

FREQUENCY AND ETIOLOGY OF URINARY TRACT INFECTION
(UTI) IN CHILDREN WITH NEPHROTIC SYNDROMEAaisha Arshad^{*1}, Muhammad Naeem Farid², Sadaf Nawaz³^{*1,2,3}CMH GujranwalaDOI: <https://doi.org/10.5281/zenodo.18204447>**Keywords**

Nephrotic Syndrome, Urinary Tract Infection, Children, Escherichia coli, Pediatrics, Duration of Illness.

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Abstract

Objectives: This study aimed to determine the frequency and microbiological etiology of urinary tract infections (UTIs) in children with nephrotic syndrome (NS), and to assess potential associations with demographic and clinical variables such as age, gender, and duration of disease. **Methodology:** A cross-sectional study was conducted over six months at the Department of Pediatrics, Combined Military Hospital, Gujranwala. A total of 169 children aged 4–16 years with diagnosed nephrotic syndrome were enrolled using a non-probability consecutive sampling technique. Data were collected through a structured proforma. Midstream urine samples were obtained and cultured to identify causative organisms. Demographic and clinical characteristics were analyzed using SPSS version 20. Post-stratification chi-square and Fisher's exact tests were applied to assess statistical associations. **Results:** The mean age of participants was 9.2 ± 3.1 years, with 58% being male. The overall frequency of UTI was 12.4% (n=21). Escherichia coli was the most commonly isolated organism (81%), followed by Klebsiella pneumoniae, Proteus mirabilis, and Enterococcus faecalis. Stratified analysis revealed a higher prevalence of UTI in younger age groups (4–8 years), females, and children with disease duration >12 months. A statistically significant association was found between longer NS duration and UTI ($p \leq 0.05$), while no significant association was observed with gender or parental education. **Conclusion:** UTI is a notable complication in children with nephrotic syndrome, particularly in those with prolonged disease duration. Routine screening is recommended to ensure timely detection and treatment.

INTRODUCTION

Nephrotic syndrome (NS) is a clinical condition defined by the presence of nephrotic-range in proteinuria, edema, hypoalbuminemia and hyperlipidemia. In children, it is characterized by the excretion of protein through urine at the rate of more than 40mg/m²/hour or a first-morning urinary protein-creatinine ratio of > 2000mg/g or 3+ proteinuria on a urine dipstick ^{1, 2}. It remains the common manifestation of glomerular disease in

childhood with common underlying histopathological lesion being the minimal change nephropathy which follows a remitting relapsing course and is highly responsive to steroids therapy ³. One of the important association of nephrotic syndrome is the loss of immunoglobulins from the body which increase the propensity of developing infections ⁴. Occurrence of infection in immune-compromised children suffering from nephrotic

syndrome (NS) increases the risk of mortality as well as morbidity for which it is essential to diagnose and treat infections timely and promptly ⁵.

One such infection is urinary tract infection (UTI) which has been considered to complicate the disease course of nephrotic syndrome (NS) in children ⁶. In this instance, a study reported that the frequency of urinary tract infection (UTI) in children with nephrotic syndrome was 52.5% ⁶. In another study, this frequency of urinary tract infection (UTI) in children with nephrotic syndrome was reported at 29.3% ⁷. Contrarily, in one study it was found that the frequency of urinary tract infection (UTI) in children with nephrotic syndrome was only 16% which is relatively quite low compared to aforementioned studies ⁸. Several organisms contribute to the etiology of UTI in children with nephrotic syndrome, according to the same study, including *Pseudomonas aeruginosa* (25%), coagulase negative *Staphylococcus* (25%), *Staphylococcus aureus* (12.5%), *E. coli* (12.5%), *Citrobacter koseri* (12.5%) and *Enterococcus* (12.5%) ⁸.

Urinary tract infections (UTIs) are often asymptomatic in children and even if they do exhibit symptoms, these are often non-specific thus making their recognition even more difficult ⁹. Since UTI can add to the morbidity and mortality of nephrotic syndrome, it is highly important to screen children with nephrotic syndrome for urinary tract infection, particularly if they are febrile. In order to address this important health issue of children with nephrotic syndrome, present study will be conducted with the aim to determine the frequency of urinary tract infection (UTI) in children with nephrotic syndrome (NS) to document the burden of this important and difficult to clinically recognize infection as well as its etiology.

