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EVALUATION OF ADHERENCE AND DETERMINANTS OF ADHERENCE TO HIGHLY ACTIVE ANTIRETROVIRAL THERAPY AMONG HIV-INFECTED ADULTS AND ADOLESCENTS ATTENDING A NIGERIA TEACHING HOSPITAL TREATMENT CENTRE

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ABSTRACT

The objective of this study was to evaluate adherence and determinants of adherence to highly active antiretroviral therapy (HAART) among HIV-infected adults and adolescents attending a Nigeria Teaching Hospital Treatment Centre. **Method:** An expert validated 41-item structured questionnaire (Cronbach alpha of 0.709) was administered to 400 HIV-infected adolescents and adults. The questionnaire was divided in to three parts: the first part was directed at the socio-demographic characteristics of the respondents, the second and the third parts were designed to assess respondents' adherence to HAART and the knowledge of the respondents on HIV infection as well as on HAART respectively. **Results:** The results revealed that female respondents (71.5%) were significantly ($p < 0.001$) more than male respondents (28.5%) with comparable level of education attained between the gender ($p = 0.376$). Most of the respondents (34%) were unemployed with females more than males ($p < 0.001$) and the majority of the respondents were married. A total of 236 (59.0%) of the respondents achieved ≥ 95% adherence by pharmacy records with both gender having comparable adherence. Only 2% and 1.5% of the respondents achieved ≥ 95% adherence by self-report and pooled adherence respectively. **Conclusion:** Overall, the adherence rates were very poor in this setting. Patients' residence from the treatment centre and knowledge on HAART were the factors that correlate with adherence. Counselling, knowledge, years on HAART and complexity of regimen were predictors of pooled adherence among the patients. Furthermore, demographic and socio-economic factors like: gender, level of education, marital status, income and occupation have influence on adherence.

KEYWORDS: Adherence, HAART, HIV-infected, knowledge, pooled adherance.

INTRODUCTION

Globally 35 million [33.2-37.2 million] people were living with human immunodeficiency virus (HIV) at the end of 2013. An estimated 0.8% of adults aged 15-49 years worldwide are living with HIV, although the burden of the epidemic continues to vary considerably between countries and regions. Sub-Saharan Africa remains the most severely affected, with nearly 1 in every 20 adults living with HIV and accounting for nearly 71% of the people living with HIV.[1] The North-East Region of Nigeria, comprising six states, has a comparative HIV prevalence (4.0%) to the National prevalence (4.1%). The prevalence in the states ranged from 0 to10.3%. The average regional urban prevalence was 4.3% while the average regional rural prevalence was 2.6%.[2]

Current Public Health Service (PHS) guidelines [3] recommend that patients should be treated with combinations of three to four antiretroviral drugs known as highly active antiretroviral therapy (HAAT), with at least two of the three available classes of drugs represented in the HAAT regimens, that is, nucleoside reverse transcriptase inhibitors [NRTIs], non-nucleoside reverse transcriptase inhibitors [NNRTIs], and protease inhibitors [PIs])[4] Adherence to HAART is critically important for patients to maximally achieve durable suppression of viral replication [5] and benefit from these regimens.[6] Adherence is the extent to which a person's behaviour – taking medication, following a diet, and/or executing lifestyle changes, corresponds with agreed recommendations from a health care provider.[7,8] Non-adherence to medication is associated with worsening of disease, increased morbidity and mortality and increase in avoidable healthcare cost.[9] Medication regimen

complexity has been recognised as the greatest obstruction to medication adherence and that a greater understanding of the disease condition and prescribed drugs facilitates the dialogue between patients and health professionals, fosters a more active participation of the user in the care of his/her health, and thus impacts positively on adherence to treatment with consequent possibility of more successfull clinical outcome. [10]

Studies [11,12] have identified greater than 95% adherence (meaning patients take ≥95% of their medication at the right dose, frequency and at the same time for a long-term) as adequate for sustained viral suppression in effective HIV management. Consequently, those patients who take less than 95% of their medication are considered no-adherents. Unfortunately, in clinical practice, maximum and durable suppression of HIV plasma virus load is achieved for as few as 40%–50% of the patients. [13] The primary reason for this failure, particularly among patients receiving HAAT regimens, is suboptimal adherence to medications. [11]

In some parts of Nigeria and other countries, several studies[14,15,16,17] using self-report method have reported the relationship of knowledge with adherence to medications in people living with HIV. Self-report as a tool for measuring adherence is associated with over-estimation of adherence by 20% or more.[18] This has led to the recommendation of a multi-method approach that combines feasible self-reporting and reasonable objective measurement of adherence behaviour.[19] As important as adherence to HAART may appear in HIV management, it has never been characterised in the University of Maiduguri Teaching Hospital (UMTH) which is the largest comprehensive HIV treatment centre in the North-East Region of Nigeria. Thus, the overall objective of this study was to evaluate adherence and determinants of adherence to highly active antiretroviral therapy (HAART) amongst HIV-infected adolescents and adults attending UMTH treatment centre.

