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PREVALENCE AND COMPARATIVE LIKELIHOOD OF URINARY TRACT INFECTION (UTI) AMONG FEMALE OUT PATIENTS IN BSMMU

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Abstract: Out of 200 urine samples of female out patients from BSMMU hospital, 128 (64%) cases were detected as E*scherichia coli* positive, 66.67% of cases in summer and 60% in winter. To compare the risks of *E. coli* infection in summer and winter and also among different age groups, odd ratio (OR) and relative risk (RR) were used as measures of comparative likelihood. The values of both OR and RR were greater than one when the risk of *E. coli* infection of adults (16-35) was compared with that of middle age (36-50) and old age (51-70) groups. The adults were always at higher risk of UTI by *E. coli*, and the livelihood of infection was not equal in summer and winter.

Key words: Escherichia coli, urinary tract, prevalence, risk ratio, odd ratio.

INTRODUCTION

Infection of the urinary tract is an extremely common clinical problem (Lambaie and Davison 1978). Even today urinary tract infection (UTI) is one of the most important causes of morbidity and mortality in the developing countries like Bangladesh. This may be attributed to lack of proper research, faulty diagnostic procedures, abuse of chemotherapeutic agents of the people and little or no preventive measures. The alarming phenomenon is that UTI does not restrict itself to the urinary tract only rather it can spread. UTI infections usually cause inflammation of the affected tissues of the urethra (urethritis) and urinary bladder. The most significant danger from lower urinary tract infections is that they can affect the kidney (causing pyelonephritis) and develop bladder infections subsequently (Nahar *et al.* 2010). Bacteria carried by blood stream can also infect the kidney and the infections can be very difficult to eradicate, are often chronic, and lead to marked damage of the kidney. Death promptly follows kidney failure unless the patient is lucky enough to be able to use artificial kidneys, or perhaps to receive a kidney transplant.

The most common aerobic members causing UTI are *Escherichia coli*, *Klebsiella* sp., *Enterobacter* sp., *Pseudomonas* sp., and *Proteus* sp. Other bacteria, such as *Staphylococcus saprophyticus* occasionally appear in spontaneous urinary infection. It has been observed that only a small number of serologically

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distinct strains are responsible for the infections caused by *E. coli.* It has been observed that the greater dominance of *E. coli* in outpatient population are serologically distinct strains responsible for the UTI.

Recurrent or persistent of UTI patient with lower urinary tract involvement tend to have repeated bouts of transient symptomatic or asymptomatic infection. Many investigators in Bangladesh also showed that women were the usual victims of the urinary pathogens. Haque *et al.* (1976) reported 78.8% of the *E. coli* infection in women. Nahar and Selim (1989) worked on adult women and reported that 70.9% organisms were found to be *E. coli. E. coli* was the predominant organism during pregnancy and was prevalent for six months after delivery in about a 1/3rd of the pregnant patients (Nahar *et al.* 2010, Khanum *et al.* 2006).

In the present paper, the prevalence of UTI was studied among the female out patients of the Bangabandhu Sheikh Mujib Medical University (BSMMU) Hospital.

MATERIAL AND METHODS

Sources of specimens: Urine specimens were collected from the BSMMU Hospital, Dhaka during the period from June 2008 to August 2009.

Urine examination: A fresh drop of uncentrifuged urine was placed on a slide, covered with a cover slip and examined with restricted light intensity under the high dry objective of an ordinary clinical microscope.

Culture of urine: A sample of the urine was streaked across the surface of one or more agar plates and placed in an incubator at body temperature for 24 hours. If *E. coli* was present, the total number of bacteria was counted (colony count), and the organisms were identified by additional biochemical tests.

Estimation: 1. Prevalence - prevalence of health-related state in a statistical population is defined as the total number of cases of the risk factor in the population at a given time, or the total number of cases in the population, divided by the number of individuals in the population Then, we can write the prevalence as

$$\text{Prevalence} = \frac{a}{a+b} \times 100 .$$

where a= Total number of cases (positive), b= Total number of non cases (negative).

2. Odds - probability theory and statistics, where the variable p is the probability in favor of the event, and the probability against the event is

therefore 1-*p*, "the odds" of the event are the quotient of the two, or $\frac{p}{1-p}$. The value may be regarded as the relative likelihood of the event that will happen, expressed as a fraction (if it is less than 1), or a multiple (if it is equal to or greater than one) of the likelihood that the event will not happen.

3. Odds ratio (OR) and Relative risk/Risk ratio (RR): Both the odds ratio and the relative risk compare the likelihood of an event between the following two groups of pathogens.

	E. coli positive	*E. coli* negative	Total
Summer	*a*	*b*	*a* + *b*
Winter	*c*	*d*	*c* + *d*
Total	*a*+*c*	*b*+*d*	*n*

where, a= No. of *E. coli* positive in summer, b= No. of *E. coli* negative in summer, c= No. of *E. coli* positive in winter, d= No. of *E. coli* negative in winter.

Now, the odds ratio for summer with respect to winter =Odds in favor of *E. coli* positive in summer/ Odds in favor of *E. coli* positive in winter. That is, $OR = \frac{a/b}{c/d}$. This mean summer season has $OR = \frac{a/b}{c/d}$ greater odds of *E. coli* positive than winter season. The relative risk (sometimes called the risk ratio) compares the probability of *E. coli* positive in each season. Relative risk for summer= Probability of *E. coli* positive in summer/probability of *E. coli* positive in winter. That is, $RR = \frac{a/a+b}{c/c+d}$. This means in summer a patient has $RR = \frac{a/a+b}{c/c+d}$ times greater probability of being *E. coli* positive than the probability in winter.

RESULTS

A total of 128 (64%) urine samples was detected by the presence of *E. coli* positive while 72 (36%) cases were found negative (Table 1). During summer, the prevalence of *E. coli* was 73.33% in June, 55% in July and 70% in August (Fig. 1). During winter, the prevalence of positive cases was 66.67% in November, 50% in December and 61.54% in January (Table 1). During the study period of six months, the highest prevalence of *E. coli* infection was in June 2008.

Prevalence of E. coli in relation to age groups (during summer season): In the study population, the females were categorized into three broad age groups, viz. adult (16-35 year), middle age (36-50 year) and old age (51-70 year).

In summer, 69.23% of adults, 66.67% of middle aged and 62.50% of old patients were exposed to *E. coli* causing UTI. The prevalence was highest (80%)

Table 1. Prevalence of UTI positive and negative during the study period.

Season	Month	Total patients	Positive results	Prevalence (%)	Negative results	Prevalence (%)	Odds	OR	RR
	June	60	44	73.33	16	26.67	2.75		
Summer	July	40	22	55.00	18	45.00	1.22		
	August	20	14	70.00	6	30.00	2.33		
	Total	120	80	66.67	40	33.33	2.00		
	November	30	20	66.67	10	33.33	2.00	1.33	1.11
Winter	December	24	12	50.00	12	50.00	1.00		
	January	26	16	61.54	10	38.46	1.60		
	Total	80	48	60.00	32	40.00	1.50		
Grand Total		**200**	**128**	**64.00**	**72**	**36.00**	**1.78**		

OR = Odds Ratio; RR = Risk Ratio

among the patients aged between 16 and 20 years; lowest (50%) in patients aged between 60 and 70 years. In winter, the prevalence was 73.33% among the adults, 61.54% in middle aged and 41.67% in old group (Table 3). The female patients of age between 16 and 20 showed the highest prevalence of 83.33% while the oldest patients aged between 66 and 70 showed 41.67%.

Table 2. Age-based incidence of *E. coli* in summer.

