



**Prevalence and Factors Associated with Renal Impairment Among
Adult HIV Infected Patients who Have Follow Up in St. Paul's and
St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia**

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**This thesis Submitted to Department of Internal Medicine in Partial
Fulfillment of the Requirement of Degree in Internal Medicine
Specialty**

January 2024, Addis Ababa, Ethiopia

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Hospital ART Clinics, Addis Ababa, Ethiopia,2024.**

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January 2024, Addis Ababa, Ethiopia

Acknowledgments

First of all, I would like to thank SPHMMC department of internal medicine in accepting my research topic and giving me this great opportunity to practice this clinical research. My deepest gratitude goes to my advisors Dr.Tsegaye(internist and nephrologist) and Ms.Yodit (MPH) who guided me throughout this work starting proposal development.

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Abbreviations/Acronyms

AIDS-Acquired Immune Deficiency Virus

AKI-Acute Kidney Injury

ARC-Annualized Rate of Change

ART-Anti Retroviral Therapy

BMI-Body Mass Index

CKD-Chronic Kidney Disease

eGFR-Estimated Glomerular Filtration Rate

ESRD-End Stage Renal Disease

FSGS-Focal Segmental Glomerular Sclerosis

HAART – Highly Active Anti-Retroviral Therapy

HCV-Hepatitis C Virus

HIVAN-HIV Associated Nephropathy

HIVICK-HIV Associated Immune Complex Kidney Disease

HIV-Human Immune Deficiency Virus

PI-Protease Inhibitors

PLHIV-People Living With HIV

Scr-Serum Creatinine

SSA-Sub Saharan Africa

SPHMM C-Saint Paul's millennium medical college.

TDF-Tenofovir Diproxil Fumerate

VL-Viral Load

WHO-World Health Organization

HBV-Hepatitis B virus

CKD-EPI-Chronic kidney disease epidemiology collaboration

CG-Cockcroft-Gault

NICMS-Non-infectious comorbidity

MDRD-Modification of diet in renal disease

APOL-1-Apolipoprotein-1

OI-Opportunistic infection

UTI-Urinary tract infection

RI-Renal impairment

Abstract

Background: It is almost four decades since Human Immune deficiency Virus (HIV) has become global issue of public health importance; a lot has changed about the disease since then. The occurrence of renal impairment in HIV infected individuals shown to be associated with both increased morbidity and mortality of the infected individuals. Due to which, finding the common causes of renal impairment in HIV infected individuals has paramount importance.

Objective: To assess the prevalence of renal impairment and its associated factors among adult HIV infected patients in St. Paul's and St. Peter Specialized Hospitals, Addis Ababa, Ethiopia, 2023.

Methods: A cross-sectional study was conducted from April to May 2023 in ART clinics in St. Paul's and St. Peter Specialized Hospitals. The study participants were selected using a simple random sampling technique. Data was collected from patients' medical chart review using check lists by nurses and physicians. Data was entered to Epi Info 7 for database construction and exported to SPSS version 26 for analysis. Different statistical analyses was done to describe variables. Bi-variable and multi-variable binary logistic regression used to assess associations between dependent and independent variable using 95% CI and AOR $P < 0.05$.

Result: A total of 262 patient records were included with the response rate of 100% and two-third 173(66%) were females. The mean age was 39.75 ± 11 years and ranged from 18-70 years. The prevalence of renal impairment was 13.4% (95%CI, 9.9, and 17.6). Female gender (AOR: 3.91%, 95% CI. 1.41, 10.82), poor adherence (AOR: 13.14, 95% CI 3.36, 51.42), CD4 < 200 cells/ m^3 (AOR: 5.81, 95% CI, 2.20, 15.28), baseline viral load ≥ 1000 copies/ml, were factors significantly associated with renal impairment.

Conclusion: In this study, the prevalence of renal impairment among PLWHIV on ART is high. Female gender, poor adherence, baseline CD4 < 200 cells/ m^3 and baseline viral load ≥ 1000 copies/ml are significantly associated with renal impairment.

Key words: Renal impairment, HIV positive, ART, St. Paul's, St. Peter, Hospital, Addis Ababa

1. Introduction

1.1. Background

Renal impairment is the inability of the kidneys to perform excretory function. Which is filtering or getting rid of toxin and waste products, removal or metabolism of drugs, keeping balance of the body fluids and electrolytes, release of hormones which acts on different parts of the body. Renal impairment can be classified as acute kidney injury (AKI) and chronic kidney disease (CKD) based on the duration and reversibility of the disease. Which is usually characterized by reduced glomerular filtration rate(GFR) with or without decrease in urine output (1).

Due to medication nephrotoxicity, HIV-associated nephropathy (HIVAN), and immunological complex kidney disorders, patients with HIV are at risk for both acute kidney injury (AKI) and chronic kidney disease (CKD). Furthermore, kidney disease due to hepatitis B virus (HBV) or hepatitis C virus (HCV) co infection as well as kidney disease attributable to classic CKD risk factors such as diabetes, hypertension, and obesity are more common in the ageing cohort of HIV patients [2,3,4].

A relatively high prevalence of renal dysfunction was reported throughout the world and most importantly in several African countries in ART naïve HIV positive people. Low body mass index (BMI), low CD4count, high viral load(VL) , concomitant hepatitis C virus (HCV) infection, and advanced stage of the disease were identified as risk factors for development of renal impairment in ART naïve HIV positive people in addition to the traditional risk factors for kidney diseases in the general population (5).

