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Depressive Symptoms and Their Impact on Health-seeking Behaviors in Newly-diagnosed HIV-infected Patients in Durban, South Africa

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Abstract

We evaluated the prevalence and correlates of depressive symptoms prior to HIV diagnosis and determined the effect of these symptoms on seeking HIV care at an urban and rural clinic in Durban, South Africa. Adults were administered a questionnaire which included the 5-item Mental Health Index (MHI-5) before HIV testing. We determined the depressive symptoms among HIV-infected subjects. Of 1,545 newly-diagnosed HIV-infected subjects, 55% had depressive symptoms by MHI-5 score. Enrolling at the urban clinic and decreasing functional activity score were associated with depressive symptoms. Subjects with depressive symptoms who were referred for HIV testing by a healthcare provider were less likely to obtain a CD4 count than those without depressive symptoms who self-referred for testing. Depressive symptoms were common among newly-diagnosed HIV-infected participants and impacted CD4 uptake. Depression screening at the time of HIV diagnosis is critical for improving linkage to mental health and HIV services in South Africa.

Keywords

HIV; Linkage to care; Depressive symptoms; Depression; South Africa; Africa

Introduction

Depression is common among HIV-infected patients in resource-limited settings [1]. Cross-sectional South African studies have reported an 11–60% prevalence of depression when screening patients after their HIV diagnosis [2–8]. Depression has been shown to negatively affect antiretroviral treatment (ART) initiation and adherence for patients enrolled in longitudinal HIV care [9–14]. However, there are limited studies on the prevalence and correlates of depressive symptoms immediately preceding a new HIV diagnosis [8], and the impact of depressive symptoms on linking to HIV care.

We examined the prevalence and correlates of depressive symptoms in adults who were surveyed before HIV testing and subsequently diagnosed with HIV in two out-patient clinics in Durban, South Africa. We also analyzed the effects of depressive symptoms on HIV related health-seeking behavior in this newly-diagnosed population. Guided by previously published work, we hypothesized that newly-diagnosed HIV-infected participants who were younger [6] and female [3] would have depressive symptoms and participants with depressive symptoms would be less likely to obtain a CD4 count.

Methods

Clinic Setting

This secondary analysis of a prospective adult cohort was conducted in the outpatient clinic of an urban and a rural hospital in KwaZulu-Natal, the province with the highest HIV prevalence in South Africa [15]. McCord Hospital is an urban, state-aided general hospital

in Durban where patients pay a subsidized fee for services. The outpatient clinic serves 3,000–4,000 adult patients per month and approximately 70% are black African, Zulu speakers, 20% are Indian, and 10% are White [16, 17]. The McCord Hospital HIV clinic has served >14,000 patients over the last 10 years and charges an inclusive fee (ZAR 180 = US $25 per visit, 2008) for comprehensive HIV services including ART [17]. The HIV clinic is subsidized by the United States President's Emergency Plan for AIDS Relief (PEPFAR) and the KwaZulu-Natal Department of Health [16].

St. Mary's Hospital is a Catholic, state-aided rural hospital that is located 20 km from Durban in Mariannhill. The hospital serves a peri-urban and rural population and charges a subsidized fee for outpatient clinic services. The St. Mary's outpatient clinic serves 4,000 adult patients per month. The HIV clinic has served >10,000 patients over the last 10 years and offers comprehensive HIV care for a subsidized fee (ZAR 50–70 = US $6–9 per visit, 2008) through PEPFAR and KwaZulu-Natal Department of Health subsidies [16].

McCord Hospital offers rapid fingerstick HIV testing to patients presenting to the outpatient clinic. At St. Mary's Hospital, HIV ELISA testing was initially offered until August 2007 when rapid fingerstick HIV testing was adopted [16, 17]. At both outpatient clinic sites, patients can self-refer for HIV testing or are tested following physician referral. Newly-diagnosed HIV-infected patients were immediately referred for CD4 testing at both clinic sites. Patients at McCord Hospital were charged a ZAR 90 fee ($12 US, 2008) for HIV clinic registration and CD4 testing; CD4 testing became free of charge in November 2008 in the McCord outpatient clinic. At St. Mary's Hospital, CD4 testing was offered free of charge. Patients were then offered an HIV clinical assessment at both sites [16]. Patients with a CD4 count <200 cells/μL or who were WHO clinical stage 3 or 4 were eligible for ART at both HIV clinics during the study period [18]. ART-eligible patients underwent standard procedures of HIV care and three literacy sessions prior to ART initiation at both sites [16].

