ORIGINAL ARTICLE

Clinical and Etiological Patterns of Urinary Tract Infections in Children

DOI: 10.5281/zenodo.17247299

Mohammed Jafar Iqbal[1], Mirza Md Ziaul Islam[1], Mohammad Atiqul Islam[1], Tanusree Sen[1], Baishaki Modak[1], Kinkar Ghosh[2]

Received: 4 Sep 2025
Accepted: 7 Sep 2025
Published: 17 Sep 2025

Published by:
Gopalganj Medical College, Gopalganj, Bangladesh

Correspondence to
Kinkar Ghosh

ORCID
https://orcid.org/0000-0001-5586-5579

ABSTRACT

Background: *Urinary tract infections (UTIs) are among the most common bacterial infections in children, associated with diagnostic challenges, recurrence, and the risk of long-term renal complications. Rising antimicrobial resistance further complicates management.* ***Aim of the study:*** *To evaluate the clinical presentations and etiological spectrum of pediatric UTIs and assess their antimicrobial susceptibility patterns in a Bangladeshi tertiary care setting.* ***Methods:*** *A cross-sectional descriptive study was conducted over 12 months on 105 children aged 0–15 years with clinically suspected UTIs and significant bacteriuria. Demographic, clinical, and laboratory data were recorded, and urine cultures were processed using standard microbiological methods. Antimicrobial susceptibility was determined by the Kirby–Bauer disk diffusion method following CLSI guidelines.* ***Result:*** *The highest prevalence was in infants under one year (24.76% males, 18.10% females). Fever with irritability (69.52%) was the most common symptom, followed by vomiting (62.86%) and dysuria with frequency (60.95%). Escherichia coli (65.71%) was the predominant uropathogen, followed by Klebsiella pneumoniae (12.38%). Most isolates showed high sensitivity to carbapenems (85–99%) and piperacillin–tazobactam (85–96%), moderate sensitivity to aminoglycosides and ciprofloxacin, and low sensitivity to third-generation cephalosporins and cotrimoxazole.* ***Conclusion:*** *Pediatric UTIs in this cohort were most common in infancy, with E. coli as the leading pathogen. High resistance to commonly used antibiotics underscores the importance of culture-based diagnosis and local antimicrobial surveillance to guide empirical therapy.*

Keywords: *Pediatric urinary tract infection, Escherichia coli, antimicrobial resistance, uropathogens, Bangladesh, antibiotic susceptibility.*

(The Insight 2025; 8(1): 138-142)

1. *Department of Infectious Disease & Community Pediatrics, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh.*
2. *Department of Epidemiology & Research, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh.*

INTRODUCTION

A urinary tract infection (UTI) is an infection affecting any part of the urinary tract, most commonly caused by bacterial invasion of the bladder (cystitis) or kidneys (pyelonephritis). UTIs represent one of the most common bacterial infections in children, presenting a significant concern in pediatric healthcare[1]. Globally, in 2021, the prevalence of UTIs was estimated to reach approximately 3.5 million cases, corresponding to an age-standardized prevalence rate (ASPR) of about 3.76 per 100,000 population[2]. In Bangladesh, a community-based study conducted at a diagnostic clinic found that among 120 pediatric patients evaluated, 63.3% were girls and 36.7% were boys, with UTIs occurring more frequently in females[3]. Pediatric UTIs are clinically significant due to their diagnostic challenges, potential for recurrence, and risk of long-term complications such as renal scarring, hypertension, and impaired renal function. Children with UTIs often display non-specific symptoms as fever, abdominal discomfort, or poor feeding in infants that can delay diagnosis and treatment[4]. By the age of six, the cumulative incidence is notably higher in girls than in boys, highlighting clear gender- and age-related patterns in pediatric UTI susceptibility[5]. Each year, UTIs contribute to a notable proportion of febrile illnesses in children and result in a substantial number of outpatient consultations as well as emergency department visits in pediatric populations[6]. Emerging antimicrobial resistance presents a growing challenge in pediatric UTI management. Extended-spectrum beta-lactamase (ESBL)–producing organisms and other multidrug-resistant (MDR) bacteria are increasingly common among pediatric uropathogens[7]. In Bangladesh, studies have revealed high rates of MDR uropathogens in community-acquired UTIs, with resistant strains including E. coli and Klebsiella showing resistance to multiple antibiotic classes[8]. This trend complicates empiric therapy, increases treatment failures, and underscores the necessity for localized antimicrobial stewardship and updated treatment guidelines[9]. Furthermore, epidemiological data reveal gender and age variations in pediatric UTIs. During the first year of life, boys and girls are affected at approximately similar rates; however, beyond infancy, girls experience a notably higher incidence[10]. These differences are largely attributed to anatomical and behavioral factors, such as the shorter female urethra, which facilitates bacterial entry[11]. Additional predisposing factors include vesicoureteral reflux, constipation, bladder–bowel dysfunction, and previous antibiotic exposure. Recurrence is also a common issue, with a considerable proportion of children developing another episode within a year of the initial infection[12]. Given the considerable clinical, epidemiological, and public health implications of pediatric UTIs including high prevalence, rising antimicrobial resistance, frequent recurrence, and potential for renal sequelae it is imperative to examine the clinical and etiological patterns of UTIs in children within the Bangladeshi context[13]. The aim of this study is to elucidate the clinical presentations and etiological spectrum of pediatric UTIs in Bangladesh to inform more effective diagnosis and treatment strategies.

