OPEN ACCESS
Global Journal of Research in Engineering & Computer Sciences
ISSN: 2583-2727 (Online)
Volume 04| Issue 03 | May-June | 2024
Journal homepage: https://gjrpublication.com/gjrecs/
Research Article

A Statistical Examination of The Rate of Death and Incidence of Hiv/Aids-Reported Cases

*Bekesuoyeibo Rebecca

Department of Statistics, School of Applied Science, Federal Polytechnic Ekowe Yenagoa, Bayelsa State, Nigeria

DOI: 10.5281/zenodo.11128052 **Submission Date:** 17 April 2024 | **Published Date:** 07 May 2024

***Corresponding author:** Bekesuoyeibo Rebecca
Department of Statistics, School of Applied Science, Federal Polytechnic Ekowe Yenagoa, Bayelsa State, Nigeria.

Abstract

This study centered on the incidence and mortality rate of reported cases of HIV/AIDS in Anambra State, Nigeria using General Hospital Onitsha Anambra State as a study case. Data were collected based on the incidence and mortality cases of HIV/AIDS patients, according to their ages and years of occurrence from 2007 to 2022. The statistical techniques used in this study were chi-square test of independence; runs test; and mortality rate. The SPSS software package version 26.0 was used for ease of data analysis. Thus, findings from the analysis revealed the following conclusions: the incidence and mortality rate of HIV/AIDS in Anambra State showed presence of trend, though the data were reported on time and could be said to be time dependent. That is to say, morbidity due to HIV/AIDS can occur at any time of the year. The incidence and mortality rate of HIV/AIDS is independent of sex, and years. The incidence and Mortality Rate of HIV/AIDS is dependent on age. The study recommended among others that future researchers should carry out a comparative study between the private and Government owned hospitals of similar study.

Keywords: Mortality Rate, Incidence Rate, HIV/AIDS, Reported Cases.

Introduction

In Nigeria, AIDS and HIV infection continue to be serious public health concerns (Omatola et al., 2019). With the exception of South Africa and India, Nigeria has the largest population in Africa and the highest rate of HIV infection worldwide (WHO, 2015). Since the first HIV case in Nigeria was documented, the prevalence rate has steadily climbed (Chilaka & Konje, 2021). HIV prevalence in persons 15–49 years of age rose from 1.8% in 1991 to 5.8% in 2000 before declining to 3.9% in 2005. It is predicted that approximately 2.9 million persons in Nigeria are infected with the virus, despite the fact that the prevalence rate is lower than in South Africa (He et al., 2023).

The international community agreed to work toward providing HIV prevention, treatment, care, and support to all people by the year 2010 (Wall, 2017). According to Germenew et al. (2018), in order to accomplish this goal, national HIV/AIDS programs must fortify their health systems and remove any obstacles to treatment and prevention initiatives. Nigeria has implemented several measures to restrict the proliferation of this illness. People living with HIV/AIDS (PLWHAs) who have taken an HIV test and are on antiretroviral therapy (ART) have increased significantly as a result of worldwide initiatives like the US Presidential Emergency Plan for Aids Relief (PEPFAR) program (Atilol et al., 2018).

Furthermore, many more pregnant HIV-positive women have received antiretroviral therapy (ART) in an effort to stop HIV transmission from mother to child (Gbadamosi et al., 2019). Stigma and discrimination are major issues that many of these international and national programs must deal with in a multi-ethnic, multi-cultural society like Nigeria (S & D). A major challenge to HIV prevention and treatment is the S&D concerns that Mann identified in 1987 as the third phase of the epidemic (Olugbenga et al., 2018). Consequently, the S&D issue must be resolved if Nigeria is to fulfill her national strategy on HIV/AIDS, which aims to curb the infection's spread and effects. Understanding the "hidden factors" that obstruct effective prevention and treatment is made easier with the help of significant research and information on

HIV related to S & D in the many ethnic and cultural contexts that make up Nigeria. Reducing the virus's spread throughout the population can be achieved in large part by implementing these results into national preventive initiatives.

