Vol-3 Issue-1 2025
Scientific Research Journal of Medical and Health Science
ISSN: 2584-1521, Peer Reviewed Journal

Impact of Antiretroviral Therapy on AIDS-Related Mortality in Nigeria: A Longitudinal Study (2010-2023)

Author: Uthman Olalekan Al-Ameen

Department of Environmental Health Sciences, Faculty of Public Health, University of Ibadan, Oyo State, Nigeria.

Email id: uthmanolanase01@gmail.com

Abstract
Background: AIDS-related death continues to be a significant public health challenge in Nigeria. The availability of Antiretroviral Therapy has altered the prevalence of HIV/AIDS from a fatal disease to a manageable disease all over the world. This research examines the effect of Antiretroviral Therapy (ART) coverage on AIDS-related death in Nigeria for the year 2010-2023. The study aimed to assess the correlation between ART coverage and AIDS-related death in Nigeria.
Methods: This research employs the secondary data analysis research method. ART coverage and AIDS-related death statistics from the year 2010 to 2023 were obtained from UNAIDS
Results: The calculated correlation between ART coverage and AIDS-related death in Nigeria was statistically significant and negative, with Pearson correlation coefficient r = - 0.976. This shows that, with improving ART coverage, AIDS-related death is reduced.
This study established a perfect negative relationship between ART coverage and AIDS-related death in Nigeria for the years 2010-2023 with a Pearson correlation coefficient (r) of (-0.976).
Conclusion: The results of this study point to the fact that ART is helpful in the reduction of AIDS-related deaths in Nigeria. HIV treatment using ART must continue to increase through enhanced health systems to ensure better delivery of services and through targeted interventions that will further reduce AIDS-related deaths and improve the overall health of the population.

Keywords: Antiretroviral Therapy, Human Immunodeficiency Virus (HIV), Acquired Immunodeficiency Syndrome (AIDS), Mortality, Nigeria.

Introduction

The Human Immunodeficiency Virus (HIV) and Acquired Immunodeficiency Syndrome (AIDS) remain one of the most critical threats to global public health. Although HIV/AIDS incidence has continued to decline and the availability of treatment has improved over the years, HIV/AIDS remains a significant epidemic, especially in sub-Saharan Africa. According to HIV and AIDS Epidemic Global Statistics, 2023, Nigeria is among the countries most affected by the HIV epidemic, having one of the most significant numbers of HIV-positive people [1, 2].
As highlighted by earlier research studies in Uganda, HIV prevalence varies across sub-national regions [3], as well as in Nigeria and South Africa [4]. Multiple partnerships, poor health services, educational frameworks, migration patterns, sex work, and poverty largely explain the high HIV prevalence in Nigeria's Niger Delta.
New research shows that in HIV-positive women, the relative fertility reduction is higher with more prolonged HIV infection [6]. People who previously underwent HIV testing and were found positive may fear stigma, rejection, or discrimination if others find out their HIV status [7, 8]. Antiretroviral therapy involves the use of a combination of one or more antiretroviral drugs aimed at reducing viral load and inhibiting HIV replication in the body, thereby allowing the immune system to recover and regain

strength. This treatment has been shown to improve the quality of life, increase the life expectancy of HIV-positive patients, and also prevent the spread of the disease to other individuals [9, 10].
Antiretroviral treatment (ART) has transformed a virtually fatal HIV infection into a chronic disease that needs lifelong management [11]. In recent years, global access to ART has significantly improved. Besides the impact of prolonging the lives of people on ART, it also decreases the risk of transmission of HIV to other uninfected individuals [12, 13].
Noncompliance also has public health implications because the emergence of resistant strains leaves newly infected patients with few therapeutic choices [14, 15].
Effective and efficient follow-up and referral to care is crucial after an HIV diagnosis [16, 17].
Antiretroviral Therapy has brought a significant change in the management of HIV/AIDS from being a death sentence to a chronic disease. According to [18], ART functions by reducing viral replication, and enhancing the immune system of persons with HIV. This results in a decrease in opportunistic infections, improved quality of life, and an increased lifespan. Accessibility and availability of ART have shifted the HIV/AIDS epidemic significantly globally, with decreased AIDS-related deaths. Various studies have shown that ART has significantly improved morbidity and mortality of the People living with HIV and is one of the key components of HIV/AIDS care and treatment interventions.
Because ART has been effective in decreasing AIDS-related deaths, such treatment is crucial for public health measures. ART also helps to reduce viral load, thereby decreasing the chances of HIV transmission and improving the quality of life of the individuals affected by HIV. As demonstrated in [18], this two-fold utility of ART makes the intervention useful both in the clinical management of patients and in the population-level containment of the epidemic. According to WHO, ART should be initiated for all HIV-positive patients irrespective of the CD4 count, given its importance in meeting the targets of HIV/AIDS worldwide.
The implementation of ART programs in Nigeria is, therefore, a key focus of the national HIV/AIDS control strategies. Nevertheless, some challenges persist in reaching as many people as possible with ART who might need it. Some of the challenges include the limited number of centers offering ART, minimal funding to support the program, and general organizational hurdles in implementing ART, especially in rural regions [19]. It is essential to understand how the coverage of ART influences AIDS-related deaths in Nigeria in an endeavour to recommend policies as well as to develop the appropriate strategies for the use of ART.
The overall objective of this study is to assess the relationship between ART coverage and AIDS-related death in Nigeria for the period 2010-2023. Specifically, the research question guiding this study is: How has ART coverage affected AIDS-related deaths in Nigeria from 2010 to 2023. This study aims to test the relationship between these two variables to generate evidence in support of the success of ART in reducing AIDS-related deaths in Nigeria and to establish measures that can be employed to enhance ART uptake among the affected populations.