The STIAL Cohort

Adults (≥18 years) who presented for HIV testing at the McCord or St. Mary's outpatient clinic between August 6, 2006 and December 31, 2008 were eligible for enrollment in the South African Test, Identify, and Link (STIAL) cohort (Fig. 1) [16, 19]. Enrolled participants were administered a verbal questionnaire, in English or Zulu, and subsequently underwent HIV testing. Subjects did not know their HIV status when administered the questionnaire. The current analysis only includes participants who were found to be HIV-infected and who collected their HIV results. HIV-infected participants were referred for CD4 testing at the time of diagnosis to assess immunologic status and ART-eligibility.

The study questionnaire was administered by five bilingual (English/Zulu) research assistants who underwent a month-long orientation and had interval follow-up training during the study period. In addition, training was provided to standardize the verbal administration of the questionnaire across participants of different ages, gender, and educational level. The study questionnaire included the following data elements:

Demographic and Geographic: Questions included age, sex, education (no school, primary, some high school, high school, tertiary), employment status, distance from their home to the clinic, living arrangement (lives alone, with partner, with relatives/friends, employer), marital status, and whether they had an HIV-infected family member or friend.

Clinical: Clinical questions included HIV testing referral pattern (referral by a healthcare provider vs. self-referred), history of tuberculosis (TB) treatment, and health rating (very good, good, fair, poor/bad). Functional activity was assessed using the 10-

item Physical Functioning Scale (PFS) of the Medical Outcomes Study 36-Item Short Form Health Survey (SF-36) [20]. The 10 PFS questions included ability to walk, carry groceries, and climb stairs, and were scored from 0 to 100 [20].

Mental Health: Subjects were asked 5 mental health screening questions from the Mental Health Index-5 (MHI-5) [21, 22]. The MHI-5 tool is the Mental Health domain of the SF-36. The SF-36 is a measure of health status that has been validated in HIV-infected populations [23, 24] in South Africa [25, 26]. The MHI-5 has been validated and used to screen for depression in international settings [22] and in the outpatient setting [21], though has not been validated in South Africa. The MHI-5 screening tool was chosen based on its suitability to the outpatient study setting and lack of other brief, validated, depression screening tools in South African HIV-infected populations at the time the study was designed in 2005. The participants were asked during the past month, how much of the time: *(1) were you a happy person, (2) have you felt calm and peaceful, (3) have you been a nervous person, (4) have you felt very sad, and (5) did you feel so sad that nothing could cheer you up?* Subjects' responses were captured on a frequency scale ranging from 1 ("all of the time") to 6 ("none of the time"). The MHI-5 responses were rescaled to a score of 0–100. Since the MHI-5 has no formal thresholds, we applied categories reported in a study that evaluated the performance of the MHI-5 in the general Japanese population [22]. In the Japanese study, participants with a score of ≤52 were categorized as severely depressed, 53–60 moderately depressed, 61–68 mildly depressed, and ≥69 not depressed [22]. For this analysis, we categorized participants with a score ≤60 as having depressive symptoms.

Participant Follow-up: We collected the dates and results of CD4 testing via chart abstraction. We also collected the proportion of ART-eligible subjects who started ART.

Written informed consent was obtained from all study participants. Patients unable to give informed consent, were known HIV-infected, <18 years old, pregnant, not willing to share their HIV test results with the study staff, or were critically ill were excluded from study enrollment. An additional eight subjects who were categorized as having a CD4 count were excluded from the study because they did not have a CD4 value or date of test available. Ethics approval was obtained from the McCord Hospital Ethics Committee, the St. Mary's Hospital Mariannhill Ethics Committee, and the Partners HealthCare Human Research Committee in Boston, Massachusetts, USA (protocol #2006-P-001379).