MATERIALS AND METHOD

Study Design

A mixed cross-sectional design using the combination of a modified USAID-developed 4-item self-report tool for measuring medication adherence and pharmacy records which measure adherence from patients' ability to keep clinic appointments for drug pick during the last real three visits, known as pooled adherence, was employed to evaluate adherence and the determinants of adherence to HAART amongst HIV-infected adolescents and adults.

Study Population

The study population involved 6000 HIV-infected adolescents and adults (> 15 years of age) that are HAART experienced attending the UMTH HIV treatment centre with 3 real visits. HIV-infected adolescents ≤ 15 years of age and adults who are naive to HAART, with less than 3 clinic visits were excluded.

Sample Size

The sample size was determined using the formulae: $n_f = \frac{N \times n_0}{N+n_0}$ as described by Araoye[20] for population of < 10,000. Where N= estimated population of HIV infected adults and adolescents; n_0= estimated population size (for population > 10,000) and n_f= adjusted sample size (if population is < 10,000).

For the estimated sample size $n_0 = \frac{Z^2pq}{d^2}$, where: Z= number of deviation (considered as 1.96 at 95% confidence interval); p = proportion of the population with adequate adherence (for maximum variability, p = 0.5); d= tolerable sampling error (5%=0.05); $n_0 = \frac{1.96^2 \times 0.5^2}{0.05^2}$ = 384.61, approximately 385.

To determine the adjusted sample size based on the estimated size of the study population as obtained above: $n_f = \frac{6000 \times 385}{6000+385}$ =361.7, approximately 362 respondents.

Sampling Technique

Convenience sampling was employed for this study because the electronic data base that would have provided us with the capacity to randomly select subjects using their identification numbers was no longer true reflection of the physical presence of the subjects at the treatment centre, owing to on-going insurgency in the region.

Ethical Clearance and Consent: Ethical clearance was obtained from the Research and Ethical Committee of the University of Maiduguri Teaching Hospital. Informed written consent was obtained from each respondent/subject before the questionnaires were administered by trained individuals to ensure that patients/respondents were properly guided as they fill the questionnaire. The questionnaire was interpreted in the local language to patients/respondents who could not understand.

Data Collection Instrument

The study was carried out using an expert validated 41-item structured questionnaire with Cronbach alpha of 0.709. The questionnaire was divided in to three parts: the first part was directed at the socio-demographic characteristic of the respondents, the second part was designed to assess respondents' adherence to HAART while the third part was designed to assess the knowledge of the respondents on HIV infection and prevention as well as HAART. Adherence was assessed by using the combination of: a modified form of USAID-developed 4-item self-report tool, which is a 5-item self-report scale with diachotomous response and pharmacy records, with an automated calculator, which measure adherence from respondents' (patients') ability to keep clinic appointments for drug pick during the last real

three visits. The 5-item self-report tool comprises: do you ever forget to take your medication in the last four days? when you feel better do you sometimes stop taking you medication? thinking back over the last four days would you say that you have missed any of your doses? some times when you feel worse when you take your medication, do you stop taking them? do you take your medication at the same time of the day in the last four days? The data were collected from eligible patients when they come for drug refill at the treatment centre.

Knowledge was assessed using an adopted 19-item questionnaire developed by Olowookere *et al.*[16] Each correct answer to a knowledge question attracted one mark while wrong answers were scored zero. Scores obtainable ranged from 0 to 10. Summated scores were used to assess the knowledge of the about HAART.

Data management and Analysis

The returned questionnaires were analysed using the statistical package for social sciences (SPSS) version 20.0. Descriptive analysis was employed using simple frequency and percentages for categorical data whereas either mean or median and standard deviation or interquartile range (IQR) was applied to continuous variables after subjection of such data to normality test. Inferential analysis was carried-out using multivariate regression and Chi-square test to identify factors that may influence adherence. Adherence by Pharmacy refill records was analysed using multivariate regression analysis while adherence by a 5-item self-report scale and pooled adherence, which could not be analysed with regression, were subjected to Chi-square due to the fewer cases of those with adequate adherence (≥95% adherence). P-value < 0.05 was considered statistically significant at 95% confidence interval (CI).

