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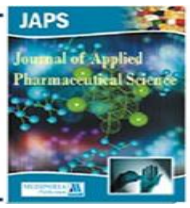

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Correlates between HIV/AIDS Antibody with some Immuno-Hematological Variables of Infected Subjects in Niger Delta Communities

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ABSTRACT

The study tend to uncover the epidemiological trend and association of HIV/AIDS with some immuno-hematological profile of infected subjects in Niger Delta. A total of 1000 subjects, made up of 464 males (46.4%) and 536 females (53.6%) were screened. HIV antibodies were detected using "Determine" (Abbott Laboratories, Japan), Start –Pak (Chembio Diagnostics, USA) and SD Bioline HIV-1/2 kits (Standard Diagnostics, Korea).Out of this number, 107(10.7%) were sero-positive. The PCV of HIV positive subjects ranged between 24.00 and 48.00% (32.94±0.53),HB ranged between 8.00 and 16.00g/dl (10.95± 0.18) while WBC counts ranged between 3.30 and 16.30 Mm^3(7.76 ±0.30). However, CD4 counts ranged between 210.00 and 937.00µl, with a mean of 480.55 (±13.44). At $P<0.01$; the PCV correlated positively with HB(r=0.999) and negatively with WBC (r = -0.303), while HB correlated negatively with WBC(r=-0.306). Conversely, CD_4 counts did not correlate with any of the parameters. The need for frequent monitoring of the impact of HIV/AIDS on the immunological profile of infected groups in Niger Delta is strongly encourage. This will prevent anemia and other hematological problems.

Keywords: HIV/AIDS, Immuno-hematological profile, Correlates, Niger Delta communities, Anemia.

INTRODUCTION

Increasingly, Human Immunodeficiency Virus (HIV) which has been implicated to cause grievous anemia and other hematological consequences in the system of an infected subject have continued to emerge as a global public health challenge and a remarkable cause of high mortality and morbidity in Nigeria and many parts of the world (Ejele *et al.*, 2004). However, HIV shares the following means of epidemiological transmission such as sexual contact (homosexual and heterosexual), intravenous drug user, transfusion of infected blood and blood products and from an infected mothers to an infant either intrapatum, perinatally or via breast milk (Fauci *et al.*, 1998).

Understanding the dynamics of various means of transmission and the need for visible behavioral change had continued to pose serious threat to the health and life of rural citizens who are not well educated on the subject matter.

However hematological complication such as anemia and leucopenia are common health complications and cause of mortality and morbidity in HIV infected patient if the trend is not checked and managed with potent antiviral therapeutic agent (Kirchoff and Silverstri 2008). This calls for better and improved management of the scourge especially in remote areas of Niger Delta. CD4 cell count is an important immunological marker which is useful in the understanding and evaluation of disease progression in Human Immuno deficiency Virus sero-positive patients. This should be regularly monitored at all time since it is one of the specialized cells that are very active in body defensive mechanism. The Virus attacks these cells and uses them to make more copies of itself, in doing so the Human Immune deficiency Virus weakens the immune system, making it unable to protect the body from illness and other form of opportunistic infections that are highly associated with HIV infection. Early in the stage of the disease, the body makes more CD4 cells to replace the ones that have been damaged by the virus. Eventually, the system might no longer keep up with the health challenge associated with this trend as the number of active T-cells continues to decrease downward leaving the body more vulnerable for attack. As more and more CD4 cells become damaged, the immune system becomes more and more weakened (Imade *et al.,* 2005). It is strongly believed that the higher the number of CD4 in the system, the active and more robust is the immunological responses of the system. People without HIV infection have about 500 to 1000 CD4 cells in a drop of blood (Mermine *et al.,* 2006). People living with HIV infection are considered to have "normal" CD4 counts, if the number is above 500 CD4 cells in a drop of blood. This can be as a result of the nutrition taken. It is strongly advised that food taken by HIV sero-positive patients should be nutritious as this will help the immune system to be stronger and makes the CD4 count higher as longer duration of Human Immune deficiency Virus infection suppresses the immune system and leads to lower CD4 cell numbers (Froebel *et al*., 2004).

However in many Niger Delta communities there is paucity of data from rural communities of the region (Ahoada East) on the correlate of HIV/AIDS in relation with some immune-hematological parameters. However, despite the multi –million and billion dollars been spent on funding of HIV/AIDS Programme yearly. The impact is not significantly felt in the rural areas (UNAIDS, 2006). In Niger delta, studies on HIV/AIDS are often been concentrated in the cities. Access to primary and secondary health care and anti-retroviral treatment are also been focused in the cities or urban areas thus those who reside in the remote villages are more often not been captured in the picture of prevention and management of this global scourge. Thus this cross sectional health facility based study was carried out to assess the sero-prevalence of HIV/AIDS and it's linkage with some immune-hematological profile of the infected subjects. It is strongly believed that, data generated will arouse curiosity to build stronger interventional strategy to control and manage the spread of the scourge especially as it concerns it's impact on the hematological parameters in our rural communities in Niger Delta.

Description of Study Area

This cross sectional study was carried out to determine the correlates of HIV/AIDS sero-positivity with some immune-hematological variables of subjects in remote communities of Niger Delta. The area is a rural local government council with a population of over 178,279 people (National Population Commission, Abuja, Nigeria, 2008) spread among fifty-two villages which collectively harbor sixteen health centers, one general hospital and fourteen private clinics. The people belong to the Ekpeye speaking ethnic group. The main occupation of people in the areas are farming, fishing and trading. There are the presence of about nineteen (19) hotels/guest houses, (5) five fast food joints. There are also several private companies, markets and oil exploration activities and companies which include Niger Delta Petroleum Development Company Ltd (NDPDC), Julius Berger Plc. Power Holdings of Nigeria. It is also surrounded by other major oil exploration host communities such as Omoku, Obagi, Erema, Obricom, Rumuekpe, Elelle and Ahoada West L.G.A which attract large influx of persons from diverse background and orientation who come for greener pasture in the area. The area falls within the sub-equatorial climate region, due to its close proximity to the equator, its climate is tropical and the relative humidity is particularly high at about 80-100^{0}C range all year round (Agi, 2002). The rainy season normally last for about three-quarter of the year from March to November (Agi, 2002).

Inclusion Criteria

The major inclusion criteria for this study are that subjects must be age ≥15 years, residence in Ahoada Local Government Area. Also willingness to give an oral consent to partake in the study after counseling was very vital. Demographic data and risk behavior/use of condom were collected via an interview-administered questionnaire. An oral informed consent was obtained from all subjects. Ethical approval was obtained from the ethics committees of the Rivers state hospital management board. Subjects were made up of 536 females and 464 males. Age range was 15- 54 years.

Sample Collection

One thousand (1000) blood samples were collected at random from patients and apparently healthy subjects of age >15 to 54 years of both sexes who attended Community Health Center Edeogha-Ekpeye (Location 1), Community Health center Ochigba (Location 2), Comprehensive Health Center Ahoada (Location 3), Ahoada General hospital (Location 7). Samples were also collected from three (3) communities which are non hospital/clinic based collection centres namely Ula-upata (Location 4), Ahoada Timber

Market (Location 5) and Ogbo town (Location 6). The research was carried out between March 2008 and November 2009. All the blood samples collected were taken to the General Hospital Ahoada for screening and analysis. This is because the hospital has a well equipped laboratory and stable power supply. However, it is very important to state that samples for CD4 cell were analyzed at the Braithwaite Memorial Hospital Port Harcourt which is well equipped with potable CD4 counting machine.

Method of Sample Collection /Preparation

Six milliliters of whole venous blood was collected from the anticubital vein of each study subject and 3ml was dispensed into a gel tube without anticoagulant. Sample was allowed to clot, centrifuged and the serum sample were separated and stored at -20^0c till the time of analysis. The remaining 3ml was dispensed into an EDTA bottle with a proper mix, for Immuno-haematological parameters (PCV, HB, WBC and CD4 cell count). They were stored in -2 to 6 ^{0}C.

Method of HIV 1 and 2 Screening

HIV screening was carried out using a double enzyme-linked immunosorbent assay (ELISA) method using Determine and Stat-Pak HIV 1 and 2 kits. The Determine HIV 1 and 2 kits (Abbott Laboratories, Japan) is an in vitro, visually read, qualitative immunoassay for the detection of antibodies to the Human Immunodeficiency Virus Type (HIV-1) and Type 2 (HIV-2) in human serum. All initially sero-positive samples were confirmed using the Stat-Pak HIV 1 and 2 (CHEMBIO Diagnostic Systems Incorporated, United States of America). The kit is based on immune chromatographic technique that employs a unique combination of a specific antibody binding protein conjugated to a colloidal gold dye particle and HIV 1 & 2 antigens which are bound to the membrane solid phase.

