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Psychiatric Disorders and adherence to antiretroviral therapy among a population of HIV-infected adults in Nigeria

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Abstract

Psychiatric disorders are common among HIV patients in Nigeria. Adherence is necessary to optimize the outcome of antiretroviral therapy. In this study, we aimed to identify associations between antiretroviral adherence measured by 1-week and 1-month self-reported missed doses, and psychiatric illness in a cohort previously assessed for psychiatric disorders using the Composite International Diagnostic instrument (CIDI). The study participants comprised 151 adults with major depression, anxiety or suicidal symptoms, and 302 matched-control participants. Two controls were randomly selected for each case within the same gender and education stratum. We compared participants with psychiatric disorders (WPDs) and without psychiatric disorders (NPDs) on selected demographic and clinical variables, in addition to adherence. Participants with 1 or more missed doses in the preceding month had twice the odds of having a major depressive episode as those with no missed doses during this period (OR 2.22, 95% CI 1.03, 4.79). This association remained significant after adjusting for selected risk factors. There was no statistically significant difference between WPD and NPD groups on either 1-week or 1-month adherence, or on age, marital status, occupational class, HIV viral load at enrollment or current CD4. Among Nigerian adults with HIV, suboptimal antiretroviral adherence is associated with, and could be a

pointer to depression. Routine self-report adherence assessments may have potential utility for identifying individuals at risk among this population.

Keywords

HIV; antiretroviral; adherence; psychiatric disorder; Nigeria

INTRODUCTION

Antiretroviral therapy (ART) is the mainstay of HIV/AIDS treatment and high levels of ART adherence are crucial to achieving viral control and preventing treatment resistance (1,2). Recent research has reported higher rates of ART adherence in low-resource regions like Africa and Asia compared to the US, Europe and other well-resourced settings (3–5). However, studies in Nigeria, a country with the second largest number of people with HIV in the world, report optimal adherence rates in less than 60% of treatment populations (6–8).

Among a variety of factors which influence ART adherence, the mental health of individuals with HIV has been recognised to play a crucial role(9–11). Psychiatric disorders occur in up to 50% of individuals with HIV (12–15). The most commonly reported of these are depression, anxiety disorders and substance use disorders (14,16–18). The role of these disorders in reducing quality of life and accelerating the progression of HIV disease(19–21) is mediated through a number of factors, including an increased likelihood of suboptimal treatment adherence (22–24). Much research has demonstrated associations between psychiatric disorders and ART adherence (10,25–27). Although this relationship is complex(28), it has been theorized that depressive symptoms could produce hopelessness, cognitive impairment and isolation from social support, all of which could lead to poor medication adherence (29,30). On the other hand, non-adherence could increase risk for further HIV disease complications, including chronically-activated inflammatory pathways, which may in turn confer additional risk for psychiatric and neurocognitive disorders (31–33).

Some studies have reported associations between poor ART adherence and psychiatric disorders among Nigerian adults with HIV. However, these either used broad screening tools to detect psychiatric morbidity rather than specific psychiatric diagnoses(7,34), or focused solely on a diagnosis of depression(35), not assessing associations with other psychiatric disorders. Furthermore, the studies on depression did not examine the influence of any mediating factors on this association with ART adherence(35). In contrast, Oladeji et al. used the WHO Composite International Diagnostic Interview (CIDI), and found a prevalence of 18.2% depression, anxiety and suicidality among 828 patients in the AIDS Prevention Initiative in Nigeria (APIN) clinic, Ibadan(36). The CIDI is a comprehensive, fully-structured diagnostic tool designed for epidemiological and cross-cultural research(37), and its validity and reliability have been reported in African countries including Ethiopia and Nigeria(38–42). Therefore, we sought to identify possible associations between ART adherence and psychiatric disorders among an ART-using subset of these patients in the Ibadan APIN clinic, by comparing self-reported adherence in patients with mood disorders

or a history of suicidality (i.e. with psychiatric diagnoses, WPD), versus those without these diagnoses (i.e., no psychiatric diagnoses, NPD). Our primary hypothesis was that rates of suboptimal ART adherence would be significantly higher among the WPD compared to the NPD group. In addition, we aimed to determine whether associations between psychiatric disorders and adherence were mediated by demographic factors such as age, marital status and occupational skill level, or clinical factors such as duration of HIV treatment and CD4 lymphocyte counts.