METHODS & MATERIALS

This was a cross-sectional descriptive study conducted at the Department of Infectious Disease & Community Pediatrics, Bangladesh Shishu Hospital & Institute, Dhaka, Bangladesh. over a 12-month period from July 2023 to June 2024. A total of 100 consecutive pediatric patients (aged 0–15 years) with clinically suspected urinary tract infection (UTI) who attended the outpatient clinic or were admitted to the pediatric wards were enrolled.

Inclusion criteria:

- Children aged 0–15 years.
- Clinical features suggestive of UTI.
- Significant bacteriuria, defined as $\geq 10^5$ CFU/mL of a single organism in a properly collected urine sample, in the presence of symptoms.

Exclusion criteria:

- Repeat samples from a patient already included in the study.
- Urine samples showing evidence of perineal contamination.
- Children with incomplete clinical or laboratory records.

Ethical Considerations

The study protocol was approved by the Institutional Review Board. Written informed consent was obtained from parents or legal guardians; assent was taken from older children as appropriate. Confidentiality of patient data was maintained throughout.

Specimen collection and transport

Urine specimens were obtained according to the child's age and ability to cooperate: clean-catch midstream urine for toilet-trained children, sterile catheter specimen for infants or non-toilet-trained children when necessary, and suprapubic aspiration only when clinically indicated. All samples were collected in sterile containers, labelled, and transported to the microbiology laboratory within 2 hours; if delay was expected, specimens were refrigerated at 4°C and processed within 24 hours.

Microbiological processing and identification

Semi-quantitative urine culture was performed by streaking 0.001 mL of well-mixed urine onto CLED (cysteine-lactose-electrolyte-deficient) and MacConkey agar plates and incubating aerobically at 35–37°C for 18–24 hours. Colony counts were expressed as colony forming units per mL (CFU/mL). Significant bacteriuria was defined as $\geq 10^5$ CFU/mL for midstream (clean-catch) specimens, $\geq 10^4$ CFU/mL for catheter specimens, and any growth on suprapubic aspirates [14]. Isolates were identified to species level using standard biochemical tests and, when available, an automated identification system or API strips.

Antimicrobial susceptibility testing

Antimicrobial susceptibility was performed using the Kirby–Bauer disk diffusion method on Mueller–Hinton agar and interpreted according to Clinical and Laboratory Standards Institute (CLSI) guidelines. The antibiotic panel included: amikacin, gentamicin, cefotaxime/ceftriaxone, ciprofloxacin, nitrofurantoin, piperacillin–tazobactam, imipenem/meropenem, and cotrimoxazole.

Data collection

A structured case record form was used to collect demographic information (age, sex), clinical features, and any known congenital urinary tract anomalies were retrieved from hospital records and entered into a predesigned proforma. Physical examination findings and basic laboratory investigations were recorded.

Statistical analysis

Data entry was performed using Microsoft Excel, and statistical analysis was done using SPSS version 26.0. Descriptive statistics were used: frequencies and percentages for categorical variables.