Thus, in a sero-positive sample, the dye conjugated-immune complex migrates on the nitrocellulose membrane and is captured by the antigens immobilized in the test membrane producing a pink/purple line. All sero-positive samples were re-screened for HIV sub-type using SD Bioline HIV 1 & 2 (Standard Diagnostics Inc, Korea) which differentiates HIV 1 & 2 infections. The SD Bioline HIV 1 and 2 test kit is an immunochromatographic rapid test which are used to separate the subtypes into 1 and 2. They are used for the qualitative detection of all antibodies of all isotopes (IgG, IgM and IgA) specific to HIV 1 including subtype O and HIV 2 simultaneously in human serum or plasma. It is important to state clearly that serum were used for the screening, although plasma and whole blood can also be used. All manufacturers' instructions were carefully followed to the later during the analysis.

Haematological Examination Of Blood Samples

All collected blood samples were examined for the following hematological parameters.

a) Hemoglobin (Hb) level
b) Packed Cell Volume (PCV)
c) White Blood Cell (WBC) count.

Estimation of Haemoglobin Levels Of Blood Samples

The haemoglobin levels of collected blood samples were estimated using the cyanmeth-haemoglobin method (Simmon, 1997). Blood (0.02ml) was diluted with 5.0ml of Drabkin's reagent. After 10 minutes, the colour intensity of the solution was measured photometrically at 540nm. Water was used as blank. The hemoglobin level was obtained from a calibration curve prepared with the aid of commercially available standards.

Determination of Packed Cell Volume

The Packed Cell Volume values were determined using the microhaematocrit method (Simmons, 1997). The capillary tube was filled with homogenized blood (70mm long and 1mm wide) by capillary action leaving approximately 10mm unfilled. The empty end was sealed with a plastic stopper. A centrifugation was carried out with haematocrit centrifuge (Microfield England) at 12,000rpm for 3-5 minutes. The Packed Cell Volume was read using a reading device called haematocrit reader scale.

White Blood Cell Count Estimation

The White Blood Cell count was determined using an improved Neubauer (Assistant, Germany) counting chamber with Turk's solution as diluents. Anticoagulated blood (0.02ml) was diluted with 0.38ml of Turks solution in a clean dry test tube. The improved Neubauer counting chamber was charged with the solution with a clean pipette. This was allowed to stand for five (5) minutes at room temperature. The principle is based on the fact that the glacia acetic acid content of the Turks solution destroys the red blood cell while the tincture of methylane blue stains the white blood cell which makes them more visible to be counted (Cheesbrough, 2006)

Statistical Analysis

With the use of Statistical package for social science (SPSS$^{(R)}$) version 17.0, mean, range of values, (minimum and maximum) standard deviations, standard error and variance were computed. Using the Pearson Product Moment Correlation Coefficient (r), the degree of relationship between the immuno-heamotologoical parameters of infected subjects was determined at $P<0.01$. It is further been used to ascertain the level of association between HB, PCV, WBC and CD4 cell count at $P<0.01$.

RESULTS

A total of 1000 subjects, made up of 464 males (46.4%) and 536 females (53.6%) were sampled for HIV (HIV 1, HIV 2 and HIV 1 & 2^{+ve} co-infections) Out of this number, 107(10.7%) accounted for total incidence of HIV sero-positive cases. 78(7.8%) tested positive to HIV 1 antibody, while 29(2.9%) tested positive to HIV 1&2 co-infections. However, none of the subjects tested positive to HIV 2 antibody. Table 1 shows that variations were observed in the immuno-haematological parameters of HIV positive subjects sampled.

Of these, CD4 counts showed the highest variation while the least variations were observed in PCV and HB counts.

Table. 1: Descriptive Statistics of the Immune-Haematological Variables of Hiv Infected Subjects.

Variable	Unit	Minimum	Maximum	Mean	SE
PCV	%	24.00	48.00	32.94	0.53
Hb	g/dl	8.00	16.00	10.95	0.18
WBC	Mm^3	3.30	16.00	7.76	0.30
CD4	Ml	210.00	937.00	480.60	13.40

SE = standard error

PCV estimations ranged between 24.00 and 48.00% (32.94±0.53), HB estimation ranged between 8.00 and 16.00g/dl (10.95± 0.18) while WBC counts ranged between 3.30 and 16.30 Mm^3 (7.76 ±0.30). However, CD4 counts ranged between 210.00 and 937.00µl, with associated mean of 480.55 (±13.44).

