

Bacterial profile, antibiotic susceptibility pattern and associated risk factors of urinary tract infection among clinically suspected children attending at Felege-Hiwot Comprehensive and Specialized Hospital, Northwest Ethiopia. A prospective study

Adugna Fenta

Wogera Primary Hospital, Northwest, Ethiopia

Mulat Dagnew

University of Gondar College of Medicine and Health Sciences

Setegn Eshetie

University of Gondar College of Medicine and Health Sciences

Teshome Belachew (✉ tesh0926@gmail.com)

University of Gondar College of Medicine and Health Sciences <https://orcid.org/0000-0003-4350-9803>

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Abstract

Background: Urinary tract infection is one of the most common bacterial infections in children. Understanding the characteristics of uropathogens and their antimicrobial susceptibility pattern in a particular setting can provide evidence for the appropriate management of cases. This study aimed to assess the bacterial profile of urinary tract infection, their antimicrobial susceptibility pattern and associated factors among clinically suspected children attending at Felege-Hiwot Comprehensive Specialized Hospital, Northwest Ethiopia.

Methods: A hospital-based cross-sectional study was conducted from February-April, 2019. A systematic sampling technique was employed. A mid-stream urine sample was inoculated on cystine lactose electrolyte deficient media and incubated for 24-48 hours. Sub-culturing was done on Mac-Conkey and blood agar. Antimicrobial susceptibility test was done on Muller-Hinton agar. A binary logistic regression model was used to see the association between dependent and independent factors. A p -value < 0.05 at 95% CI was considered as statistically significant.

Results: The overall prevalence of urinary tract infection was 16.7% (95% CI 12.4-21.1). Both Gram-negative and Gram-positive bacterial isolates were recovered with a rate of 44/50 (88%) and 6/50 (12%) respectively. Among Gram-negative isolates, *E. coli* 28/44 (63.6%) was predominant while *S. saprophyticus* 2/6 (33.3%) was prevalent among Gram-positive bacterial isolates. Overall, a high level of resistance to ampicillin, Augmentin, and tetracycline was shown by Gram-negative bacteria with a rate of 44/44 (100%), 39/44 (88.6%), and 36/44 (81.8%) respectively. About 33/50 (66%) of overall multidrug resistance was observed (95% CI 52-78). About six Gram-negative bacterial isolates were extended spectrum beta-lactamase (ESBL) producers. Having a history of urinary tract infection ($P=0.003$, AOR 1.86-22.15) and male uncircumcision ($p=0.00$, AOR 5.5-65.35) were the independent variables that associate for urinary tract infections.

Background

Urinary tract infection is a serious bacterial infection causing illness in infants and children. It is one of the most common bacterial infections faced by clinicians working in the developing world [1]. It is applied to a variety of clinical conditions ranging from the asymptomatic presence of bacteria in the urine to severe infection of the kidney with the development of sepsis. If poorly treated or undiagnosed, it is an important cause of long-term morbidities like; hypertension, failure to thrive and finally go to end-stage renal dysfunction [2, 3]. Developing kidneys of infants and young children are more susceptible to damage from pyelonephritis [4].

The epidemiology of UTI during childhood varies by age, gender, circumcision status, and other factors. Boys are more susceptible during the first year of life, mostly in the first 3 months, among boys, uncircumcised infants have an eightfold higher risk; due to phimosis, limited retraction of the foreskin is significantly associated with an increase in UTIs in male infants [5], afterward the incidence is mainly higher in girls, due to differences in anatomy [6]. Common symptoms of UTIs include burning sensation during urination, loss of bladder control, increased frequency of urination especially in small amounts, low back pain, cloudy and bloody or foul-smelling urine [7]. About 5% of girls and 2% of boys experience at least one incident of UTI up to the age of seven years [8, 9].

Urinary tract infection is among the most prevailing infectious diseases with a considerable financial burden on society. It affects approximately 150 million people worldwide per year. Populations who have a major risk of acquiring a UTI are newborns, preschool children, sexually active women, and older individuals of both sexes [10]. Studies from developing countries showed that around 10% of children with febrile illnesses have a UTI and it extends to 8–35% if the patient is malnourished children [3, 11].

It is estimated that globally 26 % of deaths are due to infectious diseases such as UTIs of which 98 % occur in low-income countries [7]. The prevalence of UTI in pediatrics of Asian countries was high. In Nepal, two studies were studied at different time from different areas and showed that 15.88% and 57% [12, 13] of prevalence was documented. Another study in India also showed 48% prevalence [14].

In South African children a hospital-based study was conducted on Burden, spectrum, and impact of healthcare-associated infection. From this study, UTI takes an 11% share [15]. Similarly, a study on the prevalence of UTI in one Nigerian teaching hospital to determine the incidence of urinary tract infection in children and adolescents was 11.9% [16], Tanzania Children who presented prolonged duration of fever (7 days or longer) were more likely to have UTI 16.8% [17], in a study on the contribution of urinary tract infection to the burden of febrile illnesses in young children in rural Kenya was 11.9% [11].

