

# The aetiology and prevalence of urinary tract infections in Sub-Saharan Africa: a Systematic Review

## Etiologia e prevalência de infecções do trato urinário na África Subsaariana: uma revisão sistemática

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### Abstract

**Objective:** This review determined and reports the prevalence of urinary tract infections and aetiological agents common in most sub-Saharan African countries. **Methods:** A literature search involved Springer, Hindawi, PubMed, Medcrave, Google Scholar, BioMed, and Elsevier databases to identify the urinary tract infection articles published between 2000 and 2021. **Results:** Of 111 articles obtained from databases, 22 met the qualities to be included in the study. Overall, the prevalence of UTI was 32.12% with *Escherichia coli* being the most commonly isolated bacteria accounting for 86.4%. *Escherichia coli* is found in the GIT thus, the proximity between the anus and urinary system makes the contamination easier. **Conclusion:** The findings of this study provide useful information for the effective intervention of urinary tract infections. Further, it is advised women wipe from front to back whenever they attend the call of nature and or during bathing.

**Keywords:** Urinary Tract Infections; Aetiology; Prevalence; Sub Saharan Africa.

### Resumo

**Objetivo:** Relatamos a prevalência de infecções do trato urinário e agentes etiológicos comuns na maioria dos países da África Subsaariana. **Metodos:** Uma pesquisa bibliográfica envolveu as bases de dados Springer, Hindawi, PubMed, Medcrave, Google Scholar, BioMed e Elsevier para identificar os artigos que abordavam infecção do trato urinário nos países da África Subsaariana, publicados entre 2000 e 2021. **Resultados:** Dos 111 artigos obtidos nas bases de dados, 22 atenderam aos critérios de inclusão e foram incluídos no estudo. No geral, a prevalência de UTI foi de 32,12%, sendo a *Escherichia coli* a bactéria mais comumente isolada, representando 86,4%. A *Escherichia coli* é encontrada no TGI, portanto, a proximidade entre o ânus e o sistema urinário facilita a contaminação. **Conclusão:** Os achados deste estudo fornecem informações úteis para a intervenção efetiva das infecções do trato urinário. Além disso, é aconselhável que as mulheres busquem fazer sua higiene íntima sempre da parte da frente para trás.

**Palavras-chave:** Infecções do Trato Urinário; Etiologia; Prevalência; África Subsaariana.

### INTRODUCTION

Urinary tract infections (UTIs) are the most common infectious diseases diagnosed around the globe, particularly in developing countries<sup>1</sup>. It is one of the most common microbial diseases encountered in medical practice. School children, students in higher learning institutions, and any of the population, especially females living in communal camps/institutions from developing and middle-income countries, monotonously hear of the disease whenever they visit health facilities. Worldwide, UTIs' prevalence is estimated at around 150 million people per year<sup>2</sup>. The disease spares no community provided dwells in risky areas. The infection occurs when micro-organisms usually Gram-negative bacteria such as *Klebsiella pneumoniae* and *Escherichia coli*, the two most common causative agents of UTI<sup>3</sup>, are transferred from the gastrointestinal tract (GIT) to the urethral opening and begin to multiply. Treatment of Gram-negative bacteria such as *E. coli* is challenged by antimicrobial

resistance to antibiotics. Also, *Staphylococcus aureus*, a Gram-positive round-shaped bacterium, usually a member of the microbiota of the body frequently found in the upper respiratory tract and on the skin, is rarely isolated as the pathogen of UTI<sup>4</sup>. Other bacterial isolates include *Staphylococcus saprophyticus*, *Proteus mirabilis*, and *Pseudomonas aeruginosa*<sup>5</sup>. *Klebsiella pneumoniae* and *Escherichia coli* are mainly from the external genitalia, vagina, genital tract, and GIT.

Factors for urinary tract infection vary with country and geographical location. Personal hygiene, prostate problems, compromised immunity, sex, diabetes, and use of spermicidal contraception are some of the factors for UTIs<sup>6,7</sup>. In the case of sex, women's genital urinary anatomy, particularly the short urethra with proximity to the perianal area, increases the chances of UTI than it is in men<sup>8</sup>.

