

RESEARCH PAPER

A Cross-Sectional Study to Assess the Factors Associated with AIDS-Related Deaths in Tamil Nadu

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ABSTRACT

Introduction: AIDS-related deaths continue to pose a significant public health challenge in India, especially in high-prevalence states like Tamil Nadu. Despite advancements in antiretroviral therapy (ART), factors such as poor adherence, late diagnosis, and high viral load contribute to ongoing mortality among People Living with HIV (PLHIV). This study aims to assess the socio-demographic, clinical, and treatment-related factors associated with AIDS-related deaths in Tamil Nadu.

Methods: A cross-sectional study was conducted over three months at the ART Centre of Government Tuticorin Medical College, Tamil Nadu. Secondary data were collected for 56 deceased PLHIV whose deaths were attributed to AIDS between 2021 and 2023. Data included demographic variables, ART regimen, clinical staging, adherence levels, CD4 count, viral load, and follow-up status. Descriptive analysis and chi-square tests were used to identify associations.

Results: Most deaths occurred among males (71.4%) and in the 41–50-year age group (35.7%). A significant number of patients were diagnosed at advanced clinical stages (Stage 3: 25%, Stage 4: 26.8%). ART adherence was poor in 44.6% of cases, and 80.4% of patients had a viral load >1000 while on ART. CD4 count was <250 in 53.6% of patients. Regular follow-up was associated with better adherence ($p < 0.001$), lower viral load ($p = 0.001$), and higher CD4 count ($p = 0.042$).

Conclusion: Late clinical presentation, high viral load, and poor adherence to ART are major contributors to AIDS-related deaths in Tamil Nadu. Strengthening early diagnosis, improving adherence through counselling and monitoring, and enhancing regular follow-up mechanisms are critical to reducing HIV-related mortality. These results can guide future plans and regulations aimed at enhancing the survival and quality of life of PLHIV in high-burden environments.

Keywords: HIV, AIDS-related mortality, Tamil Nadu, ART adherence, Viral load, CD4 count, PLHIV, Follow-up, AIDS death, public health.

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INTRODUCTION

Human Immunodeficiency Virus (HIV) and acquired immunodeficiency syndrome (AIDS) continue to represent significant global public health challenges. Since the epidemic's onset in 1981, HIV/AIDS has caused over 40 million deaths globally, with 630,000 AIDS-related deaths reported in 2022 alone. Although the availability of antiretroviral therapy (ART) has substantially reduced mortality, disparities persist, particularly in low- and middle-income countries. According to UNAIDS, by 2023, only 75% of people living with HIV (PLHIV) globally were receiving ART, with significant gaps in adherence, followup, and timely diagnosis still evident [1].

In India, an estimated 58,960 AIDS-related deaths were recorded in 2019. Tamil Nadu remains one of the six high-prevalence states, with over 1.4 lakh PLHIV and a prevalence rate higher than the national average [2].

Despite improved awareness, challenges such as social stigma, late diagnosis, and poor follow-up hinder progress. Prior studies have shown that AIDS-related mortality is closely associated with clinical stage at diagnosis, viral load, CD4 count, and adherence to ART. Moreover, studies in other high-burden states and urban centres like Mumbai have highlighted that deaths frequently occur in individuals not effectively retained in care or those who begin treatment in late stages.

In light of these findings, there is a need to assess these factors specifically within the Tamil Nadu context to guide targeted interventions. This study was conducted to evaluate socio-demographic, clinical, and treatment-related factors associated with AIDS-related deaths using secondary data from an ART Centre in Tuticorin. The hypothesis tested was that poor ART adherence, high viral load, and late clinical staging significantly contribute to

AIDS-related mortality. This work seeks to build upon and localize existing national and global findings, thereby offering insights for improving PLHIV outcomes in Tamil Nadu and similar settings [3].

MATERIALS AND METHODS

Study Design and Setting: This was a cross-sectional, descriptive study conducted over a three-month period at the Antiretroviral Therapy (ART) Centre of Government Tuticorin Medical College, Tamil Nadu, India. The objective was to assess the factors associated with AIDS-related deaths among People Living with HIV (PLHIV) using retrospective secondary data collected from 2021 to 2023.

Participants Selection and Description: The study population consisted of deceased PLHIV whose cause of death was confirmed to be AIDS-related based on medical records and death certificates. Inclusion criteria were: (1) individuals diagnosed with HIV who had died during the study period, and (2) deaths explicitly attributed to AIDS with full documentation. Exclusion criteria included: (1) PLHIV who died due to causes unrelated to AIDS, and (2) cases lacking complete records or confirmed cause of death.

A total of 56 deceased PLHIV cases meeting the inclusion criteria were included. The population comprised 40 males (71.4%), 15 females (26.8%), and 1 transgender individual (1.8%).

Data Collection: Data were extracted from ART centre records, medical case sheets, death certificates, and interviews with health professionals familiar with the

clinical course of the patients. Variables included age, gender, ART regimen, clinical staging, adherence level, follow-up status, CD4 count, viral load (pre- and on-ART), cause and place of death, and partner’s HIV status.