RESULTS

Table 1 shows female respondents (71.5%) were significantly ($p < 0.001$) more than male respondents (28.5%) with a comparable pattern of highest level of education attained between the gender ($p = 0.376$). Most of the respondents (34%) were unemployed and the occupational distribution of the study population differs by gender ($p < 0.001$). There were more unemployed females than males. A total of 228 (57.0) of the respondents were married, however the distribution of the respondents by their marital status was not significantly different between gender ($p = 0.117$).

Table 1: Characteristics of the study population using categorical background variables

Demographic	Total f (%)	Female f (%)	Male f (%)	P. value
Frequency f (%)	400 (100.0)	286 (71.5)	114 (28.5)	<0.001**
Highest level of education attained				
No formal education	130 (32.5)	94 (32.9)	36 (31.6)	0.376
Primary education	46 (11.5)	34 (11.9)	12 (10.5)	
Secondary education	100 (25.0)	76 (26.6)	24 (21.1)	
Tertiary education	124 (31.0)	82 (28.7)	42 (36.8)	
Occupation				
Civil servant	84 (21.0)	50(17.5)	34 (29.8)	<0.001**
Armed forces/Police	10 (2.5)	4 (1.4)	6 (5.3)	
Self-employed	170(42.5)	108 (37.8)	62 (54.4)	
Unemployed	13 (34.0)	124 (43.4)	12 (10.5)	
Marital status				
Single	90 (22.5)	70 (24.5)	20 (17.5)	0.117
Married	22 (57.0)	142 (49.7)	86 (75.4)	
Divorced	22 (5.5)	18 (6.3)	4 (3.5)	
Widowed	60 (15.0)	56 (19.6)	4 (3.5)	
Monthly income				
Less than ₦10,000	214 (53.5)	186 (65.0)	28 (24.6)	< 0.001*
₦10,000 – < 25,000	96 (24.0)	60 (21.0)	36 (31.6)	
₦25,000 – < 50,000	54 (13.5)	32 (11.2)	22 (19.3)	
₦50,000 – 100,000	26 (6.5)	8 (2.8)	18 (15.8)	
More than ₦100,000	10 (2.5)	0 (0.0)	10 (8.8)	
Distance of patient residence from the treatment centre				
Within the treatment clinic host town (Maiduguri)	29 (74.4)	220 (76.9)	76 (66.7)	0.025*
Outside the treatment centre host town (Maiduguri)	104(26.0)	66 (23.1)	38 (33.3)	
Years on antiretroviral drugs				
0-1	32 (8.0)	28 (9.8)	4 (3.5)	0.075
1-<2	14 (3.5)	10 (3.5)	4 (3.5)	
2-<5	86 (21.5)	60 (21.0)	26 (22.8)	
5-<10	20 (52.0)	148 (51.7)	60 (52.6)	

>10	60 (15.0)	40 (14.0)	20 (17.5)	
Ever received adherence counselling from a Pharmacist?				
Yes	288 (72)	202 (70.6)	86 (75.4)	0.200
No	112(28.0)	84 (29.4)	28 (24.6)	

*significant at p value of 0.05

A total of 269 (74.4%) respondents stay within the treatment centre host town of which the proportion of female respondents was significantly higher than the male. Male respondents are more likely to access services from outside the clinic host town (p=0.025).

A total of 208 (52.0%) of the respondents have a duration of 5 – 10 years on antiretroviral drugs. However there was no significant difference in duration on antiretroviral drugs between gender (p=0.075).

A total of 288 (72.0%) received adherence counselling from pharmacists but the proportion that received adherence counselling were not significantly different between gender (p=0.200).

Table 2: Demographic Characteristics of the study population using continuous background variables

Demographic	Total (400) Median (IQR)	Female (n = 286) Median (IQR)	Male (n = 114) Median (IQR)	P. Value
¥AGE	35 (12.75)	33 (8)	45 (12)	<0.001*
¥Number of drug product(s) taken in a day	1(0)	1(0)	1(0)	0.039*
¥Total number of tablet taken in a day	2 (1)	2(0)	1(1)	< 0.001*

¥U-test

Table 2 shows that the median age of the study population was 35 years which differs between gender (p< 0.001) with male significantly older than the female. The number of drug products (regimen) taken per day showed significant difference between gender (p=0.039). Similarly, the total number of tablets taken per day (p< 0.001).

Table 3: Percentage score of correct responses to questions on knowledge

Variables	No of questions	Percentage score of correct responses to questions on knowledge Median (IQR)			p. Value
		Total n = 400	Female (n = 286)	Male (n=114)	
Knowledge on HIV disease	4	75.0 (50.0)	75.0 (50.0)	75.0 (31.2)	0.647
Knowledge on HIV prevention	6	91.6 (16.7)	83.3 (16.7)	100.0 (16.7)	0.122
Knowledge on HAART	9	72.7 (18.2)	72.7 (18.2)	72.7 (18.2)	0.029*
pooled knowledge	19	79.5 (16.9)	79.5 (16.9)	80.1 (16.51)	0.112

Table 3 shows that median score of correct responses to questions or items evaluating knowledge on the HIV/AIDS, HIV prevention and on HAART were 75.0 %, 91.6 %, and 72.7 % respectively. While the level of knowledge on HIV/AIDS disease and HIV prevention are comparable between gender (p=0.647, 0.122), the level of knowledge on HAART significantly (0.029) differs between gender. Pooled knowledge is however comparable between gender.

Table 4: Level of adherence to HAART

Adherence	% with adequate adherence (≥ 95% adherence)			p. value
	Total n = 400 F (%)	Female n =286 F (%)	Male n = 114 F (%)	
By pharmacy record	236 (59.0)	170 (59.4)	66 (57.9)	0.777
By self-report	8 (2.0)	8 (2.8)	0 (0)	0.071
pooled adherence	6 (1.5)	6 (2.1)	0 (0)	0.119

Table 4 shows that a total of 236 (59.0%) of the respondents demonstrated ≥ 95% adherence by pharmacy records with both gender having comparable adherence. Only 2% and 1.5% of the respondents have ≥ 95% adherence by self-report and pooled adherence respectively. Adherence by self-report and pooled adherence are comparable between male and female (p = 0.777, p = 0.119).

Table 5: Factors determining level of adherence using Pharmacy Records

Variables	Univariate analysis			Multivariate analysis		
	p.value	OR	95%CI	p.value	OR	95% CI
Age						
≤ 35	ref					
> 35	0.14	0.74	0.49, 0.1	0.36	0.79	0.47, 1.31
Gender						
Female	ref					
Male	0.777	0.94	0.60, 1.46	0.18	1.54	0.81, 2.91
Highest level of education attained						
No formal education	ref					
Primary education	0.908	.959	0.47, 1.95	0.67	0.85	0.39, 1.84
Secondary education	0.206	.707	0.41,1.2	0.74	0.89	0.47, 1.69
Tertiary education	0.009*	.512	0.31, 0.85	0.27	0.65	0.30, 1.39
Occupation						
Civil servant	Ref					
Armed forces/Police	0.46	0.61	0.16,2.31	0.23	0.39	0.09, 1.78
Self-employed	0.43	1.23	0.73, 2.09	0.28	0.64	0.29, 1.44
Unemployed	0.04*	1.78	1.02 ,3.10	0.69	0.84	0.34,2.03
Marital status						
Single	ref					
Married	0.95	.986	0.60,1.62	0.93	1.03	0.58, 1.83
Divorced	0.64	.800	0.31,1.62	0.65	0.78	0.27, 2.28
Widowed	0.69	.872	0.45,1.62	0.52	0.77	0.36, 1.68
Monthly income						
Less than ₦10,000	ref					
₦10,000 – 25,000	0.04*	0.59	0.37, 0.98	0.09	0.57	0.29, 1.11
₦25,000 – 50,000	0.48	0.80	0.44, 1.48	0.54	0.74	0.28, 1.96
₦50,000 – 100,000	0.01*	0.34	0.15, 0.79	0.37	0.54	0.14, 2.05
More than ₦100,000	0.77	0.83	0.23, 3.02	0.73	0.74	0.13, 4.12
Patient residence						
Within the treatment clinic host town (Maiduguri)	Ref					
Outside the treatment clinic host town (Maiduguri)	<0.001*	1.902	0.23, 0.56	<0.001*	0.29	0.18, 0.51
Years on antiretroviral drugs						
0-1	Ref					
1-<2	0.07	4.667	0.89,24.35	0.08	5.08	0.81, 31.79
2-<5	0.52	1.312	0.58, 2.99	0.94	0.96	0.37, 2.51
5-<10	0.57	1.244	0.59, 2.64	0.52	0.74	0.29, 1.88
>10	0.12	.519	0.22, 2.64	0.08	0.37	0.12, 1.11
Ever received adherence counselling						
No	Ref					
Yes	0.18	1.36	0.87,2.14	0.08	1.61	0.95, 2.71
Number(s) of regimen						
1	ref					
2	0.29	0.66	0.31,1.4	0.99	0.0	NC
3	0.42	0.66	0.24,1.81	0.99	0.00	NC
Total number of tablet(s) taken in a day						
≤2	ref					
3-4	0.55	0.79	0.35,1.75	0.99	0.00	NC
>4	0.44	0.67	0.25,1.83	0.99	0.00	NC
Level of knowledge on disease						
Inadequate knowledge	ref					
Adequate knowledge	0.402	1.198	0.79,1.83	0.229	1.35	0.83, 2.22
Level of knowledge on HIV prevention						
Inadequate knowledge	ref					
Adequate knowledge	0.500	0.709	0.26,1.93	0.188	0.47	0.153, 1.45
Level of knowledge on HAART						
Inadequate knowledge	ref					