Since the disease's discovery, governments, organizations, and people everywhere have worked feverishly to both prevent and end HIV/AIDS (Dwyer-Lindgren et al., 2019). The initiatives of numerous other health agencies, like USAIDS, PEPFAR, WHO/UNAIDS, and others, demonstrate these efforts. The prevalence of HIV/AIDS appears to be rising daily despite all the conflicts being fought against it, particularly in developing nations like Nigeria. This study, which aims to provide a thorough overview of the incidence and mortality rate of HIV/AIDS using the available numbers, will open people's eyes in Nigeria.

Therefore, the aim of this study is to analyze the incidence and mortality rate of reported cases of HIV/AIDS in General Hospital Onitsha Anambra State, Nigeria from 2000 to 2015. Thus, the objectives of this study include to:

i) Determine the pattern of HIV/AIDS incidence and mortality.
ii) Determine the HIV/AIDS mortality rate by comparing the number of deaths to the number of cases that have been reported.
iii) Ascertain whether age, sex, or years affect HIV/AIDS incidence and mortality rates.

2. Methodology

The data for the study were purely secondary, and were collected from General Hospital Onitsha Anambra State; they comprised of the reported number of HIV/AIDS patients and the number of patients that died from HIV/AIDS from the year 2000 to 2015.

2.1 Data Description

Dataset for this study shows the monthly records of reported cases of HIV/AIDS patients and its distribution by age and sex over the years under study, and also the number of patients, in months, that died from the reported cases and their age and sex distribution over the years.

2.2 Method of Data Analysis

The data analysis in this study used the following statistical approaches or methods:
(a) Chi-Square Test of Independence
(b) Runs Test
(c) Mortality Rate

2.2.1 Chi-Square Test

Chi-square analysis is used to determine whether two classification criteria are independent of one another (Nwachukwu, 2008). Tables having cells corresponding to cross classifications at characteristics or events are known as contingency tables. Thus, the hypotheses are:

H_0: Two criteria of classification are not significant.
H_1: They are significant.

Nwobi (2003) states that chi-square test is used to examine goodness of fit and independence or connection of variables hypotheses. The contingency table is set up in rows and columns and is a two-way classification table. The test statistics is given as

$$\chi^2_{cal} = \sum_{i=1}^{r} \sum_{j=1}^{c} (O_{ij} - e_{ij})^2 / e_{ij} \qquad \ldots (2.1)$$

with v = (r – 1) (c – 1) degrees of freedom, where

r = number of rows;

c = number of columns;

O_{ij} = the observed frequency of the ijth cell;

e_{ij} = the expected frequency of the ijth cell, and is given as

$$e_{ij} = \frac{R_i \times C_j}{N} \qquad \ldots (2.2)$$

where R_i = ith row's marginal frequency;

C_j = jth column's marginal frequency;

N = the grand total

The decision rule is to reject H_0, using the level of significance (α = 5%) if $\chi^2_{cal} \geq \chi^2_{tab}$ where χ^2_{tab} is the chi-square tabulated which is read from the chi-square table (Nwobi & Nduka, 2003).

2.2.2 Runs Test

Numerous techniques exist for evaluating trend in time series, such as the sign test, runs test, and others; however, the runs test will be employed in this investigation. Nwobi and Nduka (2003) describe a run as a series of identical symbols that are preceded and followed by either different symbols or no symbols at all. Positive, negative, and zero runs are the three different kinds of runs.

The Test Hypotheses

The hypotheses to be tested are;

H_0: The sequence follows a random process (there is no trend)

H_1: The sequence does not follow a random process (there is the presence of trend.