In Ethiopia, different studies were done in different study groups. a study done at Hawassa referral hospital in pediatric patients showed that the prevalence of UTI was 27.5% [8], and a prevalence of 15.9% and 26.45% was reported in Yekatit 12 hospital Addis Ababa [18] and Gondar University hospital [19]. But, in the study area, there is no study done on prevalence of UTI and associated factors among children. Therefore, in the study area, knowledge of prevalence, antimicrobial susceptibility pattern and associated risk factors can help clinicians to make informed diagnostic and therapeutic decisions in those children.

Materials And Methods

Study setting, design, population, and sampling techniques

Hospital-based a cross-sectional prospective study was done among UTI suspected children from February-April, 2019 at Felege-Hiwot Comprehensive Specialized Hospital, Bahir-Dar, Amhara regional state. Bahir-Dar is the capital of Amhara regional state in the Northwest Ethiopia. The Town is located 576 km from the capital city of the country, Addis Ababa. Based on the 2007 Census conducted by the Central Statistical Agency (Ethiopia), Bahir Dar town has a total population of 221,990. The hospital is a tertiary care referral hospital with around 400 beds and 9 operating tables serving for over 7 million people. The hospital provides obstetrics, pediatric, internal medicine, ophthalmology, gynecology and orthopedic surgery services [20]. The sample size (299) was determined by using a single population proportion formula by considering the prevalence of 26.45% [19], with a 95% confidence interval, and a 5% margin of

error. Study participants were recruited by convenient sampling technique. Children who were ≤ 15 years and suspected of urinary tract infection were included in this study. However, children who took antibiotics two weeks before data collection and children who were critically ill were excluded.

Data collection methods

Standard questionnaire was prepared from reviewed literature and pre-tested. It was prepared in English and translated to the local language (Amharic) then translated back into English to check the accuracy of the translation. The questionnaire design included socio-demographic characteristics and associated risk factors. Data collection was done after obtaining written informed consent from parents/guardians. Socio-demographic and data related to associated factors were collected with face to face interview.

Urine sample collection

Clean voided mid-stream urine (MSU) specimens were collected from UTI suspected children in sterile bottles by the patient's parent with the assistance of a nurse and investigator and transported to the laboratory as soon as possible. Contamination was managed by giving proper instruction on how to collect the sample correctly. When the patient is unable to provide urine sample catheters were used and this is done only when the child is critically ill and the sample is needed to treat the situation [21].

Culture and identification techniques

Collected urine from each patient was inoculated onto cysteine-lactose-electrolyte deficient agar CLED/ (Oxoid, Basingstoke, Hampshire, England) plates using a calibrated inoculating loop with a capacity of 0.001ml. The inoculated plates were incubated for 24-48 hours at 37°C aerobically. If growth observed, Plates with a colony count of $\geq 10^5$ cfu/ml were considered significant bacteriuria [22]. Then sub-cultured to Mac-Conkey agar (Oxoid, Basingstoke, Hampshire, England) and 5% sheep blood agar (Oxoid, Basingstoke, Hampshire, England) [22]. Bacterial isolates were characterized/identified by Gram stain and biochemical tests; i.e. for Gram-positive bacteria: catalase test, novobiocin disk test and coagulase test were done while for Gram-negatives: Triple sugar iron agar test, indole motility test, citrate agar test, lysine decarboxylase agar test, urea agar test and oxidase test were done.

Antimicrobial susceptibility testing (DST)

Antimicrobial susceptibility test was carried out using the Kirby-Bauer disc diffusion method as per Clinical Laboratory Standards Institute (CLSI) guidelines on Muller Hinton agar [23]. The suspension of 3-5 colonies of freshly grown test organism was prepared equivalent to 0.5 McFarland standards. The surface of the Muller-Hinton agar was then completely covered by rotating the swab with the suspension. The plates were allowed to dry for 3-5 minutes: then discs were evenly distributed on the inoculated plate using sterile forceps and incubated at 37 °C for 18-24 hours. The diameter of the zone of inhibition around the disc was measured using a ruler. Results were interpreted as Sensitive, Intermediate and Resistance based on CLSI 2018 guideline [23]. The following routinely used antimicrobials were tested: ampicillin [10µg], gentamycin [10µg], amox-clav[20/10µg], cefoxitin [30µg], cefotaxime [30µg], ciprofloxacin [5µg]; meropenem [10µg], cotrimoxazole [1.25/23.75µg], ceftazidime [30 µg], chloramphenicol [30 µg], tetracycline [30µg], nitrofurantoin [300µg] and erythromycin [15µg] [23]. Multi-drug resistance was defined as resistance of an isolate to three or more antimicrobial classes tested

[24].

Extended Spectrum β -Lactamase Detection

Screening to ESBL production test: Based on CLSI-2018, bacterial strains can be a candidate to ESBL, if an isolate on the disk diffusion method has a sensitivity ≤ 22 mm for ceftazidime [30µg] or ≤ 27 mm for cefotaxime [30µg] [23]. Phenotypic confirmation of ESBL production was done by using the double disk diffusion method; i.e. cefotaxime [30µg] and cefotaxime-clavulanic acid [30/10µg] and ceftazidime [30µg] and ceftazidime-clavulanic acid [30/10µg]. Bacterial suspension was prepared while taking 2-3 fresh colonies and adjusted to 0.5 McFarland standard. Lawn culture was done on the Mueller-Hinton Agar (MHA) plate. The ceftazidime and ceftazidime-clavulanic acid discs were placed at 20 mm apart on the agar surface. After overnight incubation for about 16-18 hours at 37°C, a ≥ 5 mm increase in zone diameter for either cefotaxime or ceftazidime tested in combination with, were taken as indicative for ESBL positive/producers. *E. coli* ATCC 25922 was used as an ESBL-negative and *K. pneumoniae* ATCC 700603 was used as an ESBL-positive reference strain. Clavulanate Vs the zone diameter of the agent (ceftazidime or cefotaxime), when tested alone, was taken as positive for the presence of ESBLs in bacterial isolates [23].

Data processing and analysis

Data entry and analysis were done by using SPSS version 20 software. The results were presented through texts, tables, and graphs. Descriptive statistics were used to summarize socio-demographic data, bacterial profile and susceptibility patterns of isolates. Bivariate and multivariate logistic regression analysis was carried out to identify potential factors of urinary tract infection of children. P value < 0.2 was considered statistically significant for bivariate analysis. Adjusted odds ratio at 95% CI was used to measure the association between potential risk factors and UTI in children. A p-value < 0.05 at 95% CI was considered as statistically significant.

Ethical consideration

Ethical clearance was obtained from the University of Gondar Biomedical Laboratory Sciences, Ethical Review Committee. The reference number of the ethical letter was "Ref no- SBMLS/2123/11". This ethical letter was obtained from Mr. Mekonnen Girma (mekonnen2302@cmail.com), Markos Negash (markosnegash@yahoo.com) and Bamilaku Enawgaw (bamalak21@gmail.com). Written parental consent/assent was obtained from parents or guardians of children after explaining the purpose and objective of the study. Study participants who were not willing to participate in the study would not be forced to

participate. They were informed that all data and sample obtained from them were kept confidential by using codes instead of any personal identifiers and is meant only for the purpose of the study. Positive results were communicated to health care providers.

Results

Socio-demographic characteristics

A total of 299 urinary tract infections (UTI) suspected children were included in the present study. Of the total study subjects, 165 (55.2%) were males. The age range of the participants was between day 1 and 15 years with the median age of 6 years. About 53% of study participants were in the age group of 6-15 years. Of the study subjects, 208 (69.6%) were urban dwellers. The majority of the participant's mothers, 127 (42.5%), and fathers, 91(30.4%) were illiterate and attending primary school respectively (Table 1).

Prevalence of bacterial isolates from UTI suspected children

The overall prevalence of urinary tract infections among study participants were 50 (16.7%) (95%CI: 12.4 -21.1). Of the total culture positive participants, the majority, 30 (60%), were females ("Fig 1").

Both Gram-negative and Gram-positive bacterial species were recovered with the isolation rate of 44/50 (88%) and 6(12%) respectively. Among Gram-negative bacterial species, *E. coli* were the most frequently isolated bacteria followed by *Klebsiella* species and *Citrobacter* species with the rate of 28/50 (56%), 7(14%) and 6(12%) respectively whereas *S. saprophyticus* and *S. aureus* were Gram-positive bacteria isolated with a rate of 6% each ("Fig 2").

Antimicrobial susceptibility patterns of Gram-negative bacterial isolates

Among tested Gram-negative bacterial isolates, 97.7% were susceptible to meropenem, followed by ciprofloxacin (84.1%), ceftazidime (81.82%), ceftazidime (79.5%) and chloramphenicol (79.5%). However, 100% resistance rate was observed to ampicillin followed by augmentin (68.18%) and tetracycline (65.91%). Above 75% of *E. coli* isolates were susceptible to ceftazidime, ciprofloxacin, meropenem, chloramphenicol, and nitrofurantoin whereas *K. pneumoniae* was another bacterial isolate which showed a high level of susceptibility to meropenem (100%), ceftazidime and nitrofurantoin (80%) each (Table 2)

Multidrug resistance patterns of bacterial isolates

The overall multidrug resistance rate of the isolates was assessed in this study and about 33/50 (66%) (95% CI 52-78) showed multidrug resistance. A higher rate of MDR was observed in a Gram-negative than Gram-positives. The Majority of the Gram-negative isolates 31/44 (70.5%) showed multidrug resistance (MDR). Specifically, the highest MDR was observed in *Citrobacter* species (83.3%) followed by *Klebsiella* species (57.1%) and *E. coli* (64.3%) (Table 3).