Adequate knowledge	0.21	0.73	0.44, 1.19	0.039*	1.97	1.04, 3.74

NC= Not computed

Univariate regression analysis as shown in table 5 reveals that factors like age, gender, marital status, counselling, years on antiretroviral, number of regimen, numbers of tablets taken in a day, and knowledge on HIV diseases, its prevention and on HAART do not significantly correlate with adherence to visit for drug pick schedule while level of education attained particularly the tertiary educational level (p= 0.009, OR=0.152 at 95% CI 0.31, 0.85), occupation and distance from treatment centre (p<0.001 OR= 1.902 at 95% CI 0.23, 0.56) significantly predict adherence to clinic visits or drug pick schedule.

Respondents having a tertiary education have an 85% reduction in adherence by pharmacy records when compared with those without tertiary education and unemployment increase adherence by 78%. Respondents who earn a monthly income of ₦10,000 – 25,000 have 41% reduction in adherence. Adherence is reduced in persons with monthly income of ₦50,000 – 100,000 by 66%. Respondents who stay outside the treatment host town have an increase in adherence by 90.2% when compared with those that stay in the treatment host town.

The results from the Univariate analysis could be as a result of influence of extraneous variables.

However, when subjected to multivariate analysis to adjust for the influence of these confounding or extraneous variables it was observed that only distance from host treatment centre particularly those that stay outside the town hosting the treatment centre (p<0.001, OR=0.29 at 95% CI 0.18, 0.51) demontrated independent determinant of adherence to clinic visit or drug pick schedule. Thus, those respondents who stay outside the host treatment centre have a 71% reduction in the likelihood of adherence to drug pick schedule. Furthermore, knowledge of respondents on HAART was also an independent determinant of level of adherence to drug pick schedule (p=0.039, OR= 1.97, at 95% CI 1.04, 3.74). Respondents with adequate knowledge on HAART were 1.97 times more likely to adhere to their drug pick schedule.

Regression analysis was not carried-out due to very few cases of adequate adherence (≥ 95%) attained by most of the patients, using for self-report and pooled adherence (Table 4). Instead Chi-square test was employed. Table 6 reveals that the level of adherence may be influenced by gender (p=0.030) as the females are more likely to achieve adequate adherence than male population.

Level of education may influence adherence (p=0.041) as those without any formal education were likely to achieve adequate adherence than those with formal education. Marital status may also influence the level of adherence (p= 0.001) as only persons in the married and widowed groups were likely to achieve adequate adherence to their medication. The years of patients on HAART showed association with adherence (0.009) but the distribution of persons was not uniform. A total of 4 out of 324 (1.2%) of the respondents with adequate knowledge of HAART achieved adequate adherence while 5.4% of the respondents with inadequate knowledge of HAART achieved adequate adherence.

Table 7 shows that gender was associated with the pooled level of adherence as the females (2.1%) were more likely to have ≥ 95% adherence (p= 0.044) than the males. The level of education also may influence adherence (p=0.017), occupation (p = 0.048), marital status (p=0.007), the years on HAART (p=0.001), adherence counselling offered by Pharmacists (p=0.037), number of regimen per day (p=0.004), and the level of knowledge on HAART (p=0.037) may influence the pooled adherence.

Table 6: Factors determining level of adherence using self-report method

Variables	Adherence by self-report			
	Low (< 75%)	Moderate (75- <95%)	High (≥ 95%)	p. value
Age (years)				
≤ 35	112 (53.8)	94 (45.2)	2 (1.0)	0.27
> 35	106 (55.2)	80 (41.7)	6 (3.1)	
Gender				
Female	146 (51.0)	132 (46.2)	8 (2.8)	0.030*
Male	72 (63.2)	42 (36.8)	0 (0.0)	
Highest level of education attained				
No formal education	76 (58.5)	50 (38.5)	4 (3.1)	
Primary education	20(43.5)	24 (52.2)	2 (4.3)	0.041*-
Secondary education	46 (46.0)	54 (54)	0 (0)	
Tertiary education	76 (61.3)	46 (37.1)	2 (1.6)	
Occupation				
Civil servant	50 (59.5)	34 (40.5)	0 (0.0)	0.06
Armed forces/Police	8 (80.0)	2 (20.0)	0 (0.0)	

Self-employed	96 (56.5)	72 (42.4)	2 (1.2)	
Unemployed	64 (47.1)	66 (48.5)	6 (4.4)	
Marital status				
Single	52 (57.8)	38 (42.2)	0 (0.0)	0.001*
Married	122 (53.5)	104 (45.6)	2 (0.9)	
Divorced	20 (90.9)	2 (9.1)	0 (0.0)	
Widowed	24 (40.0)	30 (50.0)	6 (10.0)	
Monthly income				
Less than ₦10,000	110 (51.4)	98 (45.8)	6 (2.8)	
₦10,000 – 25,000	50 (52.1)	44 (45.8)	2 (2.1)	0.38
₦25,000 – 50,000	36 (66.7)	18 (33.3)	0 (0.0)	
₦50,000 – 100,000	14 (53.8)	12 (46.2)	0 (0.0)	
More than ₦100,000	8 (80.0)	2 (20.0)	0 (0.0)	
Distance of patient accommodation from the treatment centre				
Within the treatment centre host town (Maiduguri)	166 (56.1)	124 (41.9)	6 (2.0)	0.55
Outside the treatment centre host town (Maiduguri)	52 (50.0)	50 (48.1)	2 (1.9)	
Years on HAART				
0-1	18 (56.2)	12 (37.5)	2 (6.2)	
1-<2	6 (42.9)	6 (42.9)	2 (14.3)	0.009*
2-<5	46 (53.5)	40 (46.5)	0 (0.0)	
5-<10	110 (52.9)	96 (46.2)	2 (1.0)	
>10	38 (63.3)	20 (33.3)	2 (3.3)	
Ever received adherence counselling from a Pharmacist				0.075
No	150 (52.1)	134 (46.5)	4 (1.4)	
Yes	68 (60.7)	40 (35.7)	4 (3.6)	
Number(s) of regimen				
1	188 (52.8)	160 (44.9)	8 (2.2)	0.317
2	18 (64.3)	10 (35.7)	0 (0.0)	
3	12 (75.0)	4 (25.0)	0 (0.0)	
Total number of tablet(s) taken in a day				
≤2	188 (52.5)	162 (45.3)	8 (2.2)	0.203
3-4	18 (69.2)	8 (30.8)	0 (0.0)	
›4	12 (75.0)	4 (25.0)	0 (0.0)	
Percent knowledge on HIV disease				
Inadequate knowledge	74 (56.1)	56 (42.4)	2 (1.5)	0.83
Adequate knowledge	144 (53.7)	118 (44.0)	6 (2.2)	
Percent knowledge on HIV prevention				
Inadequate knowledge	10 (55.6)	8 (44.4)	0 (0.0)	0.83
Adequate knowledge	208 (54.5)	166 (43.5)	8 (2.1)	
Percent knowledge on HAART				
Inadequate knowledge	44 (57.9)	28 (36.8)	4 (5.3)	0.046*
Adequate knowledge	174 (53.7)	146 (45.1)	4 (1.2)	
Pooled level of knowledge				
Inadequate knowledge	24 (52.2)	20 (43.5)	2 (4.3)	0.48
Adequate knowledge	194 (54.8)	154 (43.5)	6 (1.7)	

Table 7: Factors determining pooled adherence

Variables	Adherence by self-report			
	Low (< 75%)	Moderate (75 - <95%)	High (≥ 95%)	p. value
Age				
≤35	66 (31.7)	140 (67.3)	2 (1.0)	0.63
>35	58 (30.2)	130 (67.7)	4 (2.1)	
Gender				0.044*

