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Effects of adherence to antiretroviral therapy on body mass index, immunological and virological status of Nigerians living with HIV/AIDS



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CD4 count;
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Abstract *Objective:* This study determined the effect of adherence to highly active antiretroviral therapy (HAART) on body mass index (BMI) and immunological and virological parameters of people living with HIV/AIDS (PLWHA) attending University College Hospital, Ibadan.

Methodology: Prospective cohort of consenting PLWHA was followed up for a minimum of 3 months, had their drug adherence determined using pharmacy records and self-reporting. The sociodemographic data, weight, height, plasma viral load and CD4 count were recorded at baseline and 3 months. These data were entered into the computer and analyzed.

Results: A total of 318 PLWHA with a median age of 38 ± 9.6 years participated. Fifty-four percent were female. Sixty-three percent were 95% adherent to HAART. Most (99.4%) were on non-nucleoside reverse transcriptase inhibitor-based therapy. There was a remarkable fall in viral load to non-detectable levels among adherent compared with non-adherent PLWHA. Furthermore, there was a significant increase in CD4 count among adherent compared with non-adherent PLWHA. Adherent clients showed marked improvement in BMI and immunological and virological status.

Conclusion: Adherence to HAART reduced viral load to an undetectable level and increased CD4 count among adherent PLWHA on HAART.

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1. Introduction

HIV/AIDS has spread almost worldwide, with the majority of people infected living in sub-Saharan Africa.¹ Since 1986 when the first case in Nigeria was reported, the prevalence has increased among antenatal clinic attendees from 1.8% (1991), 5.8% (2001), 4.4% (2005), 4.6% (2008), and 4.1% (2010).^{2,3}

Highly active antiretroviral therapy (HAART) is the only proven treatment of HIV and is provided free at the antiretroviral clinic, University College Hospital, Ibadan, Nigeria.⁴⁻⁶ It consists of a combination of three or more drugs from at least two different classes of antiretroviral (ARV) therapy.^{4,5} Good adherence to therapy is the key to prevention of treatment failure, development of drug resistance and subsequent virological and immunological failure.^{4,5}

Although 100% adherence is desirable, various adherence studies have reported that at least 95% of the doses should be taken for an optimal response, while lesser degrees of adherence are more often associated with virological failure.^{4,5,7} It has been documented that people living with HIV/AIDS (PLWHA) with good adherence have undetected viral loads and increased CD4 counts, live longer, and have better quality of life.^{4,5,7} This study was conducted to determine the effect of HAART adherence on body mass index (BMI) and immunological and virological parameters of PLWHA attending University College Hospital, Ibadan.

2. Materials and methods

The study site was the Antiretroviral (ARV) Clinic of the University College Hospital (an 850-bed tertiary hospital), Ibadan, Nigeria. The ARV clinic was one of 25 other ARV clinics established and funded by the Federal Government since 2002 to provide comprehensive HIV/AIDS care including antiretroviral therapy initially at a subsidized rate. Since 2004, the President Bush's Emergency Plan for AIDS Relief (PEPFAR) provided support for the scale-up of the nation's antiretroviral treatment program. The services provided at the ARV clinic became free since January, 2006. The ARV Clinic opens daily from 8:00 a.m. to 5:00 p.m. Monday through Thursday. The clinic serves the entire southwestern part of Nigeria and beyond.⁶ HIV positive patients with CD4 count \leq 350 cells/ μ l, AIDS defining disease at any CD4 count, are recruited into the antiretroviral treatment program while patients asymptomatic with CD4 count $>$ 350 cells/ μ l are placed on supportive therapy.

A prospective cohort of drug naïve PLWHA was commenced on antiretroviral drugs and followed up for 3 months at the Antiretroviral Clinic, University College Hospital, Ibadan, Nigeria. Informed consent was obtained from all respondents while serial numbers and not names were used to maintain confidentiality. Patients with tuberculosis and other comorbidities such as Diabetes mellitus and hypertension were excluded. Clinical checklist data such as sociodemographic information, weight, height, plasma viral load and CD4 count at baseline (that is before commencement of HAART) and at 3 months after commencement of HAART were recorded. BMI at baseline and after 3 months was calculated using the formula = weight (kg)/height (m²). Undetected viral load was defined as $<$ 400 copies/ μ l (log viral load

$<$ 2.6 copies/ μ l). The degree of adherence by individual patients was estimated manually by patients' drug pickup at the clinic pharmacy and by patient self-report at a follow-up session. The degree of adherence from patient self-reporting was estimated using the following formula.⁴

$$\% \text{ adherence over past 7 days} = \frac{\text{doses should have taken} - \# \text{missed doses}}{\text{doses should have taken}} \times 100\%$$

From the formula, level of adherence by individual patients was classified into those with $<$ 95% adherence and those with \geq 95% adherence.⁴ HAART-adherent patients were defined in this study as individuals with \geq 95% adherence level.

