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Original Research Article

Urinary tract infections and infertility among adult population in tertiary care hospital Chennai- A comparative cross sectional study

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Abstract

Background: This study aimed to determine the prevalence and clinical characteristics of urinary tract infections (UTIs) and its association with infertility in individuals attending the gynaecology outpatient department at a tertiary care hospital in Chennai, Tamil Nadu, India. The study was motivated by the high burden of UTIs and the potential link between UTIs and infertility in the region.
Materials and Methods: This was a comparative cross-sectional study. Urine samples were collected from 1,321 participants (834 female's and 487 males) in the reproductive age group of 19-45 years. The samples were processed using standard microbiological techniques to identify the causative uropathogens and their antibiotic susceptibility patterns.
Result: The overall incidence of UTI was 26.2%, with Gram-negative bacteria (61.5%) being the most common causative agents, particularly *Escherichia coli* (30.4%) and *Klebsiella species* (8.1%). Candida species were detected in6.1% of urine samples from infertile females and 4.5% of females in the control group. The incidence of UTI-causing pathogens was statistically significant in both the infertile male and female groups compared to the control groups.
Conclusions: The study found a high prevalence of UTIs, particularly among individuals with infertility, but did not establish a statistically significant association between UTIs and infertility. The findings highlight the need for improved management and prevention of UTIs, as well as further research to elucidate the complex relationship between UTIs and infertility in the local context of Tamil Nadu.

Keywords: Urinary tract infection (UTI), Infertility, Reproductive health

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1. Introduction

Urinary tract infections (UTIs) affect an estimated 150 million individuals globally each year, with women being four times more likely to experience them than men.[1] While often perceived as acute and treatable, growing evidence suggests that recurrent or poorly treated UTIs can have lasting effects on reproductive health.[2] When not effectively managed or when recurrent, UTIs can lead to long-term issues such as chronic pelvic pain, increased risk of kidney infections, and ongoing lower urinary tract symptoms like painful urination and urinary urgency. These persistent symptoms can severely reduce an individual's quality of life. UTIs are the most common outpatient infections, and women are having 50-60% lifetime risk at least one.[3] A considerable proportion (20-30%) of women will experience recurrent infections, defined as three or more UTIs within a year.[4] Uncomplicated UTIs are primarily caused by the bacterium Escherichia coli, which is responsible for 75% to 95% of infections.[1]

In Tamil Nadu, the burden of UTIs is further exacerbated by factors such as inadequate sanitation, limited access to healthcare services, gendered disparities in healthcare-seeking behavior, and cultural taboos related to reproductive and urogenital health. For women, the frequency of UTIs is

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also influenced by anatomical factors, hormonal changes, and behaviors such as poor menstrual hygiene and lack of knowledge about genital health. UTIs in men, though less common, are often misdiagnosed or overlooked, especially in cases involving chronic prostatitis or other systemic health conditions like diabetes. The persistent nature of recurrent UTIs requires continuous medical management and public health attention, yet these aspects are often lacking in many areas of Tamil Nadu. Moreover, the absence of specific local data hinders the development of tailored intervention strategies that align with the region's unique health and cultural challenges.

At the same time, infertility is becoming an increasingly critical reproductive health issue in Tamil Nadu, with national data showing a prevalence of 10-15% among Indian couples. The causes of infertility are multifactorial, involving hormonal, anatomical, environmental, genetic, and behavioral factors. Infections of the reproductive and urinary systems, particularly UTIs, are gaining recognition for their potential to cause both primary and secondary infertility through a range of direct and indirect physiological effects. The emotional and social toll of infertility is substantial, often leading to stigma, reduced self-esteem, anxiety, and depression. In many rural areas of Tamil Nadu, women may be blamed or excluded from family roles, while men often face feelings of shame or inadequacy. These psychological burdens not only intensify the existing health issues but also discourage individuals from seeking the medical care they need, thus perpetuating the cycle of untreated infertility.

Chronic or improperly managed UTIs in women can lead to severe complications, such as pelvic inflammatory disease (PID), which can cause damage to the fallopian tubes, leading to ectopic pregnancies and infertility. In men, recurrent UTIs may result in inflammation of the prostate and epididymis, which can affect sperm motility, decrease semen quality, and obstruct the spermatic pathways. While the potential link between UTIs and infertility is biologically plausible, there is a notable gap in research from Tamil Nadu on this topic, limiting our understanding and the development of effective clinical and public health responses.

This study aims to determine the prevalence and clinical characteristics of UTIs and its association with infertility in individuals attending gynaecology OPD in tertiary care hospital, Chennai.