Female	80 (28.0)	200 (69.9)	6 (2.1)	
Male	44 (38.6)	70 (61.4)	0 (0.0)	
Highest level of education attained				
No formal education	42 (32.3)	84 (64.6)	4 (3.1)	0.017*
Primary education	24 (24.0)	76 (76.0)	0 (0.0)	
Secondary education	24 (24.0)	76 (76.0)	0 (0.0)	
Tertiary education	48 (38.7)	76 (61.3)	0 (0.0)	
Occupation				
Civil servant	24 (28.6)	60 (71.4)	0 (0.0)	0.048*
Armed forces/Police	4 (40.0)	6 (60.0)	0 (0.0)	
Self-employed	56 (32.9)	114 (67.1)	0 (0.0)	
Unemployed	40 (29.4)	90 (66.2)	6 (4.4)	
Marital status				
Single	28 (31.1)	62 (68.9)	0 (0.0)	0.007*
Married	74 (32.5)	152 (66.7)	2 (0.9)	
Divorced	10 (45.5)	12 (54.5)	0 (0.0)	
Widowed	12 (20.0)	44 (73.3)	4 (6.7)	
Monthly income				
Less than ₦10,000	66 (30.8)	142 (66.4)	6 (2.8)	0.52
₦10,000 – 25,000	26 (27.1)	70 (72.9)	0 (0.0)	
₦25,000 – 50,000	18 (33.3)	36 (66.7)	0 (0.0)	
₦50,000 – 100,000	10 (38.5)	16 (61.5)	0 (0.0)	
More than ₦100,000	4 (40.0)	6 (60.0)	0 (0.0)	
Distance of patient accommodation from the treatment centre				
Within the treatment clinic host town (Maiduguri)	86 (29.1)	204 (68.9)	6 (2.0)	0.15
Outside the treatment centre host town (Maiduguri)	38 (36.5)	66 (63.5)	0 (0.0)	
Years on antiretroviral drugs				
0-1	12 (37.5)	18 (56.2)	2 (6.2)	0.001*
1-<2	2 (14.3)	10 (71.4)	2 (14.3)	
2-<5	36 (41.9)	50 (58.1)	0 (0.0)	
5-<10	54 (26.0)	152 (73.1)	2 (1.0)	
>10	20 (33.3)	40 (66.7)	0 (0.0)	
Ever received adherence counselling from a Pharmacist				
No	28 (25.0)	80 (71.4)	4 (3.6)	0.037*
Yes	96 (33.3)	190 (66.0)	2 (0.7)	
Number(s) of regimen				
1	104 (29.2)	246 (69.1)	6 (1.7)	0.004*
2	8 (28.6)	20(71.4)	0(0.0)	
3	6 (1.7)	0 (0.0)	0 (0.0)	
Total number of tablet(s) taken in a day				
≤ 2	104 (29.1)	248 (69.3)	6 (1.7)	0.16
3-4	12 (46.2)	14 (53.8)	0 (0.0)	
≥4	8 (50.0)	8 (50.0)	0 (0.0)	
Percent knowledge on disease				0.78
Inadequate knowledge	44 (33.3)	86 (65.2)	2 (1.5)	
Adequate knowledge	80 (29.9)	184 (68.7)	4 (1.5)	
Percent knowledge on HIV prevention				
Inadequate knowledge	6 (33.3)	12 (66.7)	0 (0.0)	0.85
Adequate knowledge	118 (30.9)	258 (67.5)	6 (1.6)	
Percent knowledge on HAART				
Inadequate knowledge	32 (42.1)	42 (55.3)	2 (2.6)	0.037*
Adequate knowledge	92 (28.4)	228 (70.4)	4 (1.2)	

*significance at 95% CI

DISCUSSION

In the treatment of patients with HIV infection, it is essential to sustainably achieve more than 95 percent adherence to highly active antiretroviral therapy (HAART) in order to suppress viral replication and avoid the emergence of resistance.[21,22] This study identified that adherence by pharmacy records was 59% while adherence by self-report was only 2%. The pooled adherence, which is 1.5% of the studied population, was obtained using the cumulative average of the adherence by self-report and pharmacy records for drug pick schedule. Some studies in Nigeria using pharmacy refill records have reported comparable and lower levels of adherence than observed in this study: 62%, [16] 49.2% [15] and 36.3% [23] among patients respectively. However, in a cohort study, higher level of adherence (91%) was identified by Etard *et al* [24] using pharmacy refill records. Another study by Akinboro *et al* [25] found a 62.6% pooled pharmacy refill adherence while Weiser *et al* [14] reported 54% as against 2% adherence by self-report in this study. Self-report as a tool for measuring adherence is associated with over-estimation of adherence by 20% or more, [18] hence the use of pooled adherence measurement in this study. The low pooled adherence observed could be attributed to the illiteracy level of the studied population (32.5%) and the use of multiple approaches to measure adherence viz: self-report and pharmacy refill records.

