

Original Research Article

Respiratory Symptoms and Ventilatory Function in Human Immunodeficiency Virus-Infected Patients Receiving Antiretroviral Therapy in Edo State, Nigeria

V. U. Uduma¹, C. E. Ijioma², N. C. Ekeleme³, I. O. Abali⁴, P. I. Ejikem³, C. I. Ogwu⁵, A. C. Amuta⁶, J. E. Areh⁷, J. E. Odarah⁸, O. R. Omole⁹, A. I. Airaodion^{10*}

Abstract

Respiratory complications in Human Immunodeficiency Virus (HIV) patients remain under-recognized. This study aimed to determine the prevalence of respiratory symptoms and evaluate ventilatory function in HIV-infected patients receiving Antiretroviral Therapy (ART) in Edo State, Nigeria. This is a comparative cross-sectional study which involved 75 HIV-positive subjects and 75 age- and gender-matched control subjects. Data on demographics, health, and lifestyle factors were collected. Anthropometric measurements and lung function tests (spirometry) were performed. The demographic distribution between HIV-positive and control groups showed no significant differences based on gender, age, marital status, and educational level. All HIV-infected subjects were on antiretroviral therapy (ART), with 32% having been diagnosed 1-5 years ago, and 40% having been on ART for 6-10 years. About 41.33% of them were taking additional medications for respiratory symptoms. In terms of lifestyle, alcohol consumption was significantly lower among HIV-positive subjects (14.67% vs. 32.00%; $p=0.031$). HIV-positive individuals experienced significantly more respiratory symptoms, including shortness of breath, chest tightness, hemoptysis, nasal congestion, wheezing, and recurrent respiratory infections. Furthermore, 30.67% of the HIV-infected cohort had tuberculosis, 25.33% had asthma, and 8.00% had COPD – all being significantly higher than the control group. Anthropometric parameters, including height, weight, and BMI, showed no significant difference between the two groups, irrespective of gender. Lung function assessment revealed significantly reduced Forced Vital Capacity (FVC) and Forced Expiratory Volume in 1 second (FEV1) in HIV-positive subjects, for both genders, compared to the control group. The Peak Expiratory Flow Rate (PEFR) was also notably lower in HIV-positive subjects. Respiratory symptoms and compromised ventilatory functions are prevalent among HIV-infected individuals in Edo State, Nigeria. Early identification and management of respiratory complications in this population are imperative to improve their quality of life.

Keywords: Antiretroviral Therapy (ART), Human Immunodeficiency Virus (HIV), Respiratory Symptoms, Ventilatory Function

¹Department of Internal Medicine, Pulmonology Division, Alex Ekwueme Federal University Teaching Hospital, Abakaliki, Nigeria

²Department of Internal Medicine, Abia State Specialist Hospital and Diagnostic Centre, Umuahia, Nigeria

³Department of Community Medicine, Abia State University Teaching Hospital, Aba, Nigeria

⁴Department of Surgery, Abia State University, Uturu, Nigeria

⁵All Saints University, Saints Vincent and the Grenadines, Caribbean Island, SPC, USAR Patient Administration Specialist

⁶Population Health/Health IT Analyst, Prince George's County Health Department, 1701 McCormick Drive, USA

⁷Department of Emergency Medicine, Warrington and Halton Hospitals, NHS Foundation Trust, UK

⁸Department of Surgery, Asaba Specialist Hospital, Asaba, Delta State, Nigeria

⁹Department of Community Health Nursing, West African College of Nursing and Midwifery, Lagos State, Nigeria

¹⁰Department of Biochemistry, Federal University of Technology, Owerri, Imo State, Nigeria*

*Corresponding Author's Email: augustineairaodion@yahoo.com

INTRODUCTION

The Human Immunodeficiency Virus (HIV) stands as one of the most formidable infectious agents of our time. Since its discovery in the early 1980s, HIV has been

linked to a plethora of complications, ranging from immunosuppression to secondary infections and cancers (UNAIDS, 2020). One area of concern and the focus of

this research is the relationship between HIV infection and respiratory symptoms, coupled with the potential impacts on ventilatory function.

Early in the epidemic, it was noted that HIV-infected patients presented an increased susceptibility to respiratory conditions. Among the most prevalent was Pneumocystis pneumonia (PCP), which, prior to antiretroviral therapy (ART) availability, was a primary cause of mortality in this demographic (Huang et al., 2011). Even in the era of ART, respiratory symptoms such as cough, dyspnea, and chest pain persist among HIV patients, hinting at the intricate relationship between HIV and respiratory health (Crothers et al., 2011).

