

Prevalence and Contributing Factors of Urinary Tract Infection in Human Immunodeficiency Virus Patients: A Systematic Review

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ABSTRACT

Aims and background: This study aims to understand the effect of human immunodeficiency virus (HIV) incidence with cluster of differentiation 8 (CD8) T cell maturity accompanied by urinary tract infection (UTI).

Methods: This study is a systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) method; this method is carried out systematically by following the correct stages or research protocols. The sources were taken from the PubMed and Google Scholar sites with the requirements of journals published in 2017–2022, and then screening was carried out, obtaining the results of 20,486.

Results: The result of this study is—journal clustering was carried out, and the number of journals indexed by Scopus Q1 and Q2 was two, while it was indexed by Science and Technology Index (SINTA) National Index S1. This study found a significant association between HIV infection and an increased risk of UTI.

Conclusion: The majority of journals discuss the age-related effects of HIV on CD8 T cell maturity with UTI in commercial sex workers.

Keywords: Cluster of differentiation 4, Human immunodeficiency virus, Prevalence, Urinary tract infection.

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INTRODUCTION

Human immunodeficiency virus (HIV) is a kind of virus attacking the body's immune system, which makes the body vulnerable to various illnesses such as tuberculosis (TB), toxoplasmosis, other (syphilis, varicella-zoster, parvovirus B19), rubella, cytomegalovirus, and herpes simplex virus (TORCH), and others. Acquired immune deficiency syndrome (AIDS) is a term used to describe the loss of cell-mediated immunity that occurs during the last stage of HIV infection. AIDS is a retrovirus disease caused by HIV characterized by a decrease in immune system, especially attacks T lymphocytes, and a decrease in the number of cluster of differentiation 4 (CD4), which is responsible for preventing infection. CD4 decreases to <200 cells per μL of blood or 1% of all lymphocytes regardless of clinical status. A normal CD4 count of 1–4 is 400–1,200 cells per μL of blood. Urinary tract infection (UTI) is the existence of a certain number of pathogenic microorganisms.

Certain groups of individuals have a higher chance of developing UTIs. The vulnerable community is women, particularly amid pregnancy, breastfeeding mothers, and elderly patients. Certain conditions that will increase vulnerability to urinary tract contaminations are spinal cord injury, urinary catheter insertion errors, diabetes, multiple sclerosis, immunodeficiency, and underlying urologic disorders. HIV patients are also susceptible to urinary tract contaminations. The frequency of UTI in HIV population, which is associated with contamination and decreased immune function, is based on the CD4⁺ lymphocyte cell. Based on observational studies, the frequency of bacterial contaminations in HIV-infected patients, counting urinary tract diseases, is contrarily connected to CD4⁺ lymphocyte counts.

Urinary tract infection (UTI) is an infection characterized by the bacteria development proliferation within urinary tract, including

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infection in the kidney parenchyma to the bladder with a significant quantity of bacteriuria.¹ Bacterial growth of >100,000 colony units per mL of fresh morning midstream urine is used as a diagnostic limitation for UTI.²

The most common causes of UTIs are gram-negative bacteria, including bacteria that normally inhabit the intestines and will ascend to the urinary system, including *Escherichia coli*, *Proteus* spp., *Klebsiella*, and *Enterobacter*.³ Besides the various microbial causes of UTIs, there are numerous risk factors that lead to an increase in the rate of UTIs. The most commonly identified risk factors are previous antibiotic use and the use of catheterization.⁴

Risk factors for UTI in previous antibiotic use were due to resistance to various antibiotic drugs (sulfamethoxazole–trimethoprim) and

