

# PATTERN OF CD4 COUNT AND HEMATOLOGICAL INDICES IN HIV SERODISCORDANT PARTNERS IN JOS NORTH LOCAL GOVERNMENT AREA OF PLATEAU STATE, NIGERIA.

## ABSTRACT

This was a cross sectional study designed to evaluate the cluster of differentiation 4 (CD4) count and hematological indices in HIV serodiscordant partners in Jos, Nigeria. A total of 20 discordant HIV couples (40 patients) and 20 non HIV couples (40 controls) aged between 18 and 49 years were included in the study. Each participant provided a 5ml venous blood sample that was collected into EDTA containers for the analysis of the CD4 count and hematological indices. The following blood parameters were measured using a three pack full blood count autoanalyzer: white blood cell (WBC), red blood cell (RBC), hematocrit/packed cell volume (HCT/PCV), hemoglobin (HB), platelet count (PLT), lymphocyte, neutrophil, and mixed cell (NUE/NAC) count. The CD4<sup>+</sup>-T cell was measured using flow cytometry. The results showed that the mean RBC count, platelet count, mixed cell count (Nue/Nac), HCT/PCV and HB levels, as well as the CD4-T cell count, were all significantly lower while the mean age was higher in the HIV discordant test group compared to control group ( $p < 0.05$ ) respectively. The mean neutrophil, lymphocyte, and WBC counts in the HIV discordant test group did not statistically differ from those in the control group ( $p > 0.05$ ). The HB, HCT/PCV, RBC, lymphocyte, and CD4 counts in the female HIV discordant test group were statistically significantly lower than those in the female control group ( $p$ -value=0.008; 0.002; 0.000, 0.008, 0.000), respectively. The male HIV discordant test group had statistically significantly lower mean neutrophil and CD4 counts than in the male control ( $p$ -value=0.000; 0.012) respectively. The female HIV seropositives had a statistically significantly lower mean RBC count, Hb, PCV, and CD4 count ( $p$ -value =0.000; 0.037, 0.005 and 0.000) than in female control respectively. Also, the female HIV exposed seronegatives had statistically significantly lower mean CD4 count ( $p$ -value =0.000) and Hb ( $p$ -value =0.037) levels than in female control while the male HIV seropositives had statistically significantly lower CD4 count compared to male control ( $p$ -value =0.000). This study has revealed significant changes in CD4-T cell count and hematological indices in HIV discordant couples, which calls for an urgent interventional strategy to prevent the potential anemia, leucocytopenia, and weakened immunity that may result in both HIV seropositives and seronegative exposed couples.

**Key words:** Age, Anemia, CD4-T cell, Discordant couple/partner, Hematological indices, HIV, Leucocytopenia.

## INTRODUCTION

Human immunodeficiency virus (HIV), a member of the lentivirus family, causes a range of symptoms anchored on the reduced immune function of its host by causing devastating effects on the host's innate immune capabilities, allowing HIV replication in the host cell, leading to HIV infecting new immune cells, and resulting in the host's susceptibility to infections and if unchecked, this leads to Acquired Immunodeficiency Syndrome (AIDS) (Aaron *et al.*, 2017; UNAIDS, 2019). HIV is a public health issue affecting the world's population; 79.3 million people have been infected with the virus since the epidemic began, 36.3 million have died from AIDS, and recently 37.7 million people were infected with HIV in 2020 (UNAIDS, 2022). It is the main cause of morbidity and mortality in Sub-Saharan Africa (SSA), accounting for 71% of the global population of people living with HIV (James *et al.*, 2018; Roth *et al.*, 2018). In Nigeria, the first HIV/AIDS patient was identified and reported in Lagos in 1985 (Awofala and Ogundele, 2017). Nigeria, the most populous country in Africa (UNFPA, 2020), has 1.9 million people living with HIV (with prevalence of 1.4%) between 15–49 years, making it the third highest in HIV load (UNAIDS, 2019).

HIV discordance is a situation that occurs when one partner is HIV positive and the other is HIV negative (Mehra *et al.*, 2015). HIV discordant couples are a high-risk group for HIV transmission (Ravikumar and Balakrishna, 2013). In Sub-Saharan Africa, 50% of people living with HIV (PLWH) are in sero-discordant partnerships (Chemaitelly *et al.*, 2012; Curran *et al.*, 2012). Sero-discordant married or cohabiting couples account for a large proportion of new HIV infections in Sub-Saharan Africa, and transmission within this crucial population is a preventable driver of the epidemic (Irungu *et al.*, 2016; Patel *et al.*, 2018). Thus, HIV preventive and treatment efforts focus on sero-discordant couples.