METHODS

Study site

The study was conducted in the AIDS Prevention in Nigeria (APIN) clinic, University College Hospital, Ibadan, Nigeria. This outpatient clinic is staffed by specially-trained family physicians, medical officers and nurses, offers HIV testing and treatment services to referrals from primary, secondary and tertiary health care facilities in the region, and caters for attendees from all over South-West Nigeria. Over the past 13 years, the clinic has registered approximately 19,000 HIV patients aged 18 years and older, and provides treatment to over 2,000 patients every year. Treatment-eligible patients receive a monthly supply of ART at scheduled pharmacy appointments, free of charge. Dates of medication pick up and dates of expected return for a refill are recorded at each of these visits. The APIN clinic also maintains an electronic database of demographic information collected at patient enrollment, as well as routine clinical data including ART and non-ART medications prescribed during clinic visits, 6-monthly CD4 lymphocyte counts and HIV viral load.

Study participants

Participants were identified from the 828 adult patients previously assessed cross-sectionally for psychiatric disorders in the APIN clinic between May and August 2011 (Oladeji et al, 2012)(36). Psychiatric diagnoses were made by trained research assistants using the WHO Composite International Diagnostic Interview (CIDI), as psychiatric screening tools are not routinely administered in this clinic. Of the 828 patients, 744 had been receiving ART for durations ranging from 1 to 91 months, and were thus considered eligible for inclusion in the current analyses. In order to maximize the power to detect significant associations between psychiatric disorder and adherence, all participants with psychiatric diagnoses (the WPD group), numbering 151, were selected for inclusion. Thereafter the participants without psychiatric diagnoses group was stratified by gender (male and female) and educational status (no formal education, primary, secondary, or tertiary education). Two participants without psychiatric diagnoses (the NPD control group) were randomly selected for each case within the same gender and educational stratum, resulting in 302 controls. Thus the study consisted of 453 total participants.

Procedure

The current study was a retrospective comparative analysis of existing data from the study by Oladeji et al, 2012. In the parent study, diagnoses of psychiatric disorder were made based on ICD-10 diagnostic criteria for major depressive disorder, generalized anxiety disorder, a history of suicidal ideation, plan or attempt since HIV diagnosis, or any

combination of these diagnoses, as measured using corresponding modules of the CIDI. These psychiatric evaluations involved the use of the Yoruba version of the CIDI, which was earlier derived using standard iterative back-translation methods, for use in Nigeria(42–44). Alongside other language versions, the Yoruba CIDI has been demonstrated to have acceptable reliability and validity by the WHO-CIDI Field Trials and other clinical calibration studies(37). The CIDI is scored according to the number of diagnostic criteria present for each disorder, corresponding with definitions in the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV) and the ICD-10 Classification of Mental and Behavioral Disorders (ICD-10)(37,45,46).

In addition, an interviewer-administered questionnaire was used to obtain information on demographic variables and on participant adherence. Participants were required to indicate the number of ART doses they had missed in the preceding one week and one month, from an option of none, one, two or greater than two missed doses. These interviews were conducted by two postgraduate students of Public Health at the University of Ibadan, who had been selected and trained by the investigator of the parent study, a specialist Psychiatrist, in the use of the CIDI. Additional available information was obtained from participants' electronic medical records, including date of clinic enrollment and duration of ART, viral load before ART commencement, and the most recent CD4 count before entry into the parent study. Ethical approval for the current analysis was given by the joint ethical committee of the University of Ibadan and University College Hospital. The Northwestern University IRB determined that the study met criteria for exemption from IRB review and approval.

