Int.J.Curr.Microbiol.App.Sci (2026) *15*(8): 210-216

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 15 Number 8 (2026)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2026.1508.020

Proteinuria in Urinary Tract Infection Patients at Kosti Teaching Hospital

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Keywords

Proteinuria, Urine analysis, Renal System, UTI, Urinary Tract Infection, Microbiology, Sudan

Article Info

Received:
11 June 2026
Accepted:
30 July 2026
Available Online:
10 August 2026

A B S T R A C T

Urinary tract infection (UTI) is one of the most common bacterial infections and may cause temporary changes in urinary composition, including proteinuria. This study aimed to determine the frequency and degree of proteinuria among UTI patients and to assess its relationship with other urine findings and culture results. The study included 150 individuals, divided equally into 75 patients diagnosed with UTI and 75 healthy controls. The study was conducted at Kosti Teaching Hospital from July to October. Urine samples were analyzed using urine strip tests, microscopic examination, and urine culture. The results showed that the mean urinary protein level was significantly higher in patients with UTI (157.06 ± 177.64 mg/dL) than in controls (51.60 ± 27.34 mg/dL) ($p = 0.000$). Proteinuria was mostly mild (+1 to +2) and transient. Females represented the majority in both groups, confirming the higher prevalence of UTI among women. Leukocytes and pus cells increased significantly, while nitrate positivity was rare. Urinary pH did not differ significantly between groups. No correlation was found between proteinuria and urine culture results, suggesting that proteinuria likely reflects inflammation and renal irritation rather than bacterial growth. The study concludes that screening for proteinuria in patients with UTI is useful for the early detection of potential renal involvement.

Introduction

Proteinuria is a term used to describe the presence of protein in urine, including albumin, globulin and mucoprotein. (1) In multiple myeloma, monoclonal Bence Jones protein appears in urine because excess immunoglobulin light chains are filtered at the glomerulus. (2) Proteinuria can also result from urinary schistosomiasis, which results from infection with Schistosoma haematobium. (3) *One* of the most common

causes of proteinuria is a urinary tract infection, which results from the growth of microorganisms in the human urinary tract. (4), commonly caused by *Escherichia coli in addition to Klebsiella spp., Proteus mirabilis* and *pseudomonas aergenosa*. Urinary tract infections are common in humans, especially in women, with a recurrence rate of about 20% to 35%. About 10% have three to five infections per year because women have shorter urethras than men. (5, 6) Major risk factors for UTI are urinary catheters, surgical intervention, chronic kidney disease and transplantation, diabetes and antibiotic abuse. (4) About 63-80% of UTIs are associated with proteinuria. (7) Pathogenesis begins when uropathogenic bacteria adhere to the urethra and subsequently ascend to the bladder through specialised adhesion. Once these microbes evade host immune defences, they proliferate and form biofilms.

From the lower urinary tract, bacteria can ascend to the kidneys, and the infection may progress to bacteremia. In complicated UTIs, uropathogens commonly attach to catheters, where biofilm protection facilitates their growth. Without timely treatment, the condition may advance to pyelonephritis and bloodstream infection. (8)

Materials and Methods

This case-control study was conducted at Kosti Teaching Hospital in Kosti City, White Nile State, from July 2025 to October 2025. The study was approved by the Ethical Committee of the University of El-imam El Mahdi and by Kosti Teaching Hospital. All participants were individually informed and provided informed consent.

The study aimed to estimate proteinuria levels and perform urine analysis in patients with UTI. It included 75 participants (study group) and 75 healthy participants (control group), selected through convenience sampling and subdivided by gender.

Sampling**:** Urine samples were collected from all participants in clean, dry, and sterile containers. Samples were separated by centrifugation.

The remaining sample was checked by strip (Comper10), then 1 to 1.5 mL of the sample was centrifuged at 3000 rpm for 3 minutes, and the last drops were examined under a microscope at 40x.

From the centrifuged sample, 10 microliters were taken, added to 1ml of 3% trichloroacetic acid (TCA), incubated in a water bath for 5 minutes, and read spectrophotometrically.

Statistical analysis

Data obtained were computerised and analysed using the Statistical Package for the Social Sciences (SPSS) version 21 (Statistical Sciences). Data were assessed using an independent-samples t-test and a correlation test. Data were expressed as mean (m) with standard deviation (SD), and a p-value < 0.05 was considered significant.

Result and Discussion

The study compared socio-demographic data and clinical characteristics between the study and control groups (Table 1). The average age of participants in the study group (n=75) was 44.97 years (SD=15.37), while the control group's average age (n=75) was 38.52 years (SD=1.69); the p-value was 0.060.

Regarding urine assessment, pH levels were measured between cases and controls, segmented by gender (Table 2), showing the following:

For male participants, 5 (5.3%) cases and 11 (7.3%) controls had acidic pH, with a p-value of 0.314.

For females, 5 (3.3%) in the case group and 14 (9.3%) in the control group showed similar results, with a significant p-value of 0.001.