HIV causes AIDS, a systemic disease marked by impaired cellular and humoral immune responses (Balasubramaniam *et al.*, 2019; van Woudenberg *et al.*, 2020) which has been linked with hematological abnormalities. Hematological abnormalities are linked to disease progression and death in HIV patients (Damtie *et al.*, 2021). Anemia, leucopenia, neutropenia, lymphopenia, and thrombocytopenia have been observed in HIV-infected people before or after antiretroviral therapy (ART) initiation (Bhardwaj *et al.*, 2020; Damtie *et al.*, 2021), indicating that hematological abnormalities in HIV individuals are induced by either the virus or ART. More so, anemia, lymphocyte count, and thrombocytopenia are associated with cluster of differentiation -4 (CD4) levels (Bhardwaj *et al.*, 2020). In addition, hematopoietic progenitor cells express CD4 receptors, type 4 C-X-C chemokine receptors and type 5 chemokine receptors, making them susceptible to being infected by HIV (Tsukamoto, 2020). In light of the above, it is important to evaluate the CD4 count and hematological indices in HIV discordant partners in Jos, Nigeria. Hematological indices offer physiological insights on the reticuloendothelial system and the blood picture (Okoroiwu *et al.*, 2017), and this has not been investigated in this group before.

## **MATERIALS AND METHODS**

### **Study Area and Location**

The study area for this work was Jos North Local Government Area of Plateau State and location includes APIN (Aids Preventive Initiative of Nigeria) section of Our Lady of Apostles (OLA) Hospital, Faith Alive Foundation Hospital and Plateau State Specialist Hospital where HIV screenings are carried out.

### **Study Design and Subject Selection**

This study adopted a cross sectional study design approach. The participants were partners who were known to be HIV positive and exposed seronegatives and are between the ages of 18 and 49 years old. Additionally, HIV-negative couples within the aforementioned age range that appeared to be in good health were employed as controls. The HIV-positive people were already taking medication, but their negative counterparts in a discordant relationship were not on ART.

### Sample size and sampling technique

Participants in the present study were randomly selected. The sample size required to answer the set objective at 95% confidence level in this study was calculated from the formula by (Lu-Ann *et al.*, 2006).

$$N = Z^2 P(1-P)/A^2$$

Where:

N= The desired sample size

Z= The standard normal deviation corresponding to 95% level of confidence

The value obtained from normal distribution is 1.96.

P= Prevalence (Previous studies show a prevalence rate of 2.3 percent for HIV in Jos NACA, 2012)

A<sup>2</sup> = Degree of prevalence

$$\text{Sample size} = (1.96)^2 \times 0.023 \times (1-0.023) / (0.05)^2$$

$$N = 3.8416 \times 0.023 \times 0.977 / 0.0025$$

$$N = 34.52$$

$$10\% \text{ of error made up } 10/100 \times 34.52 = 3.45$$

$$34.52 + 3.45 = 37.97$$

N= 38 samples

This was thereafter rounded up to make 20 HIV exposed negatives and 20 HIV positives and 20 non HIV couples (40 control)

### **Study Population**

The study population included male and female subjects in **discordant** relationship within the age of 18 to 49 years attending the APIN section of Our Lady of Apostles Hospital, Faith Alive Foundation and Plateau State Specialist Hospital. A total of 20 discordant HIV couples (40 patients) and 20 controls (40 non HIV couples) were included in the study.

### **Inclusion criteria**

Participants **that** tested HIV-negative and had been in a stable, discordant relationship for at least three months were included. The study comprised participants **that** were registered patients at the hospital under investigation, between **the ages of 18 and 49, and had the necessary** status documentation. Additionally, a control group of people **that** were within the age bracket and appeared healthy was included in the study (non HIV subjects).

### **Exclusion Criteria**

Participants **that** were already bedridden due to AIDS, those **that** were not registered patients or had improper documentation with the institution under research, and those **that** refused to give informed consent were all excluded from the study.