Data management and statistical analysis

Analyses were conducted using SPSS version 20.0 (IBM Corp. Released 2011. IBM SPSS Statistics for Windows, Version 20.0. Armonk, NY: IBM Corp.). Statistical testing was conducted at the 5% significance level. Participants with missing data on any variable were excluded from analyses involving that variable. Self-report adherence was dichotomized as 100% adherent (no ART doses missed in the preceding week or month), or <100% adherent (one or more ART doses missed). Participants' marital status was dichotomized as married or unmarried. Associations between these variables, with psychiatric disorder status (WPD versus NPD), were tested using the Pearson's χ^2 test. Viral load was converted to $\log_{10}$ values for ease of data handling and analysis. Participants' ages, duration on ART, viral load at initial HIV diagnosis, and their CD4 lymphocyte count at the time of psychiatric assessment in 2011 were analyzed as continuous variables. Means of continuous variables were compared between the WPD and NPD groups, and mean differences were evaluated using independent-sample t tests.

In addition to comparing the WPD and NPD groups in this manner, eight separate analyses were conducted to similarly test associations between the same demographic and clinical variables, with each subgroups within the WPD group (depression, generalized anxiety disorder, suicidality or any depression or anxiety). Variables identified to have significant bivariate associations were then entered into a multivariable regression model to adjust for confounders and identify persisting associations of adherence with psychiatric disorder.

Thus, one-month adherence was entered into a logistic regression model with dependent variable depression, along with other variables known from literature to be associated with depression in HIV, including age(47), gender(48), marital status(49), educational status(50), class of occupation(51), duration on ART(52), and current CD4(24). For this purpose, age was grouped in 10-year intervals, and duration on ART was grouped in 12-month intervals.

Lastly, we evaluated the validity of the 1-week and 1-month reports of missed doses as accurate adherence measures in this study by testing associations between each of them and the closest viral load and CD4 counts to assessment, which have been used as surrogate measures of adherence in previous studies(53–56). For participants who had data on the most recent viral load or CD4 counts (ranging from 2weeks to 6months before adherence assessment), we compared these variables between those identified as adherent or non-adherent by self-reported missed doses.

RESULTS

Participant characteristics

From the parent study, 151 (20.2%) of the patients met criteria for at least one psychiatric disorder. One hundred and fourteen (15.3%) of participants had a history of suicidal ideations, plans or attempts, 48 (6.5%) met criteria for a major depressive episode, and 57 (7.7%) met criteria for any depression and or anxiety disorder.

Of the 453 participants selected for this study, the majority (76.8%) were female, with mean age of 41.2 years (SD = 9.9 years), and mean length of time since HIV diagnosis of 3.6 years (SD = 1.8 years). Table 1 compares demographic and clinical characteristics of the WPD and NPD groups. There were no significant differences between the WPD and NPD groups in age (OR 0.84; 95% CI 0.57, 1.25), marital status (OR 0.80; 95% CI 0.54, 1.18), class of occupation (OR 2.19; 95% CI 0.99, 4.87), duration since HIV diagnosis (OR 1.03; 95% CI 0.69, 1.52), duration of ART (OR 0.84; 95% CI 0.47, 1.52), viral load before ART commencement (mean difference 0.22; 95% CI -0.02, 0.45), or current CD4 count (mean difference 31.7; 95% CI -10.18, 73.49) (Table 1).

ART adherence and psychiatric disorders

Reported adherence was high, with a total of 410 (90.3%) participants having no missed ART doses in the preceding week, while 36 (7.9%) of them had missed one or more doses. Similarly, 393 (86.8%) reported no missed doses in the preceding month, while 11.5% had missed at least one dose. Seven and eight participants respectively gave no reports on missed doses during these periods. Among WPDs, 8.6% had missed one or more doses in the previous week, compared to 7.6% of NPDs (OR 1.15; 95% CI 0.57, 2.34; $P = 0.80$). Also, within the previous month, 14.0% of WPDs, compared to 10.3% of NPDs, had missed at least one dose (OR 1.44; 95% CI 0.79, 2.60; $P = 0.42$), although none of these associations was statistically significant (Table 1).