Table 2 shows the correlation coefficients of the immuno-haematological parameters. At P<0.01; most of the parameters showed strong relationships. PCV correlated positively with HB(r=0.999) and negatively with WBC (r = -0.303), while HB correlated negatively with WBC(r=-0.306). Conversely, CD_4 counts did not correlate with any of the parameters measured.

Table. 2: Correlation Matrix of the Immune-Haematological Parameters Of HIV Sero-Positive Subjects.

	PCV	Hb	WBC
Hb	0.999**		
WBC	-0.303**	-0.306**	
CD4	-0.032	-0.029	-0.066

DISCUSSION

The study reveals that 107 (10.7%) tested positive for HIV (AIDS) antibody, out of 1000 subject screened using enzyme linked immune-sorbent assay (ELISA). However, it is suggested that a negative ELISA test at any given time does not preclude the possibility of an exposure or infection by HIV. This is potentially because a false negative or positive result which may likely occur if ELISA testing is carried out soon after infection by HIV (WHO, UNAIDS, UNICEF, 2008). This implies that the percentage of HIV sero-positive persons may in fact be higher than reported in this study. The prevalence of 10.7% in this study has shown that the incidence of HIV in Nigeria is on the increase especially in rural communities where lack of awareness, poverty, and decay in basic health infrastructures are increasingly visible. In Nigeria, the prevalence of HIV has been increasing steadily from 1.8% in 1991, 3.8% in 1993, 4.5 in 1999 and 5.8% in 2001; an increase of about 120% (Federal Ministry of Health Nigeria 2001). In many African countries 70% of HIV infection is as a result of heterosexual transmission (Fowler et al; 1997).

Wide variations in HIV prevalence has been observed across states especially between rural-urban localities but the spread of HIV to rural communities in Nigeria posse a lot of health concern especially anemia and other immunological crises. In Port Harcourt which is an urban City and capital of Rivers State, the prevalence of HIV in 2001, 2003, 2005 and 2008 are as follows 7.0, 3.7, 5.1 and 7.0% respectively while the semi urban area like Bonny had the following prevalence: In 2001 (82%), 2003 (83%), 2005 (6.0%), 2008 (8.4%) and Bori recorded 2001 (7.9%), 2003 (7.7%), 2005 (5.7%) and 8.3% in 2008 (HIV Sentinel Survey 2008); indicating higher prevalence in Bonny and Bori than in Port Harcourt which is an urban city. The above report agrees with the present study in Ahoada-East communities that recorded 10.7% higher than Port Harcourt. This suggests that there is a drift and shift of the burden from urban to rural areas in Nigeria cum Africa which is possibly influenced by the following factors:

1. Multiple sexual partners
2. Mother to child transmission
3. Blood transfusion
4. Low condom use
5. Untreated sexually transmitted infections.

However, these risk factors are encapsulated by widespread poverty, low literacy rate, low status of women in terms of condom use and over-burdened health care system as duly reported by Azuonwu *et al.*,(2010) in his study conducted in Ndoki community of Abia state, Nigeria. However, on the contrary, Caeswell in Kampala, Uganda observed 15.8% prevalence of HIV among Uganda blood donors which is far higher than the percentage recorded in this present work (Caeswell 1995). The prevalence of 10.7% recorded in this study is lower than the prevalence of HIV in Kaboboa, Zimbia which stood at 11% - 12% between 1999 – 2004 (Ministry of Health Zimbia, 2005).

The above result has further stressed the magnitude of the problem in Nigeria especially in rural communities and its impact to hematological profile of the infected subjects will be unimaginable with the end result of anemia if not checked. It is believed that many of the sero-positive subjects living in Ahoada may have acquired this virus through risky life style especially their sexual activities. Socioeconomic hardship which is prevalent in Ahoada East Local Government and Niger Delta in general could potentially suggest for this trend.