2. Materials and Methods

The urine samples from study participants were collected, labelled, and processed following standard protocols with appropriate microbiological safety precautions in the Department of Microbiology, A.C.S. Medical College and Hospital, Chennai, Tamil Nadu, India.

2.1. Study design

It's a comparative cross-sectional study.

2.2. Sample size

1321.

2.3. Sampling technique

The urine samples were collected from study participants reporting to the Gynecology department of ACS Medical College and Hospital. The midstream urine samples were collected in sterile wide mouthed container by clean catch method. The collected urine samples were labelled and sent to the microbiology laboratory for processing immediately or within half an hour of collection.

2.4. Inclusion and exclusion criteria

Participants who had given informed consent were only considered for the study. Both female (n=834) and male (n=487) participants included in the study were in the reproductive age group of 19-45 years and not reported to have taken antibiotics in any of the seven days before sampling were included in the study. Female (n=148) participants and male (n=42) participants with infertility were included as the study population. The remaining 686 females and males (n=445) in the reproductive age group and who had children were included as the control group. Those below 19 years of age and above 45 years of age, those who had taken antibiotics in the preceding week before sampling, and those who had HIV, Hepatitis B and other viral infections were excluded from the study.

2.5. Sample processing

The urine samples were received at the Microbiology laboratory of the central processing laboratory in A.C.S. Medical College and Hospital, Chennai and catalogued. The samples were processed as per the established standard protocols. The spent medium and disposables were disposed as per the biomedical waste management rule, India, 2016 (including the amendment added in 2018 and 2019) implemented under the supervision of hospital waste committee of A.C.S. Medical College and Hospital,

2.6. Isolation and identification of bacteria

The urine sample was inoculated on MacConkey agar plates and 5% Sheep Blood agar plates. The standard protocol for inoculation and identification was followed as per the procedures given in Koneman's color atlas and textbook of diagnostic microbiology, seventh edition, 2020. The seeded MacConkey plates were labelled and incubated at 37°C for 18 hours to 24 hours. The inoculated blood agar plate was incubated in a candle jar for 18 to 24 hours. The six different observed colony morphologies on MacConkey agar and two different colonies on Blood agar plates were identified using standard biochemical tests. Biochemical tests used in the identification include catalase test, oxidase test, mannitol

utilization and motility, reactions in Triple sugar iron agar, utilization of citrate as a sole source of carbon, urease production and indole formation for the identification of gram-negative bacteria present in urine sample was as per the standard protocol. The isolates of Gram positive cocci growing on blood agar plates were identified based on catalase production, coagulase production, and esculin hydrolysis. All the tests were performed as per the standard protocols of Balows, A.[5]

2.7. Statistical analysis

Qualitative data was represented in the form of frequency and percentage. Association between qualitative variables was assessed by Chi-square test. A P-value of <0.05 was considered statistically significant. SigmaPlot software was used for data analysis.

3. Results

The mean age of infertile men in the study population was 31.2 years and mean age of infertile women in the study population was 30.02 years.

3.1. Prevalence of uropathogens

Here the urine samples were collected from 1321 study participants – both male and female in the reproductive age group of 19-45 years; that satisfied the inclusion criteria. The collected urine samples included 42 males with infertility and 445 male participants who had children as control plus 834 female participants - 148 infertile women and 686 women who had given birth to a child as control group. Urine samples were subjected to microscopy and culture. 975 urine samples had no significant growth or no growth of either bacteria or yeast. The overall incidence of UTI was determined to be 26.2%. Positive bacterial cultures were further tested for sensitivity to drug by antibiotic sensitivity test (AST) by Kirby-Bauer disk diffusion test. The prevalence of fungi in the positive cases of UTI was 12.2%. The yeast identified as causative agent of UTI in 42 urine samples with 3.2% overall incidence was *Candida* species. *The Candida* species were identified based on typical yeast colony morphology on Sabouraud's dextrose agar, gram-positive yeast in microscopy and the presence of pseudohyphae. The prevalence of bacteria in the positive cases of UTI was 87.8%. Around 61.5% of the bacterial infections were caused by Gram negative bacteria (GNB). The bacteria were identified based on colony morphology on MacConkey agar, and 5% sheep blood agar medium and standard biochemical tests. The most common bacteria identified from urine samples *Enterococcus*species (6.6%). (**Table 1**).

