

Evaluation of the effectiveness of probiotics in the treatment of urinary tract infection among women in Bangladesh

Fatima Farhana

Uttara Adhunik Medical College

Nafisa Mosaddek

Bangladesh University of Professionals

Md. Saiful Islam

Jahangirnagar University

Nazmul Hossain

Jahangirnagar University

Anima Sarker

Uttara Adhunik Medical College and Hospital

Taposhi Rabeya Mukta

Uttara Adhunik Medical College and Hospital

Rumi Akter

South East University

Rinat Rizvi

Hasan K.M. Rakibul

E A F Ansary

Uttara Adhunik Medical College and Hospital

Abu Syed Mosaddek (✉ drmosaddek1968@gmail.com)

Uttara Adhunik Medical College

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Abstract

Background: Urinary tract infection (UTI) occurs more in women than men. *Escherichia coli* are responsible in most cases. The microbial (*Lactobacillus*) species which inhabit in the vaginal tract, play an important role in the prevention of infection. Irrational use of antibiotics contributes to changes in antibiotic susceptibility patterns of pathogens. Hence, administration of probiotics exogenously may cause colonization of *Lactobacillus* in female urogenital organs.

Objectives: The study aimed to assess the effectiveness of probiotics in the treatment of UTI among women in Bangladesh.

Methods: This interventional, prospective, non-randomized trial was conducted among women suffering from UTI in the department of Pharmacology and Gynecology of Uttara Adhunik Medical College Hospital, Bangladesh from January, 2019 to June, 2021. A total of 162 women who suffered from UTI were enrolled to receive probiotic, antibiotic, and probiotic + antibiotic treatments. Urine culture and sensitivity test of all participants was done during enrollment. Patients came for follow-up visits on day 30 of completion of therapy and the final study population was 132.

Results: Among the 132 participants, the mean ages were 34.23 ± 14.28 years (mean \pm SD). Average duration of UTI prior to enrollment was 77.61 ± 288.59 days. 93.18% patients complaint burning sensation of urination, pain or pressure in the back or lower abdomen (67.42%) and fever (37.12%), respectively. During enrollment, urine R/M/E test revealed that most of the urine samples showed no growth of organisms (84.8%) and *E. coli* (09.85%). Most commonly used antibiotic was nitrofurantoin (43.33%), cefixime (18.88%), and ciprofloxacin (18.88%). During follow-up, urine sample culture revealed no growth of pathogenic organisms in 131 (99.24%) and *E. coli* in one patient who was treated with only probiotics.

Conclusions: The present study revealed that the use of probiotics is effective and safe to treat UTI in women in Bangladesh.

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Introduction

Urinary tract infection (UTI) is one of the most common types of bacterial infection seen by health care professionals. It occurs in all populations and ages from the neonate to the geriatric age group¹. The annual cost of healthcare services for the treatment of UTI is staggering, reaching over \$6 billion worldwide². UTI is one of the most important causes of morbidity in developing countries like Bangladesh³.

UTI occurs more often in women than in men, at a ratio of 8:1. Approximately 50–60% of women report at least one UTI in their lifetime, and one in three have at least one symptomatic UTI necessitating antibiotic treatment by age 24^{2,4,5}. The estimated number of UTIS per person per year is 0.5 in young

females with a recurrence rate of between 27% and 48%. All around the world, it is estimated that several hundred million women suffer from UTIs annually⁶. Recurrences usually occur within three months of the original infection⁷.

Most uropathogens from the rectal *flora* ascend to the bladder after colonizing the periurethral area and urethra. Stamm and Hooton reported *Escherichia coli* as the agent is responsible in most cases (up to 85%)⁸. Other significant pathogens that can cause UTI include *Proteus mirabilis*, *Staphylococcus saprophyticus*, *Staphylococcus epidermidis*, and *Klebsiella pneumonia*⁹.

