^5$ colonies of a single pathogen per milliliter of urine is known as bacteriuria. The isolation of bacteria in urine in a significant quantities consistent with infection. Therefore isolation of organisms causing UTI and their antibiotic susceptibility is essential for their appropriate management. Antibiotics are the specific treatment for a urinary tract infection though resistance to antibiotics is highly prevalent in bacterial isolates all over the world, particularly in developing countries [4].

In developing countries like Nepal UTI is the most communal bacterial infection causing illness in females due to illiteracy, unsanitary conditions and deficiency of good toilet facilities [3]. The time period in which hormonal variations favor vaginal colonization by nephritogenic strains of bacteria, which can travel to the periurethral area and cause UTI, these are the main causes of higher prevalence during adolescence [4].

This study is undertaken to device the ideal screening method for UTI, by comparing the gold standard method of urine culture and the other rapid screening tests, and to identify the commonest isolate causing UTI in adolescent as it may help to initiate early educational intervention to mitigate UTI problems among adolescent girls and also later in their lives.

2. METHODOLOGY

2.1. Study design

A school-based cross-sectional study was carried out at Brahma Rupa Higher Secondary School and Universe English Boarding School of Lekhnath community from August 2018 to December 2018 on the female adolescent student. 170 female adolescent student participated in the study.

Clean freshly voided mid-stream urine were collected after giving proper guidelines, in a sterile plastic, leak proof sterile container.

2.2. Lab diagnosis and identification

Analysis of urine sample was done by the use of dipsticks, which is a chemically treated paper, with various colors indicating the presence of protein, pH and sugar when dipped into the urine. Then followed by Microscopy, Urine Culture were performed on MacConkey agar, Muller-Hinton Agar, biochemical media citrate, SIM, TSI and urease which were the product from HiMedia Laboratories Pvt. Ltd.

All the urine samples were inoculated aseptically into MacConkey agar with the help of sterile inoculating loop of diameter 4 mm using streaking technique and incubated for 24 hours at 37° C in aerobic condition. Colony count of more than 10^5cfu/ml was considered significant and further processed for identification. Antimicrobial susceptibility of isolates were tested by using Kirby-Bauer disc diffusion technique using MHA followed by biochemical test for identification.

2.3. Ethical consideration

The study was conducted in accordance to existing ethical guidelines. Ethical approval was taken from IRC, Pokhara University Research Centre (Reference number 105/075-076). A written consent was taken from the guardian of students prior to her inclusion in research.

2.4. Data processing and analysis

All the analysis of statistical data was done by using SPSS software version 20 and MS Excel. Frequency and distribution was calculated, association was analyzed using chi-square test and P value less than 0.005 was considered significant with 95% CI.

3. RESULTS

3.1. Demographic Information of the participants (Students)

A school based cross-sectional study was carried out on 170 adolescent girls from different schools of Lekhnath Community, Kaski, Nepal. The overall mean and SD of age was 13.92 ±1.72 years. Majority of the participants were in the age group 10-14 (62.9%) followed by age group 15-17 (35.9%) and 18-19 (1.2%) which showed the significant association with age class with culture for UTI with P value 0.0335 as shown in Table 1. In this study most of the participants enrolled were of lower secondary level 56.5% followed by secondary level 43.5%. It was found that the most of the students have attended menarche 72.9% followed by 27.1% who have not attended menarche.

During our study it was found that most of the girls used sanitary pads during menstrual period, while some used cotton cloth as well as both of them due to economical reason as shown in Table 2. The prevalence of UTI was significantly 3% more in those girls using cotton pads during menstruation with P value 0.002 as shown in Table 3 which shows the association of hygiene practices with UTI.

Table 1. Association of age class with UTI.

Age class/ culture	No growth	Significant growth	Insignificant growth	Multiple growth	P value
10-14	93	4	8	2	
15-17	48	2	9	2	0.035
18-19	1	1	0	0	

Table 2. Hygiene practices among students.

Pad used	Frequency	Percent (%)
Sanitary pad	87	69.60
Cotton cloth	16	12.80
Both	22	17.60

Table 3. Association of hygiene practices with UTI.

Type of sanitary pads	UTI				Total	%	P value
	Present	%	Absent	%			
Cotton	4	3.2	12	18	9.6	12.8	
Sanitary	3	2.4	84	59	67.2	69.6	0.002
Both	0	0	22	18	17.6	17.6	
Total	7	5.6	118	95	94.4		

3.2. Microbiological studies

Microscopic examination for WBCs, RBCs, epithelial cells and presence of cast and crystal helps in determination of pyuria in suspected females. Out of these samples, 83 were positive for pyuria and rest 87 cases were negative for pyuria. Similarly, RBCs was seen in 4 of them, while it was indiscernible in 166 cases. The microscopic study also defined the presence of amorphous urates in 5 of the samples, calcium oxalate in 2 samples, yeast cells in one sample. The absence of any crystals and cast were seen in 162 urine samples as shown in Figure 1.

