Correlates of Prevalent Disability Among HIV-Infected Elderly Patients

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Abstract

The growing elderly population of HIV-infected patients is leading to a significant epidemiological transition and HIV infection has been proposed as a premature and accelerated aging model rendering the individual more susceptible to premature disability. However, the determinants of disability among this emergent population are still lacking. Therefore, the aim of this study is to determine the correlates of prevalent disability in adults ≥ 50 years with HIV infection. A cross-sectional study of 184 HIV-infected adults receiving ambulatory care in an HIV clinic of a tertiary care, university-affiliated hospital in Mexico City was conducted. Disability for instrumental (IADL) and basic activities of daily living (ADL) was established. Sociodemographic factors, clinical variables, current CD4⁺ cell count, and HIV viral load (VL) were tested as potential determinants of disability. Multivariate logistic regression analyses were used to identify the correlates of both types of disability. The mean age was 59.3 years. All participants were receiving highly active antiretroviral therapy. Of participants 17.9% had disability for IADL and 26.1% for ADL. Multivariate logistic regression analyses indicated that being older; having a lower CD4⁺ cell count, and having a detectable HIV VL were independently associated with both types of disability. In addition, educational level was also independently associated with ADL disability. Age, educational level, low CD4⁺ cell count, and detectable HIV VL were independently associated with disability. Whether effective and timely antiretroviral therapy will reduce the risk of disability in HIV-infected elderly patients needs to be evaluated.

Introduction

AGING WITH HUMAN IMMUNODEFICIENCY VIRUS (HIV) infection is a current reality. The growing elderly population of HIV-infected patients is leading to a significant epidemiological transition characterized by an increased prevalence and incidence of HIV infection among subjects ≥ 50 years. The Centers for Disease Control estimate that approximately 30% of people currently living with HIV/AIDS in the United States are ≥ 50 years of age whereas in Mexico, according to the Mexican National HIV/AIDS Agency (CENSIDA), 13% of HIV-infected patients are now 50 years old or older.^{1,2} Moreover, it is expected that by the year 2020, subjects in this age group will represent more than 50% of the infected population worldwide. HIV infection has been proposed as a premature and accelerated aging model rendering

the individual more susceptible to age-related comorbidities as well as to premature disability.^{3–6}

Functional independence is critical for an individual to preserve his or her autonomy. It is also an important determinant of health-related quality of life. Disability may be a manifestation of multisystem dysfunction, and it has generally been associated with catastrophic consequences for health among elderly individuals.⁷ The possible synergistic adverse effects of HIV infection and aging on daily functioning, including basic and instrumental activities of daily living (ADL), have been previously reported.⁵ Disability for ADL and instrumental activities of daily living (IADL) has been shown to add functional information to that obtained by classical assessment tools such as the ECOG PS and Karnofsky PS in special populations. For example, about 20% of older patients with cancer will be classified as having an

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ECOG PS of at least 2; however, more than 50% of these patients will also need assistance for one or more IADL.^{8–10} Furthermore, ADL and IADL disability has been strongly related to poor health-related quality of life, hospitalization, and mortality. Physical frailty is a known cause of disability, and it explains up to 36% and 39% of IADL and ADL disability, respectively.¹¹ Nonetheless, information on the determinants of disability among HIV-infected elderly patients is still lacking. The present study aims to identify the correlates of disability in adults ≥ 50 years with HIV infection or AIDS. A secondary objective was to establish the prevalence of disability in this population.

Materials and Methods

Study population

This was a cross-sectional study that included HIV-infected participants ≥ 50 years of age receiving care at the HIV clinic of a tertiary care, university-affiliated hospital in Mexico City. Potential participants were identified through the HIV/AIDS Clinic database and through the HIV/AIDS clinic appointment schedules/records. Participants were recruited between March 1, 2013 and February 28, 2014. Eligible subjects had to be at least 50 years old and to have documented HIV infection. Subjects with class III–IV heart failure by the New York Heart Association functional classification, class III–IV chronic obstructive pulmonary disease according to the Global Initiative for Chronic Obstructive Lung Disease classification, stage III–IV rheumatoid arthritis according to the American College of Rheumatology classification, stage 4–5 Parkinson's disease according to the Hoehn and Yahr scale as well as patients with history of ischemic and/or embolic cerebrovascular disease with motor sequelae, myocardial ischemia in the previous 3 months, severe dementia, and amputation of any upper and/or lower limb were excluded in order to avoid the inclusion of subjects with physical frailty due to chronic diseases other than HIV. Subjects were invited to voluntarily participate in the study through an informed consent process carried out in the clinic during the day of their scheduled visit for HIV care. A comprehensive geriatric assessment (CGA) was applied to all participants by trained staff using standardized methods, and included the evaluations described below. The Institute's Ethics Committee reviewed and approved the study protocol.

Disability

Two measurements of disability were investigated as outcomes: IADL and ADL. For IADL, the Lawton and Brody scale was used; participants responded as to whether they were able to perform eight activities of daily living that included using a telephone, being responsible for their own medication, managing money, