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Epidemiological and bacteriological aspects of children suspected of having febrile urinary tract infections in Kisantu and Kimpese in the province of Kongo-Central in the Democratic Republic of the Congo

Buthiemuni, M. L.[1], Falay, S., D.[3], Tebandite, K., E.[3], Mbuangi, L. M.[4], Kilara, K. T.[2], & Alworong'a, O. J.[3]

[1]*Department of Pediatrics, Faculty of Medicine, President Joseph Kasa Vubu University, Boma, Democratic Republic of the Congo*
[2]*Department of Pharmacology, Faculty of Medicine, President Joseph Kasa Vubu University, Boma, Democratic Republic of the Congo*
[3]*Department of Pediatrics, Faculty of Medicine and Pharmacy, University of Kisangani, Kisangani, Democratic Republic of the Congo*
[4]*Faculty of Economics, President Joseph Kasa Vubu University, Boma, Democratic Republic of the Congo*

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Correspondence to:
Kilara Kapene Tarcisse
tarcissekilara7@gmail.com

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ABSTRACT

Introduction

Febrile urinary tract infections (FUTIs) are among the most common bacterial infections in children and represent a major cause of paediatric morbidity worldwide due to their clinical polymorphism, severity, and potential consequences on renal function.

Purpose

To evaluate the epidemiological characteristics of FUTIs in suspected children and to identify bacteria isolated from blood cultures performed in Kisantu and Kimpese in the Democratic Republic of Congo.

Methods

A descriptive, cross-sectional study was conducted using retrospective data collected between January 2018 and December 2022 in Kongo-Central Province, at Saint Luc Hospital (HSL) in Kisantu and the Evangelical Medical Institute (IME) in Kimpese. A convenience sample of 171 children who met the inclusion criteria was selected. Statistical analyses were performed using R version 4.4.2. Proportion comparisons were made using Pearson's chi-square test, with a 95% confidence interval and a significance level set at $p < 0.05$.

Results

Among the 171 children suspected of having a UTI, 161 (94.2%) were from HSL, of whom 39 (24.2%) had a positive blood culture, and 10 (5.8%) were from IME, of whom 2 (20%) were positive, giving an overall prevalence of 23.9%. The most represented age group was 0–23 months (31.0%), with girls accounting for 47.4% (95% CI: 39.9–54.9) and an overall sex ratio of 1.11. *Salmonella* sp. was the most frequently isolated bacterium (36.6%), with a slight male predominance, while *Escherichia coli* was significantly more frequent in girls (19.5%; $\chi^2 = 6.79$, $p = 0.009$). By age group, *Salmonella* sp. predominated in children aged 24–59 months, whereas *E. coli* predominated in the 120–204-month age group.

Conclusion

FUTI mainly affects very young children, with an overall balanced gender distribution. *Salmonella* sp. and *E. coli* are the most common bacterial pathogens, with variations according to age and gender. These findings provide essential local data to guide diagnostic and therapeutic decisions in paediatrics and highlight the need for further large-scale, longitudinal studies.

INTRODUCTION

Febrile urinary tract infections (FUTIs) are among the most common bacterial infections in children and represent a major cause of paediatric morbidity worldwide, often associated with upper urinary tract involvement such as pyelonephritis (Shaikh et al., 2016). Internationally, the annual incidence in children aged 0 to 17 years is estimated at approximately 1.3 episodes per 100 patient-years, with a predominance among girls and infants (Liang et al., 2024). Among children with fever, 2% to 20% of cases are attributable to urinary tract infection. Several meta-analyses report a prevalence of 10% to 15% in mixed series, with *Escherichia coli* as the predominant pathogen (Gidabayda et al., 2017; Suh, 2020).

In sub-Saharan Africa, urinary tract infection is also a common cause of fever in children, with a hospital prevalence between 10% and 30%. This high frequency is linked to diagnostic delays, hygiene conditions, and socioeconomic factors. The predominant agents are *E. coli*, *Klebsiella* spp., and *Proteus* spp., with an increasing proportion of strains resistant to commonly used antibiotics (Masika et al., 2017; Agegnehu et al., 2020).