Age group (yr)	Age limits	Total patients	Positive results	Prevalence (%)	Negative results	Prevalence (%)	Odds	OR	RR
	16-20	10	8	80.00	2	20.00	4.00	Adult/ Middle	Adult/ Middle
Adult (16-35)	21-25	20	14	70.00	6	30.00	2.33	1.13	1.04
	26-30	12	8	66.67	4	33.33	2.00	Adult/ Old	Adult/ Old
	31-35	10	6	60.00	4	40.00	1.50	1.35	1.11
	Total	52	36	69.23	16	30.77	2.25		
	36-40	12	8	66.67	4	33.33	2.00	Middle/ Adult	Middle/ Adult
Middle (36-50)	41-45	14	10	71.43	4	28.57	2.50	0.89	0.96
	46-50	10	6	60.00	4	40.00	1.50	Middle/ Old	Middle/ Old
	Total	36	24	66.67	12	33.33	2.00	1.2	1.07
	51-55	10	6	60.00	4	40.00	1.50	Old/ Adult	Old/ Adult
Old (51-70)	56-60	6	4	66.67	2	33.33	2.00	0.74	0.90
	61-65	8	6	75.00	2	25.00	3.00	Old/ Middle	Old/ Middle
	66-70	8	4	50.00	4	50.00	1.00	0.83	0.94
	Total	32	20	62.50	12	37.50	1.67		
Grand Total		**120**	**80**	**66.67**	**40**	**33.33**	**2.00**		

Although the results were different, the prevalence of the presence and absence of *E. coli* among different age groups were found uniform in summer

and winter (Figs. 1 and 2). This is an indication that age groups and seasons might not be related to the prevalence of *E. coli*. However, the age of the patient and the season, in which urinary tract was infected, draw special attention as long as the presence of *E. coli* is concerned.

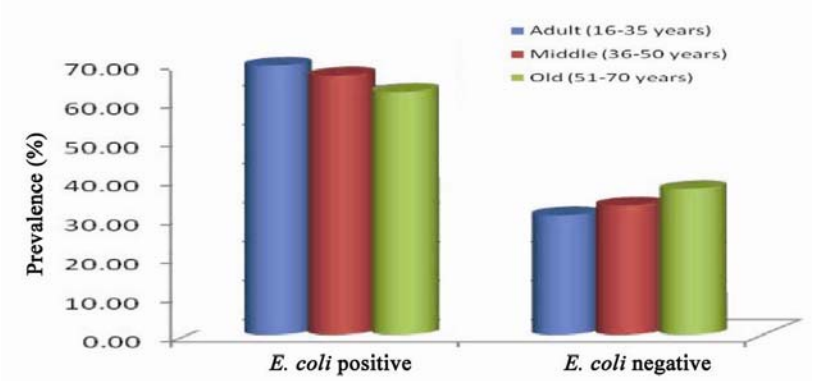

Fig. 1. Prevalence of *E. coli* infection of adult, middle aged and old female patients in summer.

Comparative likelihoods of finding E. coli using Odds ratio (OR) and Risk Ratio (RR): In the present study, it was found that the probability of a young female to be *E. coli* positive was higher than the probability of an old female. The last three columns of Tables 1, 2, 3 and 4 present these findings in terms of odds, odds ratio (OR) and risk ratio/relative risks (RR). The odds in favour of *E. coli* positive was maximum (2.75) in June and it was 1.00 in December (Table 1). In general the odds of being *E. coli* positive in summer was 2.0 and that in winter was 1.5. Both OR (2.33) and RR (1.11), being greater than 1, reveal that the likelihood of finding *E. coli* was higher in summer than in winter. Comapred to different age groups using OR, it was observed that in summer adult patients had 1.13 fold greater odds of being *E. coli* positive than the middle aged group and they had 1.35 fold greater odds of being *E. coli* positive than the old group (Table 2). Middle aged group had 1.2 fold greater odds of being *E. coli* than the old group. In winter, the adult had 1.72 fold greater odds than middle aged and 3.85 fold greater odds than old age group; Middle age group had 2.24 fold greater odds than old age group (Table 3). Similar results were obtained when the comparative likelihood was studied with respect to relative risks (RR). In summer, the adult patients had 1.04 times greater probability of being *E. coli* positive (RR=1.04) than the middle aged patients (Table 2).

