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Research Article

High Sero Prevalence of the HIV-1, HIV-2 and HIV 1+2 Co-infection Among the HIV Patients Who Are on HIV- 1 ART Treatment Regimen in Njombe and Dares Salaam, Tanzania: Retrospective Cross‑sectional Study

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Abstract

Background: HIV-1 and HIV-2 have globally known HIV types with 55% genetic differences that resulted in the difference in ART treatment outcomes. HIV-1 is worldwide spread compared to HIV-2 dominated partly in Europe, the USA, and west Africa. Current studies have shown the spread of HIV-2 to other countries due to immigration and social economic activities interactions Objective, This study was aimed to determine the Seroprevalence of HIV-1, HIV-2, and HIV1+2 dual infection among the HIV patient on HIV -1 ART regimen treatment in Njombe and Dares salaam, Tanzania. Methods: A retrospective cross-sectional study was conducted from January 2020 to December 2021 at eight HIV Care and Treatment Centers. A total of 300 participants who were on HIV -1 ART regimen treatments from 2017 to 2019 were randomly selected and re-tested to determine HIV types SPSS version 26.0 was used for analysis whereby Percentages, Odds ratios (OR), 95% confidence intervals (CIs), and p-values of ≤0.001 were used for interpretation. Ethical clearance was sought from KNCHRE. All participants were provided with informed consent. Results: The mean age was 35.0 (SD ± 0.24) years. There was more female with HIV-1 110 (53.1%) compared to HIV-2 25 (56.8%) and dual infection. The general prevalence of HIV-1 was 69%, HIV-2 was 15% and HIV-1+2 dual infections were 16%. In stratification by region, HIV-1 prevalence was high in Dares salaam 108(72%) compared to Njombe 99(66%) p=0.26 while the prevalence of HIV-2 was higher in Njombe 25(17%) compared to Dares Salaam 19(13%) p=0.33 and HIV 1+2 dual infection prevalence was high in Njombe 26(17%) compared in Dares - Salaam 23(15%) p=0.64. Conclusion: The study confirmed the presence of high prevalence of the HIV-2 and HIV 1+2 infections which were previously not found in Tanzania. Therefore, the urgent intervention on initiation of HIV-2 and HIV 1+2 dual infections ART regimen in Tanzania should be in place to reduce risks of poor clinical treatment outcomes of PLHIV with

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HIV-2 and HIV 1+2 infections.

Keywords

Sero-Prevalence, HIV-1, HIV-2, HIV 1+2 Dual Infection, Opportunistic Infections, ART, Regimen

1. Introduction

Human Immunodeficiency Virus (HIV) is a major public health concern that causes high morbidity and mortality worldwide. Globally, it is estimated that 4 million adults population (15-55 years old) has infected with HIIV whereby two -third come from SSA countries [1]. Tanzania with a 4.7% prevalence of the HIV among adults aged between 15-49 has estimated to have 1.7 million people living with HIV [2]. Despite discoveries of various subtypes of HIV and their strains, HIV-1 and HIV-2 are major common types of HIV globally known. [3-4]**.** HIV-1 is the global widespread HIV type compared to HIV-2 which is rare occurred [5-7]. The current studies show the spread of the HIV-2 from the known epidemic area of France, India, St, Francisco (USA) in West African countries including Tanzania due to social and e economic factors [8] The Joint United Nations program of AIDS (UNAIDS) in 2017 reported that 2M people are infected with HIV-2, and HIV1+2 co-infection [9-11].

Tanzania is among the countries in Africa with high HIV burden. Like in other sub-Saharan African Countries, HIV epidemic in Tanzania is among the leading causes of deaths, and poor social economic for both individual families and government in general. According to Tanzania HIV Impact Survey (THIS) 2022-2023, Tanzania's HIV/AIDS prevalence for the general adult population (15-49) was 4.4% for Tanzania Mainland and 0.4% in Zanzibar [12]. Since 1981, Tanzania dominated with HIV-1. From 2000s Tanzania started to observe the existence of the HIV-2. The pilot study conducted in 2022 HVCT in Arusha, Dar es salaam, and Kilimanjaro reported presence of 5 to 10 HIV-2 and HIV1+2 co-infection annually [13].