According to our data, out of 170 urine samples, 142 (83.53%) showed no growth, 17 (10%) were found to have insignificant bacterial growth, 4 (2.35%) were found to have multiple growth and 7 (4.12%) cases were found to have significant growth causing UTI as shown in Figure 2.
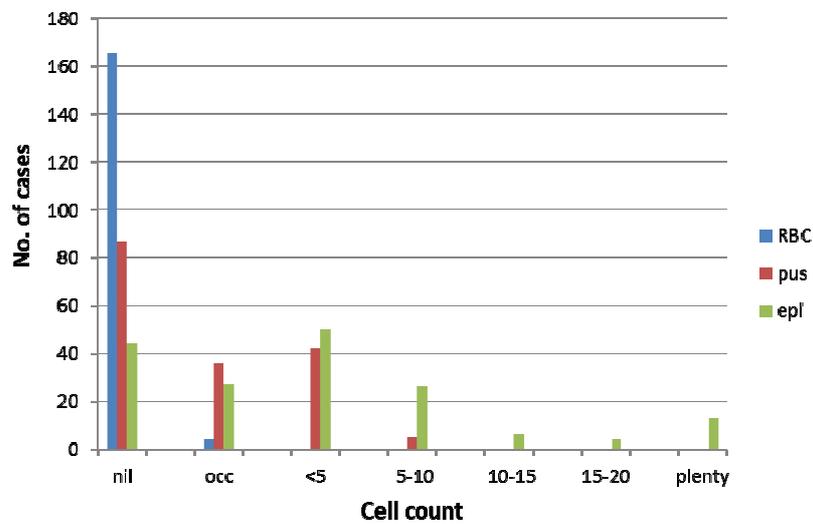
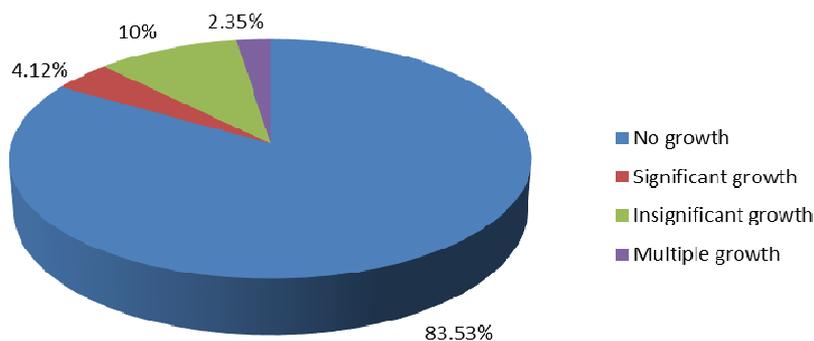**Figure 1.** Cell counts in microscopy of urine sample.

Figure 2. Organisms grown in culture.

The most common isolates obtained in urine culture was *E. coli* which is a Gram-negative organism. *E. coli* was isolated in 42.86% i.e highest percentage followed *Enterococcus* spp., *Staphylococcus aureus, Staphylococcus saprophyticus* 28.56%, 14.29%, 14.29%, respectively as shown in Figure 3. Gram-positive bacteria were the more common uropathogens responsible for UTI with 57.15% in comparison to 42.86% for Gram-negative bacteria.

Association of pyuria with UTI describes the pattern of pyuria in urine sediments against the number of samples when significant bacterial growth was isolated as well insignificant, multiple and no growth

occurred respectively. The P value is 0.000. Out of total 7 urine samples 3 samples were with <5/HPF and 4 samples were with >5/HPF showed growth with pyuria as shown in Table 4.
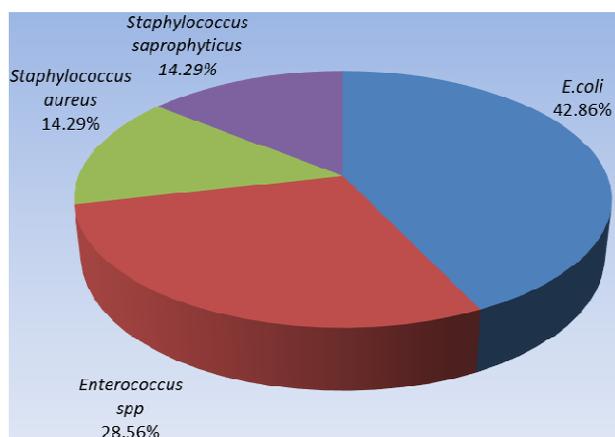

Figure 3. Distribution of uropathogens.