Extended spectrum beta-lactamase production

Extended spectrum beta-lactamase (ESBL) production property of Gram-negative bacterial species was also determined. Based on CLSI-2018, bacterial strains can be a candidate to ESBL, if an isolate on the disk diffusion method has a sensitivity ≤ 22 mm for ceftazidime [30mg] or ≤ 27 mm for cefotaxime [30mg]. In the beginning, a total of **seven** Gram-negative bacterial isolates (**six** *E. coli* and **one** *K. pneumoniae*) were candidates for ESBL production. However, only **6** bacterial isolates (5 *E. coli* and 1 *K. pneumoniae*) were phenotypically confirmed for the production of ESBL by using the double disk diffusion method; i.e cefotaxime [30mg] and cefotaxime-clavulanic acid [30/10 mg] and ceftazidime [30mg] and ceftazidime-clavulanic acid [30/10 mg]. If the inhibition zone of the combined disk is ≥ 5 mm, the disk without clavulanic acid, the isolate is an ESBL producer with fulfilling the criteria of CLSI-2018 [23].

Antimicrobial susceptibility patterns of Gram-positive bacterial isolates

All Gram-positive isolates were 100% sensitive to nitrofurantoin followed by cotrimoxazole, ceftazidime, ciprofloxacin, chloramphenicol, and gentamycin, 66.7% each. About 33.33% of *S. aureus* showed MDR (Table 4).

Associated risk factors

Based on the multivariate logistic regression model, two factors, such as circumcision status of males and history of UTI were found to be the independent risk factors for UTI in children. Therefore; being previously infected with UTI had more than six times the likelihood of developing UTIs compared to those who had not infection. On the other hand, males who were not circumcised were more than 18 times higher to be culture positive than circumcised boys (Table 5).

Discussion

The prevalence of UTI in the present study was 16.7% (95% CI 12.7-20.4). It is in line with the study done in Addis Ababa 15.8% [18]. However, it is lower than the findings of the studies in Gondar, 26.45% [19] and Hawassa, 27.5% [8]. This difference might be a female predominance to Gondar University Hospital (60.94%) in contrast to our study participants (44.8%). The majority of male study participants (71.7%) in the Hawassa University Hospital were not circumcised. Therefore, a tight foreskin may interfere with the normal passage of urine and can prevent fully emptying of the bladder [25, 26].

Though UTI can be caused by both Gram-negative and Gram-positive bacteria, Gram-negative bacteria are the most common cause of the infection, because the agents are the normal constituent of the normal intestinal microbiota [27]. Acquisition of UTI starts with periurethral contamination by a uropathogen inhabiting in the gut, followed by colonization of the urethra and successive migration of the pathogen to the bladder [28]. Among these, *E. coli* is the predominant one [14, 29, 30]. Similarly, the present study reveals that 88% (44/50, 95% CI 80-96%) of the isolate are Gram-negative bacteria. Of these, *E. coli*

accounts for 63.63% of Gram-negatives followed by *Klebsiella* species (15.9%), and *Citrobacter* species (13.63%) are the predominantly isolated uropathogens. This predominance might be due to their unique structures such as flagella and pili, which help for their attachment to the uroepithelium increases risk for infection [31]. This finding is considerably similar to studies done in Nigeria [32] for *Citrobacter* species, 10.7%, *E. coli* 57.4% in Iran [33] and *E. coli* 56% and *Klebsiella* species 19% in Scotland [3]. A study in Bangladesh reported the same prevalence of *E. coli*, 63.3% of the total Gram-negative bacterial isolates [34].

About 60% (30/50) of the isolate and 72% (20/28) of *E. coli* and *Klebsiella* species were isolated from females. This might be due to poor hygienic conditions, proximity of anal and urethral openings and relatively wide urethra [14].

All Gram-negative bacterial isolates were 100% resistant to ampicillin followed by augmentin (68.18%) and tetracycline (65.91%). Similar findings were seen in four hospitals of Scotland [35] 93% and 100% in Pakistan [36] for ampicillin respectively. The reason may be continuous use of these drugs for many years, easily available without professional prescription from pharmacy, self-prescription and the tendency of patients using relatively cheaper antibiotics for all types of infection and misuse (overuse or underuse). Meropenem 97.3% were sensitive, it might be the unavailability of this drug in the area. As table 2 shows: ciprofloxacin, ceftioxin, and ceftazidime were showed the best performance for *E. coli*. This is almost similar results to the findings from Gondar Hospital and Addis Ababa, Yekatit 12 hospital [18]. According to the findings in Gondar Hospital, the sensitivity of gentamicin and cotrimoxazole to *E. coli* was 80%, 73% [19] respectively. However, to the present study, the susceptibility to the above-listed drugs were 46.4% and 42.9% respectively. This might be due to the gradual increase of drug resistance/selective pressure of bacteria to the drug /mutation, the difference in antibiotic practices in the study area. Similar research from Iraq revealed that 75% sensitive for chloramphenicol [2].