Despite of the presence of the HIV-2 and its co-infection, there is unawareness and limited information among the clinician and policy makers on their prevalence, prevention and managements of these type of HIV. In treatment cascade Tanzania still use HIV-1 ART regimen drug for treatment of both types of HIV infections that increase the risk of treatment failure, drug resistance and general poor treatment outcomes among the PLHIVs infected with HIV-2 and HIV 1+2 co infections. [13-17]

This paper aimed to determine the Sero Prevalence of the HIV-1, HIV-2 and HIV 1+2, Co- infection Among the PLHIVs who are on HIV- 1 ART Treatment Regimen in Njombe and Dares salaam, Tanzania.

2. Material and Methods

2.1. Study Area

A retrospective cross-sectional study was conducted from January to December 2021 in Eight HIV Care and treatment Centers (HCTC) health facilities that were found in the Njombe region southern highland part of Tanzania and Dares salaam region eastern part along the Indian Ocean coast belt. The region was selected due to being East African commercial city with population of 7.7 million people [18]. and HIV prevalence of 6.9% [12] that attract local and international migrants coming for social and economic activities, thus there is high probability of HIV-2 infections to population. Njombe region that found in southern highland of Tanzania has an estimated population of 702,097 [18] and HIV prevalence of (14.8%) [12] also was selected due to being the highest HIV Prevalence region in Tanzania and consist of the business activities carried out with nearby countries and being a stop center for heavy truck drivers who use the southern highland road traffic way to transport their commodities to other African countries For this reason the probability of obtaining HIV-2 and HIV1+2 co- infections are high.

2.2. Study Design and Population

Using quantitative approach, A retrospective cross-sectional study design was conducted from January 2022 to December 2023.A files of the patients who are HIV treatment from 2016 to 2019 were used to recruit the study participants. The eligible PLHIVs who aged 18 years, had at least five CD4 and viral load tests results, not transferred in from the other HCTC and agreed to sign informed consent after a brief explanation of the study's purpose.

2.3. Sample Size and Sampling Techniques

A total sample of 300 PLHIV were recruited in the study, 150 from each region. A multi-stage sampling technique was used whereby purposive sampling was used for the selection of the districts of the study and simple random sampling was used for the selection of the eight health facilities of the study and study participants.

2.4. Data Collection

Participants were interviewed using questionnaires, and soci-

odemographic information (age, marital status, education, employment, and occupation) was gathered. An EDTI tube was used to collect a 20 µl whole blood sample from the HIV patients for HIV type determination. A 1.5 µl blood sample was pipetted and sent to SD-Bioline TM (Allere Medical Company) for the initial HIV rapid test, and the results were verified by Determine TM (Trinity Plc. Ireland) for HIV subtype determination.

2.5. Data Analysis and Interpretation

For clean, and analyze gathered data the SPSS version 26.0 was used. All categorical variables were reported as counts and percentages while Venn diagram used to interpret the prevalence of HIV-1, HIV-2 and HIV 1+2 co- infections. the Chi-square was used to determine the association between the HIV types, and social demographic measures while the Odds ratios with P- value of less that 0.05 was used to make the comparison between the PLHIVs with HIV-1, HIV-2 and HIV1+2 Co-infections.

3. Results

3.1. Social Demographic of the Participants

Among 300 recruited PLHIV, 207 had HIV-1, 44 had HIV-2, and 49 had HIV-1+2 dual infected. Also, the study involved 140 (46.7%) males and 160 (53.3%) females. The mean age of the patients was 35 years (range 15-90 years) with the standard deviation of ± 0.24 According to their HIV subtypes there were more females with HIV 1 110 (53.1%) compared to those with HIV-2 25 (56.8) and HIV11+2 dual infection. Fewer participants with secondary education infected with HIV 219 (43.2) and HIV 1+2 dual infection 15 (30.6) compares to those infected with the HIV 1. The married 68 (32.9) and self-employed 123 (59.4) participants were more infected with the HIV-1 compared to HIV 2 and HIV 1+2 dual infections. *See Table 1 below.*