The Test Statistic

The test statistic is given by

$$Z = \frac{R - \mu_r}{\delta_r} \quad (2.3)$$

Where μ_r = the mean of the runs given by the formula

$$\mu_r = 1 + \frac{2n_1 n_2}{n_1 + n_2} \quad (2.4)$$

And δ_r^2 = the variance of the runs given by the formula

$$\delta_r^2 = \frac{2n_1 n_2 (2n_1 n_2 - n_1 - n_2)}{(n_1 + n_2)^2 (n_1 + n_2 - 1)} \quad (2.5)$$

And

R = the total number of runs

n_1 and n_2 = the number of positive and negative runs respectively

The Decision Rule: H_0 is to be rejected if $|Z_{cal}| > Z_\alpha$

2.2.3 Mortality Rate

Nwogu and Iwueze (2009) define mortality rate as the number of fatalities (generally or as a result of a particular cause) in a population, scaled to that population's size, per unit of time. The usual unit of measurement for mortality rate is deaths per 1000 people annually. Mortality rate is given by the formula

$$MR = \frac{\text{Number of Deaths of a specified year}}{\text{The number of people in the population}} \times 1000 \quad (2.6)$$

$$= \frac{\partial i}{Pi} \times 1000 \quad (2.7)$$

3. Results

3.1 Testing for the Presence of Trend

This test was done to determine whether trend exists in the time series data collected. It was done for both the incidence of HIV/AIDS and HIV/AIDS mortality, respectively.

3.1.1 Testing for Trend in the Incidence of HIV/AIDS in Anambra State

The null and alternative hypotheses are;

H_0: The incidences of HIV/AIDS in Anambra State are randomly distributed (There is no trend)

H_1: The incidences of HIV/AIDS in Anambra State are not randomly distributed (There is presence of trend)

Table 3.1: SPSS Output for Runs Test of the Incidence of HIV/AIDS

	Incidence of HIV/AIDS
Test Value[a]	39.2292
Cases < Test Value	50
Cases >= Test Value	46
Total Cases	96
Number of Runs	6
Z	-8.822
Asymp. Sig. (2-tailed)	.000

Since the p-value (0.000) is less than the level of significance (0.05) in Table 3.1, then the null hypothesis is rejected. Alternatively, the decision rule could be stated as;

Since $|Z_{cal}| = (8.822) > Z_{tab} = (1.96), H_0$ is therefore rejected, where

$$Z_{tab} = Z_{\frac{\alpha}{2}} = Z_{\frac{0.05}{2}} = Z_{0.025} = 1.96$$

The incidence of HIV/AIDS in Anambra State also shows presence of trend, though the data were reported on time and could be said to be time dependent. That is to say, morbidity due to HIV/AIDS can occur at any time of the year.

3.1.2 Testing for Trend in HIV/AIDS Mortality in Anambra State

The null and alternative hypotheses are;

H_0: HIV/AIDS mortality is randomly distributed (there is no trend)

H_1: HIV/AIDS is not randomly distributed (there is presence of trend)

The SPSS output of Table 3.2 is shown below;

Table 3.2: SPSS Output for Runs Test of HIV/AIDS Mortality

	HIVAIDS Mortality
Test Value[a]	6.9583
Cases < Test Value	39
Cases >= Test Value	57
Total Cases	96
Number of Runs	10
Z	-7.939
Asymp. Sig. (2-tailed)	.000

Since the p-value (0.000) is less than the level of significance (0.05), then the null hypothesis is rejected.

3.2 Mortality Rate of Reported Cases of HIV/AIDS in Anambra State

The mortality rate is computed as presented in Table 3.3.

Table 3.3: The Mortality Rates of the Reported Cases of HIV/AIDS

Year	Reported Cases	HIV/AIDS Mortality	Mortality Rate
2007	246	34	13.82%
2008	244	42	17.21%
2009	225	37	16.44%
2010	246	37	15.04%
2011	269	56	20.82%
2012	242	40	16.53%
2013	276	41	14.86%
2014	266	44	16.54%
2015	220	48	21.82%
2016	209	48	22.97%
2017	242	43	17.77%
2018	221	44	19.91%
2019	244	48	19.67%

2020	217	51	23.5%
2021	222	29	13.06%
2022	177	26	14.69%

3.3 To Find out Whether the Incidence and Mortality Rate of HIV/AIDS are dependent on Sex, Age, and Years

Here, we used the chi-square technique to know whether the incidence and mortality rate of HIV/AIDS were dependent on sex, age, and years. They were tested one after the other.