The first description of severe proteinuria with a rapid loss of kidney function in HIV-infected patients with AIDS was published in 1984. The histopathological pattern corresponded to collapsing focal segmental glomerulosclerosis(FSGS), a condition, later known as HIV associated nephropathy (HIVAN), that usually presents. Although HIVAN is the best known example of HIV-associated kidney disease, a large spectrum of kidney syndromes is now known to occur in HIV-infected patients (6) Evidently due to the introduction of ART the classic HIVAN become less common while other kidney disease are concomitantly increased. It has been shown that

people with high viral load, low CD4 count, and advanced disease is the major risk factor for HIVAN. With introduction of ART those risk factors significantly reduced instead other risk factors become more prominent, like lifelong exposure of ART (7).

Early initiation of ART improves renal function, despite which HIV-infected patients are still at higher risk for both AKI and CKD, which are interconnected syndromes responsible for a heavy burden of mortality among HIV infected individuals (6). Since 2016 WHO recommends initiation of ART despite clinical stage and CD4 count which may further reduce the incidence of HIVAN, but the overall risk-benefit for kidney health is unknown (7). Renal impairment in HIV-infected persons manifests in a variety of ways, including AKI, HIV-associated kidney disease, co morbid CKD, and treatment-related kidney toxicity. The burden of CKD and end-stage renal disease (ESRD) remains high in the HIV- infected population (8)

1.2. Statement of the problem

HIV continues to be a major global public health issue, having claimed 40.1 million [33.6–48.6 million] lives so far. Globally, 38.4 million adults and 1.7 million children (under the age of 15) were living with HIV/AIDS by the end of 2021, and 1.5 million adults and 160,000 children had been infected with the virus for the first time. Sub-Saharan Africa is home to around 60% of the world's HIV-positive people. The coexistence of kidney disease and HIV/AIDS significantly increases mortality of affected individuals (9).

Depending on the geographic location, Kidney disease is observed in PLWHIV with a varying prevalence. Estimates may be significantly impacted by different renal function estimation methods and CKD classifications used across studies [10]. A systematic review of studies from 60 countries revealed a global prevalence of CKD of 6.4% in PLWHIV using the Modification of Diet in Renal Disease (MDRD) formula or 4.8% using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula; however, the African continent revealed the highest prevalence of CKD with 7.9% of PLWHIV affected, according to the MDRD formula [11]. According to other research, the prevalence of CKD is substantially higher in Africa; the CKD-EPI formula estimates that 44.4% of Cameroon's population has CKD [12].

There are significant regional variations in the incidence and prevalence of renal impairment in the context of HIV infection. Variability is influenced by a number of different variables, including the methods used to assess renal function, the definition of CKD, genetic heterogeneity, preventative programs, accessibility to the healthcare system, and the initiation of combination ART. Since none of the methods used to estimate glomerular filtration rate (eGFR) have been validated in PLWH, the first challenge to be solved is the accurate assessment of renal function. The most popular formulas for calculating GFR based on serum creatinine are frequently unreliable in PLWH [13].

Clinically, CKD frequently goes undetected and is discovered by routine screening [14]. To enable early detection and management of CKD, recommendations state that PLWHIV should undergo routine CKD screenings [15, 16, 17]. In addition to a thorough clinical evaluation for risk factors for renal disease and a measurement of their blood pressure, PLWHIV who are chosen for CKD screening should also have a urine protein test and a blood test for serum creatinine to determine their renal function. A urinalysis or quantitative evaluation of urine protein excretion should be

performed on PLWHIV at least once a year, and their GFR should be assessed at least every six months. Additionally, patients should be referred to a nephrologist for evaluation if their eGFR has fallen by 25% or more, to a level below 60 mL/min per 1.73 m², or if they excrete more than 300 mg of protein each day [18]. Referrals for evaluation should also be made for PLWHIV who are discovered to have hematuria with any degree of proteinuria or with an abnormal eGFR. More regular CKD screening, including serum phosphate monitoring, is advised in PLWHIV on TDF [19].there is Variable degree of adherence to established recommendations for CKD screening in PLWHIV. The stated guidelines are not met by current screening procedures [20,21,22].

Globally, 28.7 million people living with HIV were receiving ART in 2021. Global ART coverage was 75% [66–85%] in 2021. However, more efforts are needed to scale up treatment, particularly for children and adolescents. Only 52% [42–65%] of children (0–14 years old) were receiving ART at the end of 2021.

ART coverage in Ethiopia increased from 3% in 2005 to 56% in 2014 and to 78% in 2020(23).ART improves renal survival even when started after renal disease has ensued. As a result, there is increasing prevalence of CKD, now found in 2.4–47.6% of HIV-infected patients, across variable geographic areas and Ethnicities(13). However to the best knowledge of the investigator, studies conducted regarding renal dysfunction among HIV patients in Ethiopia are limited. This study will generate evidence on duration of ART, regimen of ART, age, the presence of other traditional risk factors of renal impairment,CD4, VL and WHO clinical stage and Renal impairment and the clear picture of possible association of renal impairment and the disease characteristic and demography of HIV which intern would indicate possible mitigation strategy. To the scope of the researcher, no similar study is done at the study area among people living with HIV/AIDS. Therefore, this study is aimed at assessing the prevalence and factors associated with renal dysfunction among people living with HIV and attending the ART clinic at St. Paul's and St. Peter Hospitals.