Table 1: Journal analysis

No.	Journal title and author	Population/sample	Result	Journal indices
1	Factors associated with UTIs among HIV-1-infected patients ⁸	The clinic database collects all medical information on patients who routinely attended from 1994 to 2015	608 patients had urine culture, 176 (28.9%) were female and 432 (71.1%) were male. 71.1% were male, 378 (62.2%) were enrolled in treatment before/in 2007, and 258 (42.4%) were infected through homosexual intercourse. Baseline CD4 ⁺ lymphocyte was 385 (IQR: 204–565) cells/ μ L and median nadir CD4 ⁺ lymphocyte was 197 (86–306) cells/ μ L	Q2
2	Magnitude and associated factors of UTIs among adults living with HIV in Ethiopia. Systematic review and meta-analysis ⁹	To find relevant studies, researchers browsed through Web of Science, Science Direct, PubMed, Excerpta Medica Database, Cochrane Library, Google Scholar, and World Science	In Ethiopia, one in every eight HIV-positive people is at risk of getting a UTI. Despite that, this research explored the relation between gender, residence, CD4 count, history of catheterization, and DM and UTI; however, none was found. To avoid this phenomenon, every HIV patient should undergo UTI screening in every follow-up	Q1
3	Prevalence of UTI in HIV patients on antiretroviral drugs in Jos Metropolis, Nigeria ¹⁰	225 midstream urine samples were obtained from HIV patients	Out of 225 HIV patients tested, 13 (5.8%) were positive for UTI with males had five (4.8%) while females had eight (6.6%). The study showed the presence of UTI in every age-group except the \geq 46 years age-group. The low prevalence of UTIs recorded in this study is an indication of the efficacy of prophylaxis given to HIV patients to prevent opportunistic infections	Q1
4	Bacterial-associated UTI, risk factors, and drug susceptibility profile among adult people living with HIV at Haswassa University Comprehensive Specialized Hospital, Hawassa, Southern Ethiopia ¹¹	224 HIV-positive people attending Hawassa University Comprehensive Specialized Hospital (HUCSH)	From 224 participants, 23 (10.3%) [95% confidence interval (CI) 6.7–14.7] had UTI confirmed by culture. The distribution of bacteria as follows— <i>Escherichia coli</i> 16 (69.6%), <i>Staphylococcus aureus</i> two (8.7%), <i>Klebsiella pneumoniae</i> two (8.7%), <i>Enterobacter aerogenes</i> two (8.7%) and <i>Pseudomonas</i> spp. one (4.3%). The prevalence of UTI was also high among participants with a previous history of UTI and CD4 ⁺ counts <200/mm ³ . Female participants were about five times more likely to experience UTI [adjusted odds ratio (AOR) 5.3, 95% CI 1.5–19.2]. Ninety-three percent of bacteria isolated were susceptible to nitrofurantoin, ceftriaxone, and gentamicin; 87.5% were susceptible to meropenem and norfloxacin; while 93.8, 68.8, and 62.5% of isolates were resistant to ampicillin, tetracycline, and cotrim, respectively. Multidrug resistance (MDR) was seen in 18 (78.3%) bacterial isolates	Q1
5	Prevalence and antibiotic susceptibility pattern of bacteriuria among HIV-seropositive patients attending the Bamenda Regional Hospital, Cameroon ¹²	Midstream urine samples were collected from 135 HIV-seropositive patients	The prevalence of bacteriuria was 67.4% (91/135). <i>Staphylococcus aureus</i> was the most dominant isolate (42.9%), followed by <i>Escherichia coli</i> (24.2%), then coagulase-negative <i>Staphylococci</i> (10.9%). The highest proportion of bacteria was isolated from patients who had a CD4 ⁺ T-cell are <300 cells/mm ³ (39.6%). There was an association between CD4 ⁺ cell count and urinary tract bacterial infection ($p = 0.001$). The most sensitive drugs were gentamicin, vancomycin, and amoxicillin–clavulanic acid while the drug with the greatest resistance was sulfamethoxazole–trimethoprim, with <i>Enterococcus</i> and <i>Proteus</i> indicating 100% resistance to this drug	Q1
6	Bacteria UTI in HIV-infected children and adolescents in Abuja, Nigeria: a cross-sectional study ¹³	Among HIV-infected children and adolescents from 2 months to 18 years of age at follow-up visits at the Pediatric Outpatient Specialty Care Clinic (POSTC) of the University of Abuja Teaching Hospital (UATH)	Among the 166 HIV-infected children and adolescents studied, 106 (63.9%) were male, 82 (49.4%) were 5–10 years age-group, and 110 (66.3%) from low socioeconomic class. Significant bacteria (UTI) were isolated in 54 (32.5%) subjects, with 38 (70.4%) women, and 51 (94.4%) taking first-line antiretroviral therapy. The isolates were <i>Escherichia coli</i> 20 (37.0%), <i>Klebsiella pneumoniae</i> 16 (29.6%), <i>Staphylococcus aureus</i> eight (14.8%), <i>Pseudomonas aeruginosa</i> six (11.1%), and <i>Proteus mirabilis</i> four (7.4%). Leukocyturia in 19 (35.2%), nitrituria in 10 (18.5%), and hematuria in 15 (27.8%) subjects with significant. The isolates were sensitive to ofloxacin (81.5%), nalidixic acid (74.1%) and cefuroxime (61.1%), while the isolates were resistant to cotrimoxazole (100%), ampicillin (98.1%) and piperacillin (94.4%). Significant differences were observed in the average CD4 and viral load of subjects with significant bacteriuria compared to those with none; 838.6 \pm 177.8 vs 1009.9 \pm 234.7 cells/ μ L ($p = 0.02$), and 10, 360.5 \pm 471.0 vs 5,840.8 \pm 563.8 copies/mL ($p = 0.003$) for CD4 and viral load, respectively	Q2