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Also, the prevalence of UTIs in Africa varies from country to country and geographical location. For instance, in Ghana, the prevalence rate is 15.9%, in Senegal 4.5%, and 12.3% in Nigeria<sup>9</sup>. *Escherichia coli* is the most predominant isolated uropathogen in most studies with 46.4%<sup>10</sup>. Despite this fact and the increasing development of microbial drug-resistant genes, the overall prevalence and the most common aetiology of UTI across people of various age groups in sub-Saharan Africa is required to guide in diagnosis and, therefore, proper treatment. This systematic review was conducted to determine the overall prevalence and the most common aetiology of urinary tract infection across various age groups in sub-Saharan Africa for sustainable informed management of the condition.

### METHODS

This review was done by searching articles published between 2000 to 2021 in various databases including Springer, Hindawi, PubMed, Medcrave, Google Scholar, Elsevier, and BioMed Central (BMC). The key search terms were: "Urinary Tract Infection", "sub-

Saharan Africa countries (Fig. 2)", "Prevalence" or "aetiology", or "risk factors" and diagnosis. We excluded studies with abstracts only, UTI cases in studies other than sub-Saharan African countries, studies with incomplete data, and articles in languages other than English. Records on the authors, specific country, the population involved in the study, total participants of a particular study, study design, method of diagnosis, and the most prevalent etiological agent concerning the particular study were recorded (Table 1).

The methodological quality of selected prevalence studies was evaluated by using a quality assessment checklist adapted from The Joanna Briggs Institute Prevalence Critical Appraisal tool<sup>11</sup>. The risk of bias was assessed using eight domains: target population, study participants, sample size, study subjects and setting, mode of data analysis, objective and standard criteria used for measurement, reliability of condition, and statistical analysis. A descriptive analysis using Microsoft Excel 2013 was employed.

**Table 1:** The characteristics of studies included in the systematic review by country, design and population

No	Reference	Country	Design	Population	Sample size	Prevalence (%)	Diagnosis	Etiological Agents
1.	[12]	Nigeria	Cross-sectional study	Febrile children 0-5 years	165	13.95	Urinalysis, microscopy culture	<i>Staphylococcus aureus</i> 34.8%
2.	[13]	Ghana	Cross-sectional study	Patients aged from 1 day	422	22.5	Kirby-Bauer's disk diffusion method	<i>Escherichia coli</i> 37.89%
3.	[14]	Ethiopia	cross-sectional study	Pregnant women	100	15.0	Urine culture	<i>Escherichia coli</i> 39.2%
4.	[15]	Kenya	Cross-sectional study	Pregnant women	150	26.7	microscopy culture	<i>Escherichia coli</i> 40%
5.	[16]	Kenya	Cross-sectional study	pregnant women	1020	21.5	microscopy culture	<i>Escherichia coli</i> 38.8%
6.	[17]	Kenya	Cross-sectional study	Children 2-month -5 year	260	11.9	Dipstick tests, microscopy and culture	<i>Escherichia coli</i> 64.5%
7.	[18]	Uganda	Cross-sectional study	patients aged 8 months to 95years	267	32.2	Laboratory tests	<i>Escherichia coli</i> 41.9%
8.	[19]	Zambia	Cross-sectional study	pregnant women above 18 years	203	60.0	Urine culture	<i>Escherichia coli</i> 59%
9.	[20]	Zambia	Retrospective review of medical records	HIV infected pregnant women	380	16.5		<i>Escherichia coli</i>
10.	[21]	Tanzania	Cross-sectional study	Children below 5 years	382	16.8	urinalysis, urine culture	<i>Escherichia coli</i> 39.1%
11.	[22]	Ethiopia	Cross-sectional study	Diabetic patients	250	9.8	urine culture	<i>Escherichia coli</i> 63.6%