Descriptive statistics (Table 1) of immuno-hematological parameters of HIV infected subjects results revealed that among the HIV sero-psoitive subject sampled, their Packed Cell Volume (PCV) ranged between 24.00 and 48.00% (32.94 ± 0.52), with an associated normal range of 37-54%. Hemoglobin estimation ranged between 8.00 and 16.00g/dl (10.95 ± 0.17) with a normal range of 12 g/dl for men and female is 14 – 18 g/dl. The white blood cell count ranged between 3.30 and 16.30mm^3 (7.75 ± 0.30) and has it's normal range in a healthy subjects between 4,000 – 11000 cells/mm^3. However, CD4 count ranged between 210.00 and 937.00Nl (480.55 ± 13.44) with an associated normal range of 500 – 1000 cells/$mm^{3.}$ Hematological crises are among the most common complications of HIV sero-positive subjects, these encompass all forms of blood cells (Kirchoff and Silvestri 2008). HIV associated hematological crisis seem to be dependent on the level of virus replication as well as the amount of viral load. Studies in the past has shown that anemia is the most critical common hematological crises in HIV sero-positive patients and its prevalence is strongly associated with the progression of the disease (Kirchoff and Silverstri 2008). It becomes evident from the results of the parameters (PCV, HB, WBC, CD4 count) assayed that non was able to fall within the normal range and this suggest critical hematological disorder such as anemia if not well managed

in the nearest future. Pack Cell Volume (PCV) is an integral part of human's complete blood counts in HIV infected subjects. The result of pack cell volume which ranged between 24.00 to 48.00% is not within the normal range as such this will lead to damage of blood cells with high level of viral replication as it's correlation consequences will be severely felt in late stage of AIDS patients hematological profiles especially in remote villages where access to health facility cum antiviral drugs seem to be a monumental challenge. It is strongly suggested that high viremia in HIV patients blood could probably lead to low level of Packed Cell Volume which is suggestive of anemia. The effect of HIV on heamoglobin level (HB) is very important and it's assay is very vital since it is used to monitor the progress of HIV infection especially in the remote low resource settings where the use of flow cytometery will be inaccessible, thus the use of Hemoglobin estimation is very critical and cardinal in HIV management. The primary function of hemoglobin is to transport oxygen from the lungs to every cells and tissues in the body system. Red blood cells are composed predominantly of a protein and iron compound called hemoglobin that captures oxygen molecules as the blood moves through the lungs. HIV weakens the immune system and destroys the red cell which contains protein and iron compound thus leaving the system susceptible to myriad of infections. However, the end product of these activities is anemia. The result of this study falls below the normal range of Hemoglobin level. This will definitely affects it's function to the entire system. Study in this area also shows that hemoglobin plays a role as an independent prognostic marker of progression to AIDS and Lower hemoglobin values are associated with an increased risk of disease progression (Justyna *et al.,* 2007). The importance of white blood cell count (WBC) cannot be overemphasized especially during viral or bacterial infection of the system. HIV is a virus which attacked the white blood cell of the host specifically lymphocytes. These cells defend the body system against diseases by producing antibodies when the virus enters the blood stream. During active infection the body produces more white blood cells to combat the virus and the white blood cell count goes up (Kirchoff and Silverstri 2008). As the virus replicate faster, the ability of the body to produced white blood cells will begin to reduce drastically hence making way for illness to set in. The white blood cell count (WBC) of the infected subjects of this study falls below the normal range 3.30 and 16.30mm^3 while the normal range in the healthy subjects ranged from 4,000 – 11000 cells/mm^3. This will obviously open up the system of the infected groups to myriad of opportunistic infections that will seem uncontrollable if the trend is not checked with prompt diagnosis and treatment.

CD4 count is also an important immunological marker of disease progression in human immune virus sero-positive patients. HIV attacks the CD4 cells and uses them to make more copies of HIV and in doing so HIV weakens the immune system making it unable to protect the body from further infection. It has been reported that early in the stage of the disease, the body makes more CD4 cells to replace the ones that have been damaged by HIV (Mermin *et al.,* 2006). Eventually the system could not maintain the number of functional T-cells and the cells will decrease. As more CD4 cell are damaged, the immune system becomes fragile and weakens (Imade *et al*., 2005). The higher the number of CD4 cells, the stronger the immune system. People without HIV infection have about 500 to 1000 CD4 cells in a drop of blood. HIV infected people are considered to have normal CD4 counts if their number is above 500 CD4 cells in that drop of blood which could be influenced by the nutrition taken and living a healthy life. It is strongly suggested that food taken by HIV sero-positive patients should be nutritious especially with fruits and vegetables as these will help the immune system to be stronger and make the CD4 cell count higher. Study has shown that if the number of CD4 cells in a drop of blood ever drops below 200 cells, it could be linked and classified as the subject having AIDS (Mermin *et al.*, 2006). Longer duration of HIV infection suppresses the immune system and leads to lower CD4 cell number (Frobel *et al*., 2004).