Table 4. Pyuria versus UTI.

Pyuria/ Culture	No growth	Significant growth	Multiple growth	Insignificant growth	P value
Nil	78	0	2	7	
Occasional	30	0	1	5	0.000
<5	33	3	1	5	
5-10	1	4	0	0	

The antibiotic sensitivity tests showed that the most of the organisms were sensitive to ciprofloxacin (100%), gentamicin (81.71%), amikacin (71.42%), norfloxacin (71.42%), nitrofurantoin (71.42%), followed by co-trimoxazole (57.14%), cefoperazone (42.85%), novobiocin (14.28%), ceftriazone (14.28%), vancomycin (0%) as shown in Figure 4. *E. coli*, the most common isolate in this study was found to be 100% sensitive to ciprofloxacin, amikacin, norfloxacin, cefoperazone followed by gentamicin, cotrimoxazole, ceftriazone (66.67%), nitrofurantoin (33.33%) as shown in Figure 5.
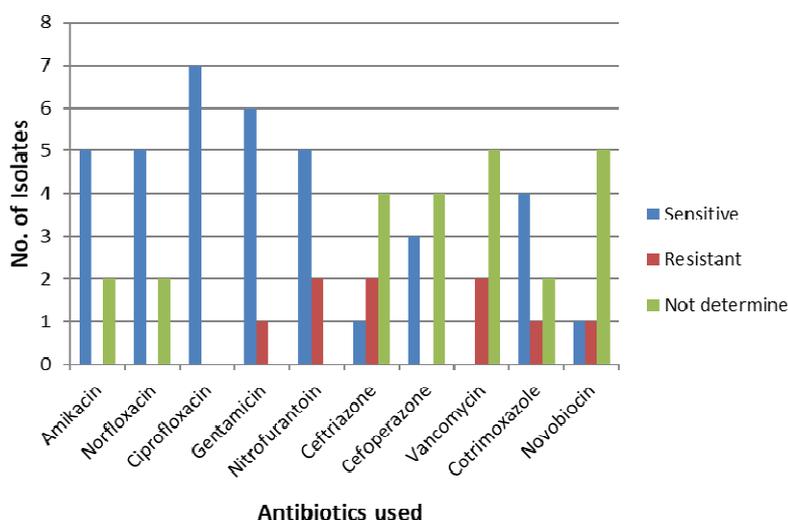

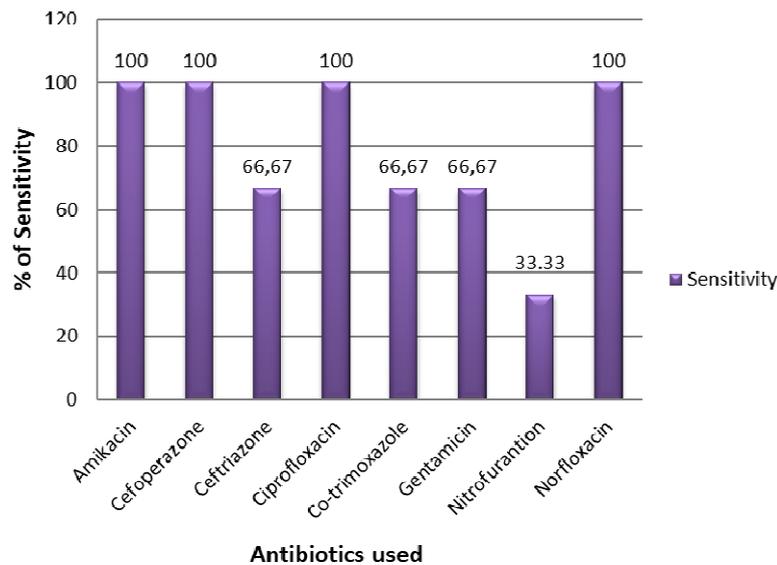**Figure 4.** Antibiotic susceptibility profile of all isolates.

Figure 5. Sensitivity of *E. coli* to common antibiotics.