Materials and Methods

This research adopts a longitudinal research method, which involves secondary data analysis. Data on AIDS-related deaths and the number of persons on ART were sourced from the UNAIDS, an international source of HIV/AIDS information.
The following are the benefits of using the secondary data from UNAIDS: Data quality, Data reliability, and Data comparability.
UNAIDS gathers data from surveys, questionnaires, and governmental and non-governmental organizations and maintains high data standards. This, in turn, helps to make the data used in this study credible and reflective of what is happening in Nigeria.
Two key variables were analyzed:
AIDS-related deaths: The mean rate of AIDS-related deaths in Nigeria for the years 1990 to 2023 was obtained from the annual data. The broader range of mortality data (1990–2023) provides valuable

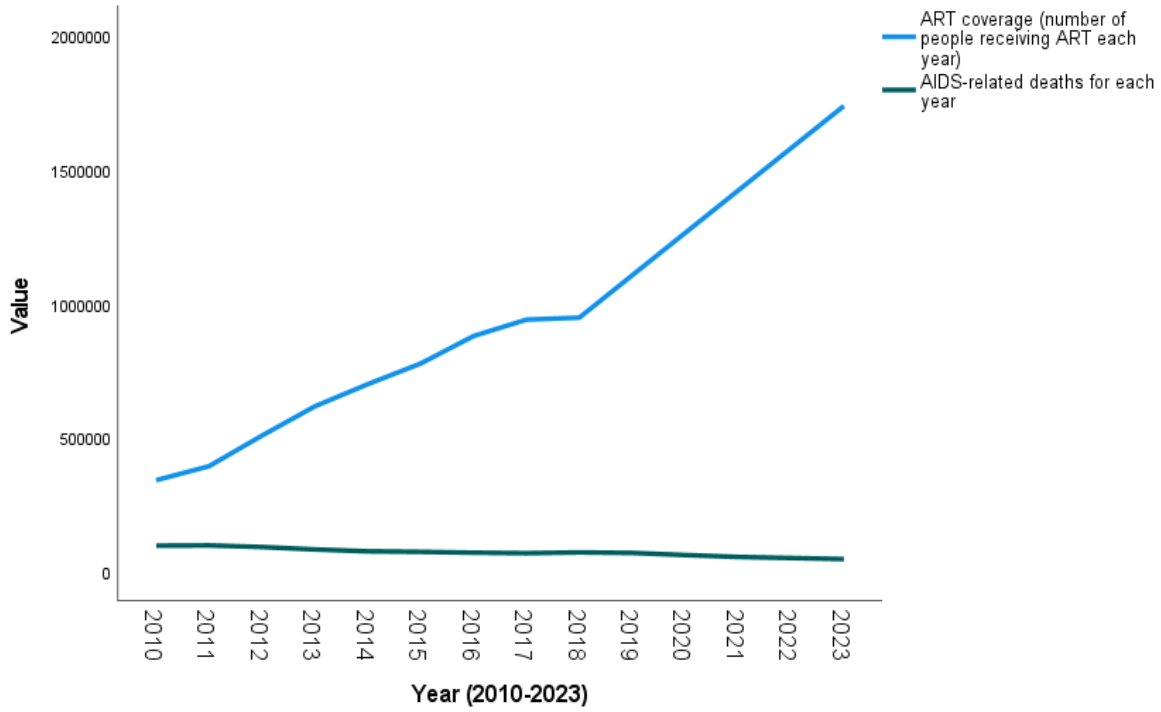
context for understanding the effects of ART, even though only the period from 2010 to 2023 was analyzed.
People receiving ART: Data on the number of people receiving ART in Nigeria from 2010 to 2023 was obtained to provide insights into the scale of ART implementation during this period.
This period corresponds with the era of massive scale-up of ART in Nigeria and is the focus of this evaluation.
UNAIDS (2024) provides annual data on ART coverage and AIDS-related deaths in Nigeria from 2010 to 2023.
Figure 1: Trends in ART Coverage and AIDS-related Deaths in Nigeria (2010-2023)