RESULT

The highest proportion of cases occurred in infants under one year of age, comprising 24.76% of males and 18.10% of females. Among children aged 1–5 years, 16.19% were males and 19.05% were females. In the 6–10-year age group, the prevalence was 9.52% in males and 6.67% in females (Table 1). Fever with irritability was most common presenting symptom (69.52%), followed by vomiting (62.86%), dysuria with frequency (60.95%), abdominal pain (51.43%), chills and rigors (29.52%), with diarrhea (4.76%), nocturnal enuresis (2.86%), and haematuria (0.95%) being less frequent (Table 2). The distribution of uropathogens showed *E. coli* as the

ISSN: 2663-9491 e-ISSN: 2789-6897

predominant isolate, accounting for 65.71% of cases, after *Klebsiella pneumoniae* (12.38%). Other organisms included *Pseudomonas aeruginosa* (5.71%), *Enterococcus faecalis* (3.81%), *Morganella morganii* (3.81%), and *Proteus mirabilis* (3.81%). Less common isolates were *Acinetobacter baumannii* (1.90%), *Enterobacter cloacae* (1.90%), and *Enterobacter aerogenes* (0.95%) (Figure 1). The antibiotic sensitivity analysis revealed that most uropathogens showed high susceptibility to carbapenems (Imipenem/Meropenem: 85–99%) and Piperacillin–Tazobactam (85–96%), followed by Amikacin (70–90%) and Nitrofurantoin (20–85%, highest in *E. coli* at 85%). Moderate sensitivity was observed for Gentamicin (45–80%) and Ciprofloxacin (30–70%), while lower sensitivity was noted for Cefotaxime (25–48%) and Cotrimoxazole (15–40%) across most isolates. *E. coli* and *Klebsiella pneumoniae* showed the highest prevalence, with *Pseudomonas aeruginosa* exhibiting strong resistance to most oral agents but high sensitivity to carbapenems and Piperacillin–Tazobactam (Table 3).

Table – I: Demographic characteristics of the study population (*n*=105)

Age (years)	Male		Female	
	n	%	n	%
<1	26	24.76	19	18.10
1-5	17	16.19	20	19.05
6-10	10	9.52	7	6.67
11-15	3	2.86	3	2.86

Table – II: Clinical presentation of pediatric UTI cases (*n*=105)

Symptoms	Frequency (n)	Percentage (%)
Fever with irritability	73	69.52
Abdominal pain	54	51.43
Vomiting	66	62.86
Dysuria with frequency of micturition	64	60.95
Chills and rigors	31	29.52
Diarrhea	5	4.76
Nocturnal enuresis	3	2.86
Haematuria	1	0.95

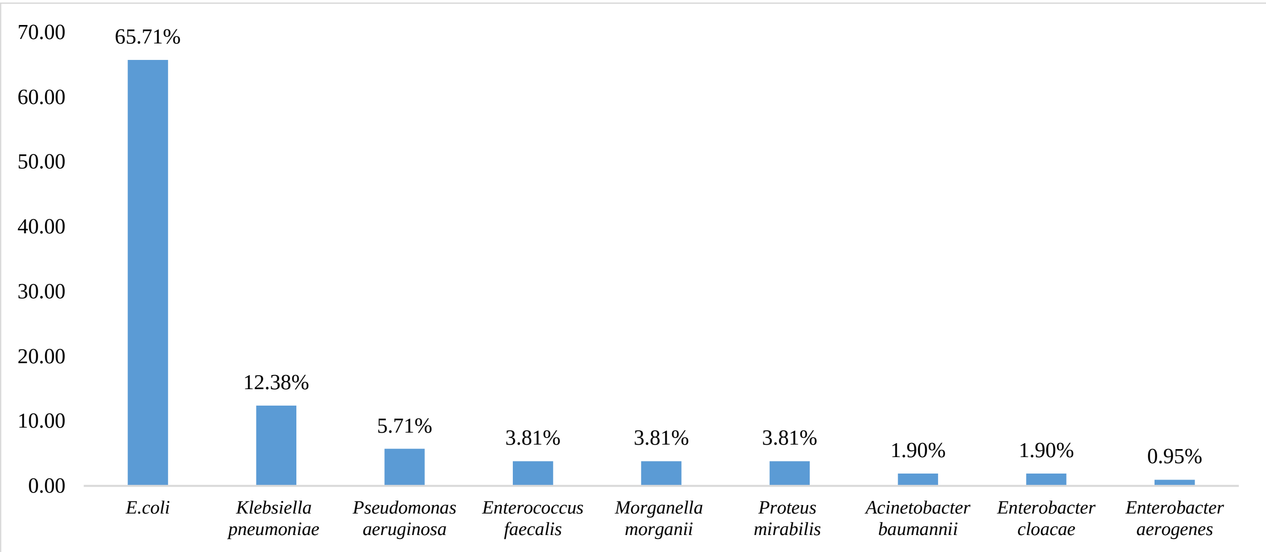

Figure – 1: Etiological agents isolated from urine culture (*n*=105)

Table – III: Antibiotic Sensitivity Pattern of Uropathogens (*n*=105)

Organism	Amikacin	Gentamicin	Cefotaxime	Ciprofloxacin	Nitrofurantoin	Piperacillin–Tazobactam	Imipenem/Meropenem	Cotrimoxazole
E. coli	88%	80%	45%	65%	85%	95%	98%	38%
Klebsiella pneumoniae	85%	72%	40%	60%	70%	93%	97%	35%
Pseudomonas aeruginosa	90%	75%	35%	68%	20%	96%	99%	15%
Enterococcus faecalis	50%	45%	25%	30%	80%	60%	85%	40%
Morganella morganii	82%	70%	42%	65%	55%	90%	95%	30%
Proteus mirabilis	87%	74%	48%	70%	40%	92%	97%	32%
Acinetobacter baumannii	70%	60%	30%	55%	25%	85%	90%	20%
Enterobacter cloacae	78%	68%	38%	60%	35%	88%	94%	28%
Enterobacter aerogenes	75%	65%	35%	58%	32%	86%	93%	25%

DISCUSSION

Urinary tract infections (UTIs) are among the most common bacterial infections in children, contributing to significant morbidity if not promptly diagnosed and treated. The clinical presentation of pediatric UTIs can vary widely, often overlapping with other childhood illnesses, which may delay diagnosis. Understanding the clinical features and underlying etiological agents is essential for guiding effective management and preventing long-term complications such as renal scarring. This study aimed to evaluate the clinical presentations and identify the etiological agents of urinary tract infections in children, in order to guide timely diagnosis, appropriate treatment, and preventive strategies. In our study, the age group most affected was children under one year, which is consistent with findings from studies conducted in India[15,16]. The least affected group was those aged 11–15 years. Males predominated in the first year of life, aligning with observations by other studies[17-19]. This may be due to the higher susceptibility of uncircumcised infant boys, as microorganisms can accumulate beneath the prepuce. The male-to-female ratio in our study was 1.2:1 during infancy and 1:1 between 11 and 15 years of age. Among children older than one year, a female predominance has been reported, with ratios ranging from 6:1 to 1.33:1 depending on sample size and age distribution[20]. Taneja et al. and Qureshi et al. found the 1–5 year age group to be most commonly affected, with a male predominance[21,22]. In pediatric patients, UTIs often lack the classic signs and symptoms typically observed in adults. Physical examination findings are also less reliable, as costovertebral angle and suprapubic tenderness are not dependable indicators in children. The present study found that fever accompanied by irritability was the most common presenting symptom, followed by abdominal pain. Among children aged 2 to 5 years, abdominal pain and fever were identified as the predominant clinical manifestations[23]. In our study, *Escherichia coli* was the most common uropathogen in pediatric UTIs (65.7%), followed by *Klebsiella pneumoniae* (12.4%), with other isolates including *Pseudomonas aeruginosa* (5.7%), *Enterococcus faecalis*, *Morganella morganii*, and *Proteus mirabilis* (each 3.8%). This distribution is consistent with previous studies, where *E. coli* and *Klebsiella* were the most common uropathogen, while *Pseudomonas* and other pathogens were less frequent and often associated with complicated or hospital-acquired cases[23,24]. Such findings highlight the need for empiric therapy targeting *E. coli* and *Klebsiella*, guided by local antimicrobial resistance data. In this study, *Escherichia coli*—the predominant uropathogen—demonstrated high susceptibility to amikacin (88%), nitrofurantoin (85%), piperacillin–tazobactam (95%), and carbapenems (98%), contrasted by markedly lower susceptibility to cefotaxime (45%) and cotrimoxazole (38%). This resistance profile is in line with prior pediatric UTI research showing a rising trend toward ESBL-mediated β-lactam resistance and reduced efficacy of trimethoprim–sulfamethoxazole, while aminoglycosides, nitrofurantoin, and β-lactam/β-lactamase inhibitor combinations retain activity[25]. In pediatric ESBL-positive isolates, nitrofurantoin has shown high effectiveness, including susceptibility rates of 95.2 % for *E. coli*, reinforcing its empirical utility [26]. *Pseudomonas aeruginosa* in our cohort displayed high sensitivity to amikacin (90 %), piperacillin–tazobactam (96 %), and carbapenems (99 %), with expected low nitrofurantoin susceptibility, consistent with its intrinsic resistance profile[25].

Limitations of the study:

- Lack of molecular analysis to detect resistance genes.
- Possible selection bias as only hospital-attending cases were included, potentially excluding community-managed cases.
- No imaging studies included to correlate anatomical abnormalities with infection risk.

CONCLUSION

This study highlights that pediatric UTIs are most prevalent in early childhood, particularly infancy, and are predominantly caused by *E. coli*. The observed high resistance to commonly prescribed oral antibiotics such as third-generation cephalosporins and cotrimoxazole raises concern for empirical treatment failures. Nitrofurantoin, aminoglycosides, piperacillin–tazobactam, and carbapenems demonstrated better activity and may be considered in empirical regimens where appropriate. These findings emphasize the need for periodic local antimicrobial resistance surveillance, targeted antibiotic stewardship, and public health initiatives to prevent recurrent infections and reduce resistance trends.

Funding: *No funding sources*
Conflict of interest: *None declared*
Ethical approval: *The study was approved by the Institutional Ethics Committee.*

REFERENCES

1. *Mancuso G, Midiri A, Gerace E, Marra M, Zummo S, Biondo C. Urinary tract infections: the current scenario and future prospects. Pathogens. 2023 Apr 20;12(4):623.*
2. *He Y, Zhao J, Han C, Yan R, Wang L, Zhu P, Qian T, Yu S, Zhu X, He W. Epidemiological Trends and Predictions of Urinary Tract Infections at the Global, Regional, and National Levels: An Analysis of the Global Burden of Disease Study 2021. Regional, and National Levels: An Analysis of the Global Burden of Disease Study. 2021.*
3. *Nazme NI, Ahsan MR, Jalil F, Fatema NN. Childhood Urinary Tract Infection: Clinical & Laboratory Profile in a Tertiary Care Hospital of Bangladesh. Journal of Advances in Medicine and Medical Research. 2018;18:1-9.*
4. *Toffolo A, Ammenti A, Montini G. Long-term clinical consequences of urinary tract infections during childhood: a review. Acta Paediatrica. 2012 Oct;101(10):1018-31.*
5. *Akoka FA. Risk Factors and Aetiology of Urinary Tract Infections (UTI) Among Elderly Patients Aged 65 and Above at Lancet Clinical Laboratories from January to December 202 (Doctoral dissertation).*
6. *Sood A, Penna FJ, Eleswarapu S, Pucheril D, Weaver J, Abd-El-Barr AE, Wagner JC, Lakshmanan Y, Menon M, Trinh QD, Sammon JD. Incidence, admission rates, and economic burden of pediatric emergency department visits for urinary tract infection: data from the nationwide emergency department sample, 2006 to 2011. Journal of pediatric urology. 2015 Oct 1;11(5):246-e1.*
7. *Ekpunobi N, Ugwu M, Agu K, Chukwunwejim C, Oghonyon E, Ogunmola T, Ajasa O, Okoye S, Obidi N. Antimicrobial Resistance in Pediatric UTIs: Molecular Profiles, Clinical Burden, and Public Health Implications of ESBL-Producing Uropathogens.*
8. *Islam MA, Islam MR, Khan R, Amin MB, Rahman M, Hossain MI, Ahmed D, Asaduzzaman M, Riley LW. Prevalence, etiology and antibiotic resistance patterns of community-acquired urinary tract infections in Dhaka, Bangladesh. Plos one. 2022 Sep 15;17(9):e0274423.*
9. *Cusack R, Little E, Martin-Loeches I. Practical lessons on antimicrobial therapy for critically Ill patients. Antibiotics. 2024 Feb 6;13(2):162.*
10. *Schlager TA. Urinary tract infections in children younger than 5 years of age: epidemiology, diagnosis, treatment, outcomes and prevention. Paediatric drugs. 2001 Mar;3(3):219-27.*