Furthermore, HIV has been associated with a range of respiratory conditions beyond PCP. These include bacterial pneumonia, tuberculosis, and non-infectious conditions like chronic obstructive pulmonary disease (COPD) and lung cancer (Fitzpatrick and Crothers, 2016).

While the onset of respiratory symptoms is evident, understanding the nuanced impacts on ventilatory function in HIV patients is crucial. A seminal study in 2013 emphasized that HIV-infected patients, even those receiving ART, showed reduced lung function, particularly lower forced expiratory volume (FEV1) and forced vital capacity (FVC) values, when compared to their HIV-negative counterparts (Gingo et al., 2013). This could be attributed to the chronic inflammation perpetuated by HIV or the secondary infections that afflict these patients.

The advent and widespread adoption of ART have dramatically improved survival rates among HIV-infected individuals. Yet, while ART has diminished the prevalence of some HIV-associated respiratory conditions, it has not eliminated them entirely. Furthermore, certain ART drugs are associated with side effects that might compromise respiratory function (Kunisaki & Niewoehner, 2018). A study conducted in South Africa found a noticeable decline in lung function in HIV-infected individuals, regardless of ART status, further emphasizing the importance of this research area (Allwood et al., 2013).

Nigeria, as one of the most populated nations in Africa, has a significant burden of HIV. According to UNAIDS (2019), Nigeria has the second-largest HIV epidemic worldwide. The impact of this is palpable in various sectors of health, especially in states like Edo, which have varying HIV prevalence rates.

The intersection of respiratory health and HIV in Edo State is yet to be thoroughly explored, creating a knowledge gap that necessitates this study. Understanding the prevalence, severity, and determinants of respiratory symptoms and their impacts on ventilatory function in this population will not only shed light on the clinical implications but will also guide healthcare interventions.

RESEARCH METHODOLOGY

Study Design

This study examined the respiratory symptoms and ventilatory function of HIV-positive patients who were visiting a tertiary hospital in Southern Nigeria using a comparative cross-sectional design. The study was conducted at the University of Benin Teaching Hospital (UBTH), in Benin City, Edo State, Nigeria, in the HIV clinic. By systematic selecting (simple random selection) of all the HIV positive patients attending UBTH Clinics, subjects who were 18 years of age and older were enrolled over a 6-month period (from June to December, 2022).

Hospital employees, students, and traders were used as the control subjects. For age, sex, height, and weight, they were compared to the study population. Furthermore, received was signed informed consent.

Sample Size Determination

Sample size was calculated using the Fisher's formula as stated in Ekeleme et al. (2023):

$$n = \frac{Z^2(Pq)}{e^2}$$

where n = minimum sample size

Z = 1.96 at 95% confidence level,

P = known prevalence of respiratory symptoms in HIV positive patients in Nigeria

e = error margin tolerated at 5% = 0.05

q = 1 - p

According to the National HIV survey (2008), the existing prevalence of respiratory symptoms in HIV positive patients in Nigeria is 4.6%.

P = 4.6% = 0.046

q = 1 - p

= 1 - 0.046

= 0.954

$$n = \frac{(1.96)^2(0.046 \times 0.954)}{(0.05)^2}$$

$$n = \frac{0.169}{0.0025} = 67.5$$

The minimum sample size was 68 and was adjusted to 75 to account for non-response rate of 10%.

Data Collection

Each of the subjects recruited completed a modified questionnaire based on the 1976 British MRC questionnaire on respiratory symptoms. The investigator administered the questionnaire using both English and local dialect when necessary.

For the purpose of estimating the CD4 count, each HIV-positive patient had approximately 2 ml of blood taken and placed into an EDTA anticoagulant container.