The relationship between immuno-haematological parameters of HIV positive subjects shows that at P<0.01 Packed Cell Volume (PCV) correlated positively with hemoglobin r =-0.999 and negative with White Blood Cell count (WBC) r = -0.33, while hemoglobin correlated negatively with White Blood Cell Count (WBC) r =-0.306. Conversely, CD4 counts did not correlate at P<0.01 with any of the parameters (HB, PCV, WBC), however, previous studies have implicated hematological disorders to be a significant clinical problem in patients with HIV infection and AIDS. In a similar study conducted by Atili *et al;*(2008) on hemoglobin (HB) and Packed Cell Volume (PCV) among HIV infected subjects showed statistical correlation significant at P<0.01 which is in agreement with the present study. Evidence based study suggest that hemoglobin plays a very vital role as an independent prognostic marker of progression to AIDS. Lower hemoglobin values are associated with an increased risk of anemia and subsequently increased death (Justina *et al*., 2007). Conversely, CD4 cell count which is a strong indicator of immunological status of the patient did not correlate with any of the parameters at P<0.01 which may likely potend that the level of infection have not progressed to the level of full blown AIDS among the screened subjects. However, the rates at which the CD4 cells of the HIV infected patients are being reduced are associated with a lot of factors. Firstly, the duration of the infection in the system, the level of viral replication and thirdly, the extent of viral load (Kirchoff and Silverstri 2008). The result of the present study did not agree with the work of Semba *et al*., (2002) who reported that CD4 count correlated with hemoglobin (HB), Packed Cell Volume (PCV) and White Blood Cell Count (WBC) respectively. Although the reason for this was not very clear. However, blood transfusion strategy has been used to improve the quality of life of HIV patients but much needed care should be employed due to the aftermath effect of transfusion reaction which is always fatal. There is need for universal access to antiretroviral drugs in our communities before their health situations will degenerate into full blown AIDS. These drugs will help in reducing the viral load, enhancing the CD4 count as well as improve the quality of life of persons living with HIV and AIDS. However, it is of great concern

that the availability and accessibility of the antiviral drugs are still not within the reach of those that lives in the remote communities. This tend to worsen the health of the infected subject with severe hematological disorders and other associated health implications. The time has come and we need to act now to save the life of those living in our remote communities from anemia and other hematological disorders which are associated with HIV/AIDS.

CONCLUSION AND RECOMMENDATION

Conclusion

The study recorded a prevalence of 10.7% for HIV. Poverty and high risk behaviors was highly implicated as a driving force in rural communities. All the subjects who were positive for HIV infections recorded a lower level of HB, WBC and CD4 count. Non were within the normal range of the hematological cut up, This are critical given the health implication of this scenario in near future which is anemia and death Also PCV correlated positively with HB ($r = 0.999$) and negatively with WBC ($r = -0306$); conversely CD4 did not correlate at $P<0.01$ with any of the parameters (PCV, HB, WBC).

Recommendation

There is need for intervention in education, health and economic empowerment of the people of the area for economic independence and knowledge to drive behavioral change. Aggressive drive for behavioral change from prevalent high risk behaviors, better health and economic advancement of Ahoada-East local government area are strongly advocated. Finally there should be more focused research in other parts of the rural communities in the region so as to continue to monitor the trend, especially with its impact on immunological profiles of the infected subjects as this will help effective prevention and management of opportunity infection. An aggressive research drive should be focus on development and provision of microbicide for the control of HIV/STD among rural woman in Nigeria by Donor Agencies. Government and other relevant agencies should set aside funds for interdisplinary research and development in the area of molecular virology in Nigeria. These are the trend globally towards solving world health problems. Consideration should be given to monitoring anemia in all HIV-positive individuals and to offer supplements like iron preparations, Vitamin B12 or folic acid and in severe cases provide erythropoietin treatment or blood transfusion which will surely promote life and reduce the crisis of anemia. Robust reference laboratories should be provided in the rural areas that could help to monitor the impact of the scourge on the hematological parameters of the rural dwellers.

Conflict of interest or competition

There is no conflict of interest among the authors.

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