All Gram-positive isolates showed 100% sensitive to nitrofurantoin. Similar results were obtained in Gondar hospital (77%) [30] and Addis Ababa, Yekatit 12 hospital (100%) [18]. The reason for the effectiveness of this drug might be, due to the nature of having multiple mechanisms and site of actions of the drug with a non-specific attack of protein synthesis, would reduce the ability of bacteria to produce resistance. Limited access to the drug, narrow-spectrum nature of the drug. However, it is 71.4% resistant to the finding in Hawassa Hospital [8]. Higher resistance to this antibiotic is perhaps due to their widespread and wrongly use as empirical therapy.

Furthermore, the overall MDR prevalence was 66% (95% CI 52-78) which comprises Gram-negative (70.5%) and Gram-positive bacteria (33.33%). This is comparable to the findings in the Gondar hospital pediatric patients 58.53% [30], the Addis Ababa, Yekatit 12 hospital 73.7% [18]. Although antimicrobial resistance comes primarily as a result of selective pressure to place on susceptible microbes by the use of therapeutic agents, there are also further multiplying factors for the spread of resistance. These are antimicrobial prescription in many resources limited countries is almost entirely empirical and based on surveillance data obtained during the survey. This result is only shown at a time of the situation, not for another time. Broad-spectrum agents are frequently used due to lack of susceptibility data, easy availability of antimicrobials in non-controlled pharmacy gives the chance to buy easily as a commodity: these drugs might be sub-standard/poor quality, not finishing the full course of treatment when they feel better, over-prescription due to a poor diagnostic set-up or fear of loss of follow-up [37].

The emergence of resistant strains among uropathogens is alarmingly increased with different resistance patterns [38]. Acquisition of resistance might be either mutational (i.e. changing the target site of a bacteria within its genetic material) or acquisition of new genetic material from other bacteria. This problem is also magnified by an irrational use and poor administration of drugs. Once a patient acquires resistant strain bacteria, then it transfers antibiotic resistance genes to other bacteria, by this means the problem becomes challenging to control [39].

The present study also demonstrated the prevalence of ESBL which was 19.4% (95% CI 6.5-32.3%). The prevalence is increasing; due to delayed initiation of appropriate treatment and the spread of the strain to the community or in hospital environment. Inappropriate use of carbapenems, increased use of third-generation cephalosporins and quinolones in the community, stool-mediated infections, and the existence of the ESBL gene in the plasmid are other possible factors [40]. The ESBL producing strains are commonly resistant to other antimicrobial agents because of mobile genetic elements encoding other antimicrobial resistance determinants and/or chromosomal mutations. The co-resistance to other agents limits the antimicrobial treatment options available and may enable selection for ESBLs by non-beta-lactam antimicrobials such as the aminoglycosides and fluoroquinolones [41].

Furthermore, the history of previous UTI and male uncircumcision was the independent risk factors for the acquisition of UTI. There are two possible reasons for the previous history of UTI as the cause of recurrent UTI: these are; frequent repeat ascending infections and persistent infections in the bladder. Gram-negative bacteria are the predominant cause of UTI. Of these uropathogenic *E. coli* is the leading strain [42]. In studies using pulsed-field gel electrophoresis, 52%–77% of recurrent UTIs were caused by uropathogenic *E. coli* strain which was identical to the primary infecting strain [43]. This due to *E. coli* has an adhesion structure for the progression of UTI [44].

Another reason suggests that, *E. coli* could replicate intracellularly, form a loose collection of bacteria, and then escape into the bladder and could form a complex of intracellular bacterial communities (IBCs) within the superficial umbrella cells of the bladder, which could be formed after 4–16 h of bacterial infection and then develop a persistent quiescent intracellular reservoir after 2 weeks [45]. These IBCs could be quiescent for extended periods, despite antibacterial therapy and then re-emerge to cause recurrent UTI [46].

Conclusion

The prevalence of UTI in children was high, and considerably a high proportion of MDR strains were observed in the present study. Previous history of UTI and male uncircumcision were the predictor variables of UTI.

List Of Abbreviations

Declarations

Ethics approval and consent to participate

An ethical clearance letter was obtained from the Departmental Research and Ethics Review Committee of School of Biomedical Laboratory Science. The reference number of the ethical letter was "Ref no- SBMLS/2123/11". Written consent was obtained from parents/guardians of all eligible subjects. Study participants were informed about the purpose of the study. Confidentiality was maintained at all levels of the study. In addition, study participants involvement was based on a voluntary basis and participants who were unwilling to take part in the study and those who need to quit their participation at any stage were informed to do so without any restriction.