Statistical Methods

The primary outcome was prevalence of depressive symptoms, defined by an MHI-5 scaled composite score of ≤60, among newly-diagnosed HIV-infected subjects. A secondary outcome was obtaining a CD4 count after HIV-diagnosis. An additional secondary outcome was initiating ART, if eligible, after HIV-diagnosis.

Bivariate analyses were performed to determine predictors of the study outcomes. We used the χ^2 test for categorical data, t-tests for continuous variables, and the Wilcoxon rank-sum test for continuous variables with non-normal distributions. For each outcome, we constructed a multivariate model using variables that exhibited statistically significant associations with the outcome in the bivariate analyses, that were associated with linkage to care in previous analyses of this cohort [16, 19], or other published studies. Multiple imputation by chained equations [27, 28] was used to retain subjects with incomplete covariate data. The multivariate model for obtaining a CD4 count included a term to account for the observed interaction between depressive symptoms and HIV testing referral pattern (referral by a healthcare provider vs. self-referred). We assessed the multivariate models using a generalized linear model with a Poisson distribution and log link function. We

present relative risks (RR), adjusted relative risks (ARR) and 95% confidence intervals (CI). All analyses were carried out using Stata statistical software (Stata Statistical Software Release 10, StataCorp, College Station, TX, USA).

Results

Cohort Characteristics

During the study period, a total of 1,545 subjects completed the study questionnaire, underwent HIV testing, and were subsequently found to be HIV-infected at the two outpatient clinic sites. Among these participants, 846 (55%) had depressive symptoms based on MHI-5 score (Table 1). The median age of the newly-diagnosed HIV-infected cohort was 34 years (interquartile range (IQR) 28–41 years), and 777 (50%) were female (Table 1). The median age was higher (35 vs. 33 years, $p < 0.001$) and functional activity scores were lower (90 vs. 95, $p < 0.001$) among those with depressive symptoms. Depressive symptoms were more common among participants at the urban compared to the rural clinic (83% vs. 34%, $p < 0.001$), and those who were referred for HIV testing by a healthcare provider compared to those who self-referred (76% vs. 35%, $p < 0.001$).

Predictors of Depressive Symptoms

We tested a multivariate model of depressive symptoms that included age, sex, educational level (high school or more vs. no, primary, or some high school), clinic site, living arrangement (lives with partner vs. other) and functional activity score. Increased risk of depressive symptoms was associated with enrolling at the urban clinic (ARR 2.45, 95% CI 2.21–2.70). Every 10 point decrease in functional activity score was associated with a 5% increase in depressive symptoms (ARR 1.05, 95% CI 1.04–1.07) (Table 2).

Effect of Depressive Symptoms on Obtaining a CD4 Count and Initiating ART

A total of 1,126 (73%) subjects obtained a CD4 count and of those who had results available, 607 (59%) had a CD4 count <200 cells/μL. Newly-diagnosed HIV-infected subjects who presented to the urban clinic were less likely to have a CD4 count compared to those at the rural clinic (64% vs. 80%, $p < 0.001$). Participants with depressive symptoms were less likely than those without depressive symptoms to obtain a CD4 count (70% vs. 78%, $p < 0.001$) (Fig. 1). The median CD4 count was lower in those with depressive symptoms (137 cells/μL; IQR 57–273) compared to those with no symptoms (172 cells/μL; IQR 78–315) ($p < 0.005$). Participants with depressive symptoms were more likely to have a CD4 count <200 cells/μL (63% vs. 56%, $p = 0.03$). The median time to obtain a CD4 count was also longer for those participants with depressive symptoms compared to those with no symptoms (1 day vs. 0 days, $p < 0.001$).

Participants referred for HIV testing by a healthcare provider compared to those who self-referred (65% vs. 81%, $p < 0.001$) were less likely to obtain a CD4 count after HIV diagnosis. A statistically significant interaction was found between depressive symptoms and HIV testing referral pattern (Fig. 2). The effect of depressive symptoms on obtaining a CD4 count differed by whether the participant was referred for HIV testing by a healthcare provider or self-referred.