1.3 Significance of the study

The findings from this study will help the two hospitals to use the study result as a base line for future studies and for academic purpose. It could also help find an important direction to organize and strengthen health services in collaboration with respective health facilities.

Furthermore, the result will assist other governmental and non-governmental organizations in collaboration with Ministry of Health to be aware of the gaps & strength and formulate strategies which can be implemented nationally. The end result of this study can also be used as a baseline data for further large studies.

2. Literature review

One of the most significant non-infectious comorbidities (NICMs) experienced by people living with HIV (PLWHIV), both in wealthy nations and in settings with limited resources [24, 25], is chronic kidney disease (CKD). Despite extremely effective antiretroviral treatment (ART), the prevalence of CKD in PLWHIV is rising [26]. While the link between HIV infection and CKD

has long been known, it's crucial to highlight that the pattern of kidney disease that PLWHIV experience has evolved [27]. CKD is now frequently linked to NICMs, particularly diabetes and hypertension, as opposed to the previously observed HIV-associated renal disorders or acute kidney injury (AKI) connected to diseases such as opportunistic infections [28]. Significant discrepancies are also readily apparent, with the majority of HIV infections occurring in minorities, in areas with few resources, or in people of African origin [29]. Renal disease burden is increased by long-term ART use in an aging cohort with PLWHIV [30].

Studies have shown that the prevalence of HIV associated renal disease varies according to geographical locations, For instance according to inter-continental research which was conducted on people living with HIV in 2019 the estimated prevalence of CKD in HIV population measured using CKD-EPI equation ranges from 2.5% in Europe to 7.4% in North America(31).

2.1 Prevalence of Renal Impairment in PLWHIV

A global prevalence of CKD of 6.4% in PLWHIV using the Modification of Diet in Renal Disease (MDRD) formula, or 4.8% using the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) formula, has been reported in a systematic review of studies from 60 countries worldwide(done in 2018); however, the African continent demonstrated the highest prevalence of CKD with 7.9% of PLWHIV affected, according to the MDRD formula (11). Some studies have reported a much higher prevalence of CKD within Africa, with 44.4% affected by CKD in Cameroon using the CKD-EPI formula [12].

A cross-sectional study done to assess the prevalence of renal dysfunction among HIV infected patients who attend the HIV clinic in Northern Cameroon showed that the prevalence of CKD was 44.4% (CKD-EPI) and 47.2% (MDRD)(32).

A cross-sectional study was conducted between June and October 2019 among adults living with HIV on ART for 6 months or more attending CTC at Muhimbili National Hospital in Dar es Salaam, Tanzania, found 24.7% of HIV patients had Renal impairment. about one-third (32.8%) had eGFR less than 90 ml/min, whereas 7% had eGFR less than 60 ml/min. Microalbuminuria and proteinuria were detected in 38.6% and 25.1% of participants, respectively(33)

A cross-sectional study conducted at Njombe Town Council Hospital in Tanzania from December 2019 to April 2020, recruiting 396 participants revealed that prevalence renal impairment was 20.7(34).

A hospital-based cross-sectional study with a secondary data review was conducted on 336 on HIV/AIDS patients on HAART from February to July 2017 at University of Gondar Referral Hospital, Northwest Ethiopia. The prevalence of CKD on the study participants was (16.1%) (95% CI, 12.2–20.4%) (35).

Another institution-based, cross-sectional quantitative study was conducted Among Adult HIV-Positive Patients Attending Antiretroviral Therapy Clinic in Mettu Karl Referral Hospital, southwest Ethiopia from March 8 to May 30, 2020. Out of 352 HIV patients on ART, 73 (20.7%) were found to have renal function impairment (36).

2.2 Factors associated with renal impairment

A cross-sectional study done to assess the prevalence of renal dysfunction among HIV infected patients who attend the HIV clinic in Northern Cameroon showed that age greater than 35 years (odds ratio [OR], 1.04; 95% confidence interval [CI], 1.02 to 1.06), longer duration of HIV (OR, 2.60; 95% CI, 1.53 to 3.95), history of hepatitis B (OR, 3.04; 95% CI, 1.08 to 8.54), and CD4 cells less than 200 cells/mL (OR, 3.64; 95% CI, 2.55 to 5.21) were associated with CKD(32).

A hospital-based cross-sectional study with a secondary data review was conducted on 336 on HIV/AIDS patients on HAART from February to July 2017 at University of Gondar Referral Hospital, Northwest Ethiopia, male gender (AOR=2.05 (1.03-4.09), p=0.04, occupation merchant (AOR=2.91(1.00-8.48),p=0.049)and viral load > 1000 copies/mm³ (AOR=3.1 (1.38- 7.00), P<0.01) were significantly associated with CKD(35).

Another institution-based, cross-sectional quantitative study was conducted Among Adult HIV-Positive Patients Attending Antiretroviral Therapy Clinic in Mettu Karl Referral Hospital, southwest Ethiopia, from March 8 to May 30, 2020, Cigarette smoking [AOR = 9.60, 95% CI: 4.73–19.48], diabetes mellitus [AOR = 6.16, 95% CI: 2.79–13.59], hypertension [AOR = 4.71, 95% CI: 1.98–11.17] and low CD4 count [AOR = 6.47, 95% CI: 3.31–12.64] were found to be independent predictors of renal function impairment among adult HIV positive patients(36).