METHODOLOGY

This was a cross-sectional study conducted at the Department of Pediatrics, Combined Military Hospital, Gujranwala, over a period of six months following approval from CPSP. A non-probability consecutive sampling technique was employed. The sample size was calculated using the WHO sample size calculator, considering a 95% confidence interval, 5% absolute precision, and an expected frequency of UTI caused by *E. coli* in nephrotic syndrome patients as

12.5%, resulting in a sample of 169 children. Inclusion criteria included children aged 4–16 years of either gender with nephrotic syndrome. Exclusion criteria included those with a history of recurrent UTI, renal failure (GFR < 60 mL/min/1.73m²), recent antibiotic use, structural urinary tract abnormalities, primary immunodeficiency syndromes, or HIV infection, all assessed via previous medical records.

After obtaining informed consent from parents, eligible patients presenting in the outpatient department were enrolled. Baseline characteristics including age, gender, weight, parental education, area of residence, and disease duration were recorded. Midstream urine samples were collected following standard clean-catch technique; in cases where this was not feasible, transurethral catheterization was used. All samples were cultured on blood and MacConkey agar to identify the causative organisms. Children diagnosed with UTI received appropriate treatment. All data were documented using a predesigned proforma, ensuring complete confidentiality and patient anonymity.

Data analysis was performed using SPSS version 20. Quantitative variables (age, weight, disease duration) were reported as mean $\pm$ SD or median (IQR) based on normality testing via Shapiro-Wilk test. Categorical variables (gender, education, residence, UTI, and etiology) were expressed as frequencies and percentages. Stratification was done by age, gender, weight, and NS duration. Post-stratification, chi-square or Fisher's exact test was applied, with $p \leq 0.05$ considered statistically significant.

RESULTS

A total of 169 children with nephrotic syndrome meeting the inclusion criteria were enrolled in the study over duration of 6 months. The demographic and clinical characteristics of the participants are summarized in Table 1, while the frequency and microbiological etiology of urinary tract infections (UTIs) are detailed in Table 2.

Descriptive Statistics

The mean age of children was 9.2 ± 3.1 years, with a male predominance (58%). The mean weight was 27.5 ± 6.8 kg. Majority of the children belonged to urban areas (60%), and 68% had at least one parent with

school-level education or higher. The median duration of nephrotic syndrome was 10 months (IQR: 6–18 months).

Table 1: Baseline Characteristics of Study Participants (n = 169)

Variable	Value
Age (years), mean $\pm$ SD	9.2 $\pm$ 3.1
Gender	
— Male	98 (58%)
— Female	71 (42%)
Weight (kg), mean $\pm$ SD	27.5 $\pm$ 6.8
Parental Education Status	
— Illiterate	54 (32%)
— School education or above	115 (68%)
Area of Residence	
— Urban	102 (60%)
— Rural	67 (40%)
Duration of Nephrotic Syndrome (months), median (IQR)	10 (6–18)

Urinary Tract Infections (UTI) and Microbiological Findings

Out of 169 children, 21 (12.4%) were diagnosed with UTI, which is consistent with the expected frequency based on previous literature. Among the positive urine cultures, *E. coli* was the most frequently isolated pathogen, accounting for 81% of the UTI cases. Other organisms included *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Enterococcus faecalis*.

Table 2: Frequency and Etiology of UTI in Children with Nephrotic Syndrome (n = 169)

Parameter	Frequency (%)
UTI Status	
— Present	21 (12.4%)
— Absent	148 (87.6%)
Etiology of UTI (n = 21)	
— <i>Escherichia coli</i> (<i>E. coli</i>)	17 (81.0%)
— <i>Klebsiella pneumoniae</i>	2 (9.5%)
— <i>Proteus mirabilis</i>	1 (4.8%)
— <i>Enterococcus faecalis</i>	1 (4.8%)

Post-Stratification Analysis

The frequency of UTI was stratified by gender, age groups (4–8 years, 9–12 years, and 13–16 years), weight, and duration of nephrotic syndrome to identify potential effect modifiers. A higher proportion of UTIs was observed in:

- **Younger children (4–8 years)** compared to older age groups.
- **Female patients**, although the difference was not statistically significant.
- Children with **longer duration of NS (>12 months)**.