We tested a multivariate model of obtaining a CD4 count that included age, sex, clinic site, distance to clinic, having an HIV-infected family member or friend, history of TB treatment, functional activity score, HIV testing referral pattern (referred by a healthcare provider vs. self-referred), depressive symptoms, and the interaction term HIV testing referral pattern and depressive symptoms (Table 3). Subjects with depressive symptoms who were referred by a healthcare provider for HIV testing were less likely to obtain a CD4 count than those

with no depressive symptoms who self-referred for testing (ARR 0.82, 95% CI 0.72–0.94). Every 10 year increase in age was associated with a 4% increase in obtaining a CD4 count (ARR 1.04, 95% CI 1.01–1.08) (Table 3). Participants at the urban clinic were less likely than those at the rural clinic to obtain a CD4 count (ARR 0.86, 95% CI 0.79–0.93).

There were 628 ART-eligible patients based on a CD4 count of <200 cells/μL or WHO clinical stage 3 or 4. Of the ART-eligible participants, 249 (40%) started ART, 143 (23%) did not start ART, and 236 (38%) had an unknown ART status. In bivariate analyses excluding those with unknown ART status, the number of subjects with depressive symptoms initiating ART was 142 (57%) compared to 107 (75%) with no depressive symptoms ($p < 0.001$). However, there was no significant difference in ART initiation by depressive symptoms in multivariate analysis controlling for age, sex, clinic site, distance to clinic, functional activity score, and HIV testing referral pattern.

Discussion

This study evaluated the prevalence and correlates of depressive symptoms in adults surveyed before HIV diagnosis and determined their impact on obtaining a CD4 count in two outpatient clinics in Durban, South Africa. Fifty-five percent of subjects surveyed before HIV diagnosis had depressive symptoms by MHI-5 score. The factors associated with depressive symptoms were enrolling at the urban clinic and a lower functional activity score. We also found that subjects with depressive symptoms who were referred for HIV testing by a healthcare provider were less likely to obtain a CD4 count than those with no depressive symptoms who self-referred for testing. This study highlights that depressive symptoms are common, and that these symptoms have a negative impact on the initial health-seeking behavior of newly-diagnosed HIV-infected subjects.

Although the high prevalence of depressive symptoms in this newly-diagnosed HIV-infected cohort is consistent with other South African studies, the majority of previous studies have screened HIV-infected patients for depression after they are enrolled in continuity HIV care, rather than prior to diagnosis [2–8]. Among a cohort of South African HIV-infected patients screened more than 6 months after their diagnosis, 35% had major depression [2], and in a semirural cohort of patients diagnosed with HIV within the prior year, nearly 40% had depression scores in or above the moderately depressed range [7]. The prevalence of depression was 60% in HIV-infected inpatients in Durban, South Africa [5]. The wide variability of depression estimates may be due to the use of different psychiatric rating scales, study location, and cohort composition, such as age, sex, and clinical HIV stage [1]. The timing of the depression assessment relative to the patient's HIV diagnosis could also affect prevalence estimates [1].

Few studies in South Africa have assessed depressive symptoms before HIV testing. A survey of the literature yielded one study in a resource-limited setting of pregnant women who were screened for depression directly prior to HIV testing [8]. HIV-negative women presenting to a rural clinic in Kwa-Zulu Natal were screened for depression using the Edinburgh Postnatal Depression Scale (EPDS) and then offered HIV testing as part of a prevention of mother to child transmission (PMTCT) program [8]. An EPDS score consistent with depression was found in 41% of the women. Forty-one percent of women were subsequently found to be HIV-infected, though no significant relationship was found between HIV status and depression. In our study we screened participants for depressive symptoms before HIV testing and diagnosis and found that symptoms are common not only in women, but also in men. This high prevalence of depressive symptoms highlights that efforts are needed to integrate depression and mental health screening at the time of HIV testing and diagnosis.

We found that enrolling at the urban clinic was a significant predictor of depressive symptoms. Although some studies have found higher prevalence of depression in urban compared to rural settings, others have found no significant difference [29, 30]. The higher prevalence of depression in urban locations is thought to be mediated by the stress of urbanization, including social isolation, crowding, unemployment, crime and violence, poverty, and pollution [29, 30]. We also found that a lower functional activity score correlates with depressive symptoms which is consistent with previous studies in HIV-infected adults in South Africa [3, 4]. Unlike other South African studies, female gender [3], younger age [6], speaking Afrikaans [6], unplanned current pregnancy [8], and absence of a regular income [8], were not associated with increased risk of depressive symptoms in newly-diagnosed HIV-infected patients.