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No.	Journal title and author names	Population/sample	Result	Journal indices
7	Prevalence, antimicrobial susceptibility pattern of bacterial isolates, and associated factors of UTIs among HIV-positive patients at Hiwot Fana Specialized University Hospital, Eastern Ethiopia ¹⁴	350 randomly selected HIV-positive patients at Hiwot Fana Specialized University Hospital from February to March 2016	The overall prevalence of UTIs was 18% (95% CI: 15.34–22.63). Individuals between 35 and 44 years old (AOR: 4.07; 95% CI: 1.09, 5.10), income <46.7 United States dollar (USD) (AOR: 2.76; 95% CI: 1.15, 6.07), and CD4 ⁺ <200 cells/mm ³ (AOR: 2.07; 95% CI: 1.15, 3.73) had higher odds of UTIs. <i>Escherichia coli</i> (38.1%), <i>Klebsiella pneumoniae</i> (23.8%), and <i>Staphylococcus aureus</i> (11.1%) are the main causes of UTIs. <i>E. coli</i> was resistant to ampicillin (95.8%), ceftazidime (95.8%), cotrimoxazole (95.8%), amoxicillin (91.7%), ceftriaxone (87.5%), and tetracycline (87.2%). MDR was observed in 46% of the isolates. The prevalence of UTIs in this study was high compared to previous reports in Ethiopia. People around 35–44 years old, having an income <46.7 USD, and a CD4 ⁺ < 200 cells/mm ³ increase the possibility of UTIs. The most common isolates were <i>E. coli</i> , <i>K. pneumoniae</i> , and <i>S. aureus</i> . Almost half of the isolates are multidrug-resistant. The measures to help reduce the further spread of resistance are urgently needed in the study area	Q2
8	Prevalence of multidrug resistant UTI among people living with HIV in Northern Tanzania ¹⁵	This cross-sectional study was conducted from July to September 2020 at Kilimanjaro Christian Medical Center (KCMC) hospital	One in eight people living with HIV (PLHIV) who attend the Care and Treatment Center (CTC) at KCMC referral hospital in northern zone of Tanzania has bacterial urinary tract infection (BUTI). Nitrite in urine was an important biomarker associated with BUTI. About two-thirds of the isolates were gram-positive bacteria, and almost half of all isolates showed MDR to commonly used antibiotics	Q2
9	UTIs among HIV-positive pregnant women in Mwanza City, Tanzania, are high and predicted by low CD4 ⁺ count ¹⁶	Between March and May 2016, midstream urine samples from 234 women attending prevention of mother-to-child transmission of HIV (PMTCT) clinics were analyzed using standard methods	The prevalence of UTI was 21.4%, 50/234 (95% CI: 16.1–26.6). Significant asymptomatic bacteriuria was higher than significant symptomatic bacteriuria (16.6 vs 4.7%, $p < 0.001$). On multivariable logistic regression analysis, single marital status (OR: 2.6, 95% CI: 1.1–6.1, and $p = 0.026$), low CD4 ⁺	Q2
10	UTIs among HIV-positive pregnant women in Mwanza City, Tanzania, are high and predicted by low CD4 ⁺ count ¹⁶	Between March and May 2016, midstream urine sample of 234 women who attended prevention of mother-to-child transmission (PMTCT) program	Most HIV-positive pregnant women in Mwanza have significant bacteriuria which introducing routine UTI screening at prevention of mother-to-child transmission (PMTCT) clinics to guide specific treatment and prevent-related complications	Q2
11	Use of tricortical iliac crest strut autograft in comminuted posterior wall acetabular fractures: a case series ¹⁷	There are six patients with highly comminuted posterior wall acetabular fractures in which the fragment was excised and the gap filled with a tricortical anterior iliac crest strut autograft, fixed with screws and plates	Good results were achieved in four of the six patients clinically analyzed using Merled'Aubigné score modified by Matta and radiologically by Matta scoring. These patients have returned to original work and walking independently. A good outcome in a patient deteriorates from good to poor for 1 or 2 years. One patient developed an infection and underwent excisional arthroplasty. The grafts attached well in five out of six patients	S1
12	Nerve injury with acetabulum fractures—incidence and factors affecting recovery ¹⁸	975 skeletons of adult patients with acetabulum fracture	Dislocation fractures of the posterior acetabulum are associated with traumatic nerve injury, although 25% of nerve injuries are iatrogenic. Nerve injury is more common among obese patients More than a quarter of patients have no record of nerve recovery	S1
13	Isolation and antibiotic susceptibility pattern of bacterial uropathogens and associated factors among adult people living with HIV/AIDS attending the HIV Center at Wolaita Sodo University Teaching Referral Hospital, South Ethiopia ¹⁹	A cross-sectional study was conducted from May to December 2018 on adults with HIV/AIDS at Wolaita Sodo University Teaching and Referral Hospital	Overall prevalence of UTIs was 29 (14.1%). The dominant bacteria isolated was <i>E. coli</i> was 13 (44.8%) followed by <i>S. aureus</i> five (17.2%). Gender, CD4 count, history of catheter insertion, history of hospitalization, and DM status were independent factors for the occurrence of UTI. <i>E. coli</i> species were 100% and 84.6% susceptible to ciprofloxacin and norfloxacin, respectively; whereas, there was complete resistance to amoxicillin–clavulanic acid and ampicillin. <i>K. pneumoniae</i> was resistant to gentamicin, amikacin and ampicillin, while it was 100% sensitive to nitrofurantoin. The MDR rate was 23(79.3%) with the majority, 16 (69.6%), gram-negative and seven (30.4%) gram-positive Conclusions—the burden of UTI among people living with HIV is high. The findings of this study will help policy makers and other stakeholders as basic information	Q2