In a cross sectional study conducted in Mwanza, Tanzania in to determine Renal Dysfunction among HIV-Infected Patients Starting Antiretroviral Therapy female gender (OR 3.0, 95% confidence interval (CI) [1.8–5.1], $p<0.0001$), Body Mass Index (BMI) <18.5 (OR 2.3 [1.3–4.1], $p=0.004$), CD4+ T-cell count <200 cells/mm³ (OR 2.3 [1.1–4.8], $p=0.04$), and World Health Organization (WHO) clinical stage II or above (OR 1.6 [1.2–2.3], $p=0.001$) were factors independently associated with renal dysfunction (44) .

2.3 ART related nephrotoxicity

The advent of ART has dramatically changed outcome of HIV+ patients in the last two decades reducing mortality and risk of progression to AIDS, even though important adverse side effects including nephrotoxicity arose with its use. Direct renal injury occurs with tubular dysfunction, acute interstitial nephritis and renal calculi. Indirect mechanisms of injury are due to medication dosing errors, drug–drug interactions, ART-induced rhabdomyolysis, lactic acidosis and metabolic complications.

2.4 Proposed conceptual framework



Figure 1: Conceptual framework of factors contributing to renal impairment in HIV positive patients on ART.

3. Objective

3.1 General Objective

- ✓ To assess prevalence of renal impairment and associated factors among HIV infected individuals in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia, 2023.

3.2 Specific Objective

- ✓ To assess the prevalence of renal impairment among HIV infected individuals in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia, 2023.
- ✓ To identify factors associated with impaired renal function among HIV infected individuals in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia, 2023.

4. Method

4.1 Study Setting

St. Paul Hospital Millennium Medical College (SPHMMC) is the second largest public hospital in Ethiopia. It is located in Gullele Sub City in Addis Ababa and built by Emperor Haile Selassie in 1969 with the mission to provide preventive, curative, and rehabilitative health care service in the country. It has 2800 clinical, academic and administrative and support staffs that provide medical specialty services to patients who are referred from all over the country, teaching medicine and nursing students and doing basic and applied researches. While the inpatient capacity is more than 700 beds, The College sees an average of 1200 emergency and outpatient clients daily and has a catchment population of more than 5 million. ART clinic is one of the several outpatient departments.

The other study site was St. Peter's Specialized Hospital is a governmental Hospital under Federal Ministry of Health of Ethiopia, which is also located in Addis Ababa, Ethiopia. The hospital provides various services especially in Tuberculosis diagnosis and Treatment with admission capacity of around 250. The Hospitals has outpatient specialty clinics where patients are referred for specific chronic disease for follow-up.

4.2 Study design and period

A cross sectional study design was conducted April 2023 to May 2023.

4.3 Population

4.3.1 Source population

- ✓ All adult HIV infected individuals who have follow up at ART clinics of St. Paul's and St. Peter Specialized Hospital

4.3.2 Study population

- ✓ All adult patients who has followed up in the past 5yrs at ART clinics of St. Paul's and St. Peter Specialized Hospitals and who fulfills the inclusion criteria.

4.4. Eligibility criteria

4.4.1 Inclusion criteria

All adult patients who have follow up at ART clinics of St. Paul's and St. Peter Specialized Hospitals and have complete laboratory and clinical data regarding their renal status during the study period and age 18years old and above.

4.4.2 Exclusion criteria

Those patients with Diagnosis of obstructive uropathy at any time in their follow up period and those with incomplete investigation results were excluded.

4.5. Sample size determination and sampling technique

4.5.1 Sample size determination

Sample size is calculated by using the single population proportion formula

$$n = Z^2 p(1-p) / d^2$$

n= required sample size

Z= confidence level at 95% (standard value of 1.96)

d= margin of error = 5%

P= estimated prevalence renal impairment of patients in ART clinic, using the prevalence of related study conducted at Mettu Karl Referral Hospital, the p value is 20%(36).

$$n = (1.96)^2 * 0.2 * 0.8 / (0.05)^2, n = 246$$

Since the study population is <10,000, there is a need to use population correction formula which is $n = n_i * N / (N + n_i)$ where n_i = initial sample size = 246

N= study population = 7000

N=total number of HIV infected individuals both at St. Pau's and St.Peter who has follow up at ART Clinic. Because the source population is <10,000, the final sample size determined as follows:

$$n_f = n / [1 + n / N]$$

$$N_f = 246 / (1 + 246 / 7000) = 238$$

Final sample size, by adding 10% (24) contingency a total of 262 was the final sample size.

4.5.2 Sampling technique

From a total of 7000 patients at the ART clinics from the two hospitals, 262 charts selected by simple random sampling method.

4.6 Data collection tools and procedures

4.6.1. Data collection tools

A questionnaire is adopted from different literatures, and used to explore the objectives of the study with four components. Part one: socio demographic factors, Part two: Disease related factors, Part three: Co morbidities and Part four: Medication related factors. All the parameters were collected from chart review.

4.6.2. Data collection procedure and measurements

The data was collected using document review by nurses and physicians working in the ART clinic. Data on socio demographic and clinical Characteristics of the study participant was collected by review of medical records.