Years	ART Coverage	AIDS-related Death
2010	95000	339343
2011	96000	391443
2012	90000	505489
2013	81000	614737
2014	74000	697559
2015	72000	774525
2016	69000	877132
2017	67000	938411
2018	70000	945874
2019	68000	1103969
2020	60000	1261955
2021	53000	1419941
2022	49000	1577926
2023	45000	1735808

All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences), version 27.0.
Pearson Correlation Analysis: To examine the association between ART coverage and AIDS-related deaths in Nigeria during the years 2010–2023, Pearson's coefficient of correlation (r) was applied. This type of statistical technique quantitatively determines the extent to which two variables measured on the interval scale are related and the direction of the relationship. A positive correlation will show that the variables are likely to increase and decrease simultaneously. In contrast, a negative correlation will show that the variables are likely to go opposite directions – that is, if one variable increases, the other decreases. A correlation coefficient equal to -1 indicates that the variables have a perfect negative correlation, while a +1 means there is a perfect positive correlation, and 0 means no correlation.

Results

The findings showed that there was a negative correlation between ART coverage and AIDS-related death in Nigeria for the years 2010-2023. Pearson correlation analysis gave values of - 0.976 and $p < 0.001$, showing that the two variables are significantly negatively related. This discovery indicates that when more people receive ART, there are likely to be fewer AIDS-related deaths.
Figure 2: Line graph of ART coverage and AIDS-related deaths over time from 2010 to 2023. Both variables are plotted on the same Y-axis (ranging from 0 to 2,000,000) against the years on the X-axis."



Discussion

As shown in Figure 2, the line graph illustrates the trends in ART coverage and AIDS-related deaths from 2010 to 2023. Both variables are represented on the same Y-axis, which ranges from 0 to 2,000,000, while the X-axis represents the years. The above graph also shows a progressive increase in ART coverage over the study period with a concomitant decrease in AIDS-related deaths. This gives a graphical display that supports the negative nature observed in the correlation.

The combined results of the correlation and trend analyses provide compelling evidence for the effectiveness of ART programs in reducing AIDS-related mortality in Nigeria. The strong negative correlation and the observed trends suggest that increasing ART coverage has played a significant role in the decline of AIDS-related deaths over the study period.

The correlation findings above depict that the accessibility and use of ART have a negative relationship with AIDS-related deaths. The implications of this study for public policy and healthcare resource mobilization in Nigeria is that the government must sustain efforts towards the expansion of ART and prompt adherence to treatment regimes among patients.

There are several reasons why such a relationship is observed. The first one is the mediated biological effect of ART. ART enhances the immune system to resist opportunistic diseases that commonly lead to causes of death for HIV-infected persons. ART also reduces the viral load in the population, therefore decreasing HIV transmission rates and AIDS morbidity and mortality rates. This supports the need to expand the use of ART as an indispensable component of both patient management as well as the overarching HIV epidemic containment strategies.

However, any association found in the study should be accompanied by a recognition of the possible confounding factors that could affect the observed relationship. Better access to other forms of health care services apart from ART could probably contribute to reducing mortality.

Increased sensitivity of diagnostic tests, improved control of opportunistic infections such as tuberculosis, and general improvements in health systems can, by themselves, result in better survival outcomes for persons living with HIV. Integrating HIV care with primary health care services as a way of enhancing ART and general health care access has been established to strengthen ART uptake [20].

Genetic factors, socioeconomic factors, behavioural patterns, and demographic transition help explain mortality distribution or trends in a given population or country [21]. Increased funding for HIV/AIDS programs, the government's and other agencies' campaigns to encourage people to test for the virus and to seek treatment, and focused efforts to reach vulnerable populations will lead to lower death rates [22]. Programs that target early diagnosis and linkage to care can significantly reduce mortality by enhancing the timely effect of Antiretroviral Therapy on mortality rates in HIV-positive individuals undergoing tuberculosis treatment [23]. Likewise, interventions aimed at targeting stigma and discrimination enhance treatment adherence and overall health [24]. Socioeconomic factors can also modulate ART coverage and mortality rate in a more rounded manner [25].