3.2. Prevalence percentage of uropathogens in infertile

The negative results for UTI in the case of males were 76.2% in infertile males and 84.9% in the control group male participants. UTI was not detected in 60.8% of infertile females in the study population and 69.2% of females in the control group. In this *Candida* species were detected in 6.1% of urine samples obtained from infertile females and in 4.5% of females in the control group whereas the prevalence percentage in males of control group was 0.4% with *Candida* species were not detected in urine samples of infertile males. In female infertile group the most common organism found is E.coli (10.1%) and in control group its Enterococcus spp (8.5%). In male both infertile and control group the most common organism is E.coli (9.5%,6.3%) respectively. (**Table 2**).

Table 1: Frequency of microorganisms isolated from urine samples of male and female study participants including participants with infertility and general population

Organism	Frequency	Percentage (%)
No growth	975	73.8
Candida species	42	3.2
Enterococcus species	87	6.6
Staphylococcus aureus	11	0.8
CONS	17	1.3
MRSA	2	0.2
Pseudomonas species	16	1.2
E. coli	78	5.9
Klebsiella species	50	3.8
Proteus species	16	1.3
Acinetobacter species	13	1
Citrobacter species	14	1.1
Total	1321	100
MRSA-Methicillin resistant Staphylococcus aureus CONS-Coagulase Negative Staphylococci		

Table 2: Distribution of uropathogenic bacteria among both fertile and infertile groups in female and male

Organism	Female				Male			
	Infertile		Fertile		Infertile		Fertile	
	(n=148)		(n=686)		(n=42)		(n=445)	
	n	%	n	%	n	%	n	%
No growth	90	60.8	475	69.2	32	76.2	378	84.
Candida species	9	6.1	31	4.5	0	0	2	0.4
Enterococcus species	8	5.4	58	8.5	2	4.8	19	4.3
Staphylococcus aureus	2	1.4	8	1.2	0	0	1	0.2
CONS	3	2	14	2	0	0	0	0
MRSA	0	0	1	0.1	0	0	1	0.2
Pseudomonas species	4	2.7	10	1.5	1	2.4	1	0.2
E. coli	15	10.1	31	4.5	4	9.5	28	6.3
Klebsiella species	12	8.1	26	3.8	2	4.8	10	2.2
Proteus species	3	2	10	1.5	1	2.4	2	0.4
Acinetobacter species	2	1.4	11	1.6	0	0	0	0
Citrobacter species	0	0	11	1.6	0	0	3	0.7
Statistical analysis	X2 – 4288.603 Df=33 P< 0.001				X2 – 4037.264 Df=33 P< 0.001			

MRSA-Methicillin resistant Staphylococcus aureus

CONS-Coagulase Negative Staphylococci
Infertile- Study participants with infertility in reproductive age group of 20-45 years with children
Fertile- Control group of participants in the reproductive age group of 20-45 years with children
Control – Participants with children in reproductive age group of 20-45 years

Table 3: Distribution of uropathogenic bacteria among both fertile and infertile groups in female and male

Organism	Frequency	Female				Male			
		Infertile		Fertile		Infertile		Fertile	
		(n=148)		(n=686)		(n=42)		(n=445)	
		P	N	P	N	P	N	P	N
No growth	975	90	58	475	211	32	10	378	67
Candida species	42	9	139	31	655	0	42	2	443
Enterococcus species	87	8	140	58	628	2	40	19	426
Staphylococcus aureus	11	2	146	8	678	0	42	1	444
CONS	17	3	145	14	672	0	42	0	445
MRSA	2	0	148	1	685	0	42	1	444
Pseudomonas species	16	4	144	10	676	1	41	1	445
E. coli	78	15	133	31	655	4	38	28	417
Klebsiella species	50	12	136	26	660	2	40	10	435
Protes species	16	3	145	10	676	1	41	2	443
Acinetobacter species	13	2	146	11	675	0	42	0	445
Citrobacter species	14	0	148	11	675	0	42	3	442
Statistical analysis		X2 – 4288.603 Df=33 P< 0.001				X2 – 4037.264 Df=33 P< 0.001			

MRSA-Methicillin resistant Staphylococcus aureus

CONS-Coagulase Negative Staphylococci
Infertile- Study participants with infertility in reproductive age group of 20-45 years with children
Fertile- Control group of participants in the reproductive age group of 20-45 years with children
Control – Participants with children in reproductive age group of 20-45 years
P-Positive – Presence of microorganism in culture
N – Negative – Absence of microorganism in culture

Table 4: Age wise distribution (years) of uropathogens in study population and control

