# On the Epidemiology and Statistical Analysis of HIV/AIDS Patients in the Insurgency Affected States of Nigeria

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## Abstract

**BACKGROUND:** The effect of insurgencies on a nation regarding the economy, education, health and infrastructure cannot be overemphasised.

**AIM:** This research is therefore focused on analysing the incidence of HIV/AIDS disease in states affected by the activities of the Boko Haram insurgency in Nigeria.

**MATERIAL AND METHODS:** The data collected refer to the period from 2004 to 2017, reporting information on 16,102 patients and including the age, gender, year of diagnosing and status of the patients. Descriptive, Chi-square test of independence and Correlation analyses were performed using Statistical Package for Social Sciences (SPSS) version 20.

**RESULTS:** It was discovered that the majority of those living with HIV/AIDS in these Boko Haram ravaged areas are females between the age group of 30 years to 39 years. Reported cases of HIV/AIDS started increasing significantly from age 20, and the highest number of reported cases of HIV/AIDS was recorded in the year 2017.

**CONCLUSION:** The status of the patient was found to be dependent on both the gender and age of the patients' treatment, though the strength of the linear relationship between status and age is not significantly different from zero.

## Introduction

Nigeria is divided into six geopolitical zones. The North East zone consists of six (6) states namely; Adamawa, Bauchi, Borno, Gombe, Taraba and Yobe. The entire Northern region of the country is in variance with their natural endowments such as vast fertile lands, rivers and lakes for irrigation, mineral resources and abundant sunshine for renewable energy. The weak social structure of the region has resulted in excruciating poverty which often manifests as homelessness and destitution, insurgency, violence and crime [1]. The region has high poverty index, low human development index, lack of potable drinking water, electoral violence, the dearth of medical personnel, high mortality, low life expectancy, decayed infrastructure and is also an epicentre for joblessness. The region also experiences a large number of underage and teenage pregnancy, female genital mutilation, epidemics, illiteracy, malnutrition and now terrorism which comes in form of coordinated attacks on military, police formations and remote villages, guerrilla attacks, kidnappings, regicide, suicide bombings, mass killings, abduction of school girls, extra-judicial killings and summary execution, hypnotizing and forced conscriptions, indoctrination and forceful conversion to Islam.

The decadence is not limited to the region but to the entire country which is a result of corruption, tribalism, military intervention in governance, inequality, misappropriation, financial recklessness, bankrupt of ideas and dearth of developmental agendas, reduction of allocation of capital due to shortfalls of Nigeria revenue as a result of decline in crude oil price. Globally, efforts towards reducing the spread of HIV have yielded desired results except in some developing countries. Moreover, other areas have been seriously affected. For example: food security and dynamics, under five malnutrition, child and maternal mortality, escalation of cholera outbreaks, infections, sexually transmitted diseases,

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worsening mental health, unsafe birth practices and abortion, child prostitution, sex for food at the displaced persons camps, increase in polio cases [2] [3] [4].

The effect of the ongoing Boko Haram insurgency is a serious health concern for Nigeria [5]. This has manifested in the child wasting [6], increasingly psychological trauma [7], intensifying hunger [8], under-five malnutrition [9] and the reemergence of polio cases [10] [11] [12]. Also, the effect has reduced the chances of Nigeria meeting the millennium and sustainable development goals as warned by [13]. Others include disruption of health activities [14], difficulty in tackling reported cases of tuberculosis [15] and increased occurrence of injury [16]. In recent times, the effects also include the adoption of school girls which might lead to raping and as a consequence, transmission of infectious diseases.

The data used in this article was obtained from one of the renowned state hospitals in Borno state which is a state from the North East region of the country that historically has high HIV/AIDS incidence [17] and now worsened by the current Boko Haram insurgency in that area. The data also contains the records of all the HIV/AIDS records of the patients in the North East region of the country.

**Table 1: Similar researches on HIV/AIDS**

| Statistical tool | Major findings | Contributor(s) |
|---|---|---|
| Correlation | Children living with HIV are most likely to have Left ventricular systolic dysfunction | [33] |
| Correlation | The effect of herbal drugs on the HIV patients receiving antiretroviral drugs | [34] |
| Correlation and Chi-square tests | A significant difference in the use of a condom by sex workers | [35] |
| Correlation | The link between the fear of HIV AIDS and infection control practices between Nigeria and the United States | [36] |
| Correlation | Prevalence of HIV antibodies in patients with pulmonary tuberculosis. | [37] |
| Correlation | Viral correlates of neurocognitive impairment (NCI) among HIV patients | [38] |
| Chi-square tests | High levels of Tuberculosis among HIV patients | [39] |
| Correlation and Chi-square tests | HIV tests as correlates of condom use among unmarried males in Nigeria. | [40] |
| Chi-square tests | Knowledge of sexually transmitted infections for example HIV as a predictor of condom use for gay sexual relationships | [41] |
| Chi-square tests | Same sex relationships as a predictor of HIV prevalence among prison inmates. | [42] |
| Chi-square tests | Differences in attitudinal and knowledge of HIV/AIDS among those with hearing impairment. | [43] |
| Chi-square tests | Voluntary testing and awareness reduces the rate of HIV transmission | [44] |
| Chi-square tests | The link between some demographic factors and AIDS mortality among the youth. | [45] |

Illiteracy, cultural practices and insecurity have led to the high incidence of HIV in that area. This has inadvertently resulted in high rates of mother to child transmission [18], depletion of blood bank reserves [19].

To fully understand the incidence, prevalence, epidemiology and awareness of the HIV and AIDS, several studies have been conducted, and the scope limited to some parts of North East Nigeria. The results reported the high incidence, low awareness and so on. Examples were the studies conducted in

Biu, Borno state [20] [21], three senatorial districts of Borno state [22] [23] [24] [25], Adamawa state [26] [27] [28] [29] [30], Gombe state [31] and Wukari, Taraba state [32]. This research is however focused on analysing the incidence of HIV/AIDS disease in states affected by the activities of the Boko Haram insurgency in Nigeria.

Some selected contributions in the area of this research using various statistical tools are presented in Table 1.

## Material and Methods

The dataset used in this research was collected as a secondary data from the University of Maiduguri Teaching Hospital, Borno State for a period of 14 years (2004 to 2017). Records of 16,102 patients were considered and information on their age at the point of diagnoses of the disease, gender, year of diagnoses and status of the patients under treatment were collected. Descriptive statistics, cross-tabulation, chi-square test of independence and correlation analysis were used to analyse the dataset using SPSS.

This particular test is used to determine if a significant relationship(s) exist between two categorical variables, in other words, it can be used to test if a variable is dependent on the other variable or not.

In general, terms, let X and Y denote the two categorical (or nominal) variables under consideration, the hypothesis to be tested would be:

H$_0$: Variable X is not dependent on variable Y

Versus

H$_1$: Variable X is dependent on variable Y

However, the specific hypotheses used are stated clearly in the next section of this paper.

The test statistic for the chi-square test of independence is:

$$\chi^2 = \sum_{i=1}^{r}\sum_{j=1}^{c} \frac{\left(o_{ij} - e_{ij}\right)^2}{e_{ij}} \square \; \chi^2_{(r-1)(c-1),\alpha} \qquad (1)$$

'r' is the number of rows
'c' is the number of columns
'$o_{ij}$' is the observed frequencies
'$e_{ij}$' is the expected frequencies
'$\alpha$' is the level of significance which is assumed to be 0.05 in this research.

Correlation analysis, on the other hand, measures the degree or strength of linear relationship between two variables. The value of the correlation

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coefficient lies between -1 and +1. So, for variables X and Y, the correlation coefficient between them is measured using:

$$r = \frac{n\left(\sum xy\right) - \left(\sum x\right)\left(\sum y\right)}{\sqrt{\left[n\sum x^2 - \left(\sum x\right)^2\right]\left[n\sum y^2 - \left(\sum y\right)^2\right]}} \qquad (2)$$

This correlation coefficient can be tested for statistical significance using the test statistic:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \square\, t_{n-2,\alpha} \qquad (3)$$

where '$n$' is the sample size and $\alpha$ is the level of significance (0.05).

The underlying hypothesis is:

$$H_0 : r = 0$$

Versus

$$H_1 : r \neq 0$$

For both the Chi-square test of independence and correlation analysis, the null hypothesis will be rejected if the p-value is less than or equal to the level of significance.

## Results

The summary of the age of the patients is made available in Table 2.

**Table 2: Summary statistics of the age of the patients**

| N | 16102 |
|---|---|
| Mean | 36.11 |
| Median | 35.00 |
| Mode | 30 |
| Minimum | 6 |
| Maximum | 88 |
| Skewness | 0.583 |

From Table 2, we observe that 16,102 patients were considered and the mean age is 36.11 years. The minimum age is 6 years while the maximum age considered is 88 years. However, the age with the highest cases of HIV/AIDS is 30 years. This information is represented graphically in Figure 1.
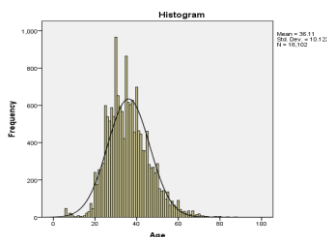


_Figure 1: Distribution of age_

The ages of the patients are further classified to enable us to know the incidence of HIV across age group (or bracket). The information is displayed in Table 3.