Risk factors for UTI include hormone level changes, frequent sexual activity, imbalance of good and bad bacteria in the genital areas, pregnancy, the use of spermicidal for contraception, taking on new sexual partners, the age of the first UTI, maternal history of UTI, voiding dysfunction, voiding patterns of pre and post-coitus, wiping technique, wearing tight undergarments, deferred voiding habits and vaginal douching, DM and immunosuppression¹⁰⁻¹⁴.

There is a well-known association between abnormal vaginal microbial flora and its formidable risk in the increased incidence of UTI. The microbial species that inhabit the vaginal tract play an important role in the maintenance of health and prevention of infection. Microbial flora of a healthy premenopausal woman is generally dominated by the *Lactobacillus*. All factors such as hormonal changes (particularly estrogen), vaginal pH, and glycogen content can affect the colonization of the *lactobacilli* in the vagina. Menstrual cycle can also cause hormonal changes¹⁵⁻²⁴.

Antimicrobial therapy is the core treatment for UTIs. In Bangladesh, the use of antibiotics by medical practitioners is rampant resulting in increases in resistance to available antibiotics. Random and extensive use of broad-spectrum antibiotics contributes to changes in the microbiological and antibiotic susceptibility patterns of pathogens isolated from UTI²⁵.

Use of broad-spectrum antibiotics not only kills the pathogenic bacteria but also beneficial bacteria hosted by the human body. Alternative treatment options may be important treatment options due to spiraling costs of antibiotic therapy, reemergence of multidrug resistant bacteria, and more importantly, unsatisfactory therapeutic options in UTI treatment. Alternative therapeutic options should use strategies to prevent the selective development of antibiotic resistant bacterial strains, restore a balanced microbial flora, and enhance the defense mechanisms of the human body. These criteria are best fulfilled by live microorganisms that are naturally hosted by the human body already²⁶⁻²⁹.

Probiotic strains have already been shown to effectively prevent diarrhea and hold a potential in preventing and treating tonsillitis, caries, renal calculi, and respiratory infections, irritable bowel syndrome and *H. pylori* infection as well as immunocompromised hosts with drug associated diarrhea³⁰.

The concept of probiotics comes from the belief that a 'dismantled' microflora in the host could be restored by the exogenous application of bacteria commonly found in that area³¹. As

Lactobacillus depletion occurs in UTI, restoration of it by administration per vaginally or orally may cause colonization of the *Lactobacillus* in the vagina and other female urogenital organs.

It has been shown in one study in the Netherlands that oral administration of *Lactobacillus rhamnosus* GR-1 and *Lactobacillus reuteri* RC-14 restores the vaginal *lactobacilli* flora and reduces colonization by potentially pathogenic bacteria and prevents recurrent urinary tract infection³². Researchers in the United States investigated the use of a topical single strain probiotic from *Lactobacillus crispatus* and reported that it lowers the rate of recurrence of UTI and prevents the development of bacterial resistance³³. A study evaluating the safety and effectiveness of *Lactobacillus* probiotics in patients with recurrent urinary tract infection revealed that *E. Coli* positive cultures reduced significantly³⁴. The use of probiotics in patients with neurogenic bladder and suffered from recurrent UTI and found that treatment with probiotics decreased the rate of recurrent UTI in future³⁵. In another study, women with recurrent UTI received probiotics reported that the recurrence of UTI over 6 months decreased to 21% for those who received *Lactobacillus* compared with 47% for patients no received probiotics³⁶. It was mentioned about an independent third party survey of more than 100 urologists attending the American Urological Association annual conference about 10 years ago, where almost 80% of the urologists stated that they would offer probiotics to patients with Recurrent UTIs if available³⁷. Postmenopausal women with recurrent UTIs received probiotics and the results showed that women with RUTIs lowered the recurrent rate of UTI and decreased the development of antibiotic resistance³⁸.