This study did not involve any laboratory-based procedures, cell lines, or animal models. Hence, no DNA/RNA quantification, protein assays, or in vivo experimental protocols were employed.

Statistical Methods: Data were entered and analysed using IBM SPSS Statistics version 23. Descriptive statistics were used to summarize demographic and clinical data. Chi-square tests were employed to evaluate associations between categorical variables such as viral load, CD4 count, ART adherence, clinical staging, and follow-up status. A p-value < 0.05 was considered statistically significant. Measures of variability and distribution were presented alongside frequency distributions.

Ethical Considerations: The study was approved by the Institutional Ethics Committee of Government Tuticorin Medical College (IEC Approval No: IEC/GTMC/2023/021). The study adhered to the ethical principles outlined in the Declaration of Helsinki (2013 revision). As secondary data were used, informed consent was waived.

No artificial intelligence or assisted technology tools were used in data collection or analysis.

RESULTS AND DISCUSSION

Table 1: Socio-demographic Profile

Variables	Frequency (N=56)	Percent	
Age	21-30	4	7.1
	31-40	13	23.2
	41-50	20	35.7
	51-60	13	23.2
	61 and above	6	10.7
Gender	Female	15	26.8
	Male	40	71.4
	Transgender	1	1.8

Figure 1&2 illustrates socio-demographic profile. Table 1 shows that out of 56 AIDS deaths, 4 (7.1%) deaths were in the age group of 21-30 years, 13 (23.2%) were in the age group of 31-40 years, majority of deaths occurred in the age group of 41-50 years, which comprises 20 (35.7%),

13(23.2%) deaths were in the age group of 51-60 years and 6 (10.7%) deaths were in the age group of 61 and above. In the male population, 40 (71.4%) PLHIV died, and 15 (26.8%) deaths were in female population and only 1(1.8%) death was from the transgender population.

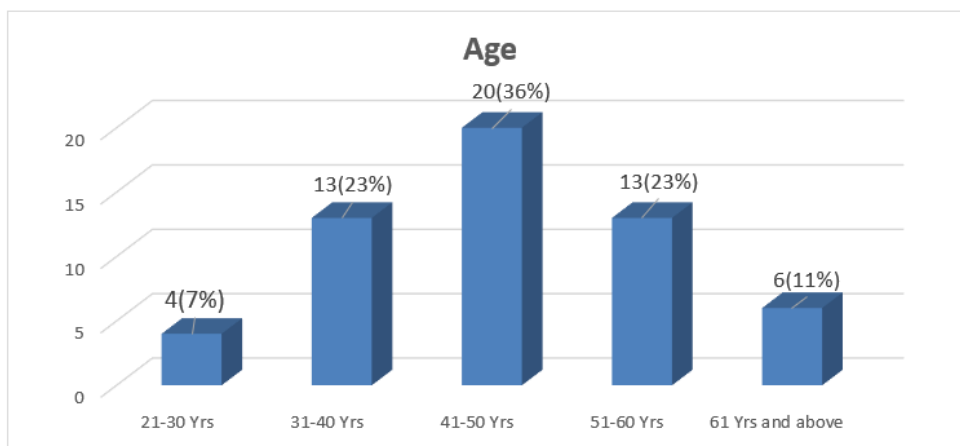


Figure 1: Age wise distribution of study participants

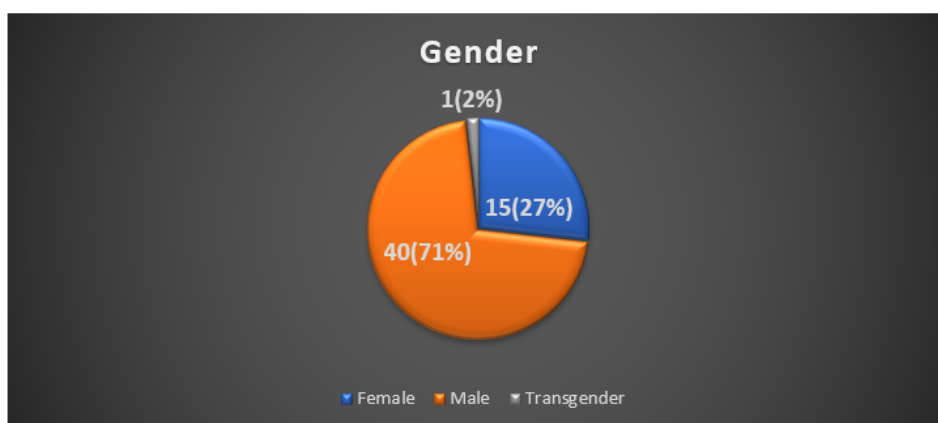


Figure 2: Gender wise distribution of study participants

Table 2: Treatment Status of PLHIV

Variables		Frequency (N=56)	Percent
Clinical Staging	Stage 1	5	8.9
	Stage 2	6	10.7
	Stage 3	14	25
	Stage 4	15	26.8
	NA	16	28.6
ART Regimen	TLD	49	87.5
	ZLE	2	3.6
	DTG	5	8.9
Adherence to ART Regimen	Poor	25	44.6
	Good	26	46.4
	New	5	8.9
Follow up Status	Regular	22	39.3
	Irregular	18	32.1
	Lost to Follow up (LFU)	11	19.6
	New	5	8.9