This study highlights the effect of depressive symptoms on obtaining a CD4 count, the first step in initiating care for newly-diagnosed HIV-infected patients. The subjects who had depressive symptoms and were referred for HIV testing by a health care provider were less likely to have a CD4 count than those with no depressive symptoms who self-referred for testing. A previous analysis of this cohort showed that newly-diagnosed HIV-infected patients who were referred for testing by a healthcare provider had a higher rate of early loss to follow-up [19]. The patients with depressive symptoms who were referred for HIV testing may be less likely to seek HIV care in the short-term because they are less prepared to learn their diagnosis [19]. Self-referred patients may also be a more motivated group of patients who will access services irrespective of their mental health state [19]. Our findings suggest that depressive symptoms may be an additional factor associated with poor uptake of initial HIV services for newly-diagnosed HIV-infected patients.

Previous studies have assessed the effect of depression on ART initiation [1, 9–11] and adherence [12–14] in HIV-infected patients who are enrolled in continuity HIV services. Although we report no difference in ART initiation by depressive symptoms in multivariate analysis, the statistical power to address this linkage question was lacking because the number of subjects with unknown ART initiation status was large. Further studies should be undertaken to evaluate the effect of depressive symptoms at the time of HIV diagnosis on ART uptake.

The study has several limitations. At the time the study was designed there were no brief validated depression tools in HIV-infected patients in resource-limited settings. The MHI-5 depression instrument has not been validated in South Africa. The MHI-5 has been used among a stratified sampling of the Japanese population ≥16 years [22]. The MHI-5 has also been used in a sample of 20–64 year olds enrolled in a Health Maintenance Organization (HMO) in the United States [21]. Although both these populations are not relevant to our study population, the MHI-5 was chosen because its brevity made it appropriate for the fast-paced clinic setting. The MHI-5 is also the Mental Health domain of the SF-36, which has been validated in HIV-infected populations [23, 24] in South Africa [25, 26]. Additionally, our study population may not be representative of government clinics where care is free because participants paid a subsidized fee for outpatient services. In addition, some potential confounders such as cognitive impairment were not addressed in our survey and were therefore not measurable in our analysis [31, 32]. We cannot comment on the prevalence of depressive symptoms among all participants who had an HIV test or whether depressive symptoms are associated with a new HIV diagnosis because we did not include participants who were HIV-negative in this analysis. Also, since newly-diagnosed HIV-infected subjects at the urban clinic were charged a CD4 count fee during the majority of the study period and those at the rural clinic were not, the effect of clinic site on obtaining a CD4 count may be explained by the fee.

Conclusion

The very high prevalence of depressive symptoms at the time of HIV diagnosis merits further research and could have important policy implications, particularly because an initiative to expand HIV counseling and testing to all South Africans is currently underway [33]. As a result of this HIV testing campaign, a substantial number of people will learn their HIV status, and many could benefit from depression screening prior to diagnosis in order to facilitate referral to mental health services [34, 35]. Identifying HIV-infected patients with depressive symptoms is also important because it affects uptake of CD4 testing, clinic attendance, and ART initiation and adherence [1, 9–14, 34]. Given the high prevalence of depressive symptoms among newly-diagnosed HIV-infected patients, policy makers should consider integrating mental health services and HIV testing and treatment programs.