No	Reference	Country	Design	Population	Sample size	Prevalence (%)	Diagnosis	Etiological Agents
12.	[23]	Uganda	Cross- sectional study	Adults	139	39.13	urine culture	<i>Escherichia coli</i> 50%
13.	[24]	Tanzania	Cross- sectional study	Children 2 -60 months	370	39.7	urine culture	<i>Escherichia coli</i> 43.5%
14.	[25]	Tanzania	Cross- sectional study	pregnant women	247	14.6	midstream urine culture	<i>Escherichia coli</i> 42.7%
15.	[26]	Kenya	Cross- sectional study	Children	186	14.0	urine culture	<i>Escherichia coli</i> 50%
16.	[10]	Ghana	Cross- sectional study	In and out-patients	705	15.9	urine culture	<i>Escherichia coli</i>
17.	[1]	Ethiopia	Cross- sectional study	Out patients	384	90.1	urine culture	<i>Escherichia coli</i> 39.3%
18.	[27]	Ethiopia	Cross-sectional study	Pregnant women	400	35.0	urine culture	<i>Klebsiella pneumoniae</i> 37.4%
19.	[28]	Nigeria	Cross- sectional study	Pregnant women	300	61.0	urine culture	<i>Escherichia coli</i> 31.7%
20.	[29]	Nigeria	Cross- sectional study	Pregnant women	200	56.0	urine culture	<i>Escherichia coli</i> 26%
21.	[30]	South Africa	Cross- sectional study	women	712	67.6	urine culture	<i>Escherichia coli</i> 57.6%
22.	[31]	Senegal	Retrospective study	Hospitalized patients	1922	5.1	Standard microbiological procedure	<i>Klebsiella pneumoniae</i> 29.1%

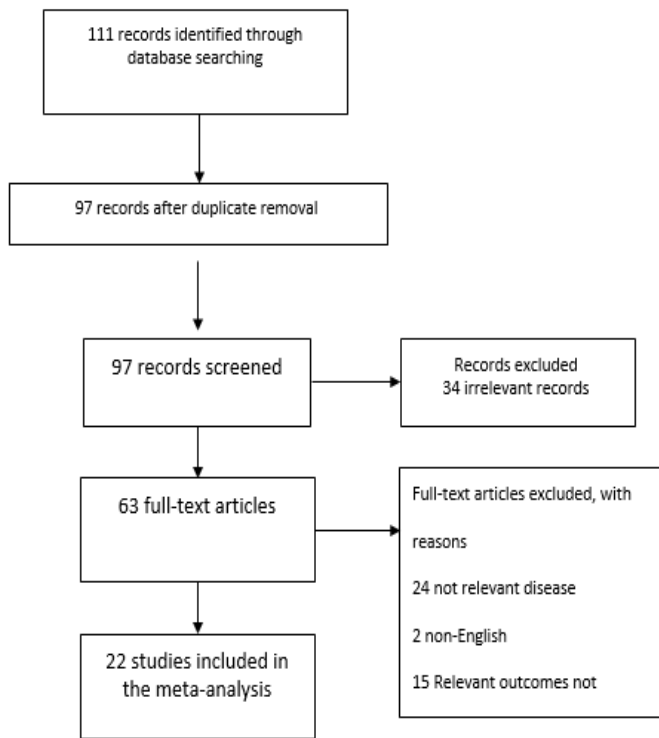
## RESULTS

A total of 111 records were retrieved. After screening, 22 studies were finally included in the review (Fig. 1). Out of 22 studies, two were retrospective cross-sectional, and 20 were prospective cross-sectional studies (Figure 1). Characterization of studies based on the region of study (country), design of the study, the population studied, reported prevalence, how the prevalence was obtained, and the reported aetiological agent of UTI are narrated (Table 1). The map showing the nine (9) sub-Saharan countries with published articles on urinary tract infections that qualified

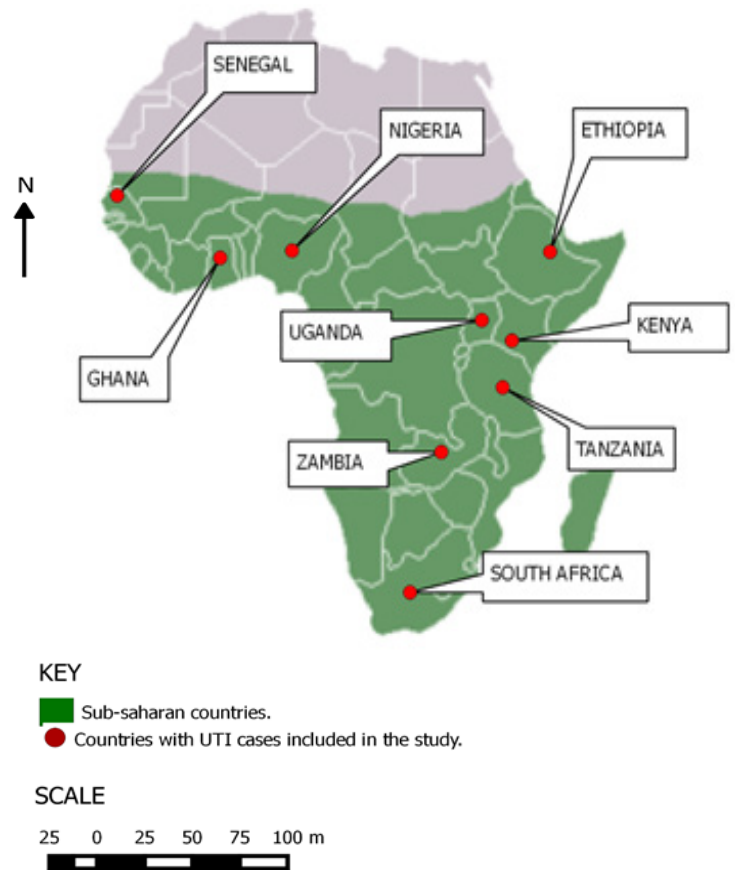
for this systematic review is presented in figure 2. Three species of microorganisms were revealed led by *Escherichia coli* which formed 86.36% of the causative agents of UTI, followed by *Klebsiella pneumoniae* (10.53%) and *Staphylococcus aureus* (5.26%) (Figure 3). On average, the overall prevalence of UTIs in the nine countries of sub-Saharan Africa was 32.12% with South Africa ranking high (67.6%); followed by Nigeria (43.65%); Zambia (38.25); Uganda (35.66%); Ethiopia (37.47%); Tanzania (23.7%); Ghana (19.2%); Kenya (18.53%); and Senegal (5.1%) (Figure 4).

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**Figure 1.** PRISMA flow chart illustrating literature selection and inclusion process.



**Figure 2.** Map showing Sub-Saharan countries with published articles on urinary tract infections included in the systematic review.