The data were entered into a computer, cleaned, and statistical analysis was performed using SPSS version 12. Tables of frequency were generated, and tests of significance were conducted using χ^2 test and paired t test. Tests were considered significant for a p value less than 0.05.

3. Results

Three hundred and eighteen consenting PLWHA participated in the study. The respondents mean age was 39.1 years (SD: 9.6 years). Fifty-four percent were female. One hundred and thirty (40.9%) belonged to the 30–39 years age group, and 77.7% had completed secondary education. The majority (66.7%) was married and 131 (41.2%) were traders (Table 1). Majority (90.3%) had AIDS.

Most (99.4%) were on non-nucleoside reverse transcriptase inhibitor (NNRTI)-based therapy. The majority (89.9%) was

Table 1 Sociodemographic characteristics of respondents.

Socio-demographic characteristics	Frequency (N = 318)	Percentage
<i>Age group (years)</i>		
15–19	3	1.0
20–29	42	13.2
30–39	130	40.9
40 and above	143	44.9
<i>Marital status</i>		
Single	43	13.5
Married	212	66.7
Divorced	31	9.7
Widowed	32	10.1
<i>Highest level of education</i>		
None	15	4.7
Primary	56	17.6
Secondary	144	45.3
Tertiary	103	32.4
<i>Occupation</i>		
Unemployed	30	9.4
Trader	131	41.2
Civil servant	95	29.9
Artisan	42	13.2
Police/soldier	20	6.3
<i>Ethnic group</i>		
Yoruba	251	78.9
Ibo	28	8.8
Hausa	12	3.8
Others	27	8.5

on a nevirapine-containing regimen, 9.4% on an Efavirenz-containing regimen, and 0.6% on Kaletra (lopinavir/ritonavir)-containing regimen (Table 2).

Table 3 shows low CD4 count in most respondents at baseline (90.3%) while the proportion of respondents with low CD4 count reduced by 3 months of HAART therapy (65.1%). At baseline the viral load was high in all respondents which reduced to undetectable level in one-fifth of them by 3 months on HAART.

Sixty-three percent were $\geq 95\%$ adherent to HAART. Participants taking nevirapine were more likely to have $\geq 95\%$ than those taking Efavirenz-based regimens (93.5% vs. 6.5%, $p = 0.011$) (Table 4).

Table 5 shows the relationship between HAART adherence and respondents' CD4 count and viral load at three month. A higher proportion of adherent respondents had higher CD4 count and undetectable viral load. There was an increased significant relationship in the CD4 count from baseline to the third month of evaluation. The viral load also indicated a significant relationship, with a decrease among the adherent patient at the second evaluation. BMI also showed significant change during the second evaluation (Table 6).

4. Discussion

This study investigated the effect of HAART adherence on immunological and virological status of PLWHA at the ARV clinic, University College Hospital, Ibadan over a 3-month period. We found that 63% of the PLWHA were adherent to HAART. Various previous studies have shown that levels of adherence to HAART vary among PLWHA worldwide, and that emphasis should be placed on 100% adherence during counseling sessions, although 95% adherence is sufficient to suppress viral load to undetectable levels and give optimal BMI response.^{3,4,7} The majority of adherent patients had undetectable viral loads. This confirms the need for PLWHA to be adherent to HAART because an undetectable viral load guarantees improved immunological status and quality of life.^{4,5,7}

In the present study, we found that most participants were on NNRTI-based therapy. This finding is in line with other studies on adherence in resource-limited settings and such a combination was found to be cost-effective among such populations.^{8,9} Participants taking nevirapine-based regimens were

Table 2 Drug therapy of PLWHA at Ibadan.

HAART	Frequency ($N = 318$)	Percentage
d4T + 3TC + NVP	159	50.0
CBV + NVP	76	23.9
Truv + NVP	32	10.1
ddI + 3TC + EFV	12	3.8
3TC + ABC + NVP	11	3.5
CBV + EFV	10	3.1
Truv + EFV	8	2.5
3TC + TNF + NVP	8	2.5
LPV/r + CBV	2	0.6

d4T, stavudine; 3TC, lamivudine; NVP, nevirapine; CBV, Combivir (lamivudine/zidovudine); Truv, Truvada (tenofovir/emtricitabine); ddI, didanosine; EFV, Efavirenz; ABC, abacavir; TNF, tenofovir; LPV/r, Kaletra (lopinavir/ritonavir).