Low adherence to treatment has been associated with higher hospitalization rates, productivity loss, disease progression, drug resistance can be transmitted to other persons during high-risk activity which can then limit therapeutic options and death in both high-income and resource limited settings.[26,27,28] Thus, there is need for interventions to improve adherence adherence of patients to HAART in this setting.

The study determined the factors correlating with adherence to HAART in HIV-infected adults and adolescents by pharmacy records in which persons who reside outside the city where the service centre is located have a reduced adherence (71%) to treatment and there is a male preponderance in persons coming from outside the host town treatment centre which invariably means the males are likely to hide their HIV status. This in concert with the findings in a study, [25] which could be infered that having to traverse other nearby care centres to a distant location may be associated with protection of confidentiality against stigmatisation. In contrast to these findings, Carlucci *et al* [29] found optimal adherence among HIV- positive patients that had to travel long to the source of care.

Level of knowledge on HAART was also predicted as a factor influencing adherence to HAART. The finding in this study is that respondents with adequate knowledge on HAART were 1.97 times more likely to adhere to their drug pick schedule. This is in concert with the findings in another study[14] which knowledge is seen as a predictor of adherence but only HIV-related knowledge determines adherence to medications.

Higher level of education was associated with non-adherence to ART in this study contrary to the study by Kaltchman *et al* [30] in which the reseachers found by multivariate analysis, years of education were a predictor of treatment adherence in a two-day review. People with low education and health literacy were respectively 3 and 4 times more likely to miss a dose of their medication in last two days. Their conclusion was that low education is a reasonable marker for non-adherence. Though by self-report method, Weiser *et al* [14] also found out that lower levels of education were associated with higher adherence, which is consistent with finding in this study using pharmacy refill records. Persons with high level of education are more likely to miss their medication which could be as a result of perceived lack of belief in the benefit of treatment. [17]

In the pooled level of adherence, number of regimen predicts adherence in which patients with a simple regimen show better adherence to HAART than those with a complex regimen and this is consistent with the finding of [31] in which adherence to medications decreases as the regimen becomes complex. Furthermore, the percentage of persons who understand their dosing instructions decreased with increasing regimen complexity which appears to lead to poor adherence. These findings suggest that simplifying antiretroviral regimen may have an even more important role in improving patients' adherence.

Meta-analysis and systemic reviews to assess the correlation of adherence to HAART and employment revealed that patients with HIV infections who were employed were 27% more likely to adhere to ART than those who were unemployed. [32] This is in agreement with the results of meta-analysis [33] who reported that one of the barriers to ART adherence in both developed and developing countries was financial constraints, which may be considered a proxy for unemployment. Employment may also promote increased material well-being, for example, by improving food security and housing quality and by reducing poverty – all three are known to be associated with adherence to HIV treatment.[34] This study demonstrates association between employment and adherence, as the employed respondents have significantly (0.048) achieved higher level of adherence than unemployed respondents.

In this study years on treatment with HAART appears to have considerable influence on adherence that is the rate of adherence tends to increase with the patients' experience on HAART. This finding contrasts with a study by Horberg *et al* [35] which revealed that years on antiretroviral experience did not affect adherence or any outcome measured.

Simoni *et al* [36] found out that pharmacists' intervention on HAART improves adherence this also agrees with this study. A study by McPherson-Baker[37] showed that before-after study testing efficacy of program of 5 monthly pharmacy visits including brief medication counselling on adherence to improve ART adherence gave a significant increase in adherence at 5 months post-intervention.

CONCLUSION

This study found that adherence rate was very poor among HIV-infected patients receiving treatment in this setting. Patients' residence from the treatment centre and knowledge on HAART were the factors that correlate with adherence. Counselling services from pharmacists, good knowledge on HAART adherence, years on HAART and complexity of regimen may predict pooled adherence among these patients. This study also demonstrates that socio-economic factors like: gender, level of education, marital status, income and occupation may influence adherence.

There is need for comprehensive individualized interventions employing behavioural educational strategies most particularly during counselling to improve adherence of patients to HAART in this setting, owing to the poor level of adherence attained by 97.2% of the patients.

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