4.7 Study Variables

4.7.1 Dependent Variable

- ✓ Renal impairment

4.7.2 Independent Variables

Socio demographic factors:

- ☐ Age, sex, wt., BMI

Disease related factors:

- ☐ Weight, presence of anemia, BMI, duration of HIV infection, history of ARV treatment failure, ART regimen, Opportunistic infection, drug adherence, Duration of ART, Baseline CD4, Baseline Viral load, WHO clinical staging.

Co morbidities:

- ☐ DM, HTN, CLD, Cardiac illness, UTI

4.8 Operational definitions

Renal impairment: Defined as eGFR(using CKD-EPI)<60ml/min and/or serum creatinine >1.2 and/or urine dipstic >=+2(1).

Hypertension: Patients with a value greater than 140/90 mmHg was considered as hypertensive (37).

Nutritional assessment: BMI cut of value according to WHO classification (in Kg/m²) was used <18.5 (underweight), 18.5-24.99(normal), 25- 29.99(overweight), >30 (obese)(37).

Diabetes mellitus: DM is defined fasting blood sugar >125 mg/dl, OR HgA1c >6.5 %, symptoms of hyperglycemia and random blood sugar >200, OR two hour oral glucose tolerance test > 200mg/dl(39).

Adherence: G (good)>=95%, F (fair) 85-94% & P(poor)<85%(40).

4.9 Data management and analysis

Data was entered to Epi Info 7 for database construction and exported to SPSS version 26 software package for analysis. Different statistical analyses were done including frequencies, mean and standard deviation. Associations between dependent and independent variables were

assessed by using binary and multiple logistic regressions. Variables that have P value <0.2 in bi-variable binary logistic analysis were entered to multiple logistic regressions. In multivariable binary logistic regressions analysis P- value < 0.05 with 95% confidence interval (CI) with AOR was used in judging the significance of the associations. Hosmer–Lemeshow test was used to determine the goodness of fit for the final logistic regression model ($P=0.383$). The results presented by using charts, graphs, tables, and texts.

4.10 Data quality control

To ensure the quality of data, preceding data collection, training of the data collectors was carried out for one day by the principal investigator on the objective, relevance of the study and confidentiality of information.

4.11 Ethical consideration

Prior to conducting the research, permission was obtained from SPHMMC research office and Institutional Review Board (IRB). Letter for cooperation was obtained. Names and other identification that was reveal patients' identity was kept confidential and anonymous. Scientific objectivity of the study was maintained with honesty and information collected from charts were respected and used only for this study purpose.

5. Result

5.1 Socio-Demographic Characteristics:

In this study, a total of 262 patient records were included with the response rate of 100%. The age of participants was ranged from 18-70 years; with mean age of 39.75 ± 11.12 years. Nearly two-third 173(66%) were females. Based on BMI, 29(11.1%) were Underweight and Obese (**Table 1**).

Table 1: Socio-Demographic characteristics of study participants in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia 2023:

Variable		Frequency	Percent
Sex	Female	173	66.0
	Male	89	34.0
Age	<50	221	84.4
	≥ 50	41	15.6
BMI	<18.5	29	11.1
	18.5-24.9	139	53.1
	25-29.9	65	24.8
	≥ 30	29	11.1

5.2 Disease related characteristics:

Based on WHO clinical staging, the majority of the study participants 233(88.9%), 229 (87.4%) and 217(82.8) were clinical stage I, current $CD4 \geq 200$ cells/mm³ and undetectable current viral load respectively. The mean age of duration since HIV infection diagnosed was 5.75 ± 4.1 years and nearly two-third 178(67.9%) were on HARRT for less than five years duration. Nearly 10% of participants and only five patients were anemic and had history of AIDS defining illness respectively (**Table 2**)

Table 2: Disease related characteristics of study participants in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023

Variable	Frequency	Percent
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WHO clinical stage	I	233	88.9
	II	14	5.3
	III	10	3.8
	IV	5	1.9
Duration on HAART in year	<5	178	67.9
	5-10	48	18.3
	≥10	36	13.7
Baseline CD4 in cells/mm ³	<200	98	37.4
	≥200	164	62.6
Current CD4	<200	33	12.6
	≥200	229	87.4
Baseline Viral load	Undetectable	145	55.3
	<1000copies/ml	67	25.6
	≥1000copies/ml	50	19.1
Current Viral load	Undetectable	217	82.8
	<1000 copies/ml	37	14.1
	≥1000 copies/ml	8	3.1
Duration HIV since diagnosis in year	≤6	200	76.3
	>6	62	23.7
Hemoglobin in mg/dl	<12	26	9.9
	≥12	236	90.1
AIDS defining illness prior to initiation of ART	No	257	98.1
	Yes*	5	1.9
Current urine RBC cast	No	257	98.1
	Yes	5	1.9
Serum creatinine	≤2	246	93.9
	>1.2	16	6.1
Urine dipstick protein	< +2	256	97.7
	≥ +2	6	2.3

*CNS toxoplasmosis (4) and Lymphoma CNS (1), WHO: World Health organization, HAART: Highly Active Anti-Retroviral Therapy, AIDS: Acquired Immune Deficiency Virus, RBC: Red blood cell

3. Comorbidity related characteristics:

In this study, 19(7.3%) of participants had Comorbidity of which 3.1%, 1.5%, 3.1%,1.1% and 0.4% had dyslipidemia, diabetes, hypertension, cardiac illness, liver disease respectively (**Table: 3**).

Table 3: Comorbidity related characteristics of the study participants in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023

Variable		Frequency	Percent
Comorbidity	Yes	29	11.1
	No	233	88.9
Dyslipidemia	No	254	96.9
	Yes	8	3.1
Diabetes	No	258	98.5
	Yes	4	1.5
Hypertension	No	254	96.9
	Yes	8	3.1
Opportunistic infection	yes	5	1.9
Cardiac illness	No	259	98.9
	Yes	3	1.1
Liver disease	No	261	99.6
	Yes	1	0.4

5.4 Medication related characteristics:

In the current study, majority of the study participants 218 (83.2%) were on 1j ART regimen. Most of the participants 250 (95.4%) and 244(93.1%) were on TDF Based regimen and had good adherence to ART regimen. But, only 1.5%, 3.8%, and 4.6% participants had history of treatment failure, taking drugs for OI, and other medications respectively (**Table 4**).

Table 4: Medication related characteristics of the study participants a St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023

Variable		Frequency	Percent
ART regimen	1d (AZT,3TC,EFV)	2	0.8
	1e (TDF,3TC, EFV)	20	7.6
	1j (TDF,3TC,DTG)	218	83.2
	2f (AZT,3TC,ATV/r	10	3.8
	2h (TDF,3TC,ATV/r	12	4.6
TDF Based regimen	Yes	250	95.4
	No	12	4.6
Using drug for OI*	No	252	96.2
	Yes	10	3.8
Adherence to ART regimen	No	18	6.9
	Yes	244	93.1
History of treatment failure	No	258	98.5
	Yes	4	1.5
Taking other medication**	No	250	95.4
	Yes	12	4.6

*CPT, cotrimoxazole, fluconazole, **Amlodipine, Hct, Amitriptlin, Atrovastatin, Enalapril, Lasix, Metformin.

5.4 Prevalence of renal impairment:

Overall, renal impairment was detected in 35(13.4%)(95%CI, 9.9, and 17.6)of the study participants. Of all participants, 6(2.3%) had proteinuria $\geq$ +2, 16 (6.1%) had serum creatinine >1.2 mg/dl and 18 (6.9) had below eGFR <60 ml/min/1.73 m² (**figure 2 and 3**).

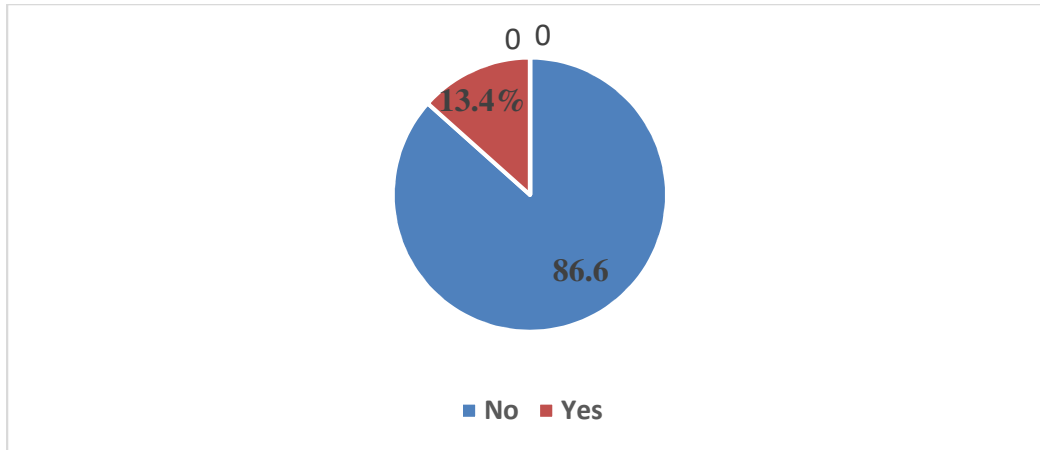


Figure 2: the prevalence of renal impairment among patents with HIV on ART in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023

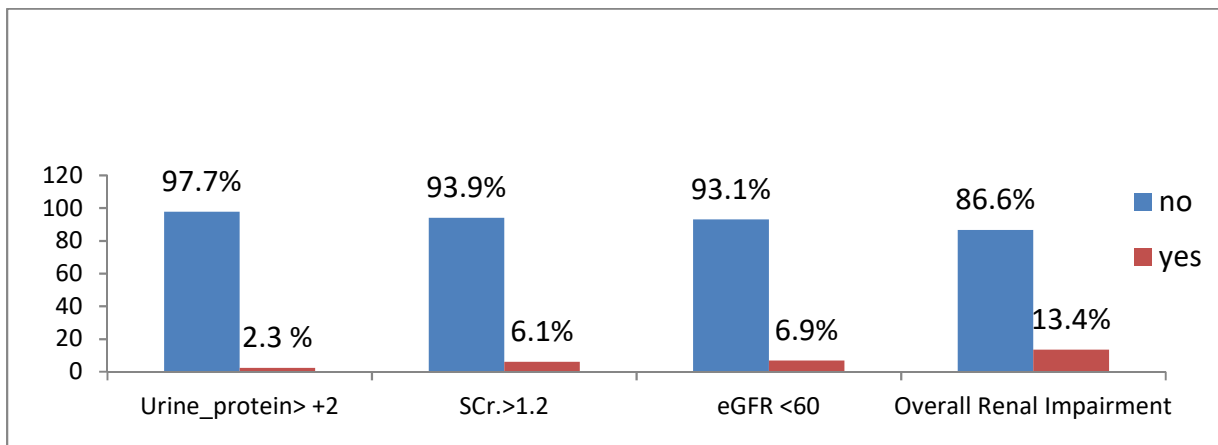


Figure 3: The proportion of renal impairment among patients with HIV on ART in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023.