In Bangladesh, no study has been conducted so far by using probiotics for the treatment of UTI in women, but UTI is a significant health problem in women. The concept of supporting the human body's normal flora with living microorganisms conferring a beneficial health effect may be an important medical strategy in our country. Consequently, the present study aimed to evaluate the effectiveness of probiotic therapy in the treatment of urinary tract infections in women.

Methodology

Study design, site, and population

This interventional, prospective, non-randomized trial was conducted among 162 women suffering from UTI in the Department of Pharmacology, and Department of Gynecology & Obstetrics, Uttara Adhunik Medical College Hospital, Uttara, Dhaka, Bangladesh from January, 2019 to June, 2021. The participants were recruited conveniently from these two departments following the inclusion and execution criteria. The inclusion criteria included nonpregnant women, uncomplicated UTI, having not received any antimicrobial and/or probiotic therapy within one month prior to enrollment in the study. The exclusion criteria were male, pre-menstruating, menstruating and pregnant women, patients received any antimicrobial and/or probiotic therapy within one month prior to enrollment in the study, patients having relevant interactions of the prescribed antimicrobial agents with concurrent medication or contraindications, patients suffering from any other co-morbidity (DM, hepatic diseases, renal diseases, RTI, cancer, coronary artery diseases etc), patients received prophylactic or curative treatment or used as

a food supplement with probiotic, cranberries, estrogens within 4 weeks prior to enrollment in the study, patients having known hypersensitivity reaction to probiotic and/or antimicrobial agent.

Study procedure

This study was approved by the National Research Ethics Committee (NREC), Bangladesh Medical Research Council (BMRC), Bangladesh, and the Ethical Review Committee of the Uttara Adhunik Medical College, Dhaka, Bangladesh. Formal written informed consent was collected from each participant before enrollment in the study. Then the socio-demographic information (e.g., age, sex, residence, etc.) was collected from the participants using a semistructured questionnaire. After enrollment, a complete clinical history was taken, and a complete physical examination was conducted and findings were recorded.

All enrolled participants were divided into 3 groups (probiotic, antibiotic, and probiotic + antibiotic) on the basis of their receiving therapy. Midstream urine was collected using standard techniques to avoid possible contamination and sent to the medical laboratory of Jahangirnagar University to do the routine urinary examination and culture and sensitivity test of pathogenic bacteria. These tests were done before receiving the above treatment options. Patients who were resistant to all major antibiotics according to culture and sensitivity tests were received probiotic therapy. The dose and regimen of the probiotic were two capsules, each containing *Lactobacillus acidophilus* (2 billion), *Lactobacillus bulgaricus* (1 billion), *Bifidobacterium bifidum* (1 billion), and *Fructooligosaccharides* (100 mg) three times daily orally until recovery or for 14 days. Another group of patients received antibiotic therapy and the remaining participants received both probiotic and antibiotic therapy. Patients were advised of a compulsory follow-up visit any time, if they developed any complications or adverse effects. No patient developed complications during the study period. The participants who continued the study procedure until recovery to day 14 and returned for follow-up visits, constituted the final study population. Among the 162 participants, 132 patients came to visit on day 30 for follow-up and the remaining 30 (18.51%) patients dropped out from the study due to lack of communication. The final study population constituted to 132 participants and the group-wise distribution of final study population was 42, 48 and 42 who received probiotic, antibiotic, and probiotic + antibiotic, respectively. Moreover, 132 participants' urine samples were collected for urine R/M/E and culture of the organism after 30 days. The respective sample identification number was assigned duly for proper patient identification. The study information was kept anonymous strictly to protect their personal and private information.

Outcomes

The clinical outcomes of the study were the number of patients who were cured from UTI due to the administration of probiotics, antibiotics, and antibiotic+ probiotic treatment. It was based on the absence or decreased severity of clinical signs symptoms after completion of the course of probiotics and antibiotics as well as to identify the organisms responsible for UTI and evaluate the status of antibiotic resistance by expressing the percentage of antibiotic resistant *E. coli* isolates from the urine of symptomatic women.