In the Democratic Republic of Congo (DRC), available data come mainly from local hospital studies, reporting a prevalence of about 7.5% in children with fever. *E. coli* remains the main pathogen, followed by other enterobacteria, with a high proportion of extended-spectrum beta-lactamase (ESBL)-producing strains, which complicates empirical management (Irenge et al., 2014). Urinary tract infections cause high morbidity and substantial socioeconomic costs for families, particularly in low-resource settings (Akute et al., 2018; Shaikh et al., 2016). Diagnosis is guided by clinical findings but requires additional laboratory tests. Leukocyturia greater than 10^4 leukocytes/mL, associated with the isolation of a single organism at 10^4–10^5 bacteria/mL, is the accepted threshold (Subcommittee on Urinary Tract Infection, AAP, 2011). However, identification of the causative agent is not always possible, which limits targeted antibiotic therapy and increases the risk of antimicrobial resistance (Tullus & Shaikh, 2020). Blood cultures are recommended in UTIs to detect bacteraemia or co-infection, while rapid tests such as urine dipsticks remain useful for initial screening but require confirmation by urine culture and antibiotic susceptibility testing (Adeniji et al., 2019; Tullus & Shaikh, 2020).

In Kongo-Central Province, where two main blood culture collection sites operate, no specific paediatric studies have yet been conducted. Considering the spatial and temporal variability of microbial ecology and the scarcity of local data, this study is essential to assess the epidemiology of febrile urinary tract infections in suspected children and to identify bacteria isolated from blood cultures.

METHODS

Study Type, Study Period, and Setting

This descriptive, cross-sectional study was based on data collected retrospectively over a five-year period (January 2018 to December 2022). It was conducted in Kongo-Central Province, southwestern Democratic Republic of Congo, in two general referral hospitals: Saint Luc Hospital (HSL) in Kisantu and the Evangelical Medical Institute (IME) in Kimpese. Both institutions have actively participated in the bacteremia surveillance network for more than 15 years and maintain detailed microbiological databases.

Study Population and Sample

The study population consisted of all children aged 0 to 17 years who attended consultations at the two hospitals during the study period (N = 17,180). Only those with suspected febrile urinary tract infection (FUTI) were eligible. A non-probabilistic convenience sample of 171 children meeting the inclusion criteria was selected. This sampling approach—determined by the retrospective design and availability of complete microbiological records—may limit generalisability due to potential selection bias. Data reliability was enhanced through standardised extraction, cross-checking of information, and inclusion of only complete records. Records lacking essential data were excluded.

Inclusion Criteria

The study included:

- All children suspected of UTI who underwent a urine dipstick test and a blood culture.
- Records containing complete clinical and haematological information, including culture results.

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Exclusion Criteria

The following were excluded:

- Incomplete records (missing essential clinical information or culture results).
- Patients who had received empirical antibiotic treatment more than 48 hours before sampling, to limit false-negative cultures.

Data Collection Technique

The study comprised two complementary components. The retrospective component involved documentary analysis using the blood culture database of the National Institute for Biomedical Research (INRB) in Kinshasa to identify cases related to febrile UTIs. The second component involved analysing clinical records of children suspected of FUTI who had undergone blood culture testing. Data were collected from Saint Luc Hospital in Kisantu and the Evangelical Medical Institute in Kimpese to gather epidemiological, clinical, and biological information from the medical records of patients identified in the INRB database.

Statistical Analyses

All statistical analyses were performed using R software version 4.4.2. Descriptive analyses included frequencies, proportions, and means with standard deviations. Results were presented using tables and graphs. In bivariate analyses, proportions were compared using Pearson's chi-square test. Means for two independent samples were compared using Welch's *t*-test. A significance level of $p < .05$ and 95% confidence intervals were used throughout.