4.3.1 To Know Whether Incidence and Mortality Rate of HIV/AIDS are Dependent on Sex

The null and alternative hypotheses are;

H_0: The incidence and Mortality Rate of HIV/AIDS is independent of sex

H_1: The incidence and Mortality Rate of HIV/AIDS is dependent on sex

The SPSS output is shown below;

Table 3.4a: SPSS Cross-Tabulation Output for Rate versus Sex

			Sex		Total
			Male	Female	
Rate	Incidence	Count	1904	1862	3766
		Expected Count	1915.3	1850.7	3766.0
		% within Rate	50.6%	49.4%	100.0%
		% within Sex	84.4%	85.5%	84.9%
		% of Total	42.9%	42.0%	84.9%
	Mortality	Count	351	317	668
		Expected Count	339.7	328.3	668.0
		% within Rate	52.5%	47.5%	100.0%
		% within Sex	15.6%	14.5%	15.1%
		% of Total	7.9%	7.1%	15.1%
Total		Count	2255	2179	4434
		Expected Count	2255.0	2179.0	4434.0
		% within Rate	50.9%	49.1%	100.0%
		% within Sex	100.0%	100.0%	100.0%
		% of Total	50.9%	49.1%	100.0%

Table 3.4b: SPSS Chi-Square Tests Output for Rate versus Sex

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.897[a]	1	.344		
Continuity Correction[b]	.819	1	.366		
Likelihood Ratio	.897	1	.344		
Fisher's Exact Test				.356	.183
Linear-by-Linear Association	.896	1	.344		
N of Valid Cases	4434				

Since the p-value (0.344) in Table 3.4b is greater than the level of significance (0.05), the null hypothesis is not rejected.

3.3.2 To Know Whether Incidence and Mortality Rate of HIV/AIDS are Dependent on Age

The null and alternative hypotheses are;

H_0: The incidence and Mortality Rate of HIV/AIDS is independent of Age

H_1: The incidence and Mortality Rate of HIV/AIDS is dependent on Age

The SPSS output is shown below;

Table 3.5a: SPSS Cross-Tabulation Output for Rate versus Age

			Age						Total
			0-14	15-29	30-44	45-59	60-74	75+	
Rate	Incidence	Count	895	1333	1088	336	70	44	3766
		Expected Count	908.0	1251.1	1048.1	415.3	90.0	53.5	3766.0
		% within Rate	23.8%	35.4%	28.9%	8.9%	1.9%	1.2%	100.0%
		% within Age	83.7%	90.5%	88.2%	68.7%	66.0%	69.8%	84.9%
		% of Total	20.2%	30.1%	24.5%	7.6%	1.6%	1.0%	84.9%
	Mortality	Count	174	140	146	153	36	19	668
		Expected Count	161.0	221.9	185.9	73.7	16.0	9.5	668.0
		% within Rate	26.0%	21.0%	21.9%	22.9%	5.4%	2.8%	100.0%
		% within Age	16.3%	9.5%	11.8%	31.3%	34.0%	30.2%	15.1%
		% of Total	3.9%	3.2%	3.3%	3.5%	0.8%	0.4%	15.1%
Total		Count	1069	1473	1234	489	106	63	4434
		Expected Count	1069.0	1473.0	1234.0	489.0	106.0	63.0	4434.0
		% within Rate	24.1%	33.2%	27.8%	11.0%	2.4%	1.4%	100.0%
		% within Age	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	24.1%	33.2%	27.8%	11.0%	2.4%	1.4%	100.0%

Table 3.5b: SPSS Chi-Square Tests Output for Rate versus Age

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	188.287[a]	5	.000
Likelihood Ratio	165.702	5	.000
Linear-by-Linear Association	58.450	1	.000
N of Valid Cases	4434		

Since the p-value (0.000) in Table 3.5b is less than the level of significance (0.05), the null hypothesis is rejected.