Statistical analysis

All data were analyzed using the Statistical Package for the Social Sciences (SPSS; version 25.0). Descriptive statistics such as frequencies and percentages were performed for categorical variables; whereas means and standard deviations (SDs) were computed for continuous variables.

Results

The socio-demographic information, clinical sign symptoms, and lab investigation during enrollment and follow-up were evaluated on the final study population (n=132). Table 1 depicts the study participants socio-demographic profile. The mean age of the participants was 34.23 years (SD = 14.28).

Table 1: Participants' socio-demographic profile

Variables	Total n=132 (100%) n(%)	Probiotic n=42 (31.82%) n(%)	Antibiotic n=48 (36.36%) n(%)	Probiotic + Antibiotic n=42 (31.82%) n(%)
Age	34.23(14.28%)	36.00(14.79%)	34.23(15.37%)	32.48(12.48%)
Level of education				
Illiterate	34(25.76%)	12(28.57%)	12(25.00%)	10(23.81%)
Primary	41(31.06%)	10(23.81%)	18(37.50%)	13(30.95%)
Secondary	35(26.52%)	11(26.19%)	11(22.92%)	13(30.95%)
Intermediate	1(.76%)	1(2.38%)	0(.00%)	0(.00%)
Graduate	21(15.91%)	8(19.05%)	7(14.58%)	6(14.29%)
Marital status				
Unmarried	4(3.03%)	1(2.38%)	2(4.17%)	1(2.38%)
Married	127(96.21%)	40(95.24%)	46(95.83%)	41(97.62%)
Widow	1(.76%)	1(2.38%)	0(.00%)	0(.00%)
Residence				
Rural	33(25.00%)	14(33.33%)	15(31.25%)	4(9.52%)
Urban	99(75.00%)	28(66.67%)	33(68.75%)	38(90.48%)
Economic status				
Poor	31(23.48%)	12(28.57%)	14(29.17%)	5(11.90%)
Middle class	94(71.21%)	28(66.67%)	30(62.50%)	36(85.71%)

In this study, majority of the participants completed their primary education and most of the participants belonged to the middle class and among 132 participants 96.21% women were married. (Table 1).

Table 2: Age-wise distribution of participants (N=132)

Age Groups	Total n (%)	Probiotic n (%)	Antibiotic n (%)	Probiotic+ Antibiotic n (%)
15-25	44(33.33%)	12(9%)	18(14%)	14(11%)
26-38	49(37.12%)	15(11%)	17(13%)	17(13%)
39-50	23(17.42%)	10(8%)	8(6%)	5(4%)
50+	16(12.12%)	5(4%)	3(2%)	8(6%)

The total participants were categorized into four age groups 15-25, 26-38, 39-50, and above 50. Among these age groups, participants in the 26-38 group were highest in number was 49 (37.12%), while the least

number of participants (12.12%) was among the above 50 age groups (Table 2).

Table 3: Presenting signs symptoms of UTI

Variables	Total n=132 (100%) n(%)	Probiotic n=42 (31.82%) n(%)	Antibiotic n=48 (36.36%) n(%)	Probiotic+Antibiotic n=42 (31.82%) n(%)
Burning sensation during urination	123(93.18%)	38(90.48%)	46(95.83%)	39(92.86%)
Pain or pressure in back or lower abdomen	89(67.42%)	26(61.90%)	33(68.75%)	30(71.43%)
Frequent or intense urge to urinate	11(8.33%)	3(7.14%)	4(8.33%)	4(9.52%)
Fever	49(37.12%)	7(16.67%)	43(75%)	21(50.00%)
Cloudy urine	9(6.82%)	5 (11.90%)	1(2.08%)	3(7.14%)
Dark urine	9(6.82%)	5 (11.90%)	1(2.08%)	3(7.14%)
Bloody or strange smelling urine	9(6.82%)	5 (11.90%)	1(2.08%)	3(7.14%)

The average duration of UTI prior to enrollment was 77.61 ± 288.59 days. According to the clinical history, 93.18% patients complained with burning sensation of urination followed by pain or pressure in the back or lower abdomen (67.42) and fever (37.12%) (Table 3).