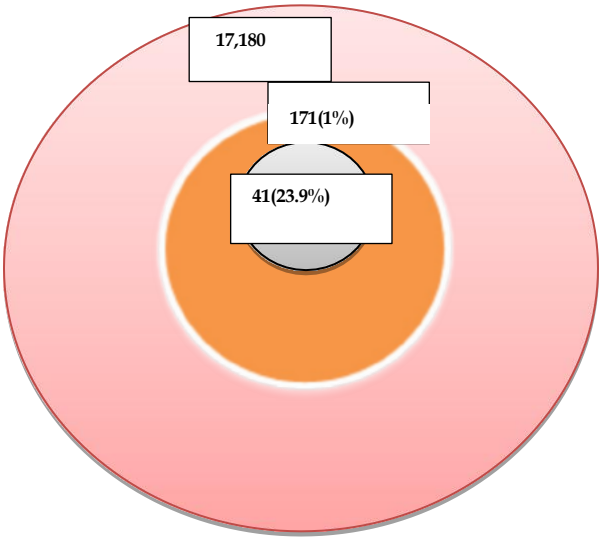
Ethical Considerations

The protocol was approved by the scientific committees of Saint Luc Hospital (Kisantu) and the Evangelical Medical Institute (Kimpese). In accordance with the revised Declaration of Helsinki (2013) and ethics committee recommendations, anonymity and confidentiality were strictly maintained. All data were anonymised both during extraction and within the INRB database. No identifying information was retained. Given the retrospective nature of the study, informed consent was not required.

RESULTS

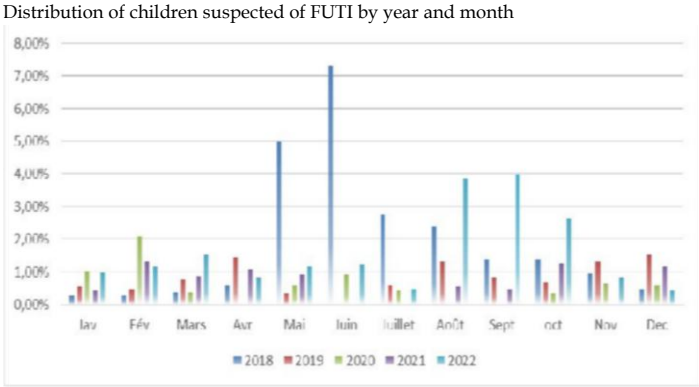
A total of 17,180 children were seen during the study period, of whom 171 (1%) had suspected febrile urinary tract infection (FUTI). Among these, 41 children had positive blood cultures, representing an overall prevalence of 23.9%. The majority of the children were from Saint Luc Hospital in Kisantu (161; 94.2%), of whom 39 (24.2%) had significant blood cultures. The remaining 10 children (5.8%) were from IME Kimpese, with 2 cases (20%) showing significant blood cultures.

Figure 1:
Distribution by frequency



A peak prevalence of **7.3%** was observed in **June 2018**.

Figure 2:
Distribution of children suspected of FUTI by year and month



The most represented age group among children suspected of FUTI was 0–23 months, totalling 53 children (31.0%). Among them, 27 were female (15.8%), representing an overall proportion of 47.4% girls (95% CI: 39.9%–54.9%). The sex ratio (M/F) was 1.11, indicating a slight male predominance. The mean age of the children was 73.6 ± 59.9 months (~6.1 ± 5 years), reflecting a wide age distribution.

Bivariate analysis using the chi-square test found no statistically significant difference in sex distribution across age groups ($\chi^2 = 3.28$; $p = 0.35$), indicating comparable distribution of males and females across age categories.

Table 1:
Distribution of children suspected of FUTI by age group and sex

Characteristics	Male (n = 90)	Female (n = 81)	Total (N = 171)
Age groups (months)			
0–23	26 (15.2%)	27 (15.8%)	53 (31.0%)
24–59	26 (15.2%)	14 (8.2%)	40 (23.4%)
60–119	15 (8.8%)	17 (9.9%)	32 (18.7%)
120–204	23 (13.5%)	23 (13.4%)	46 (26.9%)

The proportion of females among suspected FUTI cases was 47.4% (95% CI: 39.9–54.9), indicating a balanced sex distribution. The chi-square test assessing the association between sex and age categories showed no significant association ($\chi^2 = 3.28$; $p = 0.35$). The overall sex ratio (M/F = 1.11) indicated a slight male predominance, though without statistical significance. The mean age of 73.6 ± 59.9 months confirmed broad age variability in the study population.

Table 2:
Inferential statistics of demographic characteristics among children suspected of FUTI

Analyzed Parameter	Statistic	Value	95% CI	p-value	Interpretation
Proportion of females	–	47.4%	39.9–54.9	–	Balanced sex distribution
Distribution of sex across age categories	χ^2	3.28	–	0.35	Not significant (p > 0.05)
Overall sex ratio (M/F)	–	1.11	–	–	Slight male predominance
Mean age (months)	–	73.6 ± 59.9	–	–	Wide age dispersion

Among the 41 children with significant blood cultures, Salmonella sp was the most commonly isolated bacterium (15 cases; 36.6%, 95% CI: 21.8%–51.3%). Males were slightly predominant (8 cases; 19.5%), but the sex distribution difference was not statistically significant ($\chi^2 = 0.0$; $p = 1.0$), indicating an even distribution between boys and girls.