**Table 3: Distribution of age according to age group (Approximated to 2decimal places)**

| Age Group | 0-9 | 10-19 | 20-29 | 30-39 | 40-49 | 50-59 | 60-69 | 70-79 | 80-89 | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| Frequency | 83 | 203 | 3,998 | 6,368 | 3,837 | 1,227 | 321 | 54 | 11 | 16,102 |
| Percentage | 0.52% | 1.26% | 24.83% | 39.55% | 23.83% | 7.62% | 1.99% | 0.34% | 0.06% | 100% |

From Table 3, we discover that the age group with the highest cases of HIV/AIDS is 30-39 followed by 20-29 while age group 80-89 has the lowest number of reported cases.

The summary of the gender of the patients is displayed in Table 4.

**Table 4: Gender of the Patients**

| | Frequency | Per cent | Cumulative Percent |
|---|---|---|---|
| Female | 9515 | 59.1 | 59.1 |
| Male | 6583 | 40.9 | 100.0 |
| Valid Total | 16098 | 100.0 | |
| Missing | 4 | | |
| Overall Total | 16102 | | |

From Table 4, we discover that there are more females than males with reported cases of HIV/AIDS based on the data set (or record) used. Though, information on the gender of four (4) of the patients is not known. This information is further represented in a graph in Figure 2.
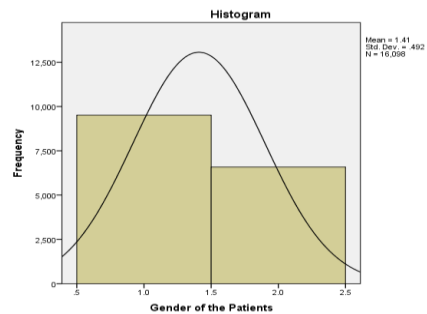


_Figure 2: Gender of the patients_

The summary of the information on the year of diagnosis of HIV/AIDS for each of the patients is displayed in Table 5.

**Table 5: Year of diagnosis of HIV/AIDS**

| | Frequency | Per cent | Cumulative Percent |
|---|---|---|---|
| 2004 | 2 | 0 | 0 |
| 2005 | 1760 | 10.9 | 10.9 |
| 2006 | 1983 | 12.3 | 23.3 |
| 2007 | 2179 | 13.5 | 36.8 |
| 2008 | 1976 | 12.3 | 49.1 |
| 2009 | 1756 | 10.9 | 60.0 |
| 2010 | 1420 | 8.8 | 68.8 |
| 2011 | 1133 | 7.0 | 75.8 |
| 2012 | 150 | 0.9 | 76.8 |
| 2013 | 62 | 0.4 | 77.1 |
| 2014 | 37 | 0.2 | 77.4 |
| 2015 | 28 | 0.2 | 77.5 |
| 2016 | 17 | 0.1 | 77.6 |
| 2017 | 3599 | 22.4 | 100.0 |
| Total | 16102 | 100.0 | |

From Table 5, we discover that there are more reported cases of HIV/AIDS in the year 2017 than in the previous years while the year with the lowest number of reported cases is the year 2004. The information is presented in diagrammatic form in Figure 3.
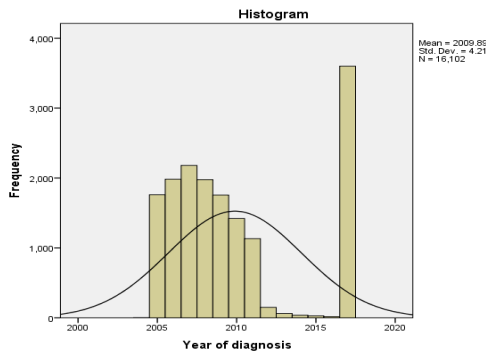


_Figure 3: Chart for the year of diagnosis of HIV/AIDS_

The summary of the information on the status of the patients under treatment which is classified into Active (the patient is still coming for treatment and check-up), LTFU (lost to follow up/the patient is no longer coming for treatment), Transfer and Died is displayed in Table 6.