Within the WPD group, there was no statistically significant association between the participants' number of mood diagnoses or suicidality symptoms, and their reported number of missed doses in the past week or month (OR 0.99; 95% CI 0.31, 3.21; $P = 0.99$).

One-month adherence and major depression

Among individual psychiatric disorders as shown in Table 2, a diagnosis of depression was significantly associated with non-adherence within the past month (OR 2.22; 95% CI 1.03, 4.79; $P = 0.04$) (Table 2)

Adjusting for age, gender, marital status, education, class of occupation, duration of ART use and current CD4 count, the odds of having depression were three times higher in participants who were non-adherent in the preceding month, compared to those who were completely adherent (OR 3.23; 95% CI 1.41, 7.40; $P = 0.01$) (Table 3).

Validity of self-report adherence

There was no statistically significant difference between adherent and non-adherent participant groups, as measured by 1-week recall, on clinical surrogate measures such as current $\log_{10}$ viral load (mean difference 0.28; 95% CI -0.21, 0.77) and current CD4 count (mean difference 15.31; 95% CI -79.58, 110.20). Similarly, there was no association between adherent and non-adherent groups by 1-month recall, on current $\log_{10}$ viral load (mean difference 0.37; 95% CI -0.24, 0.99) and current CD4 count (mean difference 1.53; 95% CI -64.89, 67.95) (Table 4).

DISCUSSION

Neuropsychiatric disorders often go undetected among individuals with HIV, especially when unassociated with prominent changes in judgment and behavior. However, psychiatric disorders are increasingly recognized to present a potential threat to patients' functioning, quality of life and medication management(21,25). Although mood disorders, especially depression, have been associated with suboptimal ART adherence(10), this relationship is complex as poor adherence may in turn increase the risk of HIV disease progression and associated neuropsychiatric complications(57,58).

Our analysis was aimed at identifying associations between self-reported ART adherence and psychiatric disorders among adults with HIV in Nigeria. We also sought to compare WPDs and NPDs on selected demographic and clinical factors. We found that participants who missed at least one ART dose in the preceding month had twice the odds of major depression compared to those who had no missed doses. This increased to three times the odds after adjusting for demographic variables such as age, gender, marital status, educational status and class of occupation, and clinical factors such duration of ART use and current CD4 count.

Among participants with anxiety disorders or suicidality, we failed to rule out the absence of any significant effects in either 1-week or 1-month adherence. With psychiatric disorders grouped together, we also failed to rule out the absence of an effect in 1-week or 1-monthly adherence between WPD and NPD groups. Similarly we failed to rule out the absence of effects in age, marital status, class of occupation, duration since HIV diagnosis, duration on ART, pre-ART viral load and CD4 counts at the time of the study, between the WPD and NPD groups.

Our findings suggest that suboptimal ART adherence in Nigerian adults with HIV is not associated with increased rates of broad psychopathology. This contrasts with the findings of Adewuya and others (2010), who found an association between general psychopathology and low ART adherence among Nigerian adults with HIV(7). Adewuya and colleagues measured general psychopathology using the General Health Questionnaire-12 (GHQ-12), an extensively-used self-administered screener for general psychiatric wellbeing, which has been proposed to have three factors: Anxiety and Depression, Social Dysfunction and Loss of Confidence(59,60). It is possible the GHQ identified psychological distress among several participants in that study who had challenges in any of these three areas. Thus, a relatively larger proportion (65.4%) was identified to have psychopathology than was found in our parent study, which identified participants with specific diagnoses. Correspondingly, our findings may be related to the relatively low rates (18.2%) of any mood disorder or suicidality in our sample, which although higher than the 4.7% reported rate of any mental health disorder in the Nigerian general population(61), are lower than the reported rates among other HIV-infected populations in Nigeria(62,63).