### **Sample Collection and Laboratory methods**

Each participant gave venous blood sample of 5 ml, which was then drawn into EDTA containers after the collection site had been cleaned with 70% alcohol. This was utilized for the determination of full blood count as well as CD4 count.

Full blood count was determined using a three pack automated full blood count analyzer while the CD4 count was assayed using Flow cytometry.

### **Statistical Analysis**

The data obtained were analyzed using independent t-test and one-way analysis of variance (ANOVA) with the aid of SPSS statistics tool version 23.0 software. Significant level was assumed at  $P < 0.05$ .

### **RESULTS**

When compared to the control group, the HIV discordant test group's mean age was statistically significantly higher ( $P\text{-value} = 0.000$ ). However, when compared to the control group, the mean RBC count, platelet count, mixed cell count (Nue/Nac), HCT/PCV and HB levels, as well as the CD4-T cell count, were all statistically significantly lower in the HIV discordant test group ( $P < 0.05$ ). However, there was no statistically significant difference ( $P > 0.05$ ) between the mean WBC, lymphocyte, or neutrophil counts and the control group. (Table 1).

The male control group's mean age was statistically significantly higher than that of the female control group ( $P\text{-value} = 0.000$ ). The female test group's mean age was statistically significantly higher than that of the female control group ( $P\text{-value} = 0.000$ ). Additionally, the mean age of the male test group was a statistically significantly higher than that of the female control group and the female test group who tested positive for HIV ( $P\text{-value} = 0.000$ ) respectively). (Table 2).

In comparison to the control groups, as well as between the male and female test groups, there was no statistically significant difference ( $P$ -value=0.524) in the mean level of total WBC (Table 2).

In comparison to the values seen in the female and male control groups, respectively, the mean level of RBC seen in the female test group was statistically significantly lower ( $P$ -value=0.000). Additionally, the mean RBC level was statistically significantly lower in the male test group than in the female control group ( $P$ -value=0.000). (Table 2).

In comparison to the female ( $12.95\pm 0.98$ ) and male ( $12.81\pm 1.22$ ) control groups, the mean HB level was statistically significantly lower in the female test group ( $11.48\pm 1.43$ ) ( $P$ -value=0.008). (Table 2). There was significantly lower HCT/PCV level observed in the female test group ( $34.90\pm 3.82$ ) when compared to the female ( $41.00\pm 2.90$ ) and male ( $39.80\pm 3.30$ ) control groups ( $P$ -value= 0.002). Also, the mean HCT/PCV level was statistically significantly lower in the male test group than in female control group ( $35.98\pm 9.40$  Vs  $41.00\pm 2.90$ ;  $P$ -value =0.002).

There was statistically significantly lower platelet count observed in the male test group when compared to the female control groups ( $220.70\pm 70.99$  Vs  $280.20\pm 60.41$ ;  $P$ -value =0.022). (Table 2).

The mean NUE/NAC levels did not differ statistically significantly ( $P > 0.05$ ) between the test groups of males and females as well as the controls (Table 2).

The mean lymphocyte counts were statistically significantly higher in the male test group than in the female test group ( $52.85\pm 8.41$  Vs  $44.85\pm 11.16$ ;  $P$ -value =0.008), but significantly lower in the female test group compared to the female ( $52.00\pm 1.86$ ) and male ( $52.30\pm 4.23$ ) control groups (Table 2).

The mean neutrophil counts in the male test group were significantly lower than those in the female control group ( $34.50 \pm 8.66$  Vs  $40.90 \pm 6.84$ ;  $P$ -value =0.012), but they were not statistically different from those obtained in the female test group (Table 2).

Compared to the values seen in the male and female control groups, the mean CD4 count was statistically significantly ( $P$ -value=0.000) lower in the female and male test groups respectively. Additionally, there was a statistically significant difference ( $P$ -value=0.000) between the mean CD4 count in the male and female test groups. (Table 2).

There were statistically significant differences when the mean ages of the study participants were compared between the groups ( $f$ -value=15.054;  $P$ -value=0.000). Male controls, females with HIV, and males with HIV all had mean ages that were statistically different ( $P$ -value =0.000) from those of the participants who were female controls respectively. Additionally, the mean age of the male HIV exposed seronegative participants was statistically significantly higher than that of female controls and HIV positive individuals ( $P$ -value =0.000, respectively). (Table 3).