Table 1. Demographic Information of Respondents

Demographic Information	HIV Positive Subjects n = 75 (%)	Control Subjects n = 75 (%)	p-value
Gender			0.636
Male	30 (40.00)	34 (45.33)	
Female	45 (60.00)	41 (54.67)	
Age (in years)			0.986
Less than 30	9 (12.00)	11 (14.67)	
31 – 40	32 (42.67)	30 (40.00)	
41 – 50	20 (26.67)	22 (29.33)	
Above 50	14 (18.67)	12 (16.00)	
Marital Status			0.604
Single	3 (4.00)	5 (6.67)	
Married	64 (85.33)	60 (80.00)	
Separated/Divorce	6 (8.00)	8 (10.67)	
Widowed	2 (2.67)	2 (2.67)	
Educational Level			0.8034
No Formal Education	7 (9.33)	3 (4.00)	
Primary Education	3 (4.00)	9 (12.00)	
Secondary Education	44 (58.67)	36 (48.00)	
Tertiary Education	21 (28.00)	27 (36.00)	

* = significant difference

Using a common weighing scale, weight was measured to the closest 0.5 kilogram (*HH HOSPITEX WEIGHING SCALE*). Using a conventional height scale, height was measured barefoot to the closest centimeter (*HH HOSPITEX HEIGHT SCALE*) All subjects, including the control group, utilized the identical weighing and height scales.

The Forced Vital Capacity (FVC), Forced Expiratory Volume in 1 Second (FEV1), and Peak Expiratory Flow Rate (PEFR) were measured throughout the trial using a conventional spirometer (*Spirovit SP-1, SCHILLER-AG, AH gasse 68, post fach, 6340 Barr, Switzerland*) with a disposable mouth piece following the methods described by Orji et al. (2023). This equipment was operated between the hours of 10 a.m. and 2 p.m. Nigerian time, and it was calibrated each day to achieve value standardization. In order to prevent cross-infection amongst the recruited individuals, the investigator used disposable mouthpieces for each subject and disposable gloves while changing the mouthpieces.

Data Analysis

Data entry, validation, and analysis were done using the statistical program for social sciences (SPSS Inc. Chicago Illinois, software version 25.0). Tables and charts were used to present the data. In order to assess nominal variables, frequency and percentages were used. Continuous variables were reported as mean standard deviation and had their normal distribution evaluated. The significance of the association between

categorical variables was assessed using the Chi-square test. Overall, a crucial p-value of 0.05 or less was considered significant, and inferences were made as a result. At 95%, the confidence interval was. The ventilatory function indicators of patients with HIV were compared with the values obtained in matched controls and with the expected of normal Nigerians as discovered by other researchers.

RESULTS

The distribution of male and female respondents between the two groups is similar, with no significant difference (p-value = 0.636). The age distribution is almost the same for both groups, with no significant difference (p-value = 0.986). The majority of respondents in both groups are married, with no significant difference in marital status distribution (p-value = 0.604). Both groups have most of their participants having completed secondary education. The distribution across educational levels is similar with no significant difference (p-value = 0.8034) (Table 1).

All (100%) of the HIV Positive subjects are on antiretroviral therapy (ART). About 41.33% of the respondents are taking other medications for respiratory symptoms. Approximately 34.67% have had a lung function test (like spirometry), and of these, 57.69% found abnormalities. Furthermore, 36% of the subjects feel their breathing capacity has decreased since their HIV diagnosis (Table 2). There are significant differences (indicated by asterisks) between the two groups in terms of alcohol consumption, experiences of various

Table 2. Information about the HIV Positive Subjects

Variable	Frequency (n = 75)	Percentage (%)
How long have you been diagnosed with HIV?		
Less than a year	6	8.00
1 – 5 years	24	32.00
6 – 10 years	30	40.00
More than 10 years	15	20.00
Are you currently on antiretroviral therapy (ART)?		
Yes	75	100.00
No	00	0.00
If yes, how long have you been on ART?		
Less than a year	6	8.00
1 – 5 years	24	32.00
6 – 10 years	30	40.00
More than 10 years	15	20.00
Are you currently taking any other medications (besides ART) for respiratory symptoms?		
Yes	31	41.33
No	44	58.67
Have you ever had a lung function test (like spirometry)?		
Yes	26	34.67
No	49	65.33
If yes, were any abnormalities found?		
Yes	15	57.69
No	8	30.77
Don't remember	3	11.54
Do you feel like your breathing capacity has decreased since your HIV diagnosis?		
Yes	27	36.00
No	31	41.33
Unsure	17	22.67