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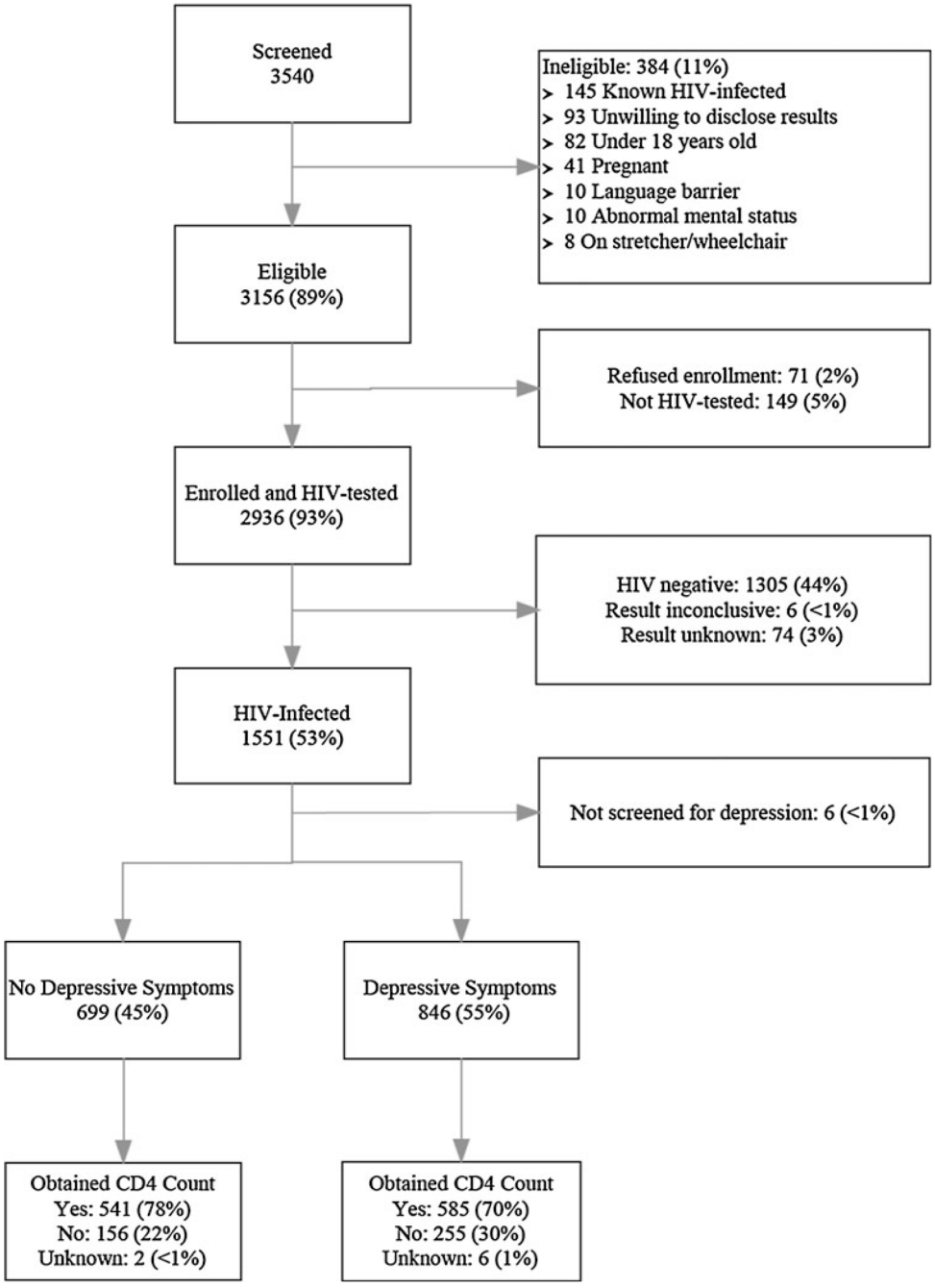

Fig. 1.

Study enrollment flow chart. Depressive symptoms are defined as an Mental Health Index-5 (MHI-5) score ≤60