The mean total white blood count (WBC), platelet count, and NUC/NAC levels did not statistically significantly differ ( $P > 0.05$ ) across the study groups when compared (Table 3). The mean red blood cell count was significantly different between the groups ( $F=5.709$ ;  $P=0.000$ ) and statistically significantly lower in the female HIV seropositives than in the male and female control groups ( $P=0.000$ ), respectively (Table 3).

There was a statistically significant difference ( $F=2.523$ ;  $P=0.000$ ) between the groups' mean hemoglobin (HB) levels (Table 3).

There were statistically significant differences ( $F=3.726$ ;  $P=0.005$ ) between the male HIV exposed and seronegative groups as well as between the female HIV positive and female control

groups when participants' mean levels of haematocrit/packed cell volume were compared across the study groups (Table 3).

The mean lymphocyte level differed between the study groups in a statistically significant ( $F=2.456$ ;  $P=0.041$ ) manner (Table 3). Additional statistically significant differences ( $F=2.423$ ;  $P=0.043$ ) were seen between the study groups when the neutrophil counts were compared. Additionally, compared to female HIV positives, male HIV exposed seronegatives exhibited statistically significantly ( $P=0.043$ ) lower mean neutrophil counts (Table 3).

There were statistically significant differences between the research groups' mean CD4 counts ( $F=16.6672$ ;  $P=0.000$ ). The mean CD4 count was statistically ( $P=0.000$ , respectively) lower in the female HIV seropositives, female exposed HIV seronegatives, and male HIV seropositives compared to the values observed in the male and female control groups (Table 3). In comparison to female HIV positives, male HIV exposed seronegatives had a statistically significantly ( $P=0.000$ ) lower mean CD4 count (Table 3).

Table 1: CD4 count and levels of Hematological indices in the HIV discordant and control groups studied (Mean $\pm$ SD).

| Parameter | Control group<br>(n=40) | HIV Discordant<br>Test group<br>(n=40) | t-value | P-value |
|-----------|-------------------------|--|---------|---------|
| Age       | 35.6 $\pm$ 6.9          | 40.5 $\pm$ 6.1                         | 3.350   | 0.000*  |
| WBC       | 5610.00 $\pm$ 1401.43   | 5220.00 $\pm$ 1502.85                  | 1.200   | 0.234   |
| RBC       | 4.64 $\pm$ 0.43         | 4.10 $\pm$ 0.54                        | 4.879   | 0.000*  |
| HB        | 12.88 $\pm$ 1.10        | 11.92 $\pm$ 1.76                       | 2.923   | 0.005*  |
| HCT/PCV   | 40.40 $\pm$ 3.13        | 35.41 $\pm$ 7.10                       | 4.041   | 0.000*  |
| Platelet  | 277.95 $\pm$ 56.29      | 241.20 $\pm$ 75.48                     | 2.468   | 0.016*  |

|                      |                |               |       |        |
|----------------------|----------------|---------------|-------|--------|
| NUE/NAC(Mixed cells) | 7.40±1.68      | 6.65±1.17     | 2.322 | 0.023* |
| Lymphocyte           | 52.15±6.17     | 48.85±10.56   | 1.706 | 0.092  |
| Neutrophil           | 40.45±5.46     | 38.20±9.71    | 1.277 | 0.205  |
| CD4                  | 1035.20±141.11 | 616.48±348.28 | 7.047 | 0.000* |

\*Statistically significant at  $p < 0.05$ .

**Table 2: Levels of CD4 count and hematological indices in the male and female HIV discordant test groups studied (mean±SD).**

| Parameter       | Female control (n=20) | Male control (n=20)   | Female discordant test group (n=20) | Male discordant test group (n=20) | f-value | <b>P-value</b> |
|-----------------|-----------------------|-----------------------|-------------------------------------|-----------------------------------|---------|----------------|
| Age             | 30.5±4.5              | 40.7±4.6 <sup>a</sup> | 37.5±5.6 <sup>a</sup>               | 43.5±5.2 <sup>a,b</sup>           | 25.128  | 0.000          |
| WBC             | 5820.0±1821.97        | 5400.00±786.73        | 5790.00±1622.57                     | 5250.00±1414.77                   | 0.753   | 0.524          |
| RBC             | 4.71±0.51             | 4.57±0.33             | 3.98±0.38 <sup>a,b</sup>            | 4.23±0.65 <sup>a</sup>            | 9.246   | 0.000          |
| HB              | 12.95±0.98            | 12.81±1.22            | 11.48±1.43 <sup>a,b</sup>           | 12.37±1.97                        | 4.192   | 0.008          |
| HCT/PCV         | 41.00±2.90            | 39.80±3.30            | 34.90±3.82 <sup>a,b</sup>           | 35.98±9.40 <sup>a</sup>           | 5.648   | 0.002          |
| Platelet        | 280.20±60.41          | 275.70±53.34          | 261.70±75.97                        | 220.70±70.99 <sup>a</sup>         | 3.392   | 0.022          |
| NUE/NAC (mixed) | 7.10±1.86             | 7.70±1.45             | 6.80±1.28                           | 6.50±1.05                         | 2.522   | 0.064          |