Chi-square test showed **no statistically significant association** between gender and UTI ($p > 0.05$), but **duration of NS > 12 months** was **significantly associated** with higher UTI frequency ($p \leq 0.05$).

Summary of Key Findings

- **Overall frequency of UTI:** 12.4%
- **Most common pathogen:** *E. coli* (81%)
- **Significant association:** Between longer NS duration and UTI presence.
- **No significant association:** Between gender or parental education and UTI.

DISCUSSION

A total of 169 children diagnosed with nephrotic syndrome, fulfilling the inclusion criteria, were enrolled in the study over duration of six months. The demographic and clinical characteristics of the participants are presented in Table 1, while the frequency and microbiological etiology of urinary tract infections (UTIs) are detailed in Table 2. In a related study conducted in 2022, approximately one-sixth of children with nephrotic syndrome were found to have UTI. The authors emphasized that UTI should be ruled out in every case of nephrotic syndrome during its active phase to reduce long-term morbidity and mortality^[10]. In the current study, the mean age of children was 9.2 ± 3.1 years, with a male predominance of 58%. The mean weight was 27.5 ± 6.8 kg. A majority of participants (60%) were residents of urban areas, and 68% had at least one parent with school-level education or higher. The median duration of nephrotic syndrome was 10 months with an interquartile range (IQR) of 6–18 months. These findings align with a previous study from 1996, which reported that UTI is a commonly overlooked but important infection in children with nephrotic

syndrome^[11]. In this study, 21 out of 169 children (12.4%) were diagnosed with UTI, which corresponds well with the expected prevalence based on earlier research. Among the culture-positive cases, *Escherichia coli* (*E. coli*) were the most frequently isolated pathogen, accounting for 81% of the infections. Other identified organisms included *Klebsiella pneumoniae*, *Proteus mirabilis*, and *Enterococcus faecalis*. Similarly, a study conducted in 2023 concluded that the frequency of UTI in children with nephrotic syndrome is high, and routine screening at regular intervals is necessary to detect infections early^[12]. In the current research, the frequency of UTI was stratified by gender, age groups (4–8 years, 9–12 years, and 13–16 years), weight, and duration of nephrotic syndrome to assess possible effect modifiers. Comparable findings were reported in a 2020 study, which highlighted that children with nephrotic syndrome are frequently predisposed to asymptomatic and underdiagnosed UTIs, with elevated serum cholesterol potentially acting as a predisposing factor^[13]. Stratified analysis in our study revealed a higher frequency of UTI among Younger children (4–8 years) compared to older age groups, Female patients, although this difference was not statistically significant, Children with nephrotic syndrome duration greater than 12 months. A recent study from 2023 reported an even higher UTI frequency of 25.5% in children with nephrotic syndrome^[14], further emphasizing the importance of early detection. In our study, the Chi-square test showed no statistically significant association between gender and UTI ($p > 0.05$). However, there was a significant association between nephrotic syndrome duration >12 months and higher UTI frequency ($p \leq 0.05$), indicating a potential risk factor. These microbiological findings are consistent with the results of a 2019 study, which identified *E. coli* as the most common pathogen in pediatric UTIs, especially in children aged 1–5 years, and reported high resistance to amoxicillin and ampicillin^[15].

CONCLUSION

This study found that 12.4% of children with nephrotic syndrome had urinary tract infections, with *E. coli* being the most common pathogen. A longer duration of nephrotic syndrome was significantly associated with higher UTI frequency, while gender

and parental education were not. Given the potential for asymptomatic presentation and associated morbidity, routine screening for UTI should be considered in children with nephrotic syndrome, especially those with prolonged disease duration.

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