In winter, adult patients had 1.19 times higher probability Risk Ratio (RR=1.19) than the old patients (Table 3). The adult patients in summer had 1.11 times higher probability (RR=1.11) to be *E. coli* positive than the old patients (Table 2). In winter it was found to be 1.76 (Table 3). When the middle

aged group was compared with the old group, RR was 1.07 in summer (Table 2) and it was 1.48 in winter (Table 3). For the adult patients, RR was 0.94 which indicates that adult patients are 0.06 times less likely to be *E. coli* positive in

Table 3. Age based incidence of *E. coli* (winter).

Age group (yr)	Age limits	Total Patients	Positive results	Preva-lence (%)	Negative results	Preva-lence (%)	Odds	OR	RR
	16-20	12	10	83.33	2	16.67	5.00	Adult/ Middle	Adult/ Middle
Adult (16-35)	21-25	8	6	75.00	2	25.00	3.00	1.72	1.19
	26-30	6	4	66.67	2	33.33	2.00	Adult/ Old	Adult/ Old
	31-35	4	2	50.00	2	50.00	1.00	3.85	1.76
	Total	30	22	73.33	8	26.67	2.75		
	36-40	12	10	83.33	2	16.67	5.00	Middle/ Adult	Middle/ Adult
Middle (36-50)	41-45	8	4	50.00	4	50.00	1.00	0.58	0.84
	46-50	6	2	33.33	4	66.67	0.50	Middle/ Old	Middle/ Old
	Total	26	16	61.54	10	38.46	1.60	2.24	1.48
	51-55	8	4	50.00	4	50.00	1.00	Old/ Adult	Old/ Adult
Old (51-70)	56-60	6	2	33.33	4	66.67	0.50	0.26	0.57
	61-65	6	2	33.33	4	66.67	0.50	Old/ Middle	Old/ Middle
	66-70	4	2	50.00	2	50.00	1.00	0.45	0.68
	Total	24	10	41.67	14	58.33	0.71		
Grand Total		**80**	**48**	**60.00**	**32**	**40.00**	**1.50**		

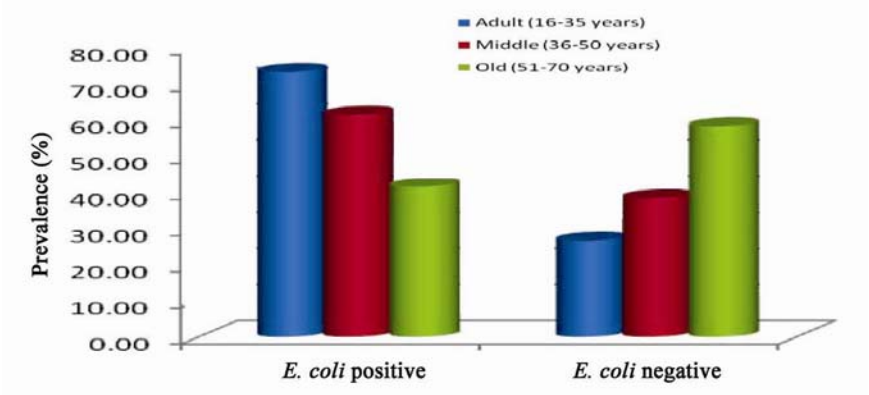

Fig. 2. Prevalence of *E. coli* infection of adult, middle aged and old female patients in winter.

summer than in winter. For middle aged patients RR=1.08 means *E. coli* in summer is 1.08 times more likely than in winter. For old patients RR=1.5 means.