Table 3 Respondents' CD4 count and viral load at baseline and three month.

	Frequency	%
<i>Baseline CD4 count (cells/μl)</i>		
≤ 200	287	90.3
> 201	31	9.7
<i>CD4 count (3 month) (cells/μl)</i>		
≤ 200	207	65.1
> 201	111	34.9
<i>Baseline log viral load (copies/μl)</i>		
> 2.6	318	100
<i>Log viral load (3 month) (copies/μl)</i>		
≤ 2.6	64	20.1
> 2.6	254	79.9

Table 4 Relationship between level of adherence and type of HAART at Ibadan.

Adherence level	Drug therapy			Total
	NVP based	EFV based	PI based	
$< 95\%$	99 (83.9%)	17 (14.4%)	2 (1.7%)	118 (37.1%)
$\geq 95\%$	187 (93.5%)	13 (6.5%)	0 (0%)	200 (62.9%)
Total	286 (89.9%)	30 (9.5%)	2 (0.6%)	318 (100%)

Chi square test: 9.069; $p = 0.011$.

Table 5 Relationship between adherence level and respondents' CD4 count and viral load at three month on HAART.

Variable	Adherence level		Total	Statistic
	$< 95\%$	$\geq 95\%$		
<i>CD4 count (3 month)</i>				
≤ 200 cells/ μ l	81 (39.1)	126 (60.9)	207 (100)	1.040; 0.308
> 201 cells/ μ l	37 (33.3)	74 (66.7)	111 (100)	
<i>Log viral load (3 month)</i>				
≤ 2.6 copies/ μ l	40 (62.5)	24 (37.5)	64 (100)	22.138; 0.0001
> 2.6 copies/ μ l	78 (30.7)	176 (69.3)	254 (100)	

also more likely to have $\geq 95\%$ adherence than those taking Efavirenz-based regimens. This contrasts with findings of Adeyemi et al. in 2008 who reported that participants taking Efavirenz-based regimens reported higher adherence to therapy.¹⁰ This finding could have resulted from the low CD4 count of most respondents at commencement of therapy with more people having more adverse effects to Efavirenz-based regimens. PLWHA on nevirapine-based regimens therapy usually have more adverse effects to HAART at higher CD4 count.

However, the fact that PLWHA had viral suppression at 3 months showed that, with good adherence in a treatment-naïve population, the likelihood of treatment failure and drug resistance is much reduced. It has been reported previously that patients adhere to their drug regimen when they are well informed about the drug combination, have a lower pill burden, convenient timing, and fewer side effects.¹¹⁻¹³

Table 6 Mean BMI, CD4 count and viral load and percent change between baseline and 3 months in HAART adherent and non-adherent PLWHA.

Variable	Baseline Mean \pm SD	3 months Mean \pm SD	Percent change and 95% CI	<i>p</i> Value
<i>Non-adherent PLWHA</i>				
BMI	21.6 \pm 5.2	21.5 \pm 5.5	-0.13 (-1.33, 1.06)	0.824
CD4 count	174.9 \pm 152.8	359.7 \pm 180.7	184.80 (155.71, 213.88)	0.001
Log viral load	4.88 \pm 0.89	3.17 \pm 0.82	-1.71 (-1.93, -1.50)	0.001
<i>Adherent PLWHA</i>				
BMI	22.2 \pm 5.2	20.8 \pm 5.1	-1.46 (-2.49, -0.42)	0.006
CD4 count	196.4 \pm 185.0	357.7 \pm 222.1	161.23 (131.40, 191.06)	0.001
Log viral load	4.6 \pm 1.1	3.8 \pm 1.0	-0.81 (-0.99, -0.63)	0.001

The study also showed that drug-adherent patients had improved immunological and virological outcomes when compared with the non-adherent population. This is in line with other studies on HAART adherence among drug-naïve populations.^{7,8,11,12}

The study is among the few studies that assessed the effect of HAART adherence on the outcome measured in a resource limited setting. However, it is limited by the short period of evaluation and adherence measurement by self report.

In conclusion, $\geq 95\%$ adherence to HAART improved PLWHA BMI, reduced viral loads to an undetectable level, and increased CD4 counts. There is a need for ongoing adherence counseling and monitoring of PLWHA on treatment.

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Conflict of interest

No conflict.

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