**Table 6: Status of the patients under treatment**

|               | Frequency | Per cent |
|---------------|-----------|----------|
| Active        | 6641      | 41.2     |
| LTFU          | 194       | 1.2      |
| Transfer      | 9054      | 56.2     |
| Died          | 190       | 1.2      |
| Valid Total   | 16079     | 100.0    |
| Missing       | 23        |          |
| Overall Total | 16102     |          |

It is observed in Table 6 that the majority of the reported cases of HIV/AIDS were being transferred from one clinic to the other. Though, information on the status of 23 patients was not available. This information is represented in Figure 4.
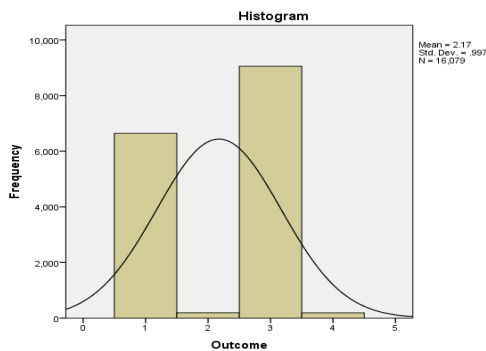


_Figure 4: Chart for the status of patients under treatment_

The result for the cross-tabulation between the status of the patients under treatment and gender of the patients is presented in Table 7.

**Table 7: Crosstab of status and gender**

| Status   |                                    | Female | Male   | Total  |
|----------|------------------------------------|--------|--------|--------|
| Active   | Count                              | 4008   | 2631   | 6639   |
|          | % within Gender of the patients    | 42.2%  | 40.0%  | 41.3%  |
| LTFU     | Count                              | 118    | 76     | 194    |
|          | % within Gender of the patients    | 1.2%   | 1.2%   | 1.2%   |
| Transfer | Count                              | 5278   | 3774   | 9052   |
|          | % within Gender of the patients    | 55.5%  | 57.4%  | 56.3%  |
| Died     | Count                              | 98     | 92     | 190    |
|          | % within Gender of the patients    | 1.0%   | 1.4%   | 1.2%   |
| Total    | Count                              | 9502   | 6573   | 16075  |
|          | % within Gender of the patients    | 100.0% | 100.0% | 100.0% |

The information in Table 7 reveals that the majority of the patients that are still showing up in the clinic for treatment and check-up are females. Also, the majority of those that died of the sickness are females. This information is represented in the form of charts in Figure 5.
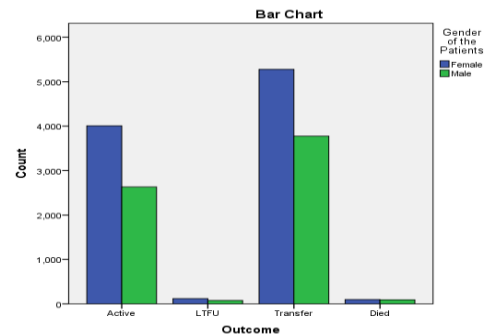


_Figure 5: Chart of status and gender of patients under treatment_

The result of the Chi-square test of independence between the status and gender of patients under treatment is made available in Table 7.

**Table 7: Chi-square test between status and gender of patients under treatment**

|                              | Value  | Degree of Freedom | P-value |
|------------------------------|--------|-------------------|---------|
| Pearson Chi-Square           | 11.471 | 3                 | 0.009   |
| Likelihood Ratio             | 11.416 | 3                 | 0.010   |
| Linear-by-Linear Association | 8.864  | 1                 | 0.003   |
| No. of valid cases           | 16075  |                   |         |

### _Hypothesis I:_

$H_0$: The status of the patients under treatment is independent of the gender of the patient.

Versus

$H_1$: The status of the patients under treatment is dependent on the gender of the patient,

**Decision**: Reject the null hypothesis because the p-value (0.009) is less than the level of significance (0.05).

**Conclusion**: Based on the information contained in the dataset, the status of the patient (Active, LTFU, Transfer, and Died) is dependent on the gender of the patients. In other words, there is a significant association between the status of the patients under treatment and their gender.

The result on the strength of the relationship between the status of the patients and their gender measured by a correlation coefficient is made available in Table 8.

**Table 8: Correlation analysis between status and gender of the patients**

|  | Value | Standard Error | T- statistic | P-value |
|---|---|---|---|---|
| Pearson's Correlation | 0.023 | 0.008 | 2.978 | 0.003 |
| Spearman Correlation | 0.024 | 0.008 | 3.009 | 0.003 |
| No. of valid cases | 16075 |  |  |  |

The correlation coefficient between the status and gender of the patients under treatment is 0.023. This implies that the measure of the linear relationship between the status and gender is very weak. There might be some other forms of relationship (logarithmic, cubic, inverse, exponential and so on) between the status and gender of the patients since because correlation coefficient only measures the degree of **linear** relationship.

