

Prevalence of Urinary Tract Infections in Polycystic Ovarian Syndrome at Al-Muthanna Province, Iraq

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Abstract

Background: Urinary tract infections (UTIs), especially in women, are common bacterial infections. Polycystic ovarian syndrome (PCOS) is the most prevalent cause leading to female infertility, impacting 5%–10% of women of reproductive age. **Objectives:** The study seeks to identify women with PCOS and most common bacteria causing UTIs. **Material and Methods:** The study duration was from August to November 2023. Women with PCOS and UTI, women without PCOS and UTI, women with excellent health, and those who were ill were randomly allocated, including 120 women with PCOS and UTI. The urine culture was grown using blood, MacConkey's agar, and chromoagar, and all samples were identified by using the VITEK 2 system. The CL-900i – Chemiluminescence Immunoassay System was used to assess testosterone, follicle-stimulating hormone, and luteinizing hormone (LH) levels. **Results:** Mean differences in age across groups were not significant in this investigation. PCOS individuals with and without UTIs, and also patients with UTIs, had differences in body mass index (BMI), and PCOS women with or without UTIs had significantly higher levels of LH and testosterone ($P < 0.05$) compared to the control group. The results indicated that Gram-negative bacteria, particularly *E. coli*, were the most common uropathogenic agents in PCOS with UTI 40% and 36.6% for UTI without PCOS. Among 90 women with PCOS and UTI or UTI without PCOS, 66.66% had Gram-positive bacterial growth and 33.33% had Gram-negative bacterial growth. **Conclusion:** Both PCOS with UTIs and PCOS without UTIs had more Gram-negative bacteria than Gram-positive bacteria, with *E. coli* and *S. aureus* being the most common. The current study shows that PCOS with and without UTI groups had higher LH, testosterone, and BMI levels than controls.

Keywords: *E. coli*, irregular menstrual cycle, LH, PCOS, UTIs

INTRODUCTION

Among women of childbearing age, polycystic ovarian syndrome (PCOS) is among the most common endocrine disorders.^[1] About 6%–20% of women at this time have symptoms. The Rotterdam Consensus considers polycystic ovarian morphology, clinical or biochemical indicators of hyperandrogenism, and two out of the three criteria for oligomenorrhea or amenorrhea as diagnostic.^[2] Excess androgen levels, insulin resistance, and oversized or malfunctioning ovaries are common symptoms of PCOS.^[3] Infertility, hirsutism, irregular menstruation, and persistent anovulation are typical clinical characteristics. The symptoms of chronic hyperandrogenism include a malfunction in the hypothalamic–pituitary feedback

loop, an overproduction of luteinizing hormone (LH), an abnormality in oocyte maturation, and early termination of primary follicle activation.^[4]

Urinary tract infection (UTI) is one of the most common types of illnesses that may happen to women at any point of time. The structure of the lower urinary tract and its closeness to the reproductive organs in women make them considerably more susceptible to

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UTIs compared to males. There is less room for germs to enter the body through the female urethra since it is shorter. Also, it opens into the vulvar vestibule, which is a highly infected area due to the high incidence of vaginitis and vulvar vestibulitis.^[5] Most women will have a recurring infection soon after the first one.^[6] Of all UTIs, uropathogenic *E. coli* (UPEC) infections account for the vast majority (75% for simple UTIs and 65% for more complex cases).^[7]

Most people agree that when a person has a UTI, microorganisms from their gut microbiota live in the area around the urethra and enter the bladder.^[8] There is no clear causal relationship between PCOS and UTIs; nonetheless, there are several risk factors that are common to both disorders. Issues with the urinary tract and/or the female reproductive system can arise from structural factors, and dysregulation of blood sugar levels can also affect these systems. Insulin resistance may have a significant impact on PCOS and UTIs, where blood sugar is a critical indicator.^[9]

A UTI is caused when specific adhesins allow uropathogens in the digestive system to enter the urethra and the bladder. After the host's inflammatory reaction fails to eradicate all germs, the bacteria grow and produce enzymes and toxins that help them survive. Once a pathogen has colonized the kidneys, it might progress to bacteremia if it penetrates the epithelial barrier. Uropathogenic infection leads to bladder function compromise, requiring catheterization in complex UTIs. Because catheterization triggers a robust immune response, fibrinogen often accumulates on the catheter.^[10] The growth of germs in the urinary system causes the illness. Different types of organisms, infection severity, the location of the infection in the urinary system, and the patient's immune response capacity determine the clinical symptoms.^[11] The study aimed to determine the prevalence of UTIs in PCOS patients at Al-Muthanna Province, Iraq.