**Figure 3.** Aetiological agents identified in various studies

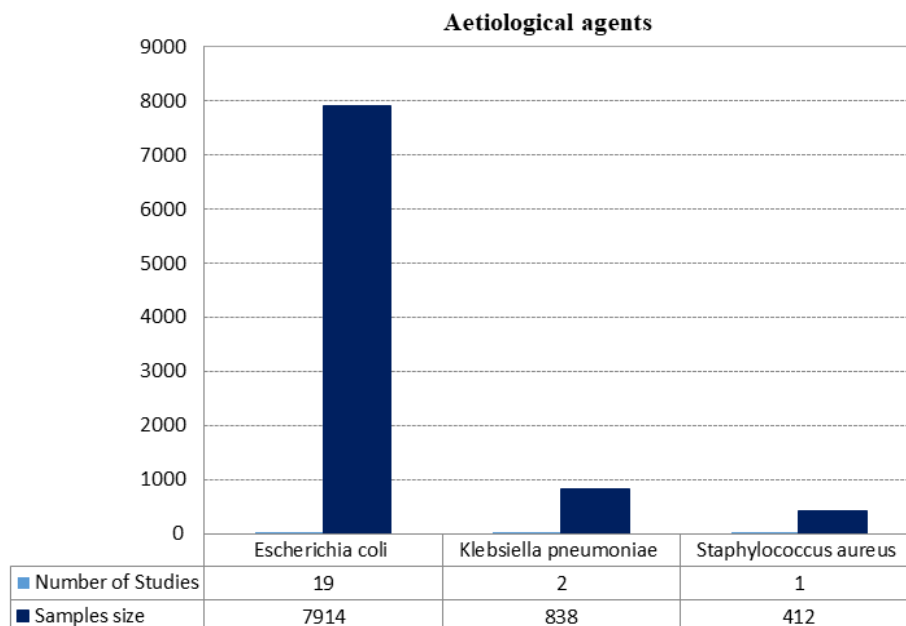
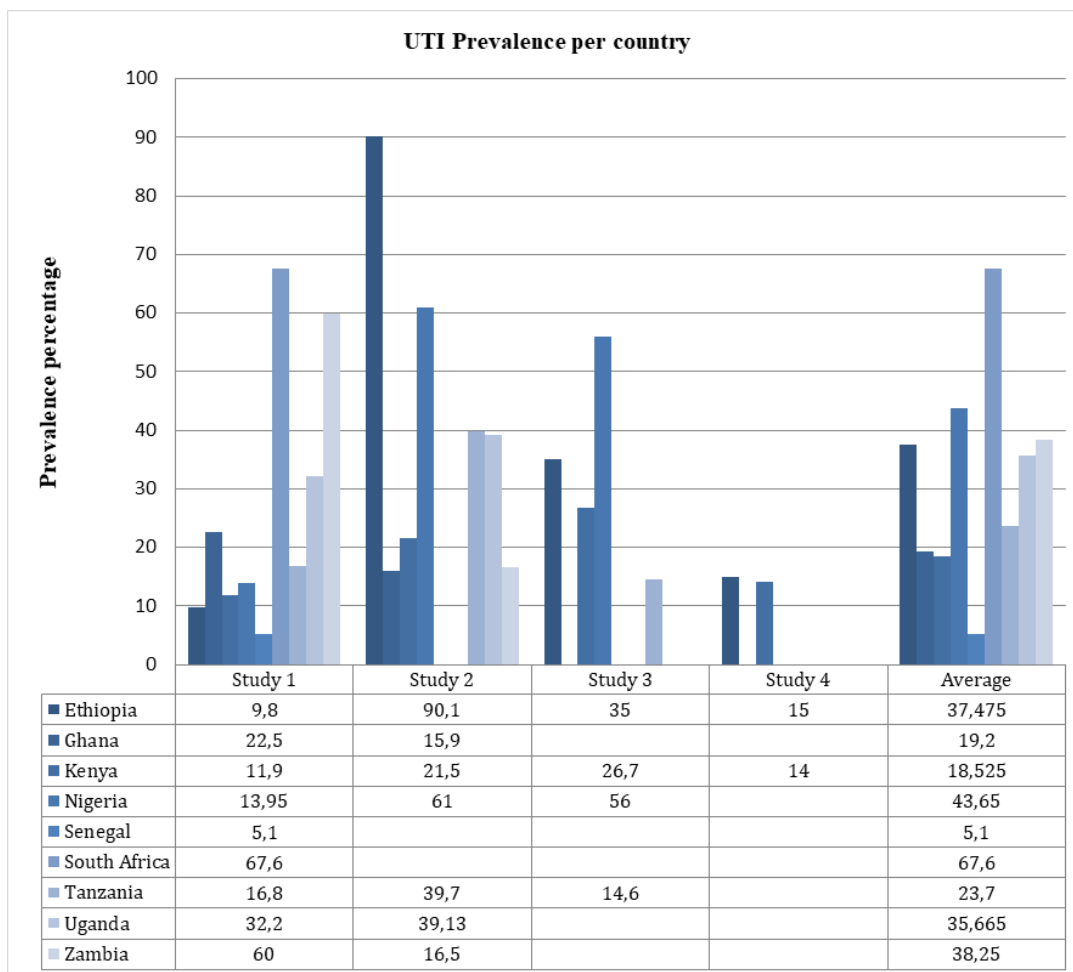


Figure 4. Prevalence of UTIs per country.