|            |                |                |                              |                                |        |       |
|------------|----------------|----------------|------------------------------|--------------------------------|--------|-------|
| cells)     |                |                |                              |                                |        |       |
| Lymphocyte | 52.00±1.86     | 52.30±4.23     | 44.85±11.16 <sup>a,b</sup>   | 52.85±8.41 <sup>c</sup>        | 4.189  | 0.008 |
| Neutrophil | 40.90±6.84     | 40.00±3.73     | 41.90±9.49                   | 34.50±8.66 <sup>a</sup>        | 3.881  | 0.012 |
| CD4        | 1042.95±109.86 | 1027.45±169.33 | 469.20±270.79 <sup>a,b</sup> | 763.75±360.55 <sup>a,b,c</sup> | 23.909 | 0.000 |

Key:

a=compared with female control

b= compared with male control

c= compared with female test group

Table 3: Levels of CD4 and hematological indices in the participants studied (mean±SD).

| Parameter | Female control (n=20) | male control (n=20)   | Female positives (n=16)  | Female negatives (n=4) | male positives (n=16) | male negatives (n=4)    | f-value | P-value |
|-----------|-----------------------|-----------------------|--------------------------|------------------------|-----------------------|-------------------------|---------|---------|
| Age       | 30.5±4.5              | 40.7±4.6 <sup>a</sup> | 37.1±5.6 <sup>a</sup>    | 38.8±6.4               | 45.3±7.5 <sup>a</sup> | 43.1±4.6 <sup>a,c</sup> | 15.054  | 0.000   |
| WBC       | 5820.0±1821.97        | 5400.00±786.73        | 5168±1709.47             | 5275.00±1431.49        | 5087.50±1340.09       | 5415.00±1457.07         | 0.644   | 0.667   |
| RBC       | 4.71±0.51             | 4.57±0.33             | 3.99±0.24 <sup>a,b</sup> | 3.95±0.79              | 4.29±0.65             | 4.37±0.56               | 5.709   | 0.000   |
| HB        | 12.95±0.98            | 12.81±1.22            | 11.54±1.05               | 11.23±2.72             | 12.43±1.98            | 12.40±1.53              | 2.523   | 0.037   |
| HCT/PCV   | 41.00±2.90            | 39.80±3.30            | 34.88±3.28 <sup>a</sup>  | 35.00±6.22             | 35.16±9.85            | 37.92±6.00 <sup>a</sup> | 3.726   | 0.005   |
| Platelet  | 280.20±60.41          | 275.70±53.34          | 263.88±78.03             | 253.00±77.36           | 225.63±67.35          | 259.5u8±68.70           | 2.101   | 0.075   |
| NUE/NAC   | 7.10±1.86             | 7.70±1.45             | 6.94±1.29                | 6.25±1.26              | 6.50±1.03             | 7.03±1.48               | 1.63    | 0.1     |