MATERIALS AND METHODS

Patients and study design

The study duration was from August to November 2023. The Al Samawa Maternity and Pediatric Teaching Hospital in Iraq and Media Laboratory were the sites of specimen and urine collection. A total of 120 Iraqi women had their blood and urine tested and were categorized as follows: those with PCOS and UTIs, PCOS" UTI, and healthy

women without PCOS or UTIs. The women's ages ranged from 17 to 45. The body mass index (BMI) is calculated in weight in kilograms divided by height in meters squared [m²]. Ultrasound imaging of the ovaries revealed thicker ovarian stroma and eight or more subcapsular cysts with a diameter of less than 10mm, allowing for the investigation of PCOS with the assistance of a specialist doctor.

The results of the UTI examination indicated the following macroscopic changes: turbidity, color change, and deposit. Using low- and high-power microscopy, we examined epithelial cells, pus cells, crystals, red blood cells, and casts. During the examination of UTIs, urine culture was grown on both MacConkey's agar and blood medium, which are both used for cultured mid-stream urine, and all samples were identified by using the VITEK2 system. Using the CL-900i – Chemiluminescence Immunoassay System, we assessed testosterone, follicle-stimulating hormone (FSH), serum LH, and anti-FSH levels.

Ethical approval

The principles outlined in the Declaration of Helsinki served as the foundation for conduction of this study. Verbal consent was obtained from the patient prior to sampling. A local ethics committee examined and approved the study protocol, subject information, and consent form in accordance with document number 67 on August 1, 2023.

Statistical analysis

The MiniTab19 software and Microsoft Excel were used to analyze all results. Comparative analyses were performed. A *P* value of less than 0.05 was considered significant.

RESULTS

A total of 120 samples collected from Al-Muthanna Province were divided into four groups. Table 1 shows no significant difference (*P* < 0.05) in age among PCOS patients with UTI, those without UTI, and UTI patients (26.9 ± 4.92, 25.76 ± 5.63, 28 ± 3.89) compared to controls (29.73 ± 5.96).

In the research groups of PCOS, PCOS & UTI, and UTI, the prevalence of irregular menstruation was significantly greater than that of normal menstruation (80%, 86.66%, 3.33%). For hirsutism, PCOS women (No.=23, 76.66%) and those with UTI (No.=26, 86.66%) had substantially higher development of abnormal hair

Table 1: Study groups were distributed with a control group depending on age and body mass index (BMI)

Parameter	Control group	Polycystic ovarian syndrome women	Polycystic ovarian syndrome with urinary tract infection (UTI) women	UTI women	<i>P</i> value
Age	29.73 ± 5.96	25.76 ± 5.63	26.9 ± 4.92	28 ± 3.89	NS
BMI	24.45 ± 2.89	28.11 ± 2.31	28.68 ± 1.99	28.57 ± 2.01	Significant <i>P</i> < 0.05

Table 2: Descriptive attributes of the study categories

Related factor	Control group	Polycystic ovarian syndrome women	Polycystic ovarian syndrome with urinary tract infection (UTI) women	UTI women
N	30	30	30	30
Menstrual cycle regulation	Regular = 30 Irregular = 0	Regular = 6 Irregular = 24	Regular = 4 Irregular = 26	Regular = 29 Irregular = 1
%	Regular 100% Irregular 0%	Regular 20% Irregular 80%	Regular 13.33% Irregular 86.66%	Regular 96.66% Irregular 3.33%
Hair density	Hirsutism = 0 No hirsutism = 30	Hirsutism = 23 No hirsutism = 7	Hirsutism = 26 No hirsutism = 4	Hirsutism = 2 No hirsutism = 28
%	Hirsutism 100% No hirsutism 0%	Hirsutism 76.66% No hirsutism 23.33%	Hirsutism 86.66% No hirsutism 13.33%	Hirsutism 6.66% No hirsutism 93.33%

Table 3: Categories of bacterial isolates found in urine specimens

"Bacterial growth"	N (%)
"Positive growth"	60 (66.66%)
"Negative growth"	30 (33.33%)
"Total"	90 (100%)

density than UTI women (No.=2, 6.66%) and control women [Tables 2 and 3].