Table 3:
Distribution of isolated pathogens by sex

Pathogen	Male (n = 18)	Female (n = 23)	Total (N = 41)
Escherichia coli	2 (4.9%)	8 (19.5%)	10 (24.4%)
Klebsiella pneumoniae	3 (7.3%)	1 (2.4%)	4 (9.7%)
Salmonella sp	8 (19.5%)	7 (17.1%)	15 (36.6%)
Salmonella Typhi	2 (4.9%)	6 (14.6%)	8 (19.5%)
Staphylococcus aureus	3 (7.3%)	1 (2.4%)	4 (9.7%)

In assessing pathogen distribution according to demographic and epidemiological characteristics:

- *Salmonella sp* was the most common pathogen among boys (8 cases; 19.5%; 95% CI: 7.2–31.8), with no significant difference compared to girls.
- *Escherichia coli* was significantly more frequent in girls (8 cases; 19.5%; 95% CI: 7.2–31.8; $\chi^2 = 6.79$; $p = 0.009$).
- By age group, *Salmonella* sp predominated in children aged 24–59 months (8 cases; 19.5%; 95% CI: 8.2–34.8).
- *E. coli* was most frequently isolated in the 120–204-month age group (8 cases; 19.5%; 95% CI: 2.1–22.3; $\chi^2 = 4.33$; $p = 0.037$).
- A total of 15 children with *Salmonella* sp (36.5%; 95% CI: 21.9–51.0) were from Saint Luc Hospital in Kisantu.

Table 4:
Distribution of pathogens by epidemiological characteristics

Epidemiological aspects	N	*Escherichia coli*	*Klebsiella pneumoniae*	*Salmonella sp*	*Salmonella typhi*	*Staphylococcus aureus*
	41	n= 10[1]	n = 4[1]	n = 15[1]	n = 8[1]	n= 4[1]
Gender						
Male	18 (43.9%)	2 (4.9%)	3 (7.3%)	8 (19.5%)	2 (4.9%)	3 (7.3%)
Female	23 (56.1%)	8 (19.5%)	1 (2.4%)	7 (17.1%)	6 (14.6%)	1 (2.4%)

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Age (in months)						
0	10 (24.4%)	1 (2.4%)	2 (4.9%)	7 (17.1%)	0	0 (0.0%)
24 - 59	9 (22.0%)	0 (0.0%)	0 (0.0%)	8 (19.5%)	0 (0.0%)	1 (2.4%)
60 - 119	8 (19.5%)	1 (2.4%)	1 (2.4%)	0 (0.0%)	4 (9.8%)	2 (4.9%)
120 - 204	14 (34.1%)	8 (19.5%)	1 (2.4%)	0 (0.0%)	4 (9.8%)	1 (2.4%)
Origin						
HSLK	39 (95.1%)	8 (19.5%)	4 (9.8%)	15 (36.5%)	8 (19.5%)	4 (9.8%)
IME	2 (4.9%)	2 (4.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)

DISCUSSION

Febrile urinary tract infections (FUTIs) represent a significant public health concern in children because of their morbidity and the risk of renal complications. In the absence of sufficient local data, this study aimed to describe the epidemiological profile of suspected cases and to identify bacteria isolated from blood cultures. Comparing our findings with results from other settings highlights both shared patterns and local specificities.

The overall prevalence of positive blood cultures among children suspected of febrile UTI in our study was 23.9% (41/171), with 24.2% at the Saint-Luc Hospital of Kisantu and 20% at the IME of Kimpese. This proportion is markedly higher than recent reports, where bacteraemia associated with paediatric UTIs generally remains below 10% (Manuel et al., 2022; Cesca et al., 2022). These differences may be explained by patient selection criteria, the proportion of very young infants included, microbiological thresholds defining a significant blood culture, and laboratory technical conditions (Shaikh et al., 2016; Buonsenso et al., 2023).