Table 4. Age and Season specific comparative likelihood of *E. coli* infection.

Season	Age group (yr)	Age limits	Odds of being positive	Risk ratio by age group	Risk ratio by season
Summer	Adult (16-35)	16-20	4.00	Adult/Middle	Summer/Winter
		21-25	2.33	1.13	
		26-30	2.00		0.94
		31-35	1.50	Adult/Old	
		16-35	2.25	1.35	
	Middle (36-50)	36-40	2.00	Middle/Adult	Summer/Winter
		41-45	2.50	0.89	
		46-50	1.50	Middle/Old	1.08
		36-50	2.00	1.2	
	Old (51-70)	51-55	1.50	Old/Adult	Summer/Winter
		56-60	2.00	0.74	
		61-65	3.00		1.5
		66-70	1.00	Old/Middle	
		51-70	1.67	0.83	
Winter	Adult (16-35)	16-20	5.00	Adult/Middle	Winter/Summer
		21-25	3.00	1.72	
		26-30	2.00		1.06
		31-35	1.00	Adult/Old	
		16-35	2.75	3.85	
	Middle (36-50)	36-40	5.00	Middle/Adult	Winter/Summer
		41-45	1.00	0.58	
		46-50	0.50	Middle/Old	0.92
		36-50	1.60	2.24	
	Old (51-70)	51-55	1.00	Old/Adult	Winter/Summer
		56-60	0.50	0.26	
		61-65	0.50		0.67
		66-70	1.00	Old/Middle	
		51-70	0.71	0.45	

DISCUSSION

Mere presence of organisms in urine is not an adequate basis for the diagnosis of UTI (Kass 1975). Quantitative bacteriology is necessary and hence colony count is necessary to distinguish contamination from true infection particularly where mixed organisms are cultured. (Wemambu and Obi 1983), usually urinary tract infection is defined as the colonization and invasion of the structures in the urinary tract by microorganisms (Metha *et al.* 1981). The course of an infection is dependent on the ability of the pathogens to overcome the complex defense system of human body (Funfotuck *et al.* 1989).

In Bangladesh significantly higher number of *E. coli* is isolated from urine. The patients of UTI were found to posses hemolytic and hem agglutinating properties (Muhammad *et al.* 1990). The hospital environment in an important determinant of the nature of the bacterial flora in UTI. In this study, prevalence

of *E. coli* in the urine samples was more in summer season than winter season because in summer season increased temperature causes sweating more than winter, therefore urine production becomes less and concentrated which provides the opportunity to multiply the bacteria. Conversely, in winter season less sweating causes more dilute urine production, which washes away any multiplying bacteria. Women of different age groups were observed to be very much prone to UTI. The highest numbers of positive cases were found among the adult women 16-20 yr group were 80% during summer and 83.33% also with the same age group, i.e. 16-20 yrs during winter season. UTI is always a very common infection among the women revealed by the studies of several workers.

Many investigators in Bangladesh also showed that women were the usual victims of the urinary pathogens. Haque *et al.* (1976) screened 170 volunteers of different sex and found 33 (19.4) positive cases. Among these 33 cases, 26 were female (78.8%). The greater prevalence of UTI among the adult females is due to the vulnerable anatomical position of the short urethra, which easily admits bacteria from the vagina to the urinary bladder and others factors like hormonal secretion, sexual intercourse and pregnancy (Smith and Bullen 1965, and Kass 1975). From the present study it appears that the urinary tract infection is fairly common in the women. The study also finds that adult women are always in higher risk of being exposed to *E. coli.* infection than others. Unfortunately, in most of the cases the women are not aware of this problem and remain without proper laboratory investigation and treatment

The results of this study indicate *E. coli* is prevalent in women and it posses virulence associated properties. So appropriate measures should be taken for the detection and treatment of such cases.

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