The bacterial isolates "in both groups (UTIs with and without PCOS)" were mostly Gram-negative, accounting for 80% and 86.66%, respectively. In contrast, Gram-positive isolates accounted for 20% and 13.33% in the two groups, respectively [Table 4].

The results revealed that among the bacteria tested, *E. coli* accounted for 40% of PCOS cases in the UTI group and 36.66% in the UTI group without PCOS. *Staphylococcus aureus* and *Klebsiella pneumoniae* were the next most prevalent, followed by 23.33% and 10% of the cases, respectively [Tables 5 and 6]. Figures 1 and 2 show the types of bacterial isolates obtained from UTIs with and without PCOS.

Table 6 indicates that both PCOS women with and without UTIs had significantly higher levels of LH and testosterone (11.22 ± 4.23 , 12.30 ± 4.55 ; 1.065 ± 0.020 , 1.027 ± 0.016) compared to the control group (4.97 ± 1.96 ; 0.313 ± 0.090), respectively, while a non-statistically significant variation in FSH was observed in PCOS women with and without UTIs (5.28 ± 1.68 , 6.12 ± 1.66) compared to the control (5.37 ± 1.87), respectively [Figure 3].

DISCUSSION

This study's findings corroborated those conducted by several authors,^[12-14] who found no statistically significant age differences between the PCOS and control groups. Since age affects immunity, hormone synthesis, hormone factors, and other factors, the results are considered neutral since there was no

discernible variation between the groups. There is a strong correlation between the ages of women and the prevalence of symptomatic bacterial UTIs; specifically, there is an increased prevalence in women aged 21–30.^[15] About 80% of community-acquired UTIs, especially in women younger than 50 years, are caused by *S. saprophyticus* and *E. coli*.^[16]

UTIs were more common in women between the ages of 21 and 38, who make up the greatest age group for female reproductive health.^[17] Contrary to what other studies have shown, there appears to be a statistically significant difference in the BMI between PCOS patients with and without UTIs. This finding aligns with those of previous research^[18] comparing UTI patients to a control group. A greater BMI is associated with an increased risk of UTIs. A different research found that compared to women worldwide, Iraqi PCOS patients tended to have a higher upper body weight.^[19,20]

Consistent with other studies,^[21,22] the current study "found that LH and testosterone levels were much higher in the PCOS" groups with and without UTI as compared to the control group consisting of healthy females. As a biomarker for hyperandrogenemia in women, which can develop into PCOS, testosterone is a common androgen hormone produced by a woman's ovaries and adrenal glands.^[23] Theca cells in the ovary produce more testosterone when LH levels are high in PCOS. The present study is in line with previous ones that showed that PCOS is associated with a much higher TT level in women than in women without PCOS.^[24]

The study results found that FSH levels were not significantly different between the control group and women with PCOS. Al-Hashimy *et al.*^[25] researched on reproductive-aged PCOS women and concluded that PCOS women had higher levels of LH and an elevated LH/FSH ratio but no discernible change in FSH levels. These findings are compatible with those of several studies conducted worldwide.^[26-28] In relation to ovarian cancer risk, there were variations in the association between menstrual cycle irregularity and BMI. Women with a

Table 4: Bacterial isolates collected from urine specimens

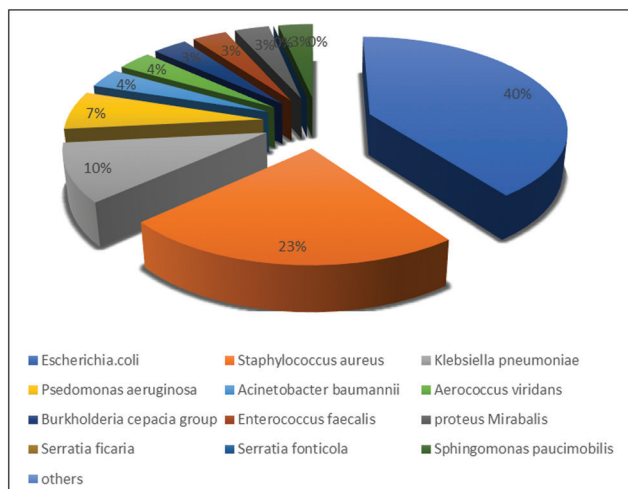
Category of bacterial isolates	Polycystic ovarian syndrome with UTIs group		UTI group		Total	
	N	%	N	%	N	%
Gram-positive (GP)	6	20%	4	13.33%	10	16.66%
Gram-negative (GN)	24	80%	26	86.66%	50	83.33%
Total	30	100%	30	100%	60	100%