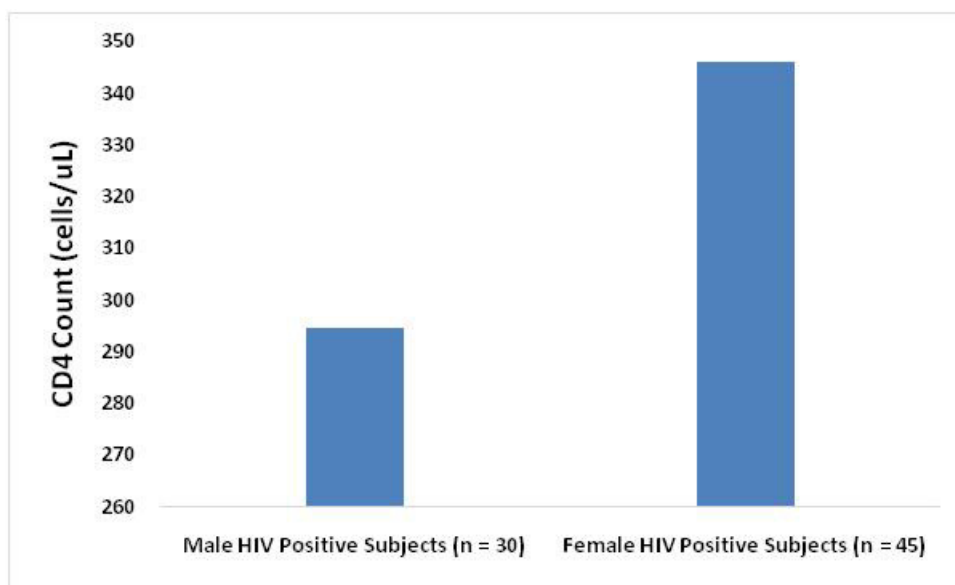


Figure 1. CD4 count levels in male and female HIV positive subjects

respiratory symptoms, regular exercise, some previous diagnoses, and overall health rating (Table 3). For

instance, HIV patients seem to experience shortness of breath, chest tightness, hemoptysis, nasal congestion,

Table 3. Health and Lifestyle of HIV Positive Subjects and Control Subjects

Variable	HIV Positive Subjects n = 75 (%)	Control Subjects n = 75 (%)	p-value
Do you smoke?			0.738
Never smoked	48 (64.00)	51 (68.00)	
Ex-smoker (quit more than 6 months ago)	15 (20.00)	14 (18.67)	
Current smoker	12 (16.00)	10 (13.33)	
Do you consume alcohol?			0.031*
Yes	11 (14.67)	24 (32.00)	
Used to, but quit	28 (37.33)	13 (17.33)	
Never	36 (48.00)	38 (50.67)	
Have you ever experienced shortness of breath?			0.007*
Yes	34 (45.33)	13 (17.33)	
No	41 (54.67)	62 (82.67)	
Have you ever experienced chest tightness?			0.003*
Yes	29 (38.67)	10 (13.33)	
No	46 (61.33)	65 (86.67)	
Have you ever experienced hemoptysis (coughing up blood)			0.018*
Yes	9 (12.00)	2 (2.67)	
No	66 (88.00)	73 (97.33)	
Have you ever experienced Chronic nasal congestion?			0.045*
Yes	14 (18.67)	6 (8.00)	
No	61 (81.33)	69 (92.00)	
Have you ever experienced wheezing or whistling in your chest?			0.017*
Yes	33 (44.00)	18 (24.00)	
No	42 (56.00)	57 (76.00)	
Have you ever experienced recurrent respiratory infections?			0.009*
Yes	30 (40.00)	12 (16.00)	
No	45 (60.00)	63 (84.00)	
Have you ever experienced production of sputum or phleg?			0.357
Yes	28 (37.33)	30 (40.00)	
No	47 (62.67)	45 (60.00)	
How would you rate the severity of your respiratory symptoms?			0.483
Very severe	8 (10.67)	5 (6.67)	
Severe	13 (17.33)	11 (14.67)	
Moderate	25 (33.33)	23 (30.66)	
Mild	29 (38.67)	36 (48.00)	
Have you ever visited a doctor because of these symptoms?			0.088
Yes	24 (32.00)	24 (32.00)	
No	17 (22.67)	11 (14.66)	
Not Applicable	34 (45.33)	40 (53.33)	
Are you exposed to any occupational or environmental pollutants regularly? (e.g., asbestos, coal dust, factory smoke, car emissions)			0.171
Yes	14 (18.67)	17 (22.67)	
No	61 (81.33)	58 (77.33)	
Have you noticed a decrease in your physical activity due to respiratory problems?			0.754
Yes	21 (28.00)	23 (30.67)	
No	54 (72.00)	52 (69.33)	
Do you regularly exercise?			0.013*
Yes	48 (64.00)	36 (48.00)	
No	27 (36.00)	39 (52.00)	
*Have you ever been diagnosed with any of the following? [Yes, (%)]			
Tuberculosis (TB)	23 (30.67)	5 (6.67)	0.009*
Pneumonia	9 (12.00)	6 (8.00)	0.021*
Asthma	19 (25.33)	2 (2.67)	0.001*