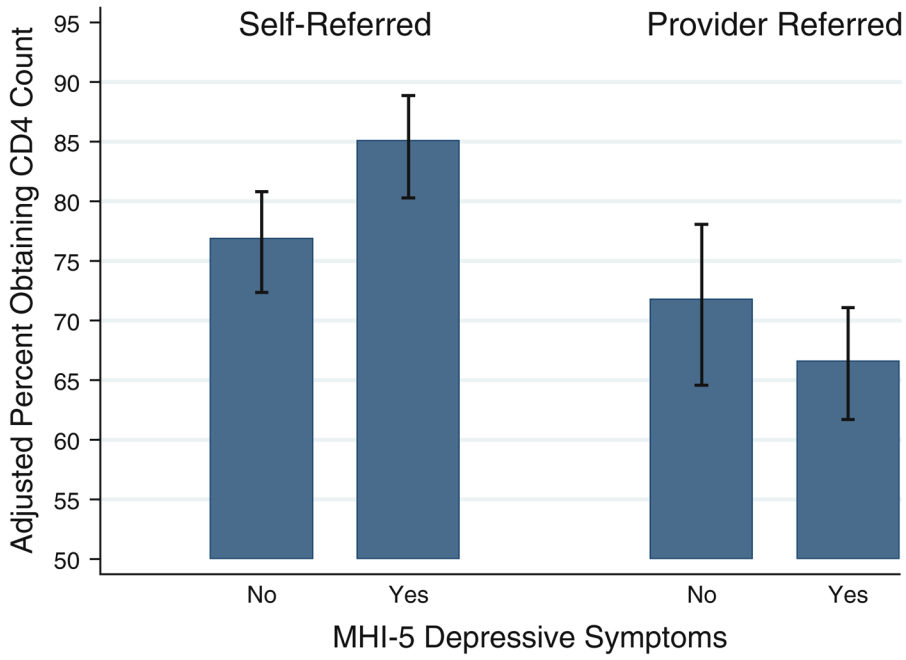

Fig. 2.

Adjusted proportion of newly-diagnosed HIV-infected patients in Durban, South Africa who underwent CD4 count by depressive symptoms and HIV testing referral pattern. Mental Health Index-5 (MHI-5) differentiates participants with depressive symptoms and no depressive symptoms. Depressive symptoms were defined as an MHI-5 score ≤60. 'Self-referred' subjects were those who self-referred for HIV testing. 'Provider referred' subjects were those who were referred for HIV testing by a healthcare provider. Generalized linear models with a Poisson distribution and log link function were used for the adjusted proportions. Proportions were adjusted for age, sex, clinic site, distance from clinic, having an HIV-infected family member or friend, history of TB treatment, functional activity score, and the interaction term HIV testing referral pattern and depressive symptoms

Table 1

Baseline characteristics of a cohort of newly-diagnosed HIV-infected adults in Durban, South Africa surveyed before HIV testing and diagnosis by depressive symptoms

	No depressive symptoms[a] (%)	Depressive symptoms (%)	Test statistic χ^2 unless indicated	*p* value
Total	699 (45)	846 (55)		
Demographic factors				
Age (years, median, IQR[b])	33 (27–40)	35 (29–42)	–4.42[c]	< 0.001
Sex				
Female	335 (43)	442 (57)	2.86	0.09
Male	364 (47)	404 (53)		
Education				
None or primary	148 (43)	199 (57)	14.46	0.001
Some high school	354 (51)	344 (49)		
High school or more	189 (40)	283 (60)		
Employment				
No full-time job	368 (46)	437 (54)	0.15	0.70
Full-time job	327 (45)	404 (55)		
Clinic site				
Urban	110 (17)	543 (83)	368.17	< 0.001
Rural	589 (66)	303 (34)		
Distance from clinic				
< 10 km	354 (47)	393 (53)	2.62	0.10
≥10 km	341 (43)	447 (57)		
Household factors				
Living arrangement				
Lives alone	113 (55)	93 (45)	19.80	< 0.001
Lives with partner	135 (53)	121 (47)		
Lives with relatives/friends	426 (41)	604 (59)		
Lives with employer	22 (47)	25 (53)		
Marital status				
Currently married	85 (36)	150 (64)	10.48	0.001
Not married	610 (48)	671 (52)		
HIV-infected family member or friend				
Yes	170 (60)	115 (40)	29.37	< 0.001
No	523 (42)	724 (58)		
Clinical characteristics				
HIV testing referral pattern				
Referred by healthcare provider	182 (24)	567 (76)	257.74	< 0.001
Self-referral	515 (65)	277 (35)		
History of TB treatment				
Yes	105 (45)	126 (55)	0.02	0.89
No	588 (45)	720 (55)		

	No depressive symptoms[a] (%)	Depressive symptoms (%)	Test statistic χ^2 unless indicated	*p* value
Self health rating				
Very good	123 (81)	28 (19)	95.69	< 0.001
Good	342 (44)	444 (56)		
Fair	192 (40)	285 (60)		
Poor/bad	34 (30)	78 (70)		
Functional activity score (IQR)	95 (75–100)	90 (55–100)	4.85[c]	< 0.001