Table 5: Distribution bacterial isolates obtained from urinary tract infections (UTIs) with and without polycystic ovarian syndrome (PCOS)

Bacterial isolate	PCOS with UTIs		UTI without PCOS	
	N	%	N	%
<i>Escherichia. coli</i>	12	40%	11	36.66%
<i>Staphylococcus aureus</i>	7	23.33%	3	10%
<i>Klebsiella pneumoniae</i>	3	10%	2	6.66%
<i>Pseudomonas aeruginosa</i>	2	6.66%	1	3.33%
<i>Acinetobacter baumannii</i>	1	3.33%	0	0
<i>Aerococcus viridans</i>	1	3.33%	1	3.33%
<i>Burkholderia cepacia group</i>	1	3.33%	2	6.66%
<i>Enterococcus faecalis</i>	1	3.33%	1	3.33%
<i>Proteus mirabilis</i>	1	3.33%	1	3.33%
<i>Serratia ficaria</i>	0	0	0	0
<i>Serratia fonticola</i>	0	0	3	10%
<i>Sphingomonas paucimobilis</i>	1	3.33%	2	6.66%
Others	0	0	2	6.66%
Total	30	100	30	100

Table 6: Serum levels of hormones in polycystic ovarian syndrome (PCOS) women with and without urinary tract infections (UTIs), as well as control women

Hormones	Mean \pm standard deviation			P value
	PCOS women with UTIs	PCOS women without UTIs	Control	
LH	11.22 \pm 4.23	12.30 \pm 4.55	4.97 \pm 1.96	Significant $P < 0.05$
FSH	5.28 \pm 1.68	6.12 \pm 1.66	5.37 \pm 1.87	No significant $P < 0.05$
Testosterone (ng/mL)	1.065 \pm 0.020	1.027 \pm 0.016	0.313 \pm 0.090	Significant $P < 0.05$

**Figure 1: Bacterial isolates obtained from urinary tract infections with polycystic ovarian syndrome**

BMI less than 25 had an inverse association, whereas those who were overweight or obese did not have a similar association. Testosterone levels may rise in tandem with BMI, according to a certain research.^[29]

E. coli was the most prevalent isolate at 40% for PCOS in the UTI group and 36.66% for those without PCOS. This result was compatible with those of Ibraheem and Alsaffar^[27] who showed that *E. coli* was the most frequent bacterial isolate “in both groups (PCOS with UTIs and UTIs without PCOS), and gram-negative bacteria were more prevalent than gram-positive isolates.”^[30,31] The most prevalent cause for UTI is *E. coli*. Other bacteria that cause UTIs are *Klebsiella*, *Proteus*, *Pseudomonas*, *Enterococcus*, and *S. aureus*.^[32]

E. coli is the most common cause of UTIs, including acute cystitis, pyelonephritis, and urosepsis, three common and clinically distinct UTI syndromes. It is widely accepted