## DISCUSSION

This systematic review reports the overall prevalence and aetiological agents of UTIs in sub-Saharan countries. Our results included studies from nine countries with retrievable published research articles on UTIs out of the forty countries in the region. The overall prevalence of UTI in sub-Saharan Africa is 32.12%. The highest prevalence (67.6%) was recorded in South Africa, followed by Nigeria (43.65%) and Zambia (38.25%). The South African prevalence came from only one study that involved 712 women and the diagnosis was by urine culture. Also, in Senegal (5.1%), a retrospective study of 1922 hospitalized patients that *Klebsiella pneumoniae* was the leading cause of UTI.

UTIs are challenged by a diagnosis that is not always straightforward and necessitates blind and so, risking antimicrobial resistances. Most UTIs are diagnosed by performing a urinalysis. In this review, urine culture for bacteria accounted for about 59.1% of all studies reviewed (Table 1). The bacterial culture is necessary for the determination of the pathogen and, therefore, antimicrobial susceptibility testing<sup>32</sup>. Although bacteria, especially *E. coli*, remain the main causes of UTIs<sup>33</sup>, the presence of other disease-causing

organisms such as fungus (*Candida* species as opportunistic pathogens)<sup>34</sup>, immunocompetent opportunistic virus (e.g. BK virus, adenovirus, and cytomegalovirus)<sup>35</sup> and protozoans (*Balantoides coli*)<sup>36</sup> challenge diagnosis of UTIs and so, proper treatment.

*Escherichia coli* were the most predominant microorganism isolated and were more prevalent among the studies which involved female patients (pregnant women). This could be due to the proximity of the vagina to the anus and the short urethra and the likelihood of pregnant women visiting clinics. Of the 22 studies, *E. coli* accounted for about 86.4% as the most isolated pathogen in UTIs<sup>37</sup>. It was followed by *Klebsiella pneumoniae* (9.09%) and *Staphylococcus aureus* (4.54%). The presence of D-serine and fimbrial appendages on the surface of many *E. coli* strains necessitates virulence because the appendages enable them to attach to the uroepithelium cells and interfere with the normal wash out of bacteria<sup>38</sup>. The same characteristics allow for growth and tissue invasion resulting in invasive infection and pyelonephritis during pregnancy<sup>38</sup>.

*Klebsiella pneumoniae* and *Staphylococcus aureus* followed by far as causative agents for UTIs. According to Oana et. al.<sup>39</sup>, *K. pneumoniae* is the most relevant human pathogen within the genus *Klebsiella*. The pathogen is involved in many nosocomial infections, long-term care facilities, and communities' worldwide infections such as lung, urinary tract, abdominal cavity, surgical sites, and soft tissue infections, including bacteremia. Elsewhere, in a clinical review on urinary tract infections among community-dwelling older women, *E. coli* (51.4%) was the most predominant pathogen for UTIs, followed by *Klebsiella pneumoniae* (4.1%), *Proteus mirabilis* (3.3%), and *Enterococcus faecalis* (2.5%)<sup>40</sup>.

## CONCLUSION

*Escherichia coli* is the most predominant cause of UTI in sub-Saharan Africa. It is more exacerbated by the proximity between the anus and vaginal regions and the commensal

nature of infecting organisms around those regions. However, the reported prevalence of UTIs under this review might not represent the population of the countries where retrievable papers formed this study. All the twenty-two (22) studies were from special groups example "pregnant women", "hospitalized patients", "women", "febrile children 0-5 years", "patients aged from 1 day", "children 2-month -5 year", "patients aged 8 months to 95years", "HIV infected pregnant women", "Diabetic patients", "In and out-patients".

The transmission dynamics of UTIs go in hand with unhygienic conditions. Since UTIs are associated with gastrointestinal bacterial infection and women are mostly affected, we advise women to wipe from front to back after attending the call of nature and during bathing. Proper knowledge of aetiological agents and proper diagnosis shall help clinicians to a specific regime of treatments to avoid the ever-continuing development of antimicrobial resistance.

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