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in use of catheterization. The gram-negative bacterial organism "*Pseudomonas aeruginosa*" is the most common pathogen responsible for the development of UTIs among catheterized patients acquired from long-term catheter insertion. It can also be caused by catheter hygiene, bladder dysfunction in elderly, and catheter insertion that is not compatible with standard operating procedures.⁵

According to Brouwer,⁶ most commercial sex workers experience anxiety regarding contracting sexually transmitted infections. This is due to limited understanding and knowledge of sexually transmitted diseases, such as HIV/AIDS, and how to prevent these infectious diseases.

The contraceptives often taken by commercial sex workers are hormonal contraceptives in the form of mini pills. In the research by McLean et al. from the National Center for Post-traumatic Syndrome Disorder (PTSD), commercial sex workers can experience mental disorders, such as mood disorders, anxiety disorders, or post-traumatic disorders. Moreover, a person can suffer from mental illness due to three factors—work environment, social support, and violence or harassment.⁷

Therefore, based on this background, the aim of this study is to analyze the impact of the incidence of HIV that develops CD8 T cells followed by UTI in commercial sex workers. Furthermore, a systematic review and meta-analysis were conducted to comprehensively evaluate the predictive role of mini pill and HIV in the prognosis of UTI.

METHODS

This research is a systematic review using the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) method. This method is performed systematically following the correct phases or research methods. Systematic review is a review method that employs the process of reviewing, evaluating, classification, and categorizing data based on previously established evidence. The steps required in conducting a systematic review are very well-organized and structured, thus, this method is very different from other methods that convey literature studies. Procedure of systematic—there are several steps involved in this review—(1) research background and objectives, (2) research question, (3) literature review, (4) selection of criteria, (5) practical screening, (6) quality checklist and procedures, (6) data extraction, and (7) data synthesis.

DATA COLLECTION METHODS

The data used for the literature search was selected based on some criteria that involved medical and social health research, additionally, by scrutinizing the literature regarding prevalence of HIV and UTIs in the journal publication period from 2017 to 2022 with variables in research articles, followed by HIV and UTI. The independent variables in the research articles are commercial sex workers and Scopus 1, 2, and Science and Technology Index (SINTA) 1, 2 indexed articles. Searching the publications on PubMed and Google Scholar with the keywords, the incidence of HIV and UTI.

Summarizing in a Literature Summary Table

To determine if the article met the author's inclusion standard in the literature review, we examined the title and abstract when choosing a journal.

Analysis and Synthesis

Analysis is the process of breaking down a subject into its individual parts and studying the parts and the relationships between them

in order to properly understand and comprehension of the whole meaning. Meanwhile, synthesis is a blend (mixture) of numerous notions or things to form a harmonious unity. The method used in synthesizing this research is narrative; this method classifies the data that has been extracted and analyzes the content of the research objectives and results. The analysis used is journal content analysis.