Table 1. *Social Demographic characteristics of the participant.*

Variables	HIV-1	HIV-2	HIV-1+2	Total
	N (%) N (%) N (%) n (%)			
Age				
11-25 yrs	43 (20.8)	12 (27.3)	10 (20.4)	65 (21.7)
26-40 yrs	62 (30.0)	16 (36.4)	19 (38.8)	97 (32.3)
41-55 yrs	83 (40.1)	14 (31.8)	17 (34.7)	114 (38.0)
>55 yrs	19 (9.2)	2 (4.6)	3 (6.1)	24 (8.0)
Sex				
Male	97 (46.9)	19 (43.2)	24(49.0)	140 (46.7)
Female	110 (53.1)	25 (56.8)	25 (51.0)	160 (53.3)
Education level				
None	19 (9.2)	2 (4.6)	6 (12.2)	27 (9.0)
Primary	117 (56.5)	20 (45.5)	26 (53.1)	163 (54.3)
Secondary	61 (29.5)	19 (43.2)	15 (30.6)	95 (31.7)
College	10 (4.8)	3 (6.8)	2 (4.1)	15 (5.0)
Marital status				
Single	61 (29.5)	18 (40.9)	19 (38.8)	98 (32.7)
Married	68 (32.9)	8 (18.2)	16 (32.7)	92 (30.7)
Widow	29 (14.0)	7 (15.9)	6 (12.2)	42 (14.0)
Cohabited	5 (2.4)	1 (2.3)	0 (0)	6 (2.0)
Divorced	44 (21.3)	10 (22.7)	8 (16.3)	62 (20.7)
Income				
< 10,000	116 (56.0)	25 (56.8)	27 (55.1)	168 (56.0)
10,000-100,000	49 (23.7)	10 (22.7)	13 (26.5)	72 (24.0)

Variables	HIV-1	HIV-2	HIV-1+2	Total
100000-500000	34 (16.4)	9 (20.5)	7 (14.3)	50 (16.7)
>500000	8 (3.9)	0 (0)	2 (4.10)	10 (3.3)
Occupation				
Employed	36 (17.4)	7 (15.9)	9 (18.4)	52 (17.3)
Self employed	123 (59.4)	21 (47.7)	26 (53.1)	170 (56.7)
Unemployed	48 (23.2)	16 (36.4)	14 (28.6)	78 (26.0)

3.2. Seroprevalence of HIV Types

From 300 PLHIVs recruited in the study 207 (69%), 44 (15%) and 49 (16%) had HIV-1, HIV-2 and had HIV-1+2 co- infections respectively as shown in Figure 1.

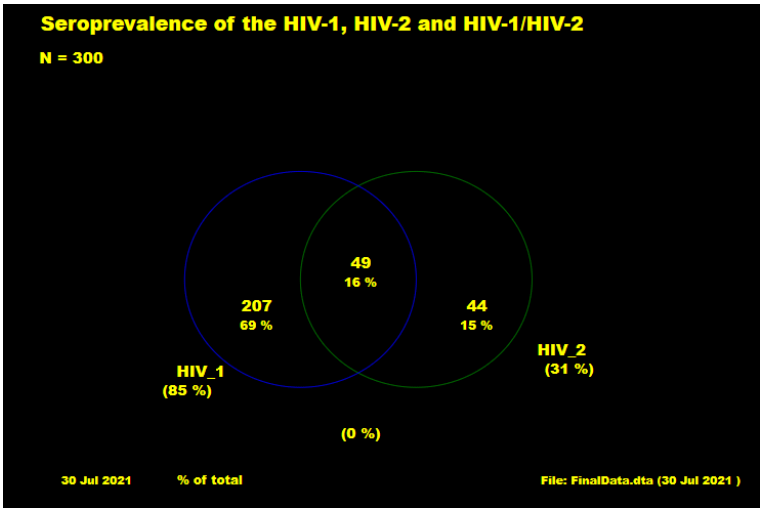

Figure 1. *Sero-Prevalence of HIV types in Njombe and Dar-es-Salaam in Tanzania.*

When the results were categorized by region, Dares Salaam 108 (72%), compared to Njombe 99 (66%), had a higher prevalence of HIV-1 (p=0.26), Njombe 25 (17%) had a higher prevalence of HIV-2 than Dares Salaam 19 (13%), and Njombe region 26 (17%) had a higher prevalence of HIV-1+2 than Dar es Salaam 23 (15%), p=0.64. However, these differences were not statistically significant (Refer to Figure 2).