3.3.3 To Know Whether Incidence and Mortality Rate of HIV/AIDS are Dependent on Years

The null and alternative hypotheses are;

H_0: The incidence and Mortality Rate of HIV/AIDS is independent of Years

H_1: The incidence and Mortality Rate of HIV/AIDS is dependent on Years

The SPSS output is shown below;

Table 3.6a: SPSS Cross-Tabulation Output for Rate versus Years

			Rate		Total
			Incidence	Mortality	
Years	2000	Count	246	34	280
		Expected Count	237.8	42.2	280.0
		% within Years	87.9%	12.1%	100.0%
	2001	Count	244	42	286
		Expected Count	242.9	43.1	286.0
		% within Years	85.3%	14.7%	100.0%
	2002	Count	225	37	262
		Expected Count	222.5	39.5	262.0
		% within Years	85.9%	14.1%	100.0%
	2003	Count	246	37	283
		Expected Count	240.4	42.6	283.0
		% within Years	86.9%	13.1%	100.0%
	2004	Count	269	56	325
		Expected Count	276.0	49.0	325.0

	% within Years	82.8%	17.2%	100.0%
	Count	242	40	282
2005	Expected Count	239.5	42.5	282.0
	% within Years	85.8%	14.2%	100.0%
	Count	276	41	317
2006	Expected Count	269.2	47.8	317.0
	% within Years	87.1%	12.9%	100.0%
	Count	266	44	310
2007	Expected Count	263.3	46.7	310.0
	% within Years	85.8%	14.2%	100.0%
	Count	220	48	268
2008	Expected Count	227.6	40.4	268.0
	% within Years	82.1%	17.9%	100.0%
	Count	209	48	257
2009	Expected Count	218.3	38.7	257.0
	% within Years	81.3%	18.7%	100.0%
	Count	242	43	285
2010	Expected Count	242.1	42.9	285.0
	% within Years	84.9%	15.1%	100.0%
	Count	221	44	265
2011	Expected Count	225.1	39.9	265.0
	% within Years	83.4%	16.6%	100.0%
	Count	244	48	292
2012	Expected Count	248.0	44.0	292.0
	% within Years	83.6%	16.4%	100.0%
	Count	217	51	268
2013	Expected Count	227.6	40.4	268.0
	% within Years	81.0%	19.0%	100.0%
	Count	222	29	251
2014	Expected Count	213.2	37.8	251.0
	% within Years	88.4%	11.6%	100.0%
	Count	177	26	203
2015	Expected Count	172.4	30.6	203.0
	% within Years	87.2%	12.8%	100.0%
	Count	3766	668	4434
Total	Expected Count	3766.0	668.0	4434.0
	% within Years	84.9%	15.1%	100.0%

Table 3.6b: SPSS Chi-Square Tests Output for Rate versus Years

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	17.387[a]	15	.296
Likelihood Ratio	17.291	15	.302
Linear-by-Linear Association	1.204	1	.273
N of Valid Cases	4434		

Since the p-value (0.296) in Table 3.6b is greater than the level of significance (0.05), the null hypothesis is not rejected.

4. Summary, Recommendation and Conclusion

This study centered on the incidence and mortality rate of reported cases of HIV/AIDS in Anambra State, Nigeria using General Hospital Onitsha Anambra State as a study case. Data were collected based on the incidence and mortality cases of HIV/AIDS patients, according to their ages and years of occurrence from 2000 to 2015. Thus, findings from our analysis in this study, revealed the following conclusions:

- The incidence and mortality Rate of HIV/AIDS in Anambra State shows presence of trend, though the data were reported on time and could be said to be time dependent. That is to say, morbidity due to HIV/AIDS can occur at any time of the year.
- The incidence and Mortality Rate of HIV/AIDS is independent of sex, and years
- The incidence and Mortality Rate of HIV/AIDS is dependent on age

Having concluded the analysis of this study, we can conclude that the incidence and Mortality Rate of HIV/AIDS is dependent on age and independent of sex and years.

As a result of findings from the analysis in this study and general knowledge, we make the following recommendations:

- Future authors should try and conduct research of this type using private owned hospitals, and as well use many sample sizes (years).
- Future researchers should carry out a comparative study between the private and Government owned hospitals of similar study.