Table 4: The name of antibiotics used in the treatment of UTI

Name of antibiotics	n=90	Percentage %
Nitrofurantoin	39	43.33%
Cefixime	17	18.88%
Cefuroxime+ clavulanic acid	7	7.77%
Cefuroxime	6	6.66%
Ciprofloxacin	17	18.88%
Azithromycin	1	1.11%
Levofloxacin	2	2.22%
Doxycycline	1	1.11%

Table 4 is showing the use of antibiotics among the final participants. There were 8 different categories of antibiotics used in this study where most of the participants (43.33%) were prescribed with nitrofurantoin. Cefixime and ciprofloxacin were in the second highest position (18.88% each). Laboratory findings of the collected urine samples of the final study population during enrollment and follow-up were expressed in Tables 5 and 6. During enrollment, 71 patients' lab investigation of urine R/M/E showed pus cells more than 4. Most of the urine samples showed no growth of pathogenic organisms (Table 5).

Table 5: Lab investigation findings during enrollment (N=132)

	Total n (%)	Probiotic n(%)	Antibiotic n(%)	Probiotic+Antibiotic n(%)
Urine R/M/E				
0-2	22(16.67%)	12(28.57%)	6(12.50%)	4(9.52%)
2-4	39(29.55%)	13(30.95%)	12(25.00%)	14(33.33%)
>4	71(53.79%)	17(40.48%)	30(62.50%)	24(57.14%)
Growth of the organisms during urine culture				
No growth	112(84.8%)	37(88.10%)	39(81.25%)	36(85.71%)
E. coli	13(9.85%)	3(7.14%)	5(10.42%)	5(11.90%)
Chlamydia	4(3.03%)	1(2.38%)	2(4.17%)	1(2.38%)
Mycoplasma	4(3.03%)	1(2.38%)	2(4.17%)	1(2.38%)
Neisseria gonorrhoeae	4(3.03%)	1(2.38%)	2(4.17%)	1(2.38%)
Klebsiella species	3(2.27%)	1(2.38%)	2(4.17%)	0(.00%)

During follow-up, urine sample culture revealed no growth of pathogenic organisms among 99.24% final study population. Among them, 97.62% of subjects treated with probiotics and 100% of participants treated with antibiotics showed no growth. Moreover, lab investigation revealed E. coli in one patient who was treated with only probiotics. In addition, the presence of pus cells was more than 4 among 17 patients (Table 6).

Table 6: Lab investigation findings during follow-up (n=132)

	Total n(%)	Probiotic n(%)	Antibiotic n(%)	Probiotic+Antibiotic n(%)
Urine R/M/E				
0-2	92(69.70%)	31(73.81%)	30(62.50%)	31(73.81%)
2-4	23(17.42%)	9(21.43%)	9(18.75%)	5(11.90%)
>4	17(12.88%)	2(4.76%)	9(18.75%)	6(14.29%)
Growth of the organisms during urine culture				
No growth	131(99.24%)	41(97.62%)	48(100.00%)	42(100.00%)
E. coli	1(0.76%)	1(2.38%)	0(.00%)	0(.00%)

Discussion

The human normal bacterial flora is increasingly recognized as an important defense against infection. Since the advent of antibiotic treatment five decades ago, a linear relation between antibiotic use and reduction in pathogenic bacteria has become established as medical conventional wisdom. However, with the use of antibiotics, the beneficial bacterial flora hosted by the human body is destroyed and pathogenic bacteria are selectively enabled to overgrow internal and external surfaces. The benign bacterial flora is crucial for body function and overgrowth of pathogenic microorganisms leads to illness. Thus, the concept of supporting the human body's normal flora with live microorganisms conferring a beneficial health effect is an important medical strategy according to the statement of Borchert et al³⁹.