11. *Abelson B, Sun D, Que L, Nebel RA, Baker D, Popiel P, Amundsen CL, Chai T, Close C, DiSanto M, Fraser MO. Sex differences in lower urinary tract biology and physiology. Biology of sex differences. 2018 Oct 22;9(1):45.*
12. *RIVUR Trial Investigators. Antimicrobial prophylaxis for children with vesicoureteral reflux. New England Journal of Medicine. 2014 Jun 19;370(25):2367-76.*
13. *Kutasy B, Coyle D, Fossum M. Urinary tract infection in children: management in the era of antibiotic resistance—a pediatric urologist's view. European urology focus. 2017 Apr 1;3(2-3):207-11.*
14. *Baron EJ. Bailey and Scott's diagnostic mocrobiology. InBailey and Scott's diagnostic mocrobiology 1990 (pp. 861-861).*
15. *Jitendranath A, Radhika R, Bhargavi L, Bhai G, Beevi R. Microbiological profile of urinary tract infection in pediatric population from a tertiary care hospital in South Kerala. J Bacteriol Mycol Open Access. 2015;1(1):4-7.*
16. *Sonkar L, Singh R, Ali I, Prakash V, Verma D. Antimicrobial susceptibility pattern of various etiological agents causing pediatric urinary tract infection. International Journal of Contemporary Medical Research. 2020;7(10):4-8.*
17. *Ghadage DP, Nale SS, Kamble DS, Muley VA, Wankhade AB, Mali RJ, Bhore AV. Study of aetiology and anti-biogram of uropathogens in children-a retrospective analysis. Journal of Clinical and Diagnostic Research: JCDR. 2014 Jan 12;8(1):20.*
18. *Ramagopal G. Clinical and Microbiological Profile of Children with Urinary Tract Infection. Journal of Pediatric Nephrology. 2018 Jul 1;6(2):1-5.*
19. *Dash M, Padhi S, Mohanty I, Panda P, Parida B. Antimicrobial resistance in pathogens causing urinary tract infections in a rural community of Odisha, India. Journal of Family and Community Medicine. 2013 Jan 1;20(1):20-6.*
20. *Chhetri PK, Rai SK, Pathak UN, Thapa JB, Devkota KC, Shrestha BO, Shrestha RR. Retrospective study on urinary tract infection at Nepal Medical College Teaching Hospital, Kathmandu. Nepal Med Coll J. 2001;3(83):5.*
21. *Taneja N, Chatterjee SS, Singh M, Singh S, Sharma M. Pediatric urinary tract infections in a tertiary care center from north India. Indian journal of medical research. 2010 Jan 1;131(1):101-5.*
22. *Qureshi AM. Organisms causing urinary tract infection in pediatric patients at Ayub Teaching Hospital Abbottabad. Journal of Ayub Medical College Abbottabad. 2005;17(1).*
23. *Kawoosa K, Malla RR, Dar SA, Kubravi SH. Clinical profile of pediatric patients with urinary tract infection in a tertiary care centre in Kashmir, India. International Journal of Contemporary Pediatrics. 2019 May;6(3):1149.*
24. *Venugopal P, Cherain CS, Raghunath P. Clinicoetiological profile of urinary tract infection in pediatric population in a teaching hospital in south India. Int J Contemp Pediatr. 2021 Dec;8(12):1958-64.*
25. *Chinnasami B, Sundaramoorthy S, Sadasivam K, Pasupathy S. Pathogens causing urinary tract infection in children and their in vitro susceptibility to antimicrobial agents-A hospital based study. Biomedical and Pharmacology Journal. 2016 Apr 28;9(1):377-83.*
26. *Park KS, Kim DR, Baek JY, Shin A, Kim KR, Park H, Son S, Cho H, Kim YJ. Susceptibility to fosfomycin and nitrofurantoin of ESBL-positive Escherichia coli and Klebsiella pneumoniae isolated from urine of pediatric patients. Journal of Korean Medical Science. 2023 Dec 11;38(48).*