Consent for publication

All authors read the manuscript and have provided their consent to publish.

Availability of data and material

Data and supporting materials associated with this study will be shared upon request

Competing interests

The authors declare that they have no competing interest.

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Authors' contribution

AF did conceptualization, analyzing the data, methodology designing, investigation during the laboratory work, writing original draft and review the final manuscript.

MD did conceptualization, methodology designing, writing original draft and review the final manuscript.

TB did conceptualization, analyzing the data, Validation, methodology designing, investigation during the laboratory work, writing original draft and review the final manuscript.

SE did conceptualization, data curation, methodology designing, writing original draft and review the final manuscript.

All authors have read and approved the manuscript.

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Tables

Table 1: Socio-demographic characteristics of UTI suspected children attending at Felege- Hiwot Comprehensive Specialized Hospital (FHCSH), Northwest, Ethiopia, February-April, 2019.

Socio-demographic characteristics	Frequency	Percentage
Sex		
Male	165	55.2
Female	134	44.8
Age (in years)		
<1	36	12.0
1 – 5	105	35.2
6 – 15	158	52.8
Residence		
Urban	91	30.4
Rural	208	69.6
Educational status of father		
Unable to read and write	83	27.8
Primary	91	30.4
High school	64	21.4
College and above	61	20.4
Educational status of mother		
Unable to read and write	127	42.5
Primary	65	21.7
High school	58	19.4
College and above	49	16.4
Total	299	100

Bacterial Iso.	Sen.	AMP	GEN	AMC	CTX	CTX	CIP	MER	COT	CAZ	CHL	TET
<i>E. coli</i> (n=28)	S	-	13 (46.4)	5 (17.9)	24(85.7)	23(82.1)	21 (75)	27(96.4)	12(42.9)	21 (75)	23(82.1)	6 (21)
	I	-	7 (25)	7 (25)	1 (3.6)	1 (3.6)	1 (3.6)	-	4(14.2)	3 (10.7)	1 (3.6)	6 (21)
	R	28(100)	8 (28.6)	16(57.1)	3 (10.7)	4 (14.3)	6 (21.4)	1 (3.6)	12(42.9)	4 (14.3)	4(14.3)	16(57.1)
<i>K.pneumoniae</i> (n=5)	S	-	1 (20)	-	3 (60)	4 (70)	4 (70)	5 (100)	2 (40)	4 (80)	3 (60)	1 (20)
	I	-	2 (40)	-	2 (40)	-	-	-	-	-	-	-
	R	5 (100)	2 (40)	5 (100)	-	1 (20)	1 (20)	-	3 (60)	1 (20)	2 (40)	4 (80)
<i>K.ozaniae</i> (n=1)	S	-	1 (100)	-	1 (100)	1 (100)	1 (100)	1 (100)	-	1 (100)	1 (100)	-
	R	1 (100)	-	1 (100)	-	-	-	-	1 (100)	-	-	1 (100)
<i>K.rhinoscleromatis</i> (n=1)	S	-	-	-	1 (100)	1 (100)	-	1 (100)	1 (100)	1 (100)	1 (100)	-
	I	-	-	1 (100)	-	-	1 (100)	-	-	-	-	-
	R	1 (100)	1 (100)	-	-	-	-	-	-	-	-	1 (100)
<i>P.vulgaris</i> (n=1)	S	1 (100)	1 (100)	-	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)
	R	-	-	1 (100)	-	-	-	-	-	-	-	-
<i>Citrobacter</i> spp. (n=6)	S	-	3 (50)	1 (16.7)	1 (16.7)	1 (16.7)	5 (83.3)	6 (100)	1 (16.7)	2 (33.33)	1(16.7)	-
	I	-	2 (33.3)	-	-	-	1 (16.7)	-	-	2 (33.33)	1(16.7)	1 (16.7)
	R	6 (100)	1 (16.7)	5 (83.3)	5 (83.3)	5 (83.3)	-	-	5 (83.3)	2 (33.33)	4(66.7)	5 (83.3)
<i>Providencia</i> spp. (n=1)	S	-	1 (100)	-	1 (100)	1 (100)	1 (100)	1 (100)	-	1 (100)	1 (100)	-
	I	-	-	1 (100)	-	-	-	-	-	-	-	-
	R	1 (100)	-	-	-	-	-	-	1 (100)	-	-	1 (100)
<i>Acinetobacter</i> spps. n=1	S	-	-	-	1 (100)	1 (100)	1 (100)	1 (100)	1 (100)	-	1 (100)	-
	R	1 (100)	1 (100)	1 (100)	-	-	-	-	-	1 (100)	-	1(100)
Total n=44	S	-	20(45.5)	5 (11.4)	33 (75)	33 (75)	34(77.3)	43(97.73)	18(40.9)	30(68.18)	33 (75)	8(18.2)
	I	-	11 (25)	9(20.46)	3 (6.8)	1 (2.3)	3 (6.8)	-	4 (9.1)	5 (11.37)	2 (4.5)	7 (15.9)
	R	44(100)	13(29.6)	30(68.2)	8(18.2)	10(22.7)	7 (15.9)	1 (2.27)	22 (50)	9 (20.5)	9(20.5)	29(65.9)