5.5 Factors associated with Renal Impairment

In bi-variable binary logistic regression analysis, gender, WHO clinical stage, adherence to ART, baseline CD4, current CD4, baseline viral load, and current viral load were candidate variables ($P < 0.2$) to fit multivariable binary logistic regression analysis. However in multivariable binary logistic regression analysis only gender, adherence to ART, baseline CD4, and baseline viral load were significantly associated.

Female patients on ART were nearly four folds (AOR: 3.91, 95% CI. 1.41, 10.82) more risk of renal impairment compared with males. The odds of renal Impairment was more than thirteen times (AOR: 13.14, 95% CI 3.36, 51.42) for those who had poor adherence to ART compared with the counterparts. Participants with baseline CD4 < 200 cells/ m^3 were nearly six times (AOR: 5.81, 95% CI, 2.20, 15.28) more likely to have renal impairment compared with CD4 ≥ 200 . Similarly, baseline viral load ≥ 1000 copies/ml, were four times (AOR: 4.02, 95% CI, 1.18, 13.74) more likely to have renal Impairment compared with undetectable viral load (**Table: 5**)

Table 5: The proportion of renal impairment among patients with HIV on ART in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, 2023.

Variable			Renal Impairment		COR (95% CI)	AOR (95% C.I)	P
			Yes	No			
Gender	Female		27	146	1.87(.81, 4.31)	3.91(1.41, 10.82)*	.008
	Male		8	81	1	1	
WHO Stage	I		27	206		1	.168
	≥II		8	21	2.90 (1.17, 7.20)	2.52 (.67, 9.44)	
Adherence To ART	No		9	9	8.38(3.05, 23	13.14 (3.36, 51.42)*	.001
	Yes		26	218	1	1	
Baseline CD4	<200		25	74	5.27(2.40,11.55)	5.81 (2.20, 15.28)*	.001
	≥200		10	153	1	1	
Current CD4	<200		10	23	3.54(1.51, 8.3)	1.3 (.38,4.47)	.67
	≥200		25	204	1	1	
Baseline viral load	undetectable		10	135	1	1	.12
	<1000		10	57	2.36(.93, 6.0)	2.33 (.80, 6.81)	
	≥1000		15	35	5.78(2.39, 13.98)	4.02 (1.18, 13.74)*	
Current viral load	undetectable		22	195	1	1	.154
	<1000		12	25	4.25 (1.87, 9.63)	1.12 (.33, 3.77)	
	≥1000		1	7	1.26 (.14, 10.77)	.15 (.01, 2.018	

*indicate variables significantly associated with renal impairment, WHO: world health organization ART: Anti Retro viral, CD4: Cell differentiation, COR: Crude odds ratio, AOR: Adjusted odds ratio

6. Discussion

Renal impairment (RI) is common among HIV infected patients. It can be associated with poor outcomes, including increased morbidity and mortality rates (41). Thus, early diagnosis and regular monitoring for renal impairment in HIV-positive patients is valuable. Therefore, this study aimed to assess prevalence of RI among patients with HIV on ART in St. Paul's and St. Peter Specialized Hospital ART Clinics, Addis Ababa, Ethiopia, 2023.

In the current study, the prevalence of renal impairment was 13.4% (95%CI, 9.9- 17.6). This finding is consistent with the study done at University of Gondar referral hospital (16.1%) (35). However, the prevalence of RI in this study is lower than studies conducted in Cameroon(44.4%), Muhimbili national hospital, Tanzania(24.7%), and Njombe town council hospital in Tanzania(20.7%),Mettu (20.7%) (32, 33,34 36). This discrepancy could be explained by difference in measurement criteria for outcome variable. In the Njombe town council hospitalTanzania, RI was measured using $eGFR < 90 \text{ ml/min/1.73 m}^2$ cut of point which might cause the higher prevalence compared with this study that used cut off point of $eGFR < 60 \text{ ml/min/1.73 m}^2$. Additionally, the study in Tanzania and Mettu excluded <6 months follow up and data collected face to face, blood sample taken and laboratory tests performed for the study purpose with high quality control; but data was collected from secondary source (chart review) in our study which might made this variation.

However, the prevalence of RI in this study was higher than inter-continental research findings that revealed 2.5% and 7.4%in Europe and North America respectively (31) and the global prevalence of CKD of 6.4% using (MDRD) formula, or 4.8% using (CKD-EPI) formula(11).This variation may be due to socio-cultural, socioeconomic, and health care system difference.