Elevated rates of depression have been widely-reported among individuals with HIV, compared to other psychiatric disorders, and multiple investigations of adherence and mental health in sub-Saharan Africa have demonstrated similar associations with depression(26,64,65). While it is recognized that reduced motivation, social withdrawal and cognitive impairment associated with depression could result in suboptimal ART adherence, poor viral control due to impaired adherence increases the risk for HIV-associated central nervous system injury resulting in inflammation and changes in emotional and hormonal regulation, which could manifest in depression(66–69). This bi-directional relationship could explain the associations between ART adherence and depression consistently reported in research, and supported by our findings among Nigerian adults.

Our analysis identified an association between depression and 1-month self-report adherence, but not 1-week self-report. Although more recall bias would be expected for longer periods of recollection, the use of one-month self-recollection periods has shown validity for adherence measurement, being less associated with over-reporting than 3- or 7-day recall durations(70), and has also been shown to correlate with adherence measured by electronic monitoring systems, and viral load(71). It may be likely that patients are more willing to acknowledge non-adherence over a longer than shorter time period. However, it is also important to note that both participants with and without psychiatric disorders reported high rates of adherence. While it is one of the most widely-used methods for assessing antiretroviral adherence, self-report may be unreliable as patients typically overestimate their ART use(72,73). Possible evidence for this in this study may have been our findings of no association between self-reported adherence and either HIV viral load or CD4 count close to the time of assessment, both of which have been used as surrogate measures of adherence in previous research(53–55,74). It should be noted however that self-reported adherence over a preceding one-month period may not correspond with recent virologic indices obtained up to 6 months preceding, as was the case with some participants in this study. Thus, durations of such length between the assessments, rather than non-validity of self-reports, may have been responsible for the lack of association we found between self-reported adherence and virologic indices.

In the Nigerian context, the tendency to overestimate self-reported adherence may be particularly strong given cultural dynamics of the provider-patient relationship in treatment settings. The often paternalistic nature of Nigerian doctor-patient relationships(75) may contribute to a tendency to over-estimate adherence for social desirability reasons. Patients receiving ART in the study location may also have felt indebted to their providers because ART is received free of charge, and may tend to portray themselves as taking full advantage of this benefit to prevent its being withdrawn. In addition, such inaccurate estimation may have resulted from recall bias, another recognised limitation of self-report measures(76,77). In keeping with existing data indicating better adherence rates in Africa compared to Europe and North America(3,78), such positive rates in Nigeria could also be reflective of successful widespread efforts (such as community-level HIV testing and ART provision) by government and international organizations, targeted at improving access to care in response to the generalized HIV/AIDS epidemic in this region. In contrast, the concentration of the epidemic among relatively focused, vulnerable and often hard-to-reach core risk subpopulations in well-resourced regions, may contribute to a relative lack of access and potentially poorer adherence rates among such groups, despite disproportionately better resources in these regions.

We acknowledge some limitations to our investigation, including the cross-sectional design of the parent study. The one-time assessment of psychiatric disorders did not permit assessment of symptom onset, duration and temporal relationships, and made it impossible to hypothesize causative relationships between nonadherence and psychiatric disorders. Also, although the use of the World Health Organisation CIDI for diagnostic assessments of psychiatric disorders was an improvement over prior studies among similar Nigerian populations, it did not provide for a graded assessment of these psychiatric symptoms. Thus, the psychiatric assessments yielded only categorical classifications of disorder presence or absence, making it difficult to study associations between adherence and severity of psychiatric disorder. Finally, the missing data on a large numbers of participants' nadir CD4 count and their viral load at point of assessment, as well as absence of data on stressful life events, resulted in gaps in our ability to measure important clinical and psychosocial factors known to be significant predictors of HIV outcome, and possibly of depression. It is also important to highlight the possibility that our observed association between 1-month adherence and depression may have occurred due to chance, given the number of independent tests of association we conducted at various stages of analysis.