In the present study, the mean±SD age of participants was 34.23±14.28 years and participants in the 26-38 age group were the highest in number, that is, 49 (37.12%) and the least number of study subjects were above the 50 age group. Furthermore, 127 participants (96.21%) were married.

In the United States, 11% of women over the age of 18 experience one episode of UTI a year. The incidence of UTI is most common between the ages of 18-24. The most important risk factors in women between the ages of 18-39 who have experienced UTI are sexual relationship and history of UTI^{40,41}. This is similar to our study because the majority of the patients were married.

According to the statement of Santosh et al., multiple risk factors predisposed to UTI include sexual intercourse with multiple partners and exposure to spermicidal agents^{42,43}. Spermicides lead to loss of *Lactobacilli* and an increase in pH, which stimulates the growth of gram-negative organisms and subsequent UTI. Additional risk factors found in postmenopausal women include a history of previous genitourinary surgery, altered bladder function and loss of estrogen^{44,45}. The incidence of asymptomatic bacteriuria increases with age among 10 to 15% of postmenopausal women⁴⁶.

As typical urinary symptoms, e.g., dysuria, frequency, and urgency, are highly predictive of urinary tract infection (UTI) in female patients^{47,48}. Dysuria in women represents 2%-5% of the reasons for encounter in general practice⁴⁹. According to the clinical history of our study, the most common presenting signs symptoms were burning sensation during urination (93.18%), followed by pain or pressure in the back or lower abdomen (67.42%) and fever (37.12%).

Bacteriological studies usually reveal the involvement of gram-negative enteric organisms that commonly cause urinary tract infections, such as *E. coli*, *Klebsiella* species, and the *Proteus* species⁵⁰. The most common organism implicated in UTIs (80-85%) is *E. coli*⁵¹. In our study, most of the urine samples (84.8%) showed no growth of organisms which may be due to the following causes: self-medication, advice from a relative, use of left-over antibiotics and use of antibiotics without prescription which are widespread practices in our country. According to the lab investigation the most common organism was *E. coli* (9.85%) followed by *Chlamydia* (3.03%), *Mycoplasma* (3.03%), *N.gonorrhoeae* (3.03%) and *Klebsiella* (2.27%). The predominant number of pathogens isolated in this study was gram-negative bacilli rather than gram-positive pathogens. According to the study of Yasmeen et al., *Escherichia coli* constituted the largest group with a prevalence of 85.16%, then *Pseudomonas sp* only 4.40%, *Acinetobacter sp* and *Group D Streptococcus* (2.20%), *Staph. Aureus*, *Klebsiella sp*, *Enterobacter sp*, *Salmonella typhi*, all of these organisms were less than 2%⁵². Other investigators Basar et al. and Saber et al. also reported higher association of *E. coli* between 66.67% and 77.8% cases, respectively in UTI patients^{53,54}. A study conducted in 2014 in Lahore; Pakistan showed the prevalence of UTI with the highest prevalence of *E. coli* (80%) followed by *Staphylococcus aureus* (9.4%), *Proteus species* (5.4%) and *Pseudomonas species* (5.2%)⁵⁵. In most of the studies, *E. coli* was the prevalent organism in UTI⁵⁶. According to the stamen of Hamdan et al. study, *E. coli* was the most common pathogen in 77.7% of the Gram-negative isolates, 42.4% of all isolates. Results were that obtained in Tanzania where *E. coli* were 38% of the Gram-negative isolates and 25% of all isolate⁵⁷. Likewise, many authors have the same findings, e.g. in Pakistan and India^{58,59}. It can be concluded that *E. coli* is the main pathogenic organism.

In this present study, the most prescribed antibiotic were nitrofurantoin (43.33%). Moreover, cefixime (18.88%). and ciprofloxacin (18.88%) were also commonly suggested for UTI treatment.