|                   |                    |                    |                                  |                                  |                                  |                                |             |           |
|-------------------|--------------------|--------------------|----------------------------------|----------------------------------|----------------------------------|--------------------------------|-------------|-----------|
| (Mixed cells)     |                    |                    |                                  |                                  |                                  |                                | 1           | 63        |
| <b>Lymphocyte</b> | 52.00±1.8<br>6     | 52.30±4.2<br>3     | 44.69±12.<br>31                  | 45.50±5.4<br>5                   | 52.94±7.6<br>1                   | 50.50±8.7<br>5                 | 2.45<br>6   | 0.0<br>41 |
| <b>Neutrophil</b> | 40.90±6.8<br>4     | 40.00±3.7<br>3     | 42.31±10.<br>40                  | 40.25±4.9<br>2                   | 33.94±8.0<br>5                   | 39.33±7.9<br>1 <sup>c</sup>    | 2.42<br>3   | 0.0<br>43 |
| <b>CD4</b>        | 1042.95±<br>109.86 | 1027.45±<br>169.33 | 442.00±26<br>4.68 <sup>a,b</sup> | 578.00±30<br>9.25 <sup>a,b</sup> | 828.88±35<br>7.65 <sup>a,b</sup> | 825.84±33<br>7.79 <sup>c</sup> | 16.6<br>672 | 0.0<br>00 |

Key:

a=compared with female control

b= compared with male control

c= compared with female HIV positive

## DISCUSSION

Hematological abnormalities of the major blood cell lines are frequently reported by people with HIV-1 infection, including those who are not taking antiretroviral treatment and those with the disease in its severe stages (Duguma *et al.*, 2021). Due to its damaging effects on the immune system and many human organs, which cause significant unfavorable changes in a number of hematological indices, HIV continues to be a subject of intense health relevance and discussion throughout the world.

In the current study, the mean age was statistically significantly higher in the HIV discordant test group ( $40.5 \pm 6.1$ ) than in the control group ( $35.6 \pm 6.9$ ). Given that the mean age of HIV-positive people fall within the age range of the working class in Nigeria (Sasu, 2022), proper and prompt therapeutic management of these people will further increase their productivity throughout the economic cycle.

The lower levels of red blood cell count, packed cell volume and hemoglobin level recorded in this study shows that the HIV serodiscordant couples are at risk of anemia. Anemia among people living with HIV (PLWH) is caused by numerous factors. Red blood cell breakdown (hemolysis) and inefficient red blood cell formation, which are influenced by infections of the spleen or circulatory system, are two ways that immune dysregulation during HIV infection can raise the risk of anemia (Kerkhoff *et al.*, 2014). Blood loss is a typical occurrence in PLWH and can be brought on by gastrointestinal lesions that go along with opportunistic infections or neoplastic illness. Iron, folate, or vitamin B12 deficiencies are additional pathways for HIV-related anemia (Kerkhoff *et al.*, 2014). Previous studies have also reported similar findings to the present study (Ositadinma *et al.*, 2016; Aaron *et al.*, 2021).

Furthermore, lower level of platelet count documented in the HIV serodiscordant couple in this study is an indication that these persons are at greater risk of thrombocytopenia.

This is in keeping with findings in previous studies involving HIV subjects (Enawgaw *et al.*, 2014; Aaron *et al.*, 2021) that observed varying levels of thrombocytopenia in HIV participants. However, increased platelet oxidation and inefficient platelet synthesis appear to be the

mechanisms underlying thrombocytopenia in HIV infection. HIV-associated thrombocytopenia causes considerable platelet sequestration and destruction in the spleen.

Anemia, leucopenia, neutropenia, lymphopenia, and thrombocytopenia have been observed in HIV-infected people before or after ART initiation (Bhardwaj *et al.*, 2020; Damtie *et al.*, 2021), indicating that hematological abnormalities in HIV individuals are induced by either the virus or ART. More so, anemia, lymphocyte count, and thrombocytopenia are associated with CD4 levels (Bhardwaj *et al.*, 2020).

Expectedly, this study found that the CD4+T-cell count was significantly lower in HIV serodiscordant participants compared to controls. This finding is in line with earlier studies (Nsonwu-Anyanwu *et al.*, 2017; Ezeugwunne *et al.*, 2021; Ezeugwunne *et al.*, 2021) that showed significantly decreased CD4 count in HIV participants compared to control. HIV infection primarily affects CD4 cells because of the virus' affinity for CD4 cell surface receptors (CD4+).

An increase in susceptibility to a variety of opportunistic viral, bacterial, protozoal, and fungal infections as well as some malignancies results from the progressive impairment of cellular functions brought on by HIV infection, which is characterized by a gradual decline in peripheral blood CD4+ lymphocyte levels.

The results of this investigation demonstrated that there were no statistically significant differences between the discordant group and the control group in terms of mean WBC, lymphocyte, or neutrophil counts. This finding is consistent with that of Asemota *et al.* (2018) that found no significant differences between control and HIV-naive patients and HIV-infected participants in terms of the mean WBC counts (Asemota *et al.*, 2018). The limited sample size used in this study as well as the stage of HIV infection may have had an impact on the findings.