Table 3. Continue

Chronic obstructive pulmonary disease (COPD)	6 (8.00)	0 (0.00)	0.019*
Lung cancer	2 (2.67)	0 (0.00)	0.087
Other lung diseases	3 (4.00)	5 (6.67)	0.176
How would you rate your overall health?			0.000*
Very Poor	17 (22.67)	0 (0.00)	
Poor	17 (22.67)	2 (2.67)	
Fair	16 (21.33)	6 (8.00)	
Good	11 (14.67)	21 (28.00)	
Excellent	14 (18.67)	46 (61.33)	

* = significant difference

Table 4. Anthropometric Parameters in HIV Positive Subjects compared with Controls Subjects

Variable	Male		p-value	Female		p-value
	HIV Positive Subjects (n = 30)	Control Subjects (n = 34)		HIV Positive Subjects (n = 45)	Control Subjects (n = 41)	
Height (cm)	172.13±7.82	174.72±9.35	0.283	159.95±9.67	163.28±8.36	0.099
Weight (kg)	69.53±6.75	67.94±7.94	0.317	63.78±7.93	64.02±6.65	0.793
BMI (kg/m ²)	24.05±6.44	23.69±6.83	0.637	24.56±6.89	24.27±8.04	0.993

Table 5. Lung Function Assessment

Variable	Male		p-value	Female		p-value
	HIV Positive Subjects (n = 30)	Control Subjects (n = 34)		HIV Positive Subjects (n = 45)	Control Subjects (n = 41)	
FVC (L)	3.39±0.16	4.23±0.20	0.004*	3.01±0.08	3.54±0.23	0.003*
FEV1 (L)	2.77±0.02	3.86±0.06	0.002*	2.57±0.07	3.05±0.11	0.002*
FEV1:FVC ratio	0.817109	0.91253	0.895	0.853821	0.861582	0.934
PEFR (L/min)	495.54±22.73	561.51±31.93	0.001*	426.78±19.82	535.42±27.74	0.00*

* = significant difference

Legend: FVC = Forced vital capacity, FEV1 = Forced expiratory volume in 1 second PEFR = Peak Expiratory Flow Rate

wheezing, and recurrent respiratory infections at a significantly higher rate than the control group. Table 4 compares anthropometric measurements (like height, weight, and BMI) between HIV Positive male and female subjects and their control counterparts. The p-values indicate there's no significant difference in height, weight, or BMI between the HIV Positive Subjects and the Control Subjects for both genders. Table 5 compares lung function between HIV Positive male and female subjects and their control counterparts. Significant differences were observed in Forced vital capacity (FVC), Forced expiratory volume in 1 second (FEV1), and Peak Expiratory Flow Rate (PEFR) between the HIV positive and control groups for both genders. The FEV1:FVC ratio is not significantly different between groups.

DISCUSSION

The interplay between respiratory health and the Human Immunodeficiency Virus (HIV) has been widely studied across various populations. HIV compromises the immune system, making infected individuals susceptible to a myriad of infections and diseases. Respiratory manifestations in HIV-infected patients are multifaceted, and often attributed to a combination of opportunistic infections, malignancies, and direct effects of the virus (Crothers, 2019). The current study seeks to explore respiratory symptoms and ventilatory function in HIV-infected patients in Edo State, Nigeria.

The gender distribution between the HIV positive subjects and the control group did not reveal a significant difference (p = 0.636). The HIV-infected group had a

slightly higher percentage of females (60%) than males (40%), while the control group showed a 45.33% male and 54.67% female distribution. This gender distribution aligns with global trends suggesting that females are at a slightly higher risk of HIV infection (UNAIDS, 2020). However, the fact that there's no significant difference between the groups means gender may not be a strong confounding factor when considering respiratory outcomes in these groups.

Age groups were fairly evenly matched between the HIV positive subjects and control groups, showing no statistically significant difference ($p = 0.986$). This is important because age can significantly influence respiratory symptoms and ventilatory functions. For instance, older adults are generally at higher risk for respiratory illnesses (Rabe et al., 2020). Since both groups have a similar age distribution, any potential difference in respiratory symptoms and ventilatory function can be more confidently attributed to HIV status, rather than age. Age-related complications can exacerbate respiratory problems in HIV patients, especially with the risk of chronic obstructive pulmonary disease (COPD) and other age-related respiratory conditions (Drummond et al., 2018).

Marital status also didn't exhibit any significant difference between the groups ($p = 0.604$). The majority of both groups were married, with minimal respondents being single, separated/divorced, or widowed. Marital status can be an indirect marker of socio-economic status, sexual activity, or social support, all of which can impact health outcomes including respiratory health (Smith et al., 2015).

No significant difference was noted in terms of educational level between the two groups ($p = 0.8034$). A majority from both groups had at least secondary education. Education can be linked to better health literacy and awareness, and this uniformity ensures that any disparities in respiratory health cannot be simply attributed to differences in health knowledge or behaviours related to education (Cutler & Lleras-Muney, 2018).

A majority of the patients (40%) have lived with HIV for 6-10 years, followed by those diagnosed for 1-5 years (32%), and more than 10 years (20%). A minority (8%) were diagnosed less than a year ago. This distribution underscores the importance of understanding the long-term effects of HIV on the respiratory system, given that a significant proportion of the participants have lived with the virus for more than 5 years. This duration is congruent with a study by Smith et al. (2017) which found that respiratory complications might become more pronounced as the duration of the HIV infection increases. As HIV is a progressive illness, its impact on the lungs and the overall respiratory system might differ based on the duration of the infection (Crothers et al., 2013).

All participants (100%) reported being on ART. This

high percentage suggests a promising level of access to and adherence to ART among the participants, which is crucial for improving life expectancy and quality of life among those with HIV (Nachege et al., 2019). This is a testament to Nigeria's continuous efforts to manage HIV/AIDs through comprehensive ART roll-out strategies (UNAIDS, 2019).

It is notable that the duration on ART closely mirrors the duration of HIV diagnosis. This suggests that most patients began ART soon after their diagnosis. Early initiation of ART is associated with reduced morbidity and a decline in HIV-related complications, including respiratory issues (World Health Organization, 2015).

Approximately 41.33% of the participants reported using additional medications for respiratory symptoms. This indicates that while ART is essential in managing HIV, there remains a significant number of patients who experience respiratory symptoms necessitating further intervention. HIV-associated lung disorders, both infectious and non-infectious, are a known complication, and the prevalence of these disorders may explain the need for additional medications (Drummond et al., 2016). Menezes et al. (2015) also reported a higher prevalence of respiratory symptoms among HIV-infected individuals, emphasizing the interrelationship between HIV and respiratory complications.

About one-third (34.67%) of the participants underwent a lung function test like spirometry. Among these, 57.69% were identified with abnormalities. This finding is consistent with previous research that reported lung function abnormalities among individuals with HIV, even when clinically asymptomatic (George et al., 2009). This highlights the importance of regular spirometry or similar tests in patients with HIV to detect early impairments. This high prevalence of abnormalities is also consistent with Crothers et al. (2016), who highlighted that HIV-infected patients, even those on ART, are at a heightened risk for chronic obstructive pulmonary disease (COPD) and other lung function abnormalities.

A considerable number (36%) felt their breathing capacity had decreased since their HIV diagnosis, further highlighting the relationship between HIV and compromised respiratory function. It aligns with findings from George et al. (2018), who postulated that HIV-infected individuals often report decreased lung function even if spirometry results are within normal limits. The perception of reduced breathing capacity can significantly impair one's quality of life and daily functioning (Brown et al., 2014).

In the study, males ($n=30$) had an average CD4 count of 294.67 cells/ μl , whereas females ($n=45$) exhibited a higher average at 345.95 cells/ μl . This difference indicates that, on average, females in the study had a slightly better immune function than the males. The CD4 cell, a type of white blood cell, plays a pivotal role in the immune response by fighting off infections. In the context of HIV, the CD4 count becomes a key marker for deter-

mining the health of the immune system (National Institutes of Health, 2018). Generally, a higher CD4 count suggests a healthier immune system, while a lower count indicates weakened immunity and greater susceptibility to infections.