[a] Depressive symptoms are defined as an Mental Health Index-5 (MHI-5) score ≤60

[b] IQR: 25% and 75% interquartile range

[c] Test statistic: *t*-test for continuous variables

Table 2

Correlates of depressive symptoms[a] in newly-diagnosed HIV-infected adults in Durban, South Africa surveyed before HIV testing and diagnosis

	Unadjusted RR	Test statistic	95% CI	*p* value	Adjusted RR[b]	Test statistic	95% CI	*p* value
Age (10 years increments)	1.10	4.10	1.05–1.15	< 0.001	1.03	1.36	0.99–1.08	0.17
Sex								
Female	1.08	1.69	0.99–1.18	0.09	1.05	1.20	0.97–1.14	0.23
Education								
High school or more	1.15	2.98	1.05–1.27	0.003	1.01	0.33	0.93–1.11	0.75
Clinic site								
Urban	2.45	17.94	2.22–2.70	< 0.001	2.45	17.69	2.21–2.70	< 0.001
Living arrangement								
Lives with partner	0.84	−2.48	0.73–0.96	0.013	0.97	−0.52	0.85–1.10	0.60
Functional activity score								
Lower score (per 10 unit decrease in functional score)	1.04	5.24	1.03–1.06	< 0.001	1.05	7.08	1.04–1.07	< 0.001

Test statistic: χ^2 test for categorical and *t*-test for continuous variables. Generalized linear models with a Poisson distribution and log link function for the adjusted relative risks

RR relative risk, 95% *CI* confidence interval

[a] Depressive symptoms are defined as an Mental Health Index-5 (MHI-5) score ≤ 60

[b] Adjusted relative risk: adjusted for age, sex, educational level, clinic site, living arrangement, and functional activity score

Table 3

Correlates of obtaining a CD4 count in a cohort of newly-diagnosed HIV-infected adults in Durban, South Africa surveyed before HIV testing and diagnosis

	Unadjusted RR	Test statistic	95% CI	*p* value	Adjusted RR[a]	Test statistic	95% CI	*p* value
Age (10 years increments)	1.02	1.36	0.99–1.05	0.17	1.04	2.77	1.01–1.08	0.006
Sex								
Female	1.03	1.09	0.97–1.10	0.28	1.05	1.67	0.99–1.12	0.09
Clinic site								
Urban	0.80	−6.63	0.75–0.85	< 0.001	0.86	−3.70	0.79–0.93	< 0.001
Distance from clinic								
≥10 km	1.05	1.51	0.99–1.11	0.13	1.02	0.77	0.96–1.09	0.44
HIV-infected family member/friend								
Yes	1.08	2.01	1.00–1.15	0.04	0.97	−0.96	0.90–1.04	0.34
History of TB treatment								
Yes	1.00	0.03	0.92–1.09	0.97	0.97	−0.66	0.89–1.06	0.51
Functional activity score								
Lower score (per 10 unit decrease in functional score)	1.00	−0.38	0.99–1.01	0.70	1.00	−0.67	0.98–1.01	0.50
HIV testing referral pattern								
Referred by healthcare provider	0.80	−7.15	0.75–0.85	< 0.001	0.94	−1.25	0.85–1.04	0.21
Depressive symptoms[b]								
Yes	0.90	−3.55	0.85–0.95	< 0.001	1.10	2.86	1.03–1.18	0.004
Interaction term								
Depressive symptoms/referred by healthcare provider	–	–	–	–	0.82	−2.89	0.72–0.94	0.004

Test statistic: χ^2 test for categorical and *t*-test for continuous variables. Generalized linear models with a Poisson distribution and log link function for the adjusted relative risks

RR relative risk, 95% *CI* confidence interval

[a]ARR: adjusted for age, sex, clinic site, distance from clinic, having a HIV-infected family member/friend, history of TB treatment, functional activity score, HIV testing referral pattern, depressive symptoms, and the interaction term depressive symptoms and HIV testing referral pattern

[b]Depressive symptoms are defined as an Mental Health Index-5 (MHI-5) score ≤60