Table 2 shows that before death majority of the clients were in the 4th clinical stage which comprises 15 (26.8%) next to that clinical stage 3 which comprises 14 (25%). 6 (10.7%) of the PLHIV were in stage 2 and 5 (8.9%) were in stage 1. TLD is a widely used regimen combination which was taken by 49 (87.5%) PLHIV, next to that DTG regimen combination used by 5 (8.9%) and ZLE regimen combination were used by only 2 (3.6%) people. 26 (46.4%) had good adherence to ART regimen and 25

(44.6%) had poor adherence to ART regimen and 5 (8.9%) were new cases so their adherence was not checked. Majority of the PLHIV kept their regular follow up which comprises 22 (39.3%) and 18 (32.1%) were in irregular follow-up, 11 (19.6%) were considered as LFU (Lost to follow up) clients and 5(8.9%) clients are newly registered. (Figure 3-6)

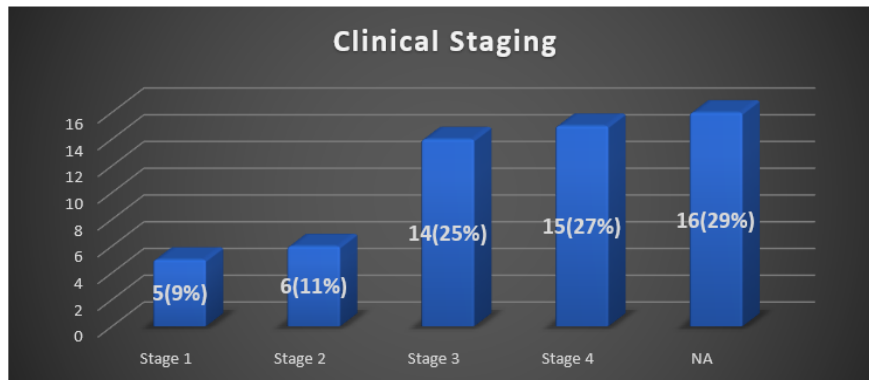


Figure 3: Distribution of Clinical Staging of PLHIV

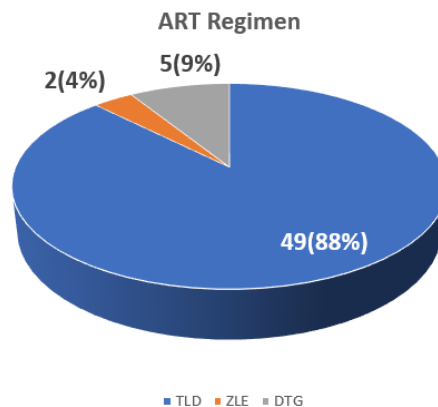


Figure 4: Distribution of ART Regimen of PLHIV

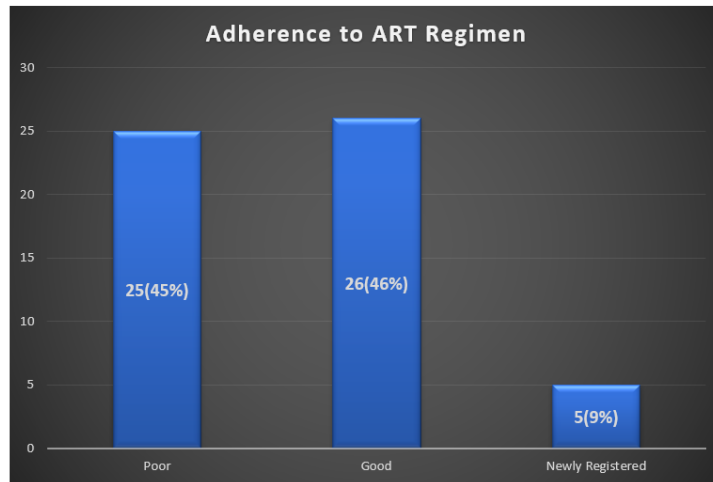


Figure 5: Adherence to ART Regimen of PLHIV

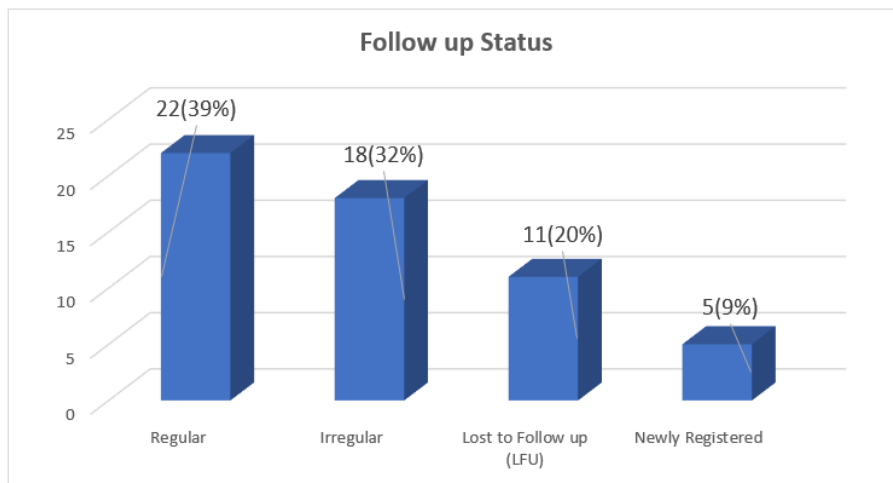


Figure 6: Follow Up Status

Table 3: Laboratory Test regarding Viral load and CD4 count for PLHIV

Variables		Frequency (N=56)	Percent
Pre- ART Viral load	Less than 1000	18	32.1
	More than 1000	38	67.9
On ART Viral Load	Less than 1000	11	19.6
	More than 1000	45	80.4
Last CD4 Count	Less than 250	30	53.6
	More than 250	26	46.4
Last Viral Load count	TND	27	48.2
	Less than 1000	4	7.1
	More than 1000	10	17.9
	NIL	15	26.8

Table 3 shows the CD4 and Viral counts of the PLHIV that died. Among 56 clients at their pre-ART state, majority of them had more than 1000 copies of viral load which comprises 67.9% and 32.1% PLHIV had less than 1000 copies of viral load. When checked for people who were on ART, the viral load was less than 1000 for 19.6% and

80.4% had more than 1000. The last CD4 count for the PLHIV was less than 250 for 53.6% and, more than 250 for 46.4%. The last viral load count was TND (Target not detectable) for 48.2%, less than 1000 for 7.1%, more than 1000 for 17.9% and no viral load count for 26.8%. (Figure 7-10)