RESULTS

This article presents results from four journals on the various impacts of the incidence of HIV experiencing CD8 T cell maturity with UTI in commercial sex workers. The journals were analyzed and extracted into a table to simplify the explanation of the journal contents (Table 1).

Data information regarding the incidence of HIV and UTI is displayed as a table of independent variables containing the journal title, publication year, author's purpose, sample and criteria, research tools, data source or research methods, and research results.

DISCUSSION

Influence of the Incidence of HIV for the Patients Who Suffer from UTI

Poor countries still continue to grapple with public health issues related to UTIs. HIV infection is a significant source of illness, contributing to the spread of the epidemic. This systemic review and meta-analysis included seven studies with 2,257 research participants.

The findings of this study are lower than the studies conducted in Cameroon (67.4%), 27.7% in Nigeria, and other studies in Nigeria with rates of 25.3 and 40.5%. This is because in the previous study, about 50% of study participants had <200 CD4 counts, whereas in our study, only 20%. This suggests that the immune status in this study, compared to previous studies, participants were relatively unharmed. Study participants with good immune system were less likely to develop UTIs than those with weakened immune system. As a result, the magnitude of UTIs in our study was less than previous ones.

In Ethiopia, one in eight people living with HIV may develop a UTI. Apart from that, we searched for an association with gender, home state, CD4 count, past catheterization, and diabetes mellitus (DM) and UTI, but none were detected. To avoid this phenomenon, every patient with HIV in each subsequent visit should include an examination for UTI.

The research in this study shows that women are more prone to UTIs than men, which is in line with previous research conducted by Chidiebere Okechukwu.²⁰ The lower prevalence of UTIs observed in this study demonstrates the effectiveness of prophylactic treatment in HIV patients to prevent opportunistic infections.

Research on the effect of HIV-developing UTIs in people with HIV is consistent with previous studies. This is in line with research by Getu et al.²¹ that found a higher prevalence of urinary bacteria among patients of HIV. Another study by Haile Hantalo et al.¹⁹ also indicated a higher prevalence of UTIs among people living with HIV/AIDS. These findings support the notion that HIV infection increases the risk of UTIs.

Moreover, this research identified specific factors associated with UTIs in people with HIV, such as marital status and contraceptive use. This enhances the existing literature by

highlighting the importance of these factors in the occurrence of UTIs in people with HIV.

Relationship between the Incidence of HIV and UTI

The first stage, which involves the detection of viral ribonucleic acid (RNA) until specific antibodies are formed, is primary HIV infection, and it takes 3–4 weeks for these antibodies to form. HIV is transmitted through the local transmission of sexual transmission and replicates in the vaginal and rectum mucous membranes; this stage is the initial stage before detecting viral RNA in plasma.^{22–27}

During this initial infection, granulocytes, macrophages, and lymphocytes participate in the activation of innate immunity, and these become the next targets of the virus. Viruses or virus-infected cells will then travel to the lymphoid tissue, where CD4 T lymphocytes then become the next target of infection.^{22–27}

Human immunodeficiency virus (HIV) enters the body and binds to dendritic cells, and transport the virus to CD4 T lymphocyte cells (as antigen-presenting cell) present in the lymphoid tissue. Then, the virus replicates until viremia occurs and spreads widely through the lymphoid tissue throughout the body.^{22–27} Although it provides protection against infection, the immune response causes persistent and chronic infections. Cytokine production and cell division direct the immune response to provide protection but also allow the virus to replicate.

Several factors lead to UTIs, mostly caused by bacteria, viruses, and fungi, and some studies suggest that HIV complications also cause UTIs. Bacteria are often the cause. The most common causes of UTIs are gram-negative bacteria, including bacteria that normally inhabit the intestines and will ascend to the urinary system, including *Escherichia coli*, *Proteus* spp., *Klebsiella*, and *Enterobacter*.³

CONCLUSION

After a certain process referring to Scopus and SINTA-indexed journals regarding systematic review, a systematic study is conducted to determine the effect of the incidence of HIV suffering from UTI with sciatic nerve pain using mini pills as emergency contraception followed by PTSD, it can be concluded that the majority of journals rely on the mentioned variables to discuss the impact of age and gender on HIV onset characteristics.

From the subchapters obtained, it can be concluded that the impact of the incidence of HIV suffering from UTI to hip dislocation with sciatic nerve pain using mini pills as emergency contraception accompanied by PTSD is determined based on gender, residency, CD4, history of catheterization, and DM and UTI.

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