Regarding demographic characteristics, the most represented age group was 0–23 months (31.0%). Overall, 47.4% of participants were female, giving a sex ratio (M/F) of 1.11, indicating a slight male predominance. The mean age was 73.6 months (≈6.1 years), with a standard deviation of 59.9 months, reflecting wide age variability. These findings align with previous studies. Lu (2022) reported that 60% of children with febrile UTI were under four years of age, with male predominance in infancy and female predominance in older children (Lu et al., 2022). Similarly, Renko (2022) noted an increasing prevalence among girls with age [Renko et al., 2022]. Masu (2025) observed that prevalence can vary widely (4–39.7%) depending on age and predisposing factors (Masu et al., 2025), while Suh (2020) reported no significant sex differences within specific age groups (Suh, 2020).

In this study, *Salmonella* spp. were the most frequently isolated bacteria among positive blood cultures (36.6%), followed by *Escherichia coli*. The high proportion of *Salmonella* contrasts sharply with the literature, where this pathogen accounts for less than 1% of paediatric UTIs (Rihane et al., 2025; Tunio et al., 2020). *E. coli*, usually the leading agent of paediatric UTIs, was also isolated in our cohort, consistent with international findings indicating that *E. coli* represents 50–80% of paediatric UTIs (Nooreddeen et al., 2020; Maringhini et al., 2024). No significant sex differences were observed for either pathogen, corroborating previous works that generally report balanced sex distributions except in certain age categories (Lu et al., 2022). These findings suggest that, although *E. coli* remains the predominant pathogen, *Salmonella* may represent a substantial proportion of bacteraemia in specific local contexts, potentially linked to gastrointestinal history or environmental exposure (Masu et al., 2025).

Potential Sources of Error

Several methodological limitations could affect the interpretation of these results. The retrospective design introduces potential selection bias, as only children who underwent blood cultures were included, which may overestimate pathogen prevalence (Irenge et al., 2014). Variations in laboratory procedures may have influenced bacterial detection. Prior antibiotic therapy, which was not systematically documented, could have contributed to false-negative cultures. Moreover, incomplete urine cytobacteriological data limited the ability to fully correlate findings with UTI diagnosis.

Clinical Implications

These findings carry important clinical implications. Clinicians should maintain a high index of suspicion for bacteraemia in young children presenting with febrile UTI, particularly in resource-limited settings. The high prevalence of *Salmonella* underscores the need to consider a broader spectrum of pathogens when selecting empirical antibiotic therapy. Early microbiological sampling, awareness of atypical pathogens, and adherence to antimicrobial stewardship principles are crucial to reducing complications and preventing antimicrobial resistance. Strengthening laboratory capacity and standardising diagnostic protocols are also essential to improving outcomes and surveillance accuracy.

Study Limitations

This study has several limitations. Some subgroups, particularly at the IME of Kimpese, were small, reducing statistical precision. Restricting the cohort to children who received blood cultures may have introduced selection bias. The absence of data on prior antibiotic use, medical history, and socio-environmental factors also limits interpretation. Additionally, the lack of complete urine cytobacteriological results prevented confirmation of UTI aetiology, and the largely monocentric design restricts generalisability.

CONCLUSION

Febrile urinary tract infections among children in Kongo-Central predominantly affect very young children and show an overall balanced sex distribution. *Salmonella* spp. and *Escherichia coli* were the most frequently isolated bacteria, with variations by age and sex. The observed prevalence of positive blood cultures (23.9%) is higher than commonly reported elsewhere, highlighting the influence of local epidemiological factors. These findings provide essential information to guide paediatric diagnostic and therapeutic strategies, emphasising early microbiological testing and context-adapted antibiotic therapy, particularly in view of the notable presence of *Salmonella*. Future studies involving larger, multicentre cohorts and longitudinal follow-up are needed to better characterise risk factors and pathogen dynamics and to inform regional policies on infection prevention and antimicrobial stewardship.

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Ethical Approval: The protocol was approved by the scientific committees of Saint Luc Hospital (Kisantu) and the Evangelical Medical Institute (Kimpese).

Conflicts of Interest: None declared.

ORCID iDs:

Buthiemuni, M. L.[1]: https://orcid.org/0009-0002-8918-8005
Falay, S., D.[3]: https://orcid.org/0000-0003-3352-9042
Tebandite, K., E.[3]: https://orcid.org/0000-0003-1274-2127
Mbuangi, L. M.[4]: https://orcid.org/0009-0005-9702-693X
Kilara, K. T.[2]: https://orcid.org/0009-0003-2110-3594
Alworong'a, O. J.[3]: https://orcid.org/0009-0000-1004-1250

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