In United State, 2000-2002, the National Ambulatory Medical Care Survey and National Hospital Ambulatory Medical Care Survey to obtain nationally representative data on antibiotics prescribed among 2638 women with UTI which reported that quinolones were the most common antibiotic class prescribed (44% of visits), followed by sulfa antibiotics (30%) and nitrofurantoin (18%)⁶⁰. This is dissimilar to our study due to the selection of drugs by physicians and drug resistance patterns in our country.

Antibiotics used in the treatment of these infections reduce the number of lactobacilli in the urinary system and may also cause antibiotic resistance in the following period and destroy the existing natural barrier of the urinary system formed against infections. More use of broad spectrum antibiotics not only destroys pathogenic bacteria but also commensals which are normal inhabitants in the female urogenital tract.

The known modes of administration of probiotics are orally, vaginally, and so on. Insertion of *Lactobacilli* into the vagina via a pessary or capsule is an effective means of boosting the content of the flora and overcoming some pathogens or reducing their ability to dominate.

The idea of oral probiotic application is based on knowledge that the pathogens that cause most of the urogenital infections progress from the rectum to the perineal region and then to the vagina and the mesentery. Clinical studies have demonstrated that oral administration of *Lactobacillus* can demonstrate its effects after reaching the vagina⁶¹⁻⁶⁴.

In our study, the oral route was chosen due to availability and patient compliance. During follow-up, urine sample culture revealed no growth of pathogenic organisms among 99.24% final study population and the percentage of successful outcomes of treatment were 100% and 97.62% by treatment of antibiotics and probiotics respectively. The consequence of using probiotics in our study is clinically effective and laboratory investigation reveals pathogenic bacteria eradication. In another studies, the authors reported that probiotic capsules administered orally may regulate the vaginal flora and may be effective against recurrent UTIs. It has also been emphasized that oral probiotics may be more comfortable for patients than for vaginal administration, and patient compliance with treatment may be better.

Zucotti et al. stated that probiotics could be a good alternative to antibiotic therapy because of their ability to bind to uroepithelial cells and inhibit pathogenic growth and biosurfactant secretion⁶⁵. The same investigators have emphasized that oral *Lactobacillus* therapy can colonize these bacteria in the urinary tract following intestinal colonization. In these studies, probiotic capsules containing *L. rhamnosus* and *L. fermentes* were administered orally.

Reid and colleagues found that a combination of *Lactobacilli* strains reduced both yeast and bacterial pathogens in the vagina even when taken orally. It also provides a better cure rate when used with

metronidazole instead of an antibiotic alone. A daily oral dose of 108 viable probiotic lactobacilli can restore and maintain the urogenital health of women^{66,67}.

According to our study, probiotics along are not expected to completely eradicate infections but inhibit the growth of pathogenic bacteria and significantly *relieve* the sign symptoms and cure UTI.

Limitations

This single-centered study was conducted only in a tertiary care hospital in Dhaka, involving a small number of patients. This study was not a representative study. As because, the trial was not conducted in any other tertiary hospital and community health centres in different areas of our country. This trial also did not include women living in other rural and urban areas of Bangladesh.

Conclusions

The findings reflect that the probiotics can efficiently cured the UTI in females. Treatment with probiotics effectively controls the pathogenic organisms in the female genital tract and it is also safe. Further large-scale study is recommended to find the efficacy and safety of probiotics in the treatment of UTI in females.

Declarations

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Authors contribution

Conceptualization: ASMM

Patient enrollment: AS, TRM, EAFA

Data collection: RA

Analysis and interpretation of data: FF, MSI, NM

Laboratory work and Sample analysis: NH

Drafting of the manuscript: ASMM, FF, NM

Editing: ASMM, FF, KMRH, EAFA

Critical revision of the manuscript: ASMM

All authors contributed to the interpretation of the result and critical review and revision of the manuscript and have approved the final version.

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Conflict of interest

The authors have no conflict of interest to declare.

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