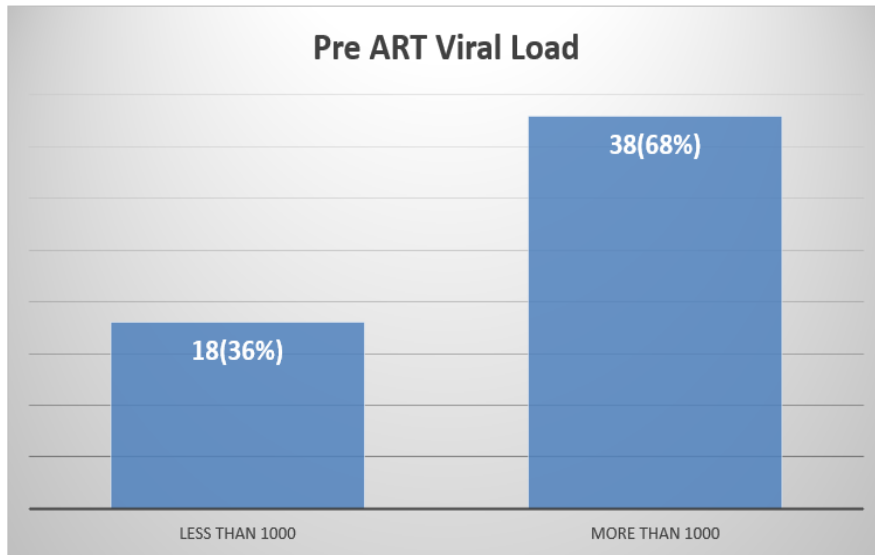


Figure 7: Pre - ART Viral Load

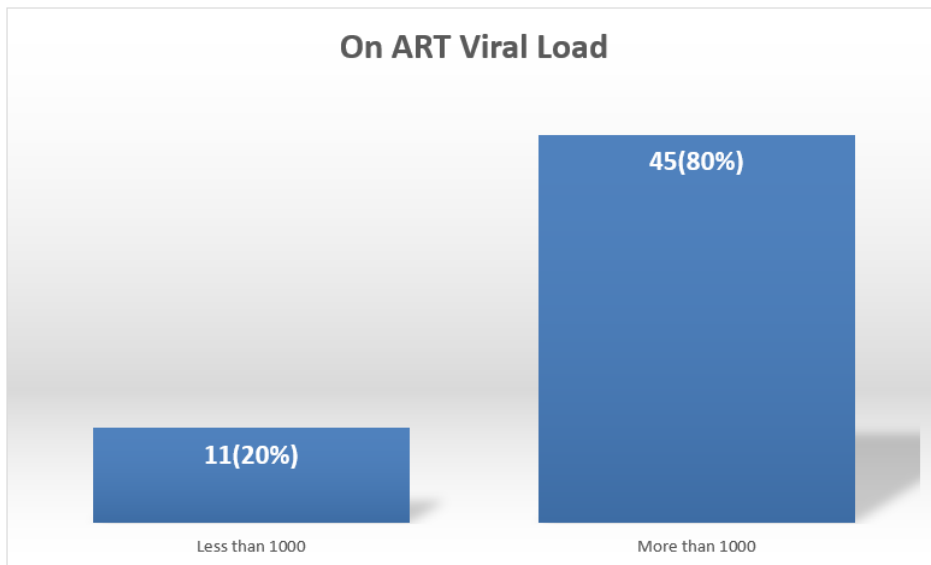


Figure 8: On ART Viral Load

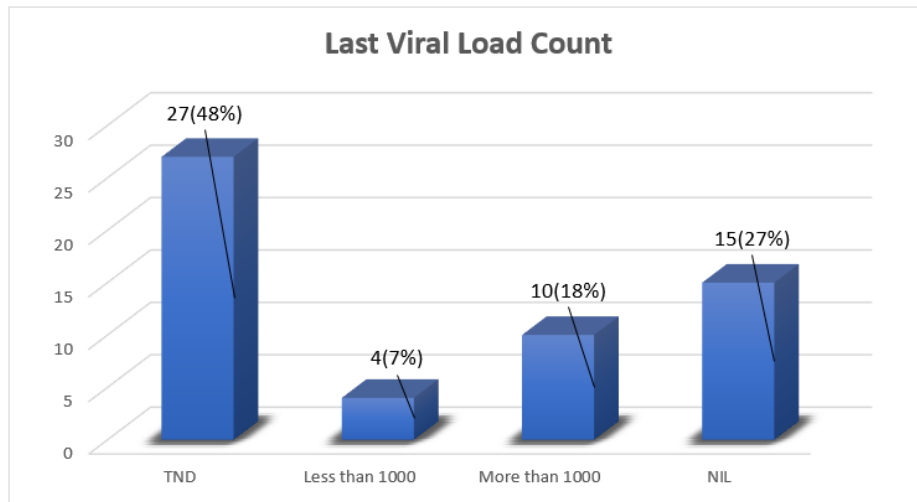


Figure 9: Last Viral Load Count

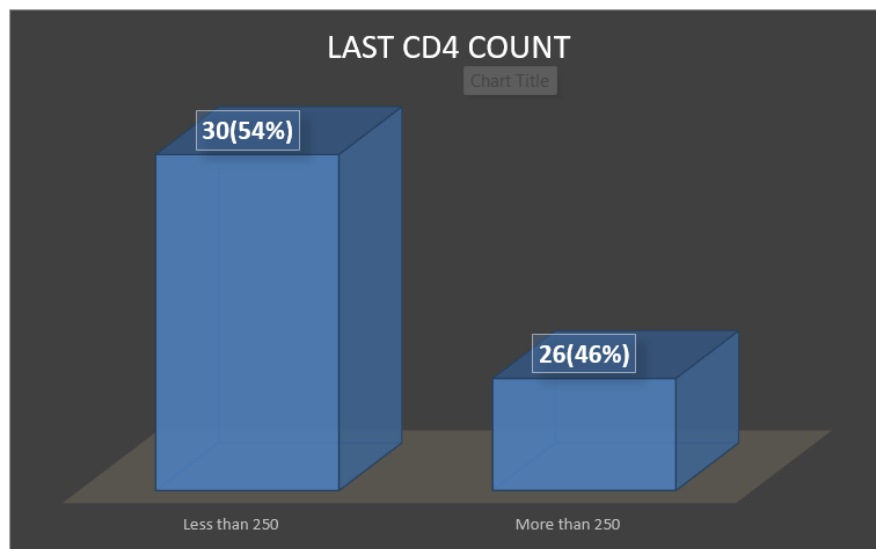


Figure 10: Last CD4 Count

Table 4: Marital and HIV Status of Partners of PLHIV

	Variables	Frequency(N=56)	Percent
Partner Status	On ART	20	35.7
	Negative for HIV	11	19.6
	Unknown	6	10.7
	Separated/Unmarried	9	16.1
	Died	10	17.9

Table 4 and Figure 11 show that 35.7% of partners were on antiretroviral therapy (ART), 19.6% were HIV negative, and 10.7% had no information. 16.1% of PLHIV were single or separated, and 17.9% of them passed away.