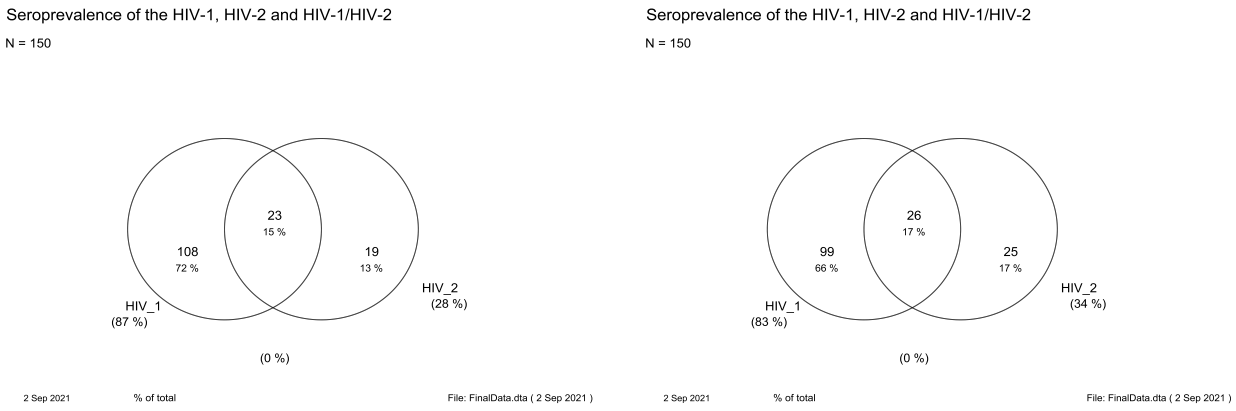

Figure 2. *Regional stratification of HIV-1, HIV-2, and HIV 1+2 seroprevalence.*

3.3. Immunological and Virological Trends of Study Participants with HIV-1, HIV-2, and HIV-1+2 Dual Infections

From the results the participants with HIV-1 had a median (IQR) of 252 (149-497) cells/mL and a mean log10 plasma HIV RNA load of 8.21 (3.3) log10 copies/mL at baseline. For participants with HIV-2, the median (IQR) of the CD4+ T cell count was 133 (86-321) cells/mL and the mean log10 plasma HIV RNA load was 9.26 (3.4) log10 copies/malform those with HIV-1/HIV-2. The median (IQR) of the CD4+ T cell count was 210 (140-362) cells/mL and the mean log10 plasma HIV RNA load was 8.7 (3.6) log10 copies/mL.

Table 2. *Immunological and Virological Trends of Participants with HIV-1, HIV-2, and HIV-1+2 co infection.*

Variable	HIV-1	HIV-2	HIV12	P-value
CD4 cell count, cells/mL				
<350	133 (64.9)	36 (81.8)	36 (73.5)	0.07
>350	72 (35.1)	8 (18.2)	13 (26.5)	
Median (IQR)	252 (149-497)	133 (86-321)	210 (140-362)	0.02
Mean CD4 log_{10}	5.57 (1.2)	5.07 (0.9)	5.28 (0.9)	
VL, copies/mL				
<1000	72 (35.1)	10 (22.7)	16 (32.7)	0.28
>1000	133 (64.9)	34 (77.3)	33 (67.4)	
Median (IQR)	3650 (185-40000)	22010(6810-126205)	9784 (420-122111)	0.16
Mean VL log_{10}	8.21 (3.3)	9.26 (3.4)	(3.6)	