The strengths of our study include the adoption of a matching strategy aimed to reduce the potential confounding effects of gender and educational status since the parent study included a large number of participants from a population rarely studied for psychiatric symptoms in the past. Our findings are therefore an important contribution to the literature on adherence and mental health among adults living with HIV in sub-Saharan Africa, and specifically in Nigeria. Self-reports of missed doses within the preceding month may be a potentially useful tool for assessing adherence in this setting, and suboptimal adherence identified through this method could be a signal of undiagnosed depression in adults with HIV. There is however need for further research into the utility of other adherence measures such as pharmacy refill records, as well as a need for longitudinal studies to not only explore

causative relationships between psychiatric disorder and adherence in this population, but also inform prevention and intervention efforts.

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Table 1

Clinical and demographic characteristics by psychiatric disorder status

	Mood disorder or suicidality present (WPD)	Mood disorder or suicidality absent (NPD)	P value	Odds ratio (95% CI)
	(n = 151) % (n)	(n = 302) % (n)		
Age				
<=40 years	54.3 (82)	50.0 (151)	0.39	0.84 (0.57–1.25)
>40 years	45.7 (69)	50.0 (151)		
Missing	0.0 (0)	0.0 (0)		
Gender ^a				
Male	23.2 (35)	23.2 (70)	1.00	Not applicable
Female	76.8 (116)	76.8 (232)		
Missing	0.0 (0)	0.0 (0)		
Level of education ^a				
No formal education	11.3 (17)	11.3 (34)	1.00	Not applicable
Primary	29.8 (45)	29.8 (90)		
Secondary	41.7 (63)	41.7 (126)		
Tertiary	17.2 (26)	17.2 (52)		
Missing	0.0 (0)	0.0 (0)		
Marital status				
Married	53.0 (80)	58.6 (177)	0.25	0.80 (0.54–1.18)
Not married	47.0 (71)	41.4 (125)		
Missing	0.0 (0)	0.0 (0)		
Occupation ^b				
Skilled	5.3 (8)	10.9 (33)	0.05	2.19 (0.99–4.87)
Semi-skilled or unskilled	94.7 (143)	89.1 (269)		
Missing	0.0 (0)	0.0 (0)		
Duration since HIV diagnosis				
3 years	45.7 (69)	46.4 (140)	0.89	1.03 (0.69–1.52)

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	Mood disorder or suicidality present (WPD)	Mood disorder or suicidality absent (NPD)	P value	Odds ratio (95% CI)
	(n = 151) % (n)	(n = 302) % (n)		
>3 years	54.3 (82)	53.6 (162)		
Missing	0.0 (0)	0.0 (0)		
Duration on ART				
0–11 months	13.2 (20)	11.6 (35)	0.57	0.84 (0.47–1.52)
12 months	74.2 (112)	77.2 (233)		
Missing	12.6 (19)	11.2 (34)		
Adherence				
Number of doses missed in preceding week				
No doses missed	89.4 (135)	91.1 (275)	0.80	1.15 (0.57–2.34)
1 or more doses missed	8.6 (13)	7.6 (23)		
Missing	2.0 (3)	1.3 (4)		
Number of doses missed in preceding month				
No doses missed	84.0 (126)	88.4 (267)	0.42	1.44 (0.79–2.60)
1 or more doses missed	14.0 (21)	10.3 (31)		
Missing	2.0 (3)	1.3 (4)		

Continuous variables						
	n	Mean	SD	Range	25 th percentile	Median
Duration of time on ART (months)						
WPD	132	38.2	21.8	1 – 91	20.0	39.0
NPD	268	39.8	21.8	1 – 88	23.0	41.0
Viral load before ART commencement (log ₁₀ copies/ml)						
WPD	134	4.8	1.1	2.3 – 7.7	4.1	4.9
NPD	266	4.6	1.2	2.3 – 6.9	3.8	4.8
Current CD4 (cells/mm ³)						
WPD	149	397.0	195.8	25.0 – 1,175.0	241.0	391.0
NPD	301	428.7	242.4	16.0 – 1,903.0	251.0	379.0
						Mean difference (95% CI)
						0.2 (–0.2 – 0.45)
						0.1 (–0.02 – 0.24)
						0.48
						0.07

Analyses on categorical variables were performed using Pearson's χ^2 test of association, and differences between means of continuous variables were evaluated using independent samples t t-test, with missing data excluded.