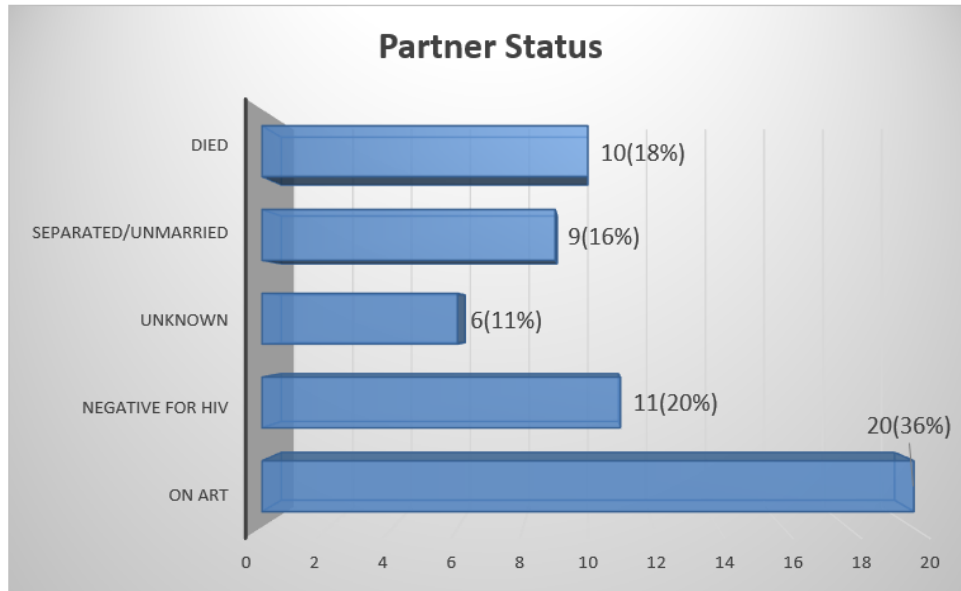


Figure 11: Partner Status

Table 5: Cause and place of Death of PLHIV

Variables		Frequency(N=56)	Percent
Cause of Death	Liver Disease	8	14.3
	Cardiac Disease	7	12.5
	Renal Disease	3	5.4
	Respiratory Disease	11	19.6
	Psychological	5	8.9
	Other	5	8.9
	Diabetes	1	1.8
	NA	16	28.6
Place of Death	Home	25	44.6
	Hospital	24	42.9
	NA	7	12.5
Death informed	Family	19	33.9
	DIC	9	16.1
	ORW	15	26.8
	NGO	9	16.1
	TB cell	4	7.1

AIDS-related causes of mortality were 14.3%, heart-related causes were 12.5%, renal-related causes were 5.4%, lung-related causes were 19.6%, psychiatric factors were 8.9%, diabetes was 1.8%, and other causes were 8.9% [4,5]. The majority of them (44.6%) passed away at

home, which was somewhat similar to the hospital death rate (42.9%). The majority of deaths were reported by family members (33.9%), DIC (16.1%), ORW (26.8%), NGO (16.1%), and TB cells (7.1%). (Table 5, Figure 12-14)