In this study gender, adherence to ART, baseline CD4, and baseline viral load were significantly associated with renal impairment. Female patients were nearly four folds increase the risk of renal impairment compared with males. This finding is consistent with the study done in Mwanza, Tanzania (44). But our finding contradicts with the study conducted at University of Gondar Referral Hospital that found males were more risk for renal impairment compared with the counterparts (35).Although the precise mechanisms are not fully understood, mechanisms behind

this may involve sex difference in basic renal structure and function, sex hormones and sex-specific gene expression.

Patients with baseline CD4 <200 cells/ m^3 were nearly six folds more likely to have RI compared with CD4 ≥ 200 cells/ m^3 . This is in agreement with findings in Mettu Karl Referral Hospital (36), Mwanza, Tanzania (44) and Northern Cameroon (32). This might be due to the fact that advanced HIV (CD4 count <200 cell/ μL) is known to be associated with development of opportunistic infections, malignancies and also use of Cotrimoxazole preventive therapy for PCP may contribute.

Similarly, baseline viral load ≥ 1000 copies/ml was nearly four times more likely to have RI compared with undetectable viral load. This finding is also consistent with the study done at University of Gondar Referral Hospital (35). This could be explained due to the fact that HIV directly infects glomerular and kidney tubular epithelial cells in humans.

Poor adherence to ART increases the risk of RI compared with good adherence. This might be due to uncontrolled HIV replication weakens the immune system, making HIV patients more susceptible to opportunistic infection some of which can affect the kidney directly. Untreated HIV infection also causes chronic inflammation, which can contribute to kidney damage overtime.

Strength and limitation

This study was conducted using three parameters to diagnose renal Impairment; urine dipstick protein, Serum creatinine and eGFR that can be the strength of this study. As limitation since the data was collected from chart review some socio-demographic and socioeconomic variables were not assessed.

Conclusion:

In this study, the prevalence of renal impairment among PLWHIV on ART is high. Female gender, poor adherence, baseline CD4 <200 cells/ m^3 and baseline viral load ≥ 1000 copies/ml are significantly associated with renal impairment.

Recommendations:

It is better that health care professionals should screen HIV patients regularly on ART for early diagnosis and management of renal function impairment. Those patients with low baseline CD4 count, high baseline viral load and poor adherence to ART should be closely followed.

☐ **For Addis Ababa Health Bureau**

- ✓ Better to do more comprehensive research including all ART centers in Addis Ababa to identify gaps and formulate strategies.

☐ **For SPHMMC and St. peter hospitals:**

- ✓ Health education should be given to patients about the importance of drug adherence and regular check up of their renal condition during their follow up visits (especially for those who have low CD4, high viral load, female patients and poor adherence).

☐ **For physicians:**

- ✓ Physicians should assess patient's knowledge and attitude towards their disease.
- ✓ Physicians should assess patients renal condition regularly atleast every 6month and more frequent for those having low CD4, high viral load, poor drug adherence and female sex.

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ANNEXES

ANNEX I: Data Collection Checklist

Part I: Socio demographic factor	
Date	
1.Chart No.	
2.Age	_____in years
3.sex	1. Female 2. Male
Part II: Disease related factors	
1.Wt.(kg)	
2.Ht.(cm)	

3.Duration of HAART	_____ (in yrs)
4. WHO clinical stage	1. stage I, 2. stage II, 3. stage III, 4. stage IV
5.Duration of HIV infection(in years)	
6.Any history of AIDS defining illness prior to initiation of ART	1.Yes 2.No If yes, Specify.....
Part III: Comorbidity Related factors	
1.Dyslipidemia	1.Yes 2.No
2.DM	1.Yes 2.No
3.HTN	1.Yes 2.No
4 .Does the patient have OI?	1.Yes 2.No If yes, Specify.....
5. Does the patient have any Cardiac illness?	1.Yes 2.No If yes, Specify.....
6. Does the patient have underlying Liver disease?	1.Yes 2.No If yes, Specify.....

Part IV: Medication related factors	
1. What ART regimen does the patient take? circle one	1.1d 2.1e 3.1g 4.1j 5.1k 6. Other specify.....
2. Is the client on any OI drugs?	1.Yes 2.No If yes, Specify.....
3. Is the client adherent to his/her ART regimen?	1.Yes 2.No

4. Does the patient have history of treatment failure?	1.Yes 2.No
5. Does the patient take other medications?	1.Yes 2.No If yes, Specify.....

Part V

Laboratory measurements: please circle the result

N o	Biochemical indices	Result	Base line	2 nd After 3months	3 rd After 6months	2 nd		
1	Hemoglobin	1.11- 12.9mg/dl 2.8-10.9mg/dl 3.<8mg/dl						

2	Urine dipstick protein (N, 1+, 2+, 3+, 4+)							
3	24 hour urine protein (mg/24hr)							
4	CD4 count							
5	Viral load(copies/ μ l)							
6	Serum creatinine (mg/dl)							

Annex II: Assurance of Investigator

I the undersigned resident agree to accept all responsibilities for the scientific, ethical and technical conduct of the research project and for provision of required progress reports as per terms and conditions of the Research and Publication Directorate and /or Department of Public Health of St. Paul's Hospital Millennium Medical College.

Name of the student: _____

Signature: _____

Date: _____

Approval of the Clinical Advisor

Name of the Clinical advisor: _____

Signature: _____

Date: _____

Approval of the Public health Advisor

Name of the Public health advisor: _____

Signature: _____

Date: _____