Table 2: Drug resistance patterns of Gram-negative bacterial isolates from urine samples of children at the FHCSH, Northwest, Ethiopia, February-April, 2019

Note: Sen. =sensitivity, AMP =Ampicillin; GEN =Gentamycin; AMC=Augmentin; CXT =Cefoxitin; CTX=Cefotaxime; CIP=Ciprofloxacin; MER=Meropenem; COT=Cotrimoxazole; CAZ= Ceftazidime; CHL=Chloramphenicol; TET=Tetracycline; NIT=Nitrofurantoin; S= Sensitive; I= Intermediate; R;

Resistant.

Bacterial isolate	Sensitivity	ERY	CXT	CPR	TET	CHL	COT	GEN	NIT
<i>S.aurues</i> , n=3	S	1(33.33)	2(66.7)	2(66.7)	1(33.33)	2(66.7)	2(66.7)	2(66.7)	3(100)
	I	1(33.33)	-	-	-	1(33.33)	-	-	-
	R	1(33.33)	1(33.33)	1(33.33)	2(66.7)	-	1(33.33)	1(33.33)	-
<i>S.saprophyticus</i> , n=3	S	2(66.7)	2(66.7)	2(66.7)	-	2(66.7)	2(66.7)	2(66.7)	3(100)
	I	1(33.33)	-	1(33.33)	2(66.7)	1(33.33)	-	-	-
	R	-	1(33.33)	-	1(33.33)	-	1(33.33)	1(33.33)	-
Total, n=6/50	S	3(50)	4(66.67)	4(66.67)	1(16.67)	4(66.67)	4(66.67)	4(66.67)	6(100)
	I	2(33.33)	-	-	2(33.33)	2(33.33)	-	-	-
	R	1(16.67)	2(33.33)	1(16.67)	3(50)	-	2(33.33)	2(33.33)	-

Table 3: Drug resistant patterns of Gram-positive bacterial isolates from urine samples of children at the FHCSH, Northwest Ethiopia, February-April, 2019.

Table 4: Multi-drug resistant profile of Gram-negative bacteria isolated from urine of UTI suspected children attending the FHCSH, Northwest, Ethiopia, February-April, 2019

Antimicrobial resistance pattern	Bacterial isolate					Total
	<i>E. col</i>	<i>Klebsiella sp</i>	<i>Citrobacte</i>	<i>Acinetobacter</i>	<i>Providencia</i>	
AMP, TET, NIT	1					1
AMP, COT, TET	2				1	3
AMP, GEN, TET	1	1				2
AMP, GEN, AMC	1					1
AMP, AMC, COT	2					2
AMP, GEN, AMC, TET		1		1		2
AMP, AMC, CIP, TET	1					1
AMP, CIP, COT, CHL	1					1
AMP, AMC, COT, TET	1	1				2
AMP, GEN, AMC, CTX, TET	1					1
AMP, GEN, COT, TET, NIT	1					1
AMP, AMC, COT, CHL, TET		2				2
AMP, GEN, AMC, CHL, NIT	1					1
AMP, AMC, CTX, CIP, COT, TET	1					1
AMP, GEN, AMC, CXT, CTX, COT, CAZ			1			1
AMP, GEN, AMC, COT, CAZ, CHL, TET	1					1
AMP, AMC, CXT, CTX, COT, CHL, TET, NIT			3			3
AMP, AMC, CXT, CTX, COT, CAZ, CHL, TET			1			1
AMP, AMC, CXT, CIP, COT, CAZ, TET, NIT	1					1
AMP, GEN, AMC, CTX, CIP, COT, CAZ, TET		1				1
AMP, GEN, AMC, CXT, CTX, CIP, COT, CAZ, CHL, TET	1					1
AMP, GEN, AMC, CXT, CTX, CIP, MER, COT, CAZ, CHL, TET	1					1
Total	18	6	5	1	1	31