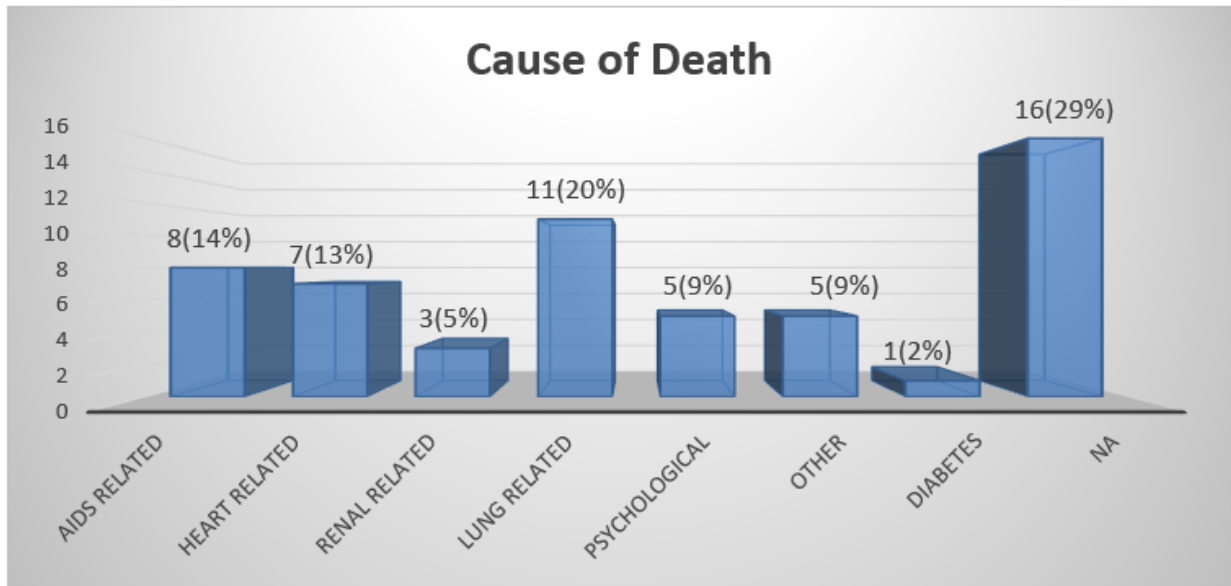


Figure 12: Cause of Death

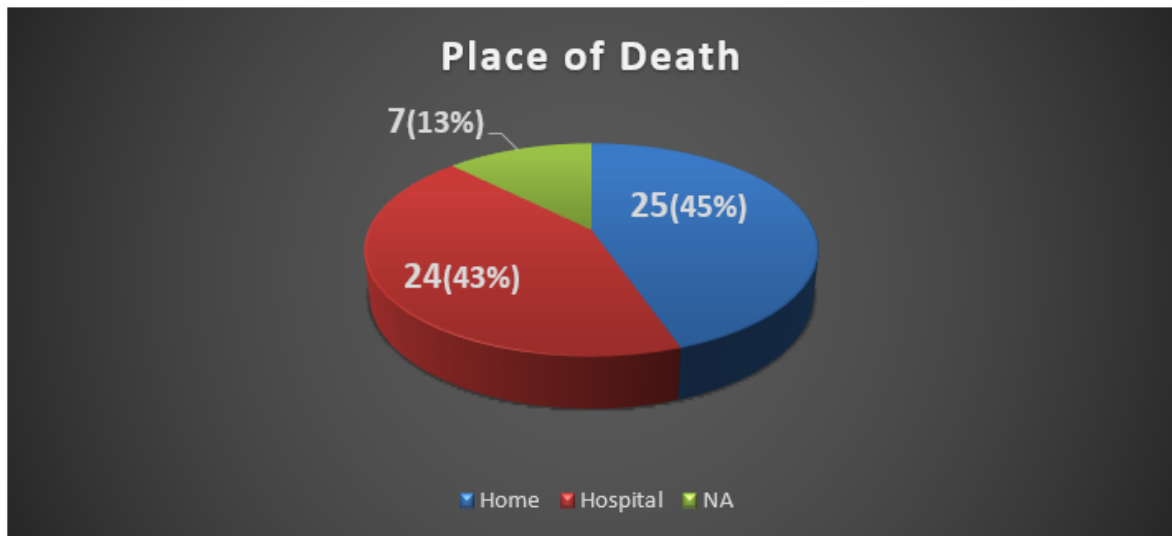


Figure 13: Place of Death

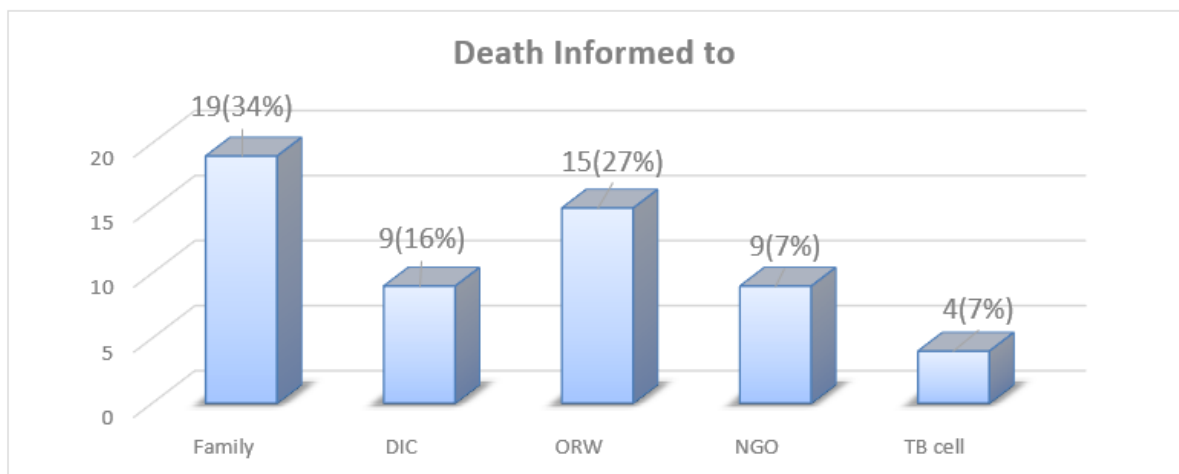


Figure 14: Death informed by

Chi Square Analysis

Table 6: Association between Pre ART viral load and On ART viral load

Variables		Viral load on ART (N=56)			
		Less than 1000	More than 1000	Chi Square Value	Asymptotic Significance
Viral load pre-ART	Less than 1000	11(19.7%)	7(12.5%)	28.899	0.00
	More than 1000	0	38(67.8%)		
Total		11(19.7%)	45(80.3%)		

Table 6 shows that there is a statistically significant association between the viral load of PLHIV prior to receiving ART and the viral load of PLHIV on ART. It can also be seen that majority who had a viral load of more than 1000 pre-ART also had a similar amount of viral load on ART.

Table 7: Association between Follow Up status and the adherence to ART Regimen

Variables		Adherence to ART Regimen (N=56)				
		Poor	Good	New	Chi Square Value	Asymptotic Significance
Follow Up Status	Regular	0	22(39%)	0	97.021	0.00
	Irregular	15(27%)	3(5%)	0		
	Lost to Follow up (LFU)	10(18%)	1(2%)	0		
	New	0	0	5(9%)		
Total		25(45%)	26(46%)	5(9%)		

Table 7 shows that there is a statistically significant association between the follow up status of the PLHIV and their adherence to the ART regimen they followed. It also shows that most people who had a regular follow up status had a good adherence to the ART regimen.

Table 8: Association between Pre ART viral load and the last CD4 count

Variables		Last CD4 Count (N=56)			
		Less than 250	More than 250	Chi Square Value	Asymptotic Significance
Viral load pre-ART	Less than 1000	6(10.7%)	12(21.4%)	4.368	0.048
	More than 1000	24(42.9%)	14(25%)		
Total		30(53.6%)	26(46.4%)		

Table 8 shows that there is a statistically significant association between the viral load of the PLHIV pre-ART and their last CD4 count before their death. It can also be seen that majority of the people who had a viral load of more than 1000 pre-ART also had a CD4 count which was less than 250.