^a NPDs were matched on age & gender with WPDs; distribution on these characteristics is shown for descriptive purposes

^b Occupational classification done according to International Labour Organisation's ISCO-08, thus:

Skilled: managers, professionals, technicians & associate professionals, armed forces

Semi-skilled or unskilled: clerical support workers, service & sales workers, skilled agricultural, forestry & fishery workers, craft & related trades workers, plant & machine operators, elementary occupations. Unemployed participants included in this group (International Labour Organisation, 2007).

WPD, participants with mood disorders or suicide-related symptoms

NPD, participants without mood disorders or suicide-related symptoms

ART, antiretroviral therapy; SD, Standard deviation; CI, Confidence Interval

Table 2Odds of non-adherence by individual psychiatric diagnoses^a

		Doses missed in past week		OR (95% CI)	p	Doses missed in past month		OR (95% CI)	p
		None	One or more			None	One or more		
Major depressive episode		n = 446, % (n)				n = 445, % (n)			
	Present	91.7 (44)	8.3 (4)	0.96 (0.33–2.85)	0.95	79.2 (38)	20.8 (10)	2.22 (1.03–4.79)	0.04
	Absent	92.0 (366)	8.0 (32)			89.4 (355)	10.6 (42)		
Generalized anxiety Disorder (GAD)		n = 446, % (n)				n = 445, % (n)			
	Present	90.9 (10)	9.1 (1)	0.88 (0.11–7.04)	0.90	72.7 (8)	27.3 (3)	2.95 (0.76–11.48)	0.10
	Absent	92.0 (400)	8.0 (35)			88.7 (385)	11.3 (49)		
Any GAD or Depression		n = 446, % (n)				n = 445, % (n)			
	Present	92.0 (358)	8.0 (31)	1.11 (0.41–2.98)	0.84	89.4 (347)	10.6 (41)	0.49 (0.24–1.03)	0.06
	Absent	91.2 (52)	8.8 (5)			80.7 (46)	19.3 (11)		
Suicidality		n = 445, % (n)				n = 444, % (n)			
	Present	92.2 (308)	7.8 (26)	1.17 (0.55–2.52)	0.68	88.9 (297)	11.1 (37)	0.85 (0.44–1.65)	0.64
	Absent	91.0 (101)	9.0 (10)			87.3 (96)	12.7 (14)		

All analyses performed using χ^2 test of association.^aNon-adherence is defined as one or more missed antiretroviral doses in the preceding week or month

Table 3

Association with major depression

	All %, (n = 453)	With depression %, (n = 48)	Without depression %, (n = 405)	OR (95% CI) ^{a, b}	P ^{b, d}	AOR (95% CI) ^{a, c}	P ^{c, d}
Adherence (missed doses in preceding month)	98.2 (445)	100.0 (48)	98.0 (397)				
1 or more		20.8 (10)	10.6 (42)	2.22 (1.03–4.78)	0.04	3.23 (1.41–7.40)	0.01
None		79.2 (38)	89.4 (355)				
Age (years)	100.0 (453)	100.0 (48)	100.0 (405)				
11–20		0.0 (0)	1.2 (5)	0.99 (0.75–1.32)	0.95	1.07 (0.77–1.48)	0.68
21–30		10.4 (5)	13.3 (54)				
31–40		37.5 (18)	37.3 (151)				
41–50		37.5 (18)	30.6 (124)				
51–60		14.6 (7)	12.1 (49)				
61–70		0.0 (0)	5.4 (22)				
Gender	100.0 (453)	100.0 (48)	100.0 (405)				
Male		33.3 (16)	22.0 (89)	1.78 (0.93–3.38)	0.08	1.90 (0.88–4.10)	0.10
Female		66.7 (32)	78.0 (316)				
Marital status	100.0 (453)	100.0 (48)	100.0 (405)				
Married		60.4 (29)	46.3 (228)	1.19 (0.64–2.18)	0.59	1.09 (0.56–2.13)	0.79
Not married		39.6 (19)	43.7 (177)				
Educational status	100.0 (453)	100.0 (48)	100.0 (405)				
No formal education		16.7 (8)	10.6 (43)	1.20 (0.86–1.67)	0.29	1.42 (0.94–2.16)	0.10
Primary		31.2 (15)	29.6 (120)				
Secondary		35.4 (17)	42.5 (172)				
Tertiary		16.7 (8)	17.3 (70)				
Class of occupation	100.0 (453)	100.0 (48)	100.0 (405)				
Unskilled/semiskilled		95.8 (46)	90.4 (366)	2.45 (0.57–10.49)	0.23	1.56 (0.32–7.52)	0.58
Skilled		4.2 (2)	9.6 (39)				
Duration on ART (months)	88.3 (400)	91.7 (44)	87.9 (356)				
0 – 12		15.9 (7)	14.3 (51)	1.09 (0.92–1.30)	0.31	1.00 (0.83–1.22)	0.92