4. Discussion

The study demonstrates the previously unknown co-infection of HIV-2 and HIV 1+2 in Tanzania. Additionally, the Njombe region has a higher frequency than the Dare es Salaam. Furthermore, the study has found high prevalence of HIV-1, HIV-2, and HIV1+2 co- infections. The high prevalence of HIV-2 and HIV-1+2 co-infections was noted among PLHIVs who are young (26-40 years old) and single. The female PLHIVs who had a primary educations and low economic income were more infected with the HIV-2 and HIV 1+2 co infections. The observed results is consistent with the findings of a research by Thandiwe A et al. 2020 in Lusaka, Zambia 2020 that assessed the characteristics, treatment outcomes, and seroprevalence of HIV-1 and HIV-2 patients receiving an HIV-1 ART regimen in conjunction with an NNRTI [19]. Likewise, a study that identified dual infection (12.2%) and HIV-2 (10.3%) in comparison to HIV-1 (6.7%), which was not detected before 2016 [19]. The study's findings demonstrate that HIV-2 and dual infection are present in Tanzania. Therefore, it is important to emphasized the use of the WHO HIV-2 and HIV 1+2 dual infection treatment regimen. The study suggests immediate actions on the management of HIV-2 and HIV1+2 co-infection because of the current high prevalence, similar to HIV-1.

Additionally, the results showed that PLHIVs with HIV-2 and HIV1+2 co-infection had a poor immunological and virological response than those with HIV-1. Since Tanzania has not yet begun using the HIV-2 ART regimen for the treatment of HIV-2 and HIV 1+2, as advised by the WHO, the low CD4 count and high viral load seen can be explained by the use of the HIV-1 ART regimen instead of the HIV-2 ART regimen. Due to their poor response to HIV-1 ART regimen treatment, people with HIV who have dual infections with HIV-2 and HIV-1+2 are at risk for opportunistic infections due to their low CD4 and high viral. [20-23]. These findings were consistent with a comparable cohort study carried out in Senegal by Smith RA et al. in 2019, which found that individuals with HIV-2 and HIV 1+2 dual infections who were on HIV-1 ART regimen had a higher prevalence of OIs and drug resistance than those with HIV-1 [24]. To improve the treatment success for patients with HIV-2 and HIV 1+2 dual infection, mitigating measures for the start of an ART regimen should be implemented.

5. Conclusions and Recommendation

The prevalence of HIV-2 and HIV 1+2 co-infection, which is not well known in Tanzania, was found by the study. Additionally, it was noted that the treatment outcomes for PLHIVs with HIV-2 and HIV 1+2 co infection are unaffected by the administration of the HIV-1 ART regimen. The treatment failure of the HIV-1 ART regimen for PLHIVs infected with HIV-2 and HIV 1+2 dual infections is demonstrated by the decrease in CD4+ T cell counts and the increase in RNA viral load copies among the HIV-2 and dual infection groups. There is a need to raise awareness among doctors, HIV implementers, and policy makers on the existence of HIV-2 and HIV 1+2 co -infections due to unique insights into their existence. In order to improve treatment outcome and management of HIV-2 and HIV 1+2 co-infections the new HIV-2 ART regimen should urgently initiated as recommended by WHO. More studies is required to provide more information on management of HIV-2 and its co- infections.

6. Ethical Consideration

The ethical clearance number KNCHREC 0010 was sought from Kibong'oto Infectious Diseases Hospital, Nelson Mandela African Institution of Sciences and Technology and Center for Education Development in Health Research Committee (KNCREC) and permission to conduct was sough to the Regional Medical officers of Njombe and Dar es salaam where the study conducted. The participants who consented to participate were given written informed consent. Each participant's questionnaire and database was given a unique identification number in order to ensure confidentiality.

Abbreviations

AIDS	Acquired Immune Deficiency Syndrome
ART	Antiretroviral Therapy
HIV	human Immunodeficiency Virus
HVCT	HIV Voluntary Counseling and Test
HCTC	HIV Care and Treatment Centre
THIS	Tanzania HIV Impact Survey
UNAIDS	United Nations AIDS

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Author Contributions

All authors have equal contribution in this study.

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Data Availability Statement

The availability of data from this study is open access to published journal with copy rights from the primary authors of the study

Conflicts of Interest

The authors declare no conflicts of interest.

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Biography

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Research Field

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