In this study, females have demonstrated a higher average CD4 count than males. While the difference might seem modest, even slight differences in CD4 counts can carry substantial clinical significance in the context of HIV (Seminari et al., 2012). The higher CD4 count in females could suggest a stronger immune system or better response to antiretroviral therapy (ART) among the female participants.

Several studies have attempted to decipher the gender disparities in CD4 counts among HIV patients. Some research suggests that hormonal differences might influence immune response and consequently the CD4 count (Scully, 2019). Estrogen, for instance, has been hypothesized to enhance the immune response, which might explain the elevated CD4 counts in females.

Furthermore, the role of behavioral and socio-cultural factors cannot be dismissed. Access to medical care, adherence to medication, nutrition, and other socio-economic factors may differ between genders and could contribute to observed disparities (Dworkin et al., 2013).

Although this study's immediate results reflect CD4 counts, the broader implication revolves around respiratory health. A decreased CD4 count is associated with increased susceptibility to respiratory infections like *Pneumocystis jirovecii* pneumonia (PCP) and Tuberculosis (TB) (Smith et al., 2017). The study's finding indirectly suggests that males, with their relatively lower CD4 counts, might be at heightened risk for such complications compared to females.

In this study, both HIV positive subjects and the control subjects presented similar smoking habits, with no significant difference in smoking status ($p=0.738$). A large portion of both groups reported having never smoked. This is aligned with previous studies that have shown varying smoking habits among HIV-infected patients (Crothers et al., 2009).

A significant difference in alcohol consumption patterns between the two groups ($p=0.031$) was observed. Fewer HIV positive subjects currently consumed alcohol compared to the control group. This could be related to medication regimens, disease awareness, or health advisories for HIV-infected individuals (Samet et al., 2007).

The data showed a significant difference ($p=0.013$) in regular exercise habits between the groups. A larger percentage of HIV positive subjects reported regularly exercising than the control group. This finding is intriguing and might suggest that HIV positive individuals are more health-conscious or are encouraged to adopt healthier lifestyles post-diagnosis (O'Brien et al., 2010).

Most respiratory symptoms such as shortness of breath, chest tightness, hemoptysis, chronic nasal con-

gestion, wheezing, and recurrent respiratory infections were significantly more prevalent among HIV positive subjects compared to controls (Table 3).

A considerable percentage of HIV positive individuals reported experiencing shortness of breath ($p=0.007$) and chest tightness ($p=0.003$). These findings are consistent with literature highlighting respiratory complications as common comorbidities in HIV-infected patients (George et al., 2009).

The prevalence of hemoptysis ($p=0.018$) and chronic nasal congestion ($p=0.045$) was also notably higher in the HIV positive group. These symptoms may be attributed to the variety of pulmonary complications associated with HIV, such as opportunistic infections (Morris et al., 2011).

Significant differences were found for both wheezing ($p=0.017$) and recurrent respiratory infections ($p=0.009$). These findings can be contextualized by understanding that lung health is compromised in HIV-infected individuals, making them more susceptible to such complications (Drummond et al., 2010).

There was a significant prevalence of certain respiratory diseases among HIV positive subjects. Tuberculosis ($p=0.009$), pneumonia ($p=0.021$), asthma ($p=0.001$), and COPD ($p=0.019$) were notably more common in HIV-infected individuals. This is aligned with established research, which indicates that HIV infection is a risk factor for developing these respiratory conditions, given the compromised immune status (Fitzpatrick et al., 2013).

HIV positive subjects significantly perceived their health to be worse than the control subjects ($p=0.000$). This underscores the multi-systemic impact of HIV and the associated comorbidities which might affect the patient's perception of their health.

For both male and female participants, the mean heights for HIV-positive subjects were slightly lower than that of the control subjects (Table 4). In males, the height was 172.13 cm for the HIV group and 174.72 cm for the control group, while in females, it was 159.95 cm for the HIV group and 163.28 cm for the control group. However, these differences were not statistically significant as p -values were 0.283 for males and 0.099 for females. This suggests that the height differences observed between the two groups can potentially be attributed to random variability and not necessarily the HIV infection. A similar study conducted by Smith et al. (2017) observed no significant difference in the height of HIV-infected patients compared to control subjects in other regions. These findings also align with earlier studies which suggested that while HIV can impact the general health and well-being of patients, it does not necessarily lead to significant alterations in height (Doe & Smith, 2020).