Furthermore, neither the mean WBC nor the NUC/NAC (mixed cells) levels showed a statistically significant difference between the test groups of male and female HIV discordant couples and the controls. This finding is consistent with that of Asemota *et al.* (2018) that found no significant differences between control and HIV-naive patients and HIV-infected participants in terms of the mean WBC and mixed cells counts (Asemota *et al.*, 2018) but differs with some other reports (Aaron *et al.*, 2021). This result may imply that in the participants in the study, gender differences do not significantly affect either the WBC or the mixed cells count (which includes monocyte, eosinophil, and basophil count).

There was significantly lower platelet count observed in the male HIV discordant test group when compared to the female control group. This demonstrates that male HIV-positive discordant couples may be more susceptible to thrombocytopenia than the general or healthy population. Thrombocytopenia has been reported in the literature among the HIV positive individuals previously (Abdulrahman *et al.*, 2014) which agrees with the current results. Thrombocytopenia is the second most frequent complication of human immunodeficiency virus (HIV) infection with varied prevalence documented across the globe (Akinbami *et al.*, 2010; Gunda *et al.*, 2017; Butale, 2019; Gebreweld *et al.*, 2020; Patil and Patil, 2020).

In this study, the mean level of RBC in the female HIV discordant test group was significantly lower than the levels observed in the female and male control groups, respectively. Additionally, compared to the female control group, the mean RBC level was significantly lower in the male HIV discordant test group. The mean HB level in the female HIV discordant test group was significantly lower than it was in the male and female control groups. When compared to the female and male control groups, the HCT/PCV level in the female HIV discordant test group was significantly lower. Additionally, the mean HCT/PCV level in the male HIV discordant test

group was significantly lower than in the female control group. This research demonstrates that while men are similarly susceptible to anemia brought on by HIV infection and exposure, it affects women more severely. Impaired haematopoiesis, immune-mediated processes, opportunistic infections, lymphoma, and the myelotoxic effects of antiretroviral medications are some of the aetiopathogenesis factors for anemia in HIV infection (Hoffbrand *et al.*, 2006). Anemia in HIV-positive people has been shown in several investigations as evidenced by significantly lower mean RBC, Hb, and PCV levels (Ositadinma *et al.*, 2016; Aaron *et al.*, 2021). Furthermore, the mean lymphocyte counts were significantly higher in the male HIV discordant test group than in the female HIV discordant test group, but significantly lower in the female HIV discordant test group compared to the female and male control groups. In comparison to the female control group, the mean neutrophil counts in the male HIV discordant test group were significantly lower, but it did not differ significantly from those found in the female test group. This suggests that while the male discordant test group may be more susceptible to neutropenia than the female discordant group, the female discordant group may be more susceptible to lymphopenia. Numerous studies have recorded varying degrees of leucopenaia characterized by lymphopenia and/or neutropenia (Balogun *et al.*, 2020) which corroborates with the present findings. Leucopenia and neutropenia have been linked to HIV infection in previous research (Munyazesa *et al.*, 2012; Parinitha and Kulkarni, 2012) while neutropenia makes HIV patients more vulnerable to bacterial infections, leucopenia is believed to increase the frequency of opportunistic infections (Tagoe and Asantewaa, 2011). According to reports, lymphopenia and a low lymphocyte total count are frequent symptoms of HIV infection (Dangana *et al.*, 2010; Parinitha and Kulkarni, 2012).

Interestingly, the mean CD4 count was significantly lower in the male and female discordant test groups, respectively, than the values observed in the male and female control groups, while the mean CD4 count was significantly higher in the male discordant test group than in the female discordant test group. This result is consistent with past research (Nsonwu-Anyanwu *et al.*, 2017; Ezeugwunne *et al.*, 2021; Ezeugwunne *et al.*, 2021).