The policy implication of the study is that it provides empirical evidence on HIV/AIDS policy and program implementation in Nigeria. The negative association between ART coverage and mortality in the current study reaffirms the call for increased funding for ART expansion and access for everyone. Pregnant women and key populations require special attention, and ART programs should be directed to achieve these goals [26]. In addition, health systems need to be enhanced for better training of healthcare workers to address practical challenges that hinder the use of ART and to realize maximal yield from it.

Conclusion

This study establishes the life-saving influence that ART has had in decreasing AIDS-related mortality across Nigeria between the years 2010 and 2023. The negative coefficient ($r = -0.976$, $p < 0.001$) confirms that AIDS-related deaths have decreased while ART coverage has improved. During the study period, there was a gradual increase in the availability of ART, which was proven to have significantly reduced causes of death as a result of HIV/AIDS.

This process works by boosting immunity, decreasing the viral load, and preventing the onset of other infections, which in turn would increase the life span and quality of life of people who are infected with HIV. All these benefits make ART an important tool in patient management and in the control of the epidemic. However, the author is aware of other interfering factors that could also lead to a decline in mortality such as an increase in the overall healthcare services offered, better diagnostic methods, and other improvements within the health system that may affect mortality.

The policy implications are clear. Consequently, continued efforts to scale up treatment with ART are crucial. This includes addressing issues such as inadequate funding, lack of access to healthcare, especially in rural areas, and stigma-related issues. The following steps should be the combination of ART delivery with primary healthcare and focusing on the patients who are at risk of being left behind. Future studies should focus on understanding the role of socioeconomic factors and other predictors, which will aid in developing more effective ART interventions, thereby enhancing the impact of ART programs in Nigeria.

The limitation of this study is that it provides Nigeria-specific results, and therefore, may not be generalizable to other countries with different health systems or epidemic patterns.

The study recommends that the government and stakeholders provide ART and make it more accessible to the people, especially in rural areas, and that ART services be incorporated into primary healthcare.

Conflict of interest:

The author declares no conflict of interest

Author contributions:

Uthman Olalekan Al-Ameen is the sole author and contributed to data analysis and manuscript writing

Funding:

This research was self-funded.

Acknowledgments:

The author would like to thank the UNAIDS organization for providing the data set used for the study.

Data Availability:
The data used in this study were obtained from UNAIDS, as detailed in the manuscript. For further information on data access, please refer to UNAIDS at [https://aidsinfo.unaids.org/].

Ethical Approval:
Ethical approval was not required for this study as it involved the use of secondary data.

Patient Consent:
This study did not involve direct interaction with human participants; therefore, patient consent was not applicable.

References

1. HIV.gov. (2023). *Global HIV statistics*. Retrieved November 27, 2024,
2. UNAIDS. (2023). *Global HIV and AIDS statistics*. Retrieved November 27, 2024.
3. Tanser, F., Lesueur, D., Solarsh, G., & Wilkinson, D. (2000). HIV heterogeneity and proximity of homestead to roads in rural South Africa: An exploration using a geographical information system. *Tropical Medicine & International Health*, *5*(4), 40.
4. Odimegwu, C. O., Alabi, O., De Wet, N., & Akinyemi, J. O. (2018). Ethnic heterogeneity in the determinants of HIV/AIDS stigma and discrimination among Nigerian women. *BMC Public Health*, *18*(1), 5668.
5. Ogunmola, O. J., Oladosu, Y. O., & Olamoyegun, M. A. (2014). Relationship between socioeconomic status and HIV infection in a rural setting. *HIV/AIDS - Research and Palliative Care*. Retrieved March 29, 2022
6. Lewis, J. J., Ronsmans, C., Ezeh, A., & Gregson, S. (2004). The population impact of HIV on fertility in sub-Saharan Africa. *AIDS (London, England)*, *18*(Suppl 2), S35–S43.
7. Weiser, S. D., Heisler, M., Leiter, K., et al. (2006). Routine HIV testing in Botswana: A population-based study on attitudes, practices, and human rights concerns. *PLoS Medicine*, *3*(7), e261. https://doi.org/10.1371/journal.pmed.0030261
8. Kalichman, S. C., & Simbayi, L. C. (2003). HIV testing attitudes, AIDS stigma, and voluntary HIV counseling and testing in a black township in Cape Town, South Africa. *Sexually Transmitted Infections*, *79*(6), 442–447.
9. World Health Organization (WHO). (2024, July 22). HIV: Antiretroviral therapy (ART)**.** Retrieved November 23, 2024,
10. UNAIDS. (2024). Global HIV & AIDS statistics — Fact sheet. Retrieved November 23, 2024
11. Swendeman, D., Ingram, B. L., & Rotheram-Borus, M. J. (2009). Common elements in self-management of HIV and other chronic illnesses: An integrative framework. *AIDS Care*, *21*(10), 1321–1334.
12. Cohen, M. S., Chen, Y. Q., McCauley, M., Gamble, T., Hosseinipour, M. C., Kumarasamy, N., et al. (2011). Prevention of HIV-1 infection with early antiretroviral therapy. *The New England Journal of Medicine*, *365*(6), 493–505.
13. Tanser, F., Bärnighausen, T., Grapsa, E., Zaidi, J., & Newell, M. L. (2013). High coverage of ART is associated with a decline in the risk of HIV acquisition in rural KwaZulu-Natal, South Africa. *Science*, *339*(6122), 966–971.
14. Boden, D., Hurley, A., Zhang, L., et al. (1999). HIV-1 drug resistance in newly infected individuals. *JAMA*, *282*(12), 1135–1141.
15. Hecht, F. M., Grant, R. M., Petropoulos, C. J., et al. (1998). Sexual transmission of an HIV-1 variant resistant to multiple reverse-transcriptase and protease inhibitors. *The New England Journal of Medicine*, *339*(5), 307–311.
16. Doherty, M., Ford, N., Vitoria, M., Weiler, G., & Hirnschall, G. (2013). The 2013 WHO guidelines for antiretroviral therapy: Evidence-based recommendations to face new epidemic realities. *Current Opinion in HIV and AIDS*, *8*(6), 528–534.