Also, the result of the Chi-square test of independence between the status of the patients and their age is made available in Table 9.

**Table 9: Chi-square test for status and age**

|  | Value | Degree of Freedom | P-value |
|---|---|---|---|
| Pearson Chi-Square | 512.388 | 237 | 0.000 |
| Likelihood Ratio | 427.439 | 237 | 0.000 |
| Linear-by-Linear Association | 0.683 | 1 | 0.408 |
| No. of valid cases | 16079 |  |  |

***Hypothesis II:***

$H_0$: The status of the patients under treatment is independent of the age of the patient.

Versus

$H_1$: The status of the patients under treatment is dependent on the age of the patient.

**Decision**: Reject the null hypothesis because the p-value (0.000) is less than the level of significance (0.05).

**Conclusion**: Based on the information contained in the dataset, the status of the patient (Active, LTFU, Transfer, and Died) is dependent on the age of the patients. That is, there is a significant association between the status and the age of the patients under treatment.

The result on the strength of the relationship between the status of the patients and their age measured by a correlation coefficient is made available in Table 10.

**Table 10: Correlation between status and age of the patients**

|  | Value | Standard Error | T- statistic | P-value |
|---|---|---|---|---|
| Pearson's Correlation | 0.007 | 0.008 | 0.827 | 0.408 |
| Spearman Correlation | 0.005 | 0.008 | 0.662 | 0.508 |
| No. of valid cases | 16079 |  |  |  |

The correlation coefficient between the status and age of the patients under treatment was obtained to be 0.007. This means that the measure of the linear relationship between the status and age is very weak. The p-value of 0.408 also suggests that the linear relationship between the status and age of the patients is not significantly different from zero. However, since correlation coefficient measures the strength of the **linear** relationship, we conclude that there might be some other forms of relationship (logarithmic, cubic, inverse, exponential and so on) between the status and gender of the patients.

## Discussion

It can be seen that youths are more infected with HIV/AIDS because Table 1 reveals that patients at age 30 have the highest record of HIV and the disease is prominent among those in the age group 30-39, followed by 20-29. This information is contained in Table 2.

Larger percentage of the patients (59.1%) are females as shown in Table 3 and Figure 2. 22.4% of the reported cases are in the year 2017 (this is the highest based on the data set used), it can, however, mean that people are becoming more aware of the need to go for treatment and education on stigmatization has reached those areas. A significant number of cases was also recorded between years 2005 to 2011, but there is a significant drop in the number from the year 2012 (except for the year 2017). This does not mean that people are not infected with HIV/AIDS from the year 2012 to 2016 in these areas, but the activities of the insurgents were immense during that period, and we assume that people may not be able to go out and health workers were unable to capture cases of HIV/AIDS.

Only a few of the patients (194) which amounts to 1.2% of the population considered are left to follow up. This means that almost all the patients were turning up for treatments and check-ups. However, a large number of transfers was noticed (9,052 patients), this might mean that majority of the nearby clinics or health centres do not have either personnel or access to drugs that could handle this disease. Though, it is commendable that only a few of the patients (190) were recorded to be dead along the line.

The status of the patients (Active, LTFU, Transfer and Died) was found to be dependent on both gender and age of the patients. This means that age and gender were significantly associated with the status of the patients under treatment. Though this research has been able to establish that the correlation coefficient between status and age of the patients is not significantly different from zero, further

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research may need to be conducted on whether age or gender would contribute to the mortality of the patients.

In conclusion, this research has been able to study the incidence and epidemiology relating to HIV in some states in Nigeria. The states considered are states that have been seriously affected by Boko Haram insurgency in the last few years. As a result of this IDP (internally displaced persons) camps had to be created in some strategic places to ensure that survivors of this Boko Haram menace are fed and taken care of. Some fellows were even kidnapped by this Boko Haram group and were raped and married forcefully; they might have been infected with this disease or other sexually transmitted diseases (STDs). As a fallout, some qualified personnel might have relocated from these targeted areas thereby depriving people of quality health care services; this might not be unconnected with the significant drop in the number of cases of HIV/AIDS reported between the year 2012 and 2016. The number of reported cases (16,102) is relatively high; this is apart from cases that are not even reported. The number of transfers from one clinic to the other is also high; this might discourage patients to continue with their treatments especially if there is a distance barrier. There are a number of missing data; this might lead to misinformation and misrepresentation. It is therefore advised that health centres should be equipped with enough and qualified personnel in this areas and security and insurance should be provided for them and their dependents.

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