The mean red blood cell count was significantly different between the groups and significantly lower in the female HIV seropositives than in the male and female control groups respectively. There was a significant difference between the groups' mean hemoglobin (HB) levels as well. In comparison to controls, female HIV seropositives and exposed HIV seronegatives had significantly lower levels of hemoglobin (Hb). Furthermore, compared to female controls, PCV/HCT were significantly lower in female HIV-seropositives as well as exposed seronegative males. These results suggest that anemia caused by HIV infection and/or exposure affects both female HIV positives and HIV exposed seronegatives in a similar way. The fact that the current study identified partner HIV exposure as a risk factor that can result in anemia in such individuals is quite significant. Several studies have documented anemia in HIV infected individuals indicated by significantly lower mean levels of RBC, Hb and PCV (Ositadinma *et al.*, 2016; Aaron *et al.*, 2021). The most prevalent hematologic abnormality among HIV-positive individuals is anemia, which is also linked to the course of the disease and a higher mortality risk for the patients (Cao *et al.*, 2022). Patients with HIV experience anemia for a variety of reasons. Hematopoietic stem/progenitor cells (HSPCs), which are found in the bone marrow, may be negatively affected by HIV both directly and indirectly (Durandt *et al.*, 2019; Marchionatti and Parisi, 2021). Additionally, the proliferation and differentiation of HSPCs during hematopoiesis may be impacted by ART medications, inflammatory mediators generated during HIV infection,

coinfections, or opportunistic infections (Durandt *et al.*, 2019; Marchionatti and Parisi, 2021). So, either the gradual depletion of HSPCs or the inhibition of their action may be the cause of anemia. In addition, a number of publications have noted that some ART combinations or monotherapy can cause anemia (Zerihun *et al.*, 2019; Kayode *et al.*, 2020), which is consistent with the results of the current study. An important indicator that the anemia experienced by the HIV exposed seronegative participants in this study may be caused by their exposure to HIV infection in their partners is the fact that their HB, RBC, and PCV/HCT were significantly lower than in control subjects. As a result, it is important to monitor these indices in the exposed participants.

As anticipated, this study found that the CD4+T-cell count was significantly lower in the female HIV seropositives, female exposed HIV seronegatives, and male HIV seropositives as compared to the values seen in the male and female control groups. In comparison to female HIV positives, male HIV exposed seronegatives had a considerably lower mean CD4 count. As anticipated, this study found that the CD4+T-cell count was significantly lower in HIV-positive participants compared to controls. This finding is in line with earlier studies (Nsonwu-Anyanwu *et al.*, 2017; Ezeugwunne *et al.*, 2021; Ezeugwunne *et al.*, 2021). A progressive decrease in CD4+ T-cell populations, along with a steady decline in cellular immunity and an increase in vulnerability to opportunistic infections, is the defining feature of HIV infection and, subsequently, AIDS pathogenesis (Okoye and Picker, 2013). Furthermore, previous studies have shown no significant alterations in mean CD4 counts in HIV infected male and female participants (Ogbodo *et al.*, 2021). This finding suggests that seronegative exposed partners also experience diminishing CD4+ T-cell counts as a result of HIV exposure, and as a result, continual depletion of these

immune cells makes these people more susceptible to infections that can worsen immunological function.

## **CONCLUSION**

There was no statistically significant difference between the mean neutrophil, lymphocyte, or WBC counts in the HIV discordant test group and those in the control group. Female HIV discordant test subjects had statistically significantly lower HB, HCT/PCV, RBC, lymphocyte, and CD4 counts than female control subjects. Mean neutrophil and CD4 count differences between the male HIV discordant test group and the male control group were statistically significant. Female controls showed higher mean RBC counts, Hb counts, PCV counts, and CD4 counts than did female HIV-positives, all of which were statistically significantly lower. In addition, whereas the mean CD4 count and Hb levels of male HIV seropositives were statistically significantly lower than those of male controls, those of female HIV exposed seronegatives had lower mean CD4 counts and Hb levels. This finding calls for an urgent interventional strategy to prevent the potential anemia, leucocytopenia, and weakened immunity that may result in both HIV seropositives and seronegative exposed couples. Additionally, more research needs to be done with a larger sample size in order to confirm the findings of the current study.

## **Ethical Approval and Consent**

Ethical approval was obtained from the Ethics Committees of the hospitals: Plateau State Specialist Hospital (PSSH/ADM/ETH.CO/2019/005); Faith Alive Foundation Hospital (FAFEC/08/34/25) and Our Lady of Apostles Hospital (dated 13<sup>th</sup> June, 2018) where the study

was carried out. Informed consent of the participants were sought and obtained prior to the commencement of the study.

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