17. Buh, A., Deonandan, R., Gomes, J., Krentel, A., Oladimeji, O., & Yaya, S. (2022). Adherence barriers and interventions to improve ART adherence in Sub-Saharan African countries: A systematic review protocol. *PLOS ONE*, *17*(6), e0269252. https://doi.org/10.1371/journal.pone.0269252
18. Bassey, A. E., & Miteu, G. D. (2023). A review of current trends in HIV epidemiology, surveillance, and control in Nigeria. Annals of medicine and surgery (2012), 85(5), 1790–1795.
19. O'BRIEN-CARELLI C, STEUBEN K, STAFFORD KA, ALIOGO R, ALAGI M, et al. (2022). Mapping HIV prevalence in Nigeria using small area estimates to develop a targeted HIV intervention strategy. PLOS ONE 17(6): e0268892.
20. Odeny, T. A., Penner, J., Lewis-Kulzer, J., Leslie, H. H., Shade, S. B., Adero, W., Kioko, J., Cohen, C. R., & Bukusi, E. A. (2013). Integration of HIV Care with Primary Health Care Services: Effect on Patient Satisfaction and Stigma in Rural Kenya. *AIDS research and treatment, 2013*, 485715
21. Santosa, A., Wall, S., Fottrell, E., Högberg, U., & Byass, P. (2014). The development and experience of epidemiological transition theory over four decades: a systematic review. *Global health action, 7*, 23574.
22. Adepoju P. (2019). APIN: A history of HIV management in Nigeria. The Lancet. HIV, 6(6), e353.
23. Salomon, A., Law, S., Johnson, C., Baddeley, A., Rangaraj, A., Singh, S., & Daftary, A. (2022). Interventions to improve linkage along the HIV-tuberculosis care cascades in low- and middle-income countries: A systematic review and meta-analysis. *PloS one*, *17*(5), e0267511
24. Klaas, N. E., Thupayagale-Tshweneagae, G., & Makua, T. P. (2018). The role of gender in the spread of HIV and AIDS among farmworkers in South Africa. *African Journal of Primary Health Care & Family Medicine*, *10*(1), e1–e8.
25. Burkey, M. D., Weiser, S. D., Fehmie, D., Alamo-Talisuna, S., Sunday, P., Nannyunja, J., Reynolds, S. J., & Chang, L. W. (2014). Socioeconomic determinants of mortality in HIV: evidence from a clinical cohort in Uganda. *Journal of Acquired Immune Deficiency Syndromes (1999)*, *66*(1), 41–47.
26. Ibiloye, O., Decroo, T., Masquillier, C., Jwanle, P., Okonkwo, P., van Olmen, J., Lynen, L., & Van Belle, S. (2022). Outcomes of a community-based antiretroviral therapy program for key populations living with HIV in Benue State, Nigeria: protocol for a realist evaluation. *BMJ open*, *12*(11), e062941.