Table 9: Association between On ART viral load and the last CD4 count

Variables		Last CD4 Count (N=56)			
		Less than 250	More than 250	Chi Square Value	Asymptotic Significance
Viral load on ART	Less than 1000	1(1.8%)	10(17.9%)	10.889	0.001
	More than 1000	29(51.8%)	16(28.6%)		
Total		30(53.6%)	26(46.4%)		

Table 9 shows that there is a statistically significant association between the viral load of PLHIV on ART and

their last CD4 count. It also shows that most people who had a viral load of more than 1000 on ART had a CD4 count of less than 250 prior to their death.

Table 10: Association between Follow Up status and last Viral load count

Variables		Last Viral Load Count (N=56)				Chi Square Value	Asymptotic Significance
		TND	Less than 1000	More than 1000	NIL		
Follow Up Status	Regular	14(25%)	3(5.4%)	4(7.1%)	1(1.8%)	27.112	0.001
	Irregular	9(16.1%)	0	5(8.9%)	3(5.4%)		
	Lost to Follow up (LFU)	1(1.8%)	0	1(1.8%)	9(16.1%)		
	New	3(5.4%)	0	0	2(3.6%)		
Total		27(48.2%)	4(7.1%)	10(17.9%)	15(26.8%)		

Table 10 shows that there is a statistically significant association between the follow up status of the PLHIV and their last viral load count. It also shows that majority of the PLHIV who had a regular follow up status, their viral load count showed TND (Target not detectable) on test.

Table 11: Association between Clinical Stage and the Last CD4 count

Variables		Last CD4 Count (N=56)		Chi Square Value	Asymptotic Significance
		Less than 250	More than 250		
xClinical Stage	Stage 1	1(1.8%)	4(7.1%)	9.917	0.042
	Stage 2	1(1.8%)	5(8.9%)		
	Stage 3	8(14.3%)	6(10.7%)		
	Stage 4	12(21.4%)	3(5.4%)		
	NA	8(14.3%)	8(14.3%)		
Total		30(53.6%)	26(46.4%)		

Table 11 shows that there is a statistically significant association between the clinical stage of the PLHIV and their last CD4 count. It can also be seen that most people who were in stage 4 had a CD4 count which was less than 250 prior to their death.

CONCLUSION

This cross-sectional study identified several key factors associated with AIDS-related deaths among PLHIV in Tamil Nadu. The majority of deaths occurred in males and in the 41–50-year age group, with most individuals diagnosed at advanced clinical stages. Poor ART adherence, high viral load levels both before and during treatment, and low CD4 counts were common among the deceased, highlighting critical gaps in timely diagnosis, treatment initiation, and follow-up care.

Frequent follow-up was strongly linked to greater CD4 counts, reduced viral loads, and increased ART adherence, highlighting the significance of ongoing care. Despite the widespread use of the TLD regimen, many individuals failed to achieve viral suppression, suggesting the need for enhanced adherence counselling and monitoring strategies. Limitations including reliance on secondary data and potential recall bias highlight the need for future prospective and multicentric research to validate and build upon these findings, even though they provide insightful information about AIDS mortality in a high-burden

situation. Further research exploring psychosocial, behavioural, and healthcare access factors will also be essential to develop comprehensive, patient-centred interventions.

We recommend that other researchers investigating HIV mortality in similar settings consider integrating both quantitative and qualitative approaches to gain a holistic understanding of care gaps. Strengthening routine viral load testing, ensuring earlier HIV diagnosis, and enhancing ART adherence through targeted community outreach and digital follow-up tools can play a pivotal role in reducing AIDS-related deaths.

Ultimately, this study reinforces the urgent need to scale up strategies that support long-term retention in HIV care and treatment—thereby contributing to national and global efforts in achieving zero AIDS-related deaths.

Declarations and Final Statements

Conflict of Interest: The authors declare that they have no conflict of interest to disclose.

Ethics Approval: This study was conducted in accordance with the Declaration of Helsinki (as revised in 2013), and the protocol was reviewed and approved by the Institutional Ethics Committee of Government Tuticorin Medical College, Tamil Nadu (Approval No: IEC/GTMC/2023/021).

Informed Consent: As this study utilized de-identified secondary data of deceased individuals, informed consent was waived by the Institutional Ethics Committee. No direct involvement of human participants occurred during the study.

https://naco.gov.in/sites/default/files/Facts_figure_page.pdf [Accessed 2024-06-01]

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Data Availability Statement: The datasets generated and/or analysed during the current study are not publicly available due to confidentiality agreements with the ART Centre and TANSACS but are available from the corresponding author on reasonable request.

Artificial Intelligence Disclosure: No artificial intelligence or AI-assisted technologies were used in the preparation, writing, analysis, or figure generation for this manuscript.

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