In both the control and case groups, a high neutral urine pH was reported, with 44 (29.3%) and 62 (41.3%) males, respectively, and 37 (24.7%) and 69 (46%) females, respectively.

Protein levels in the urine differed significantly: 19 participants (12.7%) in the study group tested negative, compared with 74 (49.3%) in the control group (Table 2), yielding a p-value of 0.000. Leucocyte counts in the urine also differed significantly: 39 participants (26%) in the study group tested positive for leukocytes, while 75 (50%) in the control group tested negative, yielding a p-value of 0.000.

Proteinuria also differed significantly, with the study group showing a mean of 157.06 (SD 177.64) compared to 51.60 (SD 27.34) in the control group (Table 3), with a p-value of.000.

Further analysis compared clinical parameters between the two groups (Table 4). Regarding age distribution, 21 participants (28%) from both groups were below 30 years old, while the study group had 28 (37.3%) aged between 30 and 50 years old, and 26 (34.7%) over 50 years, compared with 43 (57.3%) and 11 (14.7%), respectively, in the control group.

The gender distribution showed 27 males (36%) and 48 females (64%) in the study group, compared with 23 males (30.7%) and 52 females (69.3%) in the control group.

Fever was reported in 46 participants (61.3%) in the study group, while 29 (38.7%) reported no fever (Table 4). pH status showed that 9 (12%) had acidic urine, 17 (22.7%) had alkaline urine, and 49 (65.3%) had normal pH (Table 4).

In terms of protein status, 23 (30.7%) participants tested nil, 51 (68%) had +1 to +2 protein, and only 1 (1.3%) had +3 protein.

Culture results showed that 42 (56%) in the study group were positive, while 33 (44%) were negative (Table 4).

Various bacteria types were identified, including Enterococcus in 4 (5.3%), Klebsiella in 5 (6.7%), and E. coli in 17 (22.7%). The correlation between leukocytes and culture yielded a p-value of 0.274, indicating no statistically significant association (Table 5).

Conversely, the correlation between urine protein and culture displayed a p-value of 0.626, also indicating no significant relationship (Table 6).

This study aimed to examine the relationship between proteinuria and urinary tract infection (UTI) using data from Sudanese patients.

Socio-Demographic and Clinical Characteristics

The mean age of the study group was higher than that of controls; the correlation was not statistically significant, consistent with data from Sudan and the region, where UTIs are more prevalent among adults and the elderly (9). Both groups showed female predominance, aligning with regional studies, as women are more susceptible to UTIs than men for anatomical and physiological reasons (10). Local factors such as cultural practices, healthcare access, and hygiene also contribute to more UTIs in females (11).

Urine pH and Gender Differences

Urine pH analysis showed that neutral pH was most frequent, but a significant gender difference was observed in females between the study and control groups (p=0.001). Studies documented the influence of factors such as dietary habits, hydration status, and infection on urine pH (12).

Proteinuria in UTI

Proteinuria was significant among patients with UTI compared with the control group. Mean urine protein concentration was significantly higher in cases (157.06 mg/dl vs 51.60 mg/dl, p=0.000).

Similar studies in Sudan and regional countries reported transient proteinuria in patients with acute UTI (13).

Renal involvement following malaria is seen in countries endemic with malaria, like Sudan (15). The mechanism of proteinuria is infection-induced inflammation that increases glomerular permeability (14).

However, persistent proteinuria following UTI indicates underlying renal pathology, such as chronic glomerulonephritis, which is due to factors such as schistosomiasis, which is endemic and post-infectious sequelae (16).

Leukocyturia and Infection Markers

A significantly higher number of UTI patients had positive leukocyte counts in urine, as leukocyturia as a hallmark of urinary tract infection. However, the study reported a statistically insignificant association between leukocyturia and culture positivity (p=0.274), indicating that there are non-bacterial or culture-negative infections, or prior antibiotic exposure. In Sudan over-the-counter antibiotic prescription is a common practice (17).

Bacterial Isolates and Regional Pathogens

The most common bacterial isolate was *Escherichia coli*, followed by *Klebsiella* and *Enterococcus*, which is consistent with studies in Sudan and other African countries (9).

Table.1 Socio-Demographic Data and Clinical Characteristics

Variable	Study Group (n=75) Mean ± SD	Control Group (n=75) Mean ± SD	P-Value
Age (years)	44.97 ± 15.37	38.52 ± 1.69	0.060

Table.2 Urine Compartment Assessment

pH Levels by Gender

pH Status	Group	Male n (%)	Female n (%)	P-Value
Acidic	Case	5 (5.3%)	5 (3.3%)	0.314 (Male), 0.001 (Female)
Acidic	Control	11 (7.3%)	14 (9.3%)	
Neutral	Case	44 (29.3%)	37 (24.7%)	
Neutral	Control	62 (41.3%)	69 (46%)	

Protein Levels

Protein Status	Study Group n (%)	Control Group n (%)	P-Value
Negative	19 (12.7%)	74 (49.3%)	0.000

Leucocyte Counts

Leucocyte Status	Study Group n (%)	Control Group n (%)	P-Value
Positive	39 (26%)		0.000
Negative		75 (50%)	