References

1. Atilola, G., Randle, T., Obadara, T., Komolafe, I. O., Odutolu, G., Olomu, J., & Adenuga, L. (2018). Epidemiology of HIV and Tuberculosis in pregnant women, South West Nigeria. Journal of Infection and Public Health, 11(6), 826-833.
2. Chilaka, V. N., & Konje, J. C. (2021). HIV in pregnancy–an update. European Journal of Obstetrics & Gynecology and Reproductive Biology, 256, 484-491.
3. Dwyer-Lindgren, L., Cork, M. A., Sligar, A., Steuben, K. M., Wilson, K. F., Provost, N. R., & Hay, S. I. (2019). Mapping HIV prevalence in sub-Saharan Africa between 2000 and 2017. Nature, 570(7760), 189-193.
4. Gbadamosi, S.O., Itanyi, I.U., Menson, W.N.A., Olawepo, J.O., Bruno, T., Ogidi, A.G., Patel, D.V., Oko, J.O., Onoka, C.A., & Ezeanolue, E.E. (2019). Targeted HIV testing for male partners of HIV-positive pregnant women in a high prevalence setting in Nigeria. PloS one, 14(1), p.e0211022.
5. Geremew, D., Tajebe, F., Ambachew, S., Endalamaw, A., & Eshetie, S. (2018). Seroprevalence of HIV among pregnant women in Ethiopia: a systematic review and meta-analysis. BMC research notes, 11, 1-7.
6. He, S., Shuang, G., Yinglan, W., Lan, W., Wei, W., Ailing, W., Changhe, W., Xiaoyan, W., Qun, G., Zechun, L., & Dongxu, H. (2023). Prevalence and factors associated with hepatitis C among pregnant women in China: a cross-sectional study. Scientific Reports, 13(1), 759.
7. Nwachukwu, V.O. (2008). Principles of Statistical Inference. Zelon Publishers, Port-Harcourt, Rivers State Nigeria.
8. Nwobi, F. N. (2008). Statistics 2: Introductory Inference Supreme Publishers, Owerri.
9. Nwobi, F.N and Nduka, E.C. (2003). Statistical Notes and Tables for Research. Alphabet Nigerian Publishers.
10. Nwogu, E.C. and Iwueze, I.S. (2009). Introductory to Demography. Supreme Publishers, Owerri
11. Olugbenga, I., Taiwo, O., Laverty, M., Ngige, E., Anyaike, C., Bakare, R., Ogunleye, V., Peterson Maddox, B.L., Newman, D.R., Gliddon, H.D., & Ofondu, E. (2018). Clinic-based evaluation study of the diagnostic accuracy of a dual rapid test for the screening of HIV and syphilis in pregnant women in Nigeria. PLoS One, 13(7), e0198698.
12. Omatola, C. A., Lawal, C., Omosayin, D. O., Okolo, M. L. O., Adaji, D. M., Mofolorunsho, C. K., & Bello, K. E. (2019). Seroprevalence of HBV, HCV, and HIV and associated risk factors among apparently healthy pregnant women in Anyigba, Nigeria. Viral immunology, 32(4), 186-191.
13. Wall, K.M., Rida, W., Haddad, L.B., Kamali, A., Karita, E., Lakhi, S., Kilembe, W., Allen, S., Inambao, M., Yang, A.H., & Latka, M.H. (2017). Pregnancy and HIV disease progression in an early infection cohort from five African countries. Epidemiology, 28(2), 224-232.
14. World Health Organization. (2015). Guidelines guideline on when to start antiretroviral therapy and on pre-exposure prophylaxis for HIV. World Heal Organ, 78(978), 92.

CITATION
Bekesuoyeibo R. (2024). A Statistical Examination of The Rate of Death and Incidence of Hiv/Aids-Reported Cases. In Global Journal of Research in Engineering & Computer Sciences (Vol. 4, Number 3, pp. 5–12). https://doi.org/10.5281/zenodo.11128052