4. DISCUSSION

A cross sectional study was carried out on school going adolescent female as a participant with the intention to prevent UTI among them through early diagnosis. In our study, the total number of 170 samples were collected from adolescent females of two schools of Lekhnath community, Pokhara, Kaski. Out of 170 processed samples, 142 (83.53%) samples yielded no growth, 17 (10%) samples showed insignificant growth whereas 7 (4.12%) samples came up with significant growth and 4 (2.35%) samples with multiple growth. The absence of significant growth in 83.53% sample was established as such when microscopically, mostly non-significant pus cell count(less than 5 per h.p.f) was observed [5].

This present study showed prevalence of 4.12 % UTI among adolescent female students, which is consistent with the similar study done by Ahmed and Avasarala in Karimnagar, India [6] reported the prevalence rate of 12.7%. Likewise, the study in Ile-Ife, Nigeria [7] concluded the prevalence of 11.96%, which is higher than the present data. This low prevalence of UTI in our study may be attributed to the extensive health care education provided by the school to the students, due to the difference in environmental condition, social behavior and standards of hygiene maintenance of the participants of study. Whereas, the frequency is approximate to the incidence reported by Singh et al. [8], who reported 4.2% UTI in a community based study. This data is nearly close to the research conducted by Rahman et al. [9] in Dhaka, Bangladesh which had a prevalence rate of 9%.

The females of age group 10-14 were found to have higher incidence of UTI. The reason might be due to the hormonal changes during the adolescent period. UTI was significantly present in the girls who had attained menarche than the girls who had not. Similar results are also observed in another study by Ahmed et al. [6] in Karimnagar. Likewise, this study revealed a strong association between UTI and hygiene practices during menstrual period which were co-related with the studies done by Singh et al. [8] and Narayan [10].

A total of 7 bacterial isolates were identified out of 170 urine samples after culture and AST. They comprised of 4 different groups of organism including both gram positive and gram negative bacteria. They are: *Escherichia coli*, *Enterococcus spp., Staphylococcus aureus, and Staphylococcus saprophyticus*. Gram-positive bacteria was the most common of uropathogens responsible for UTI with a 57.15% in comparison to

42.85% for Gram-negative bacteria. Finding is consistent with the report of a previous author who isolated 48.7% Gram-positive bacteria and 43.4% Gram-negative bacilli [11].

The most predominant organism was found to be *E. coli* (43%), which is close to the study done by Aiyegoro et al. (52.78%) [7]. Higher prevalence of *E. coli* might be due to poor hygienic condition and especially higher among females due to contamination of perineum through the fecal flora Jha et al. [12]. The dominance of *E. coli* was followed by *Enterococcus* spp. (29%) in this study which resembles to the study done by Gupta et al. [3] and Tamang et al. [13] which found out that *Enterococcus spp.* (6.25% and 22.2%) was the second most organism causing UTI. Other organisms isolated were *Staphylococcus aureus* (14%) and *S. saprophyticus* (14%).

The antibiotic sensitivity testing of this study showed that most of the organism were sensitive to ciprofloxacin (100%), gentamicin (85.71%), amikacin (71.42%), norfloxacin (71.42%), nitrofurantoin (71.42%) followed by co-trimoxazole (57.14%), cefoperazone (42.85%), novobiocin (14.28%), ceftriaxone (14.28%) and vancomycin (0%).

E. coli was found predominant and the majority of isolates showed susceptibility towards ciprofloxacin, amikacin, norfloxacin and cefoperazone (100%). Reduced sensitivity of *E. coli* to gentamicin, co-trimoxazole, ceftriaxone (66.67%) and nitrofurantoin (33.33%) was observed.

In *Enterococcus* spp., gentamicin and ciprofloxacin was found to be 100% sensitive, whereas 50% of sensitivity was observed to nitrofurantoin. likewise, it was not sensitive to vancomycin.

The *Staphylococcus aureus* showed 100% sensitivity towards amikacin, norfloxacin, ciprofloxacin, gentamicin, nitrofurantoin, co-trimoxazole and novobiocin. Whereas, the sensitivity pattern of *Staphylococcus saprophyticus* showed 100% sensitivity to amikacin, norfloxacin, ciprofloxacin, gentamicin, nitrofurantoin, co-trimoxazole and resistance to novobiocin.

5. CONCLUSIONS

A prevalence of asymptomatic bacteriuria with the rate of 4.12% in this study suggest that UTI may be one of the health problems among the female students (who are mainly residential) of Lekhnath community. *Escherichia coli* is the most common bacteria causing UTI followed by gram positive pathogens like *Enterococcus* species, *Staphylococcus aureus, S. saprophyticus*. Frequent education about hygiene and sanitation practices during menstruation in this regard will prevent asymptomatic UTI or bacteriuria cases becoming symptomatic with accompanying renal damage.

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Conflict of Interest: The authors have no conflict of interest to declare.

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