Variables		UTI N (%)	No. UTI (%)	p-value	COR	p-value	AOR
Age	<1	11 (3.7)	25 (8.4)	0.043	0.372 (0.143_0.962)	0.237	0.408(0.092_1.804)
	1_5	10 (3.3)	95 (31.8)	0.067	2.117 (0.949_4.723)	0.111	3.12 (0.766_13.36)
	6_15	29 (9.7)	129 (43.1)		1		1
Sex	Female	30 (10)	145 (48.5)	0.022	2.07 (1.11_3.86)		
	Male	20 (6.7)	122 (73.9)		1		
Circumcision in boys	No	15 (9.1)	23 (13.9)	0.00	15.93 (5.27_48.09)	0.00	18.99 (5.5_65.35) *
	Yes	5 (3.0)	104 (34.8)		1		1
Residence	Rural	10 (3.3)	81 (27.1)	0.08	1.98 (0.92_4.28)		
	Urban	40 (13.4)	168 (56.2)		1		
Diabetes mellitus	Yes	13 (4.3)	16 (5.4)	0.00	0.195 (0.09_0.44)		
	No	37 (12.4)	233 (77.9)		1		
History of UTI	Yes	31 (10.4)	19 (6.4)	0.00	0.09 (0.05_0.18)	0.003	6.42 (1.86_22.15) *
	No	32 (10.7)	217 (72.6)		1		1
History of catheterization	Yes	31 (10.4)	19 (6.4)	0.00	0.06 (0.03_0.13)		
	No	23 (7.7)	226 (75.6)		1		
Education of father	Illiterate	19 (3.0)	74 (24.7)	0.14	2.01 (0.79_5.14)		
	primary	17 (5.7)	74 (24.7)	0.88	1.07 (0.47_2.43)		
	High school	12 (4.0)	52 (17.4)	0.89	1.07 (0.47_2.58)		
	College and above	12 (4.0)	49 (16.4)		1		
Education of mother	Illiterate	18 (6.0)	109 (36.5)	0.48	0.69 (0.24_1.97)		
	Primary	11 (3.7)	54 (18.1)	0.311	0.56 (0.18_1.73)		
	High shcool	16 (5.4)	42 (14.0)	0.03	0.30 (0.10_0.89)		
	College and above	5 (1.7)	44 (14.7)		1		
Malnutrition	Yes	18(6)	32(10.7)	0.00	3.81(1.92_7.58)		
	No	32(10.7)	217(72.6)		1		

Table 5: Predictors of urinary tract infections among children who attend pediatric OPD of FHCSH, Northwest

Figures

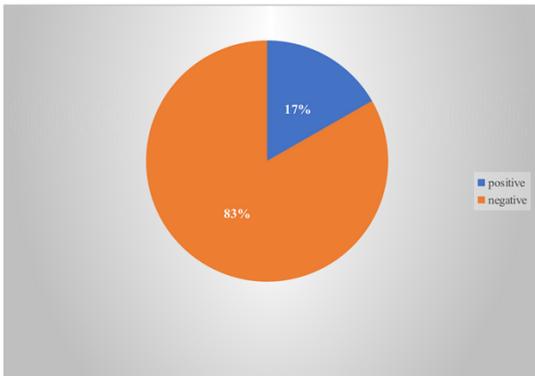


Figure 1
Culture positivity rate of study participants at FHCSH, Northwest Ethiopia, 2019. The highest percentage of participants (83%) were negative for urinary tract infection. About 17% of the study participants were positive for urinary tract infection

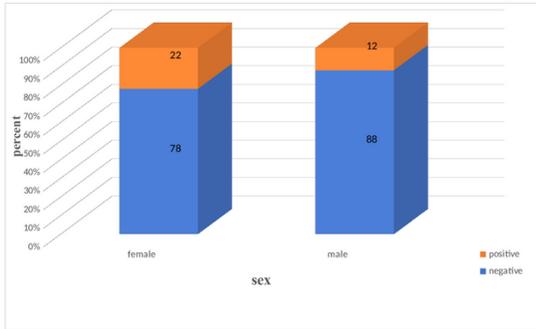


Figure 2

Distribution of culture positivity by sex among study participants at FHCSH, Northwest Ethiopia, 2019. Among female participants about 22% were positive for urinary tract infections. But, only 12% of positivity was observed among male participants.

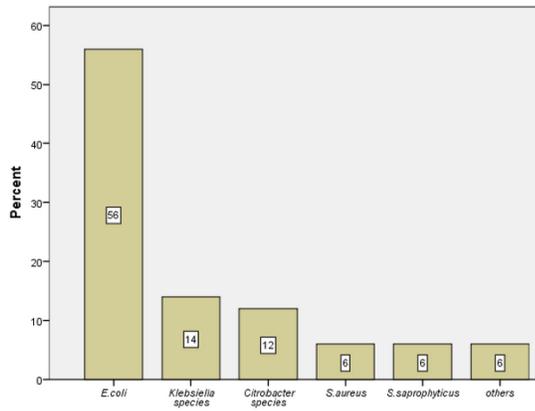


Figure 3

Bacterial profile of study participants at FHCSH, Northwest Ethiopia, 2019. About 56% of the total isolates were *E. coli* (the longest bar) whereas *S. aureus* and *S. saprophyticus* were among bacterial isolates with lowest isolation rate (6%) (the shortest bar).

Supplementary Files

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