Table.3 Measurement of Proteinuria

Variable	Study Group (n=75) Mean ± SD	Control Group (n=75) Mean ± SD	P-Value
Proteinuria	157.06 ± 177.64	51.60 ± 27.34	0.000

Table.4 Comparison of Clinical Parameters between Groups

Parameter	Category	Study Group n (%)	Control Group n (%)
Age	<30 years old	21 (28%)	21 (28%)
	30 to 50 years old	28 (37.3%)	43 (57.3%)
	>50 years old	26 (34.7%)	11 (14.7%)
Gender	Male	27 (36%)	23 (30.7%)
	Female	48 (64%)	52 (69.3%)
Fever	Yes	46 (61.3%)	
	No	29 (38.7%)	
pH Status	Acidic	9 (12%)	
	Alkaline	17 (22.7%)	
	Normal	49 (65.3%)	
Protein	Nill	23 (30.7%)	
	+1 to +2 protein	51 (68%)	
	+3 protein	1 (1.3%)	
Culture	Positive	42 (56%)	
	Negative	33 (44%)	
Bacteria Type	Enterococcus	4 (5.3%)	
	Klebsiella	5 (6.7%)	
	Proteus	3 (4%)	
	Staph aureus	7 (9.3%)	
	Candida	2 (2.7%)	
	No Organism	34 (45.3%)	
	E-coli	17 (22.7%)	
	Pseudomonas	2 (2.7%)	

Table.5 Correlation between Leukocytes and Culture (P-value = 0.274)

Leukocytes \ Culture	Positive Count (%)	Negative Count (%)	Total Count (%)
Positive	18 (24.0%)	19 (24.3%)	37 (49.3%)
Negative	24 (32.0%)	14 (18.7%)	38 (50.7%)
Total	42 (56.0%)	33 (44.0%)	75 (100.0%)

Table.6 Correlation between Urine Protein and Culture (P-value = 0.626)

Protein \ Culture	Positive Count (%)	Negative Count (%)	Total Count (%)
Nill	12 (16.0%)	11 (14.7%)	23 (30.7%)
+1 to +2 protein	29 (38.7%)	22 (29.3%)	51 (68.0%)
+3 protein	1 (1.3%)	0 (0.0%)	1 (1.3%)
Total	42 (56.0%)	33 (44.0%)	75 (100.0%)

In Sudan, the high prevalence of *E. coli* in UTIs is due to many factors like: limited water and sanitation, widespread antibiotic use, and climatic factors (11).

Correlation between Proteinuria, Leukocyturia, and Culture

This study found no significant correlation between proteinuria or leukocyturia and urine culture positivity. This may be explained by transient proteinuria from nonbacterial causes, sterile pyuria from partially treated or subclinical infections, or limited culture sensitivity in low-resource settings (18). These findings underline the need for comprehensive diagnostic approaches, especially in Sudan, where laboratory infrastructure can be limited.

Public Health Implications

The high prevalence of proteinuria among Sudanese patients with UTI raises the concern about possible early renal involvement and the risk of progression to chronic kidney disease (CKD). Studies in Sudan recommended early community screening for proteinuria to diagnose renal diseases early (19, 20). Early detection and management of UTI are critical, especially given the regional burden of infectious diseases and limited access to nephrological care (13).

Study Limitations

Limitations include the cross-sectional design and the use of a single urine sample, which may miss intermittent proteinuria or pyuria.

Additionally, culture sensitivity and specificity may be impacted by prior antibiotic use, a common practice in Sudan.

Author Contributions

Abazar Mahmoud Ismail Siddig: Investigation, formal analysis, writing—original draft. Abdelfatah Birer Abdelfatah Mohamed: Validation, methodology, writing—reviewing. Mohamed Osman Ali:—Formal analysis, writing—review and editing. Samah Sidahmed M.S ELSAFI: Investigation, writing—reviewing. Babiker Saad Almugadam: Resources, investigation writing—reviewing. Hala Salah Mohamed: Validation, formal analysis, writing—reviewing. Omnia Hassan Mohamed: Conceptualization, methodology, data curation, supervision, writing—reviewing the final version of the manuscript. Ayat Yousif Mohamed: Investigation, formal analysis, writing—original draft. Maab Almahadi Mohamed Ahmed: Validation, methodology, writing—reviewing. Elsharif A. Bazie:—Formal analysis, writing—review and editing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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How to cite this article:

Abazar Mahmoud Ismail Siddig, Abdelfatah Birer Abdelfatah Mohamed, Mohamed Osman Ali, Samah Sidahmed M.S ELSAFI, Babiker Saad Almugadam, Hala Salah Mohamed, Omnia Hassan Mohamed, Ayat Yousif Mohamed, Maab Almahadi Mohamed Ahmed and Elsharif Ahmed Bazie. 2026. Proteinuria in Urinary Tract Infection Patients at Kosti Teaching Hospital. *Int.J.Curr.Microbiol.App.Sci.* 15(8): 210-216.
doi: https://doi.org/10.20546/ijcmas.2026.1508.020