Organism	Gender	Infertile (n=148)			Control (n=686)		
		Age in years			Age in years		
		20-30	31-40	>41	20-30	31-40	>41
Candida species	Female	6	3	0	17	9	4
Enterococcus species		5	1	2	28	28	4
E. coli		8	6	2	23	16	8
Klebsiella species		4	5	3	16	12	1
Statistical Analysis		X2 = 10.320					
Analysed as		Df = 9					
<30 and >31 years		P = 0.325					
Candida species	Male	0	0	0	1	1	1
Enterococcus species		1	1	0	6	9	2
E. coli		2	1	1	8	2	1
Klebsiella species		1	0	1	5	1	1
Statistical Analysis		X2 = 8.437					
Analysed as		Df = 9					
<30 and >31 years		P = 0.491					

3.3. Distribution of pathogens between groups included in the study and significance

Among study participants *Candida* species was detected in infertile female only. Pseudomonas, Proteus and Acineobactor were mostly found in fertile group. The incidence of pathogens in infertile group of female participants was statistically significant ($p<0.001$). And the incidence of pathogens in infertile group of male participants was statistically significant ($p<0.001$). (**Table 3**).

3.4. Statistical significance of incidence of UTI and infertility

The analysis of demographic data confirmed that women were more than three times prone to bacteriuria than men. The data obtained determined that women were 13 times more likely to get UTIs from *Candida* spp than men. *Candida* species, *Enterococcus* species, *E. coli* and *Klebsiella* species were more prevalent causative agents of UTI in the 20-30 years age group of infertile females. Infertile women in 31-40 years age group were next most susceptible to UTIs. The incidence of cases of UTI in infertile females of study population of <30 years and >31 years was statistically not significant ($p=0.325$). Among the four microorganisms - *Candida* species, *Enterococcus* species, *E. coli* and *Klebsiella* species that caused UTIs in infertile males of study population; *E. coli* caused most amount of bacteriuria incidence of cases of UTI in infertile males of study population of <30 years and >31 years was statistically not significant ($p=0.491$). (**Table 4**)

4. Discussion

4.1. Pathogen types and frequency in UTI

Midstream urine was recommended a sample to be collected by clean-catch method.[6] The reproductive age group for women was recommended as 19-45 years.[7] The number of females with UTI was many times that of males - 3.81 times of female with UTI when compared to males with UTI.[8] Urine samples were subjected to microscopy as there was diagnostic value to perform microscopy or grams stain as a guide to type of microbe[9] and culture to determine significant or insignificant bacteriuria based on CFU which could be as low as >1000 Colony forming units (CFU)/ ml of urine[10] or and >100, 000 CFU/ ml of urine in GNB.[11] Here, the overall incidence of UTI was determined to be 26.2% which compared to the study by Pardeshi et al[12] with incidence of UTI being 33.26%. In this study the incidence of Candida species in UTI was 3.2% which was correlated to the study by Fisher et al[13] where the overall incidence of *Candida* species in UTI was generally between 5-10%. *Candida* species were identified based on typical yeast colony morphology on Sabouraud's dextrose agar, gram-positive yeast in microscopy and the presence of pseudohyphae.[14] The diagnosis of bacteria which caused UTI was based on colony morphology on MacConkey agar, and 5% sheep blood agar medium and standard biochemical tests.[15] This study reported 6.6% of incidence of *Enterococcus* species in UTI and this correlated with the study by Lin et al[16] that identified *Enterococcus* species as uropathogen and the study by Barros et al[17] which reported 5.45 – 7.1 percent incidence of *Enterococcus* species in UTI. The study identified 0.8% as the incidence percentage of *Staphylococcus aureus* that was very much opposed to the study by Bajaj et al[18] where they reported 6.93% incidence for *Staphylococcus aureus*. *Staphylococcus aureus* was identified and reported as a pathogen that caused UTI by Muder et al[19] and Jarvis et al[20]

in their study. The study identified CONS as a causative agent of UTI with incidence of 1.3% which was much lower than the report by Shakya et al[21] where they reported 5.88% incidence for CONS in UTI. Here the incidence of MRSA was 0.2% and correlated with the studies by Ishikawa et al[22] and Tiengrim et al[23] where they reported MRSA as a minor pathogen. The study identified *Pseudomonas* species as a pathogen that caused UTI in 1.2% of identified positive and this was approximately four times lesser than the 5.4% incidence for *Pseudomonas* species in UTIs reported by Shah et al.[24] E. coli and Proteus species were identified as uropathogens in this study and correlated with the study by Leflon-Guibout et al[25] and Kahlmeter et al[26] identified *E. coli* as pathogen in UTI while the study by Chen et al[27] reported *Proteus* species were isolated from UTI. This study identified Klebsiella species as uropathogen and compared with the report by Al Yousef et al[28] wherein they identified the characteristics of *Klebsiella* species associated with UTI and Ipekci et al[29] reported the antibiotic profile of *Klebsiella* species isolated from urine. Seifert et al[30] reported *Acinetobacter* species as an uropathogen and Ranjan et al[31] confirmed *Citrobacter* species as an uropathogen.

4.2. Distribution of pathogens

The combined overall prevalence percentage for *E. coli* in the enrolled in the study was 30.4%, for *Pseudomonas* species it was 6.8%; and the incidence of *Enterococcus* species female participants was 14.6% and the incidence of *Citrobacter* species ranged from 0.7%-1.6%. This result was comparable to the report of Wilson et al, 2004 where they documented *E. coli* caused 17.5 – 53% UTIs, *Klebsiella* species caused 6-12% of UTIs, *Staphylococcus* species caused 2-10.5% UTIs, *Enterococcus*species caused 1.7-15.8% UTIs, *Pseudomonas*species 1.3-11% of UTIs, *Proteus* species caused 4-6% UTIs, *Citrobacter* species caused 0.2-3% UTIs. Here, the incidence of Acinetobacter species was between 1.4% and 1.6% and this varied from the reported incidence of 5.9% for *Acinetobacter* species.

The difference in incidence of *Candida* species between infertile females with Candiduria in 6.1% compared to 4.5% and the result varied with the report of Oladeinde et al[32] in 2011 wherein they reported 12.6% Candiduria. Here, Candiduria incidence in infertile females was significant and compared to the result of Behzadi et al,[33] 2010 where they reported Candiduria in females as significant ($p<0.05$). The 6.1-fold difference in Candiduria between infertile males and infertile females and 11.25-fold difference in Candiduria between infertile males and infertile females in the study was much higher than the 1.7-2.15-fold difference in Candiduria reported by Gajdács et al[34] in 2019. Women in the studies were more prone to get Candiduria than men and agreed with the analysis of where they found females more susceptible to Candiduria when compared to males. The study determined that *E. coli* as an uropathogen caused 2.24 times more UTIs in infertile females when compared to fertile females and this was the first report of such incidence. The overall incidence of *E. coli* between males and females of the study was 15.8% and 14.5% which was almost same when compared to the result by Christy et al,[35] 2019 wherein they reported similar rates of incidence between males and females for UTIs by *E. coli*. The study determined *Klebsiella* species as a major pathogen in UTI with 8.1% incidence in infertile females and this compared with the reported incidence of 7.9% for *Klebsiella species* as uropathogen by Shaifali et al,[36] 2012. In study it was reported that uropathogenic *Klebsiella* species infected females almost 2.5 times more than males with UTI and this was higher than the 1.7 times more incidence for *Klebsiella species* in females than males in this study.

4.3. Statistical significance of UTI and infertility

The statistical analysis of the age-wise distribution of uropathogen found that the incidence with the four major uropathogens *Candida* species, *E. coli*, *Enterococcus* species and *Klebsiella* species between females in infertile study population and control group to be statistically insignificant ($p=0.325$) for age group <30 and >31 and showed no relation between UTI and infertility. This result varied with the result of other studies wherein they confirmed urogenital infections both *Candida* species and bacterial was one of the factors for infertility in females. The statistical analysis of the age-wise distribution of uropathogen found that the incidence with the four major uropathogens *Candida* species, *E. coli*, *Enterococcus* species and *Klebsiella* species between males in infertile study population and control group to be statistically insignificant ($p=0.491$) for age group <30 and >31 and showed no relation between UTI and infertility. The result varied with the report of Askienazy-Elbhar,[37] 2005 wherein they determined that one in three infections of the male genitourinary tract caused infertility associated with adverse immune reaction – inflammation of testis, and epididymis also the finding of study that the common UPEC caused infertility in females by expressed lipopolysaccharide that altered hormone levels and cytokine TNFα which prevented proper implantation of foetus plus varied with the fact stated by study that UPEC immobilized sperm and was implicated as a factor in male infertility.

5. Conclusion

The study examined the relationship between urinary tract infections (UTIs) and infertility in both males and females

1. For females:
    a. Analysis of age-wise distribution of uropathogens (Candida species, E. coli, Enterococcus species, and Klebsiella species) showed no statistically significant difference ($p=0.325$) between infertile and control groups
2. For males:
    a. Similar analysis showed no statistically significant difference ($p=0.491$) between infertile and control groups

The study's conclusions generally found no significant relationship between UTIs and infertility, which appears to contradict several previous studies in the field.

6. Source of Funding

None.

7. Conflict of Interest

None.

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