	All %, (n = 453)	With depression %, (n = 48)	Without depression %, (n = 405)	OR (95% CI) ^{a, b}	P ^{b, d}	AOR (95% CI) ^{a, c}	P ^{c, d}
13 – 24		20.5 (9)	13.2 (47)				
25 – 36		9.1 (4)	15.7 (56)				
37 – 48		27.3 (12)	19.1 (68)				
49 – 60		13.6 (6)	19.7 (70)				
61 – 72		6.8 (3)	9.8 (35)				
73 – 84		6.8 (3)	7.6 (27)				
86 – 96		0.0 (0)	0.6 (2)				
Current CD4 count (cells/mm³)	99.3 (450)	100.0 (48)	99.2 (402)				
<200		25.0 (12)	2.9 (52)	0.60 (0.38–0.94)	0.03	1.71 (1.00–2.92)	0.05
200–499		52.1 (25)	53.7 (216)				
500		22.9 (11)	33.3 (134)				

^a Odds ratios compare the odds of major depression in participant groups by selected risk factors, including 1-month adherence.

^b These refer to bivariate analysis of relationships between major depression and each of the listed risk factors

^c These refer to multivariate analysis of relationships between major depression and 1-month self-reported adherence, adjusting for age, gender, marital status (married/ unmarried), educational status (no formal education, primary, secondary or tertiary), class of occupation, duration of antiretroviral use and current CD4.

^d Only P values less than 0.05 are noted.
OR, odds ratio; AOR, adjusted odds ratio

Table 4

Differences between adherent and non-adherent participants on current viral load and CD4 count

Current viral load a (log ₁₀ copies/ml) b Mean (±SD)	Doses missed in preceding week N = 222			
	None n = 205	One or more n = 17	Mean difference in current viral load (95% CI)	P
	2.75 (± 0.96)	3.03 (± 1.36)	0.28 (−0.21 – 0.77)	0.26
	Doses missed in preceding month N = 222			
	None n = 201	One or more n = 21	Mean difference in current viral load (95% CI)	P
	2.74 (±0.95)	3.11 (± 1.33)	0.37 (−0.24 – 0.99)	0.22
	Doses missed in preceding week N = 444			
	None n = 408	One or more n = 36	Mean difference in current CD4 (95% CI)	P
	417.47 (± 224.98)	432.78 (± 273.49)	15.31 (−79.58 – 110.20)	0.75
	Doses missed in preceding month N = 443			
Current CD4 (cells/mm ³) Mean (±SD)	None n = 391	One or more n = 52	Mean difference in current CD4 (95% CI)	P
	419.28 (± 226.16)	420.81 (± 249.23)	1.53 (−64.89 – 67.95)	0.97

Adherent participants were those with no missed doses, and non-adherent were those with one or more missed doses.

^a Analysis performed for comparison. Current viral load was not used in any other analysis due to unavailable values for 231 of the participants.^b Log10 values were used because viral load is highly skewed.