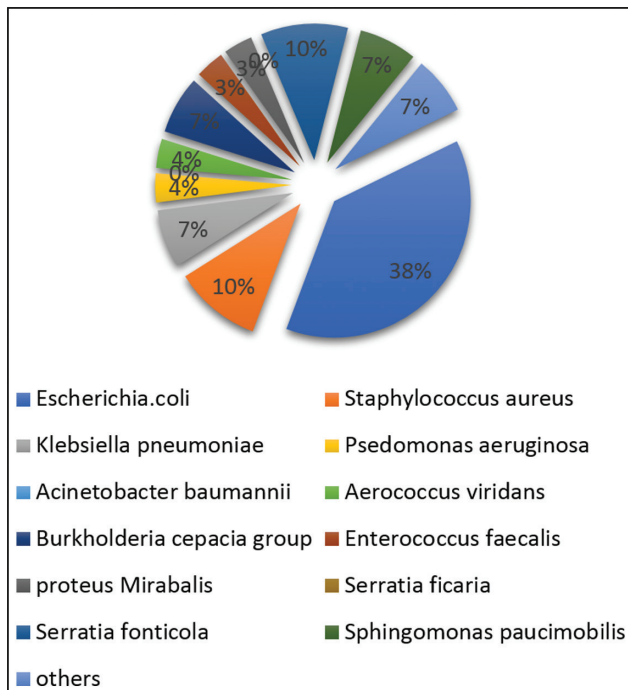


Figure 2: Bacterial isolates obtained from urinary tract infections without polycystic ovarian syndrome

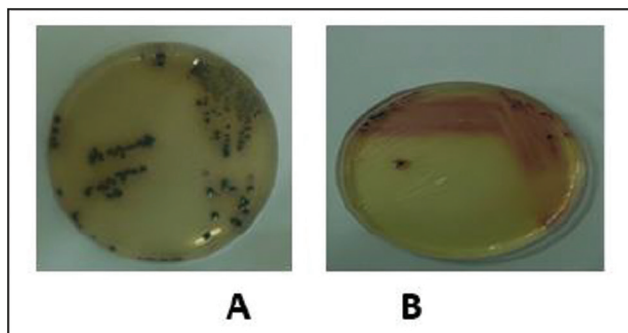


Figure 3: A: CHROM agar *E. coli*. B: CHROM agar *Staph aureus*

that uropathogenic *E. coli* (UPEC) originates from the distal gut microbiota.^[33]

Hyperandrogenic disorders, such as PCOS, increase a woman's risk of developing UTIs.^[29] The second most common bacterium was *K. pneumoniae*, as stated by several authors worldwide.^[34,35] This finding is in agreement with that of the current investigation. On the other hand, Gram-negative bacteria such as *Pseudomonas aeruginosa* are rather common.^[36] This finding aligns with those of previous research showing that Gram-negative bacteria predominate compared to Gram-positive bacteria.^[37] *S. saprophyticus* causes 5%–20% of community-acquired UTIs and up to 42% of UTI among 16–25 year old women.^[38]

Although certain Gram-positive bacteria, such as *Enterococcus faecalis* and *S. saprophyticus*, can cause UTIs, the most prevalent Gram-negative pathogens are *K.*

pneumoniae and *Proteus mirabilis*, while *E. coli* is the most common pathogen overall.^[39] The remainder of hospital-acquired infections usually occur after colonization with *Klebsiella*, *Enterobacter*, *Citrobacter*, *Serratia*, *P. aeruginosa*, *Providencia*, *E. faecalis*, or *S. epidermidis*.^[40] The infection-causing bacteria *E. coli* or *Klebsiella* may become stuck in the urinary system for a variety of reasons. A compromised immune system or a persistent renal condition are two particular risk factors that put some women at a higher risk of developing a UTI.^[41]

When some bacterial strains, such as *Staphylococcus* species, travel from the skin to the urinary tract, they can cause an infection or illness.^[42] This discovery becomes more relevant to translational research when Olson *et al.*^[43] demonstrated that androgen-mediated UTI susceptibility affects women in addition to men. However, most clinical investigations of PCOS have not explicitly determined this frequency in these women.^[44] Among 62 women studied, 69% had samples that tested positive for bacteriological cultures, while 31% came out negative. Belly fat-induced strain may influence the normal urinary tract characteristic and cause problems related to this feature, such as UTIs, which is concerning because obesity is common among women with PCOS.^[45]

CONCLUSION

Signs of PCOS), acne, and hirsutism, all of which are hyperandrogenic disorders, were best indicated by an irregular menstrual cycle. In both the PCOS with UTIs and those without PCOS groups, most of the causative bacteria were Gram-negative, with *E. coli* and *Staphylococcus aureus* being the most common. The age and FSH levels of PCOS individuals with and without UTIs and those with UTIs did not differ significantly. The present research found that compared to the control group, the PCOS groups with and without UTI had higher levels of LH and testosterone, BMI).

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Nil.

Conflicts of interest

There are no conflict of interest.

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