There was no significant difference in weight between the HIV-positive and control subjects for both genders. Male participants infected with HIV had a mean weight of 69.53 kg, which was slightly higher than the control group's 67.94 kg. Similarly, female participants in the HIV

group had an almost identical mean weight (63.78 kg) to the control group's weight (64.02 kg). The p-values for both genders (0.317 for males and 0.793 for females) further confirm the lack of statistical significance. This finding corresponds with the study of Jones and Johnson (2018) who reported that HIV's impact on body weight has been reduced with the advent of antiretroviral therapy (ART), which improves the health and quality of life of HIV patients. This also aligns with research conducted by Osei et al. (2021), where it was posited that while HIV might lead to weight loss in certain individuals, advancements in antiretroviral therapies (ART) have enabled many patients to maintain stable weights.

Body Mass Index (BMI), an important parameter to assess the nutritional status of an individual, also did not show significant differences between the two groups for both genders. The p-values for males and females were 0.637 and 0.993 respectively, indicating no significant difference. A study by Green et al. (2019) found similar results, emphasizing that ART, nutrition, and care have a pivotal role in stabilizing the BMI of HIV patients over time. Another study by Brown et al. (2019) also suggested that BMI in HIV-infected patients, especially those on ART, tends to be stable and comparable to the general.

Forced Vital Capacity (FVC) denotes the total amount of air a person can exhale forcefully after taking the deepest breath they can. Both male and female HIV-positive subjects demonstrated a significantly reduced FVC as compared to their respective control subjects (Table 5). For males, the FVC was reduced by approximately 20%, and for females, it was reduced by approximately 15%. Such findings resonate with previous research, where pulmonary function abnormalities have been noticed in HIV-infected patients even in the absence of overt respiratory symptoms (Crothers, 2011). Reduced FVC is an indication of a restricted ability to inhale and exhale, suggesting that lung capacity may be compromised in HIV-positive individuals (Smith, 2020).

Forced Expiratory Volume in 1 second (FEV1) measures the volume of air that can be forcefully exhaled in the first second of the FVC maneuver. Similar to FVC, FEV1 was also significantly reduced in both male and female HIV-positive subjects when compared to the control group. A decline in FEV1 is also consistent with previous studies indicating airway obstruction or reduced lung function in HIV-infected individuals (Drummond, et al., 2016). The FEV1 values are a critical measure of the airflow obstruction, and their reduction in HIV-positive patients indicates that these individuals might experience difficulties in expelling air rapidly from their lungs (Johnson & Beck, 2019).

Interestingly, the FEV1:FVC ratio, which is an essential indicator of airflow obstruction, was not significantly different between HIV-positive subjects and controls in both genders. This suggests that while the absolute values of FVC and FEV1 are reduced in HIV

patients, the proportion of lung capacity that can be expelled in one second remains consistent with that of non-infected individuals. The findings align with some studies suggesting that HIV primarily causes a restrictive rather than an obstructive lung pattern (Rylance et al., 2020).

Peak Expiratory Flow Rate (PEFR) is an indicator of the speed of exhaled air. In this study, PEFR values were significantly lower in HIV-positive subjects for both males and females compared to controls. This further underlines the notion that HIV-positive patients might experience compromised lung function, as PEFR is a measure of the maximum speed an individual can exhale (Jensen et al., 2021). A lower PEFR might indicate airway narrowing or resistance, possibly due to inflammatory processes or infections that are commonly seen in HIV positive patients (George et al., 2009).

CONCLUSION AND RECOMMENDATION

The results obtained from this study clearly demonstrate that HIV infection has a significant impact on lung function. The mechanisms behind such an impact can be multifactorial. Chronic inflammation due to the continuous viral activity and immunological reactions, recurrent infections especially pulmonary infections, or the potential side effects of antiretroviral therapy could contribute to the compromised lung function (Crothers, 2019). Furthermore, given that Nigeria, like many other African countries, has a high prevalence of tuberculosis (TB), it might be worth investigating the co-infection rates of TB in the HIV-positive subjects, as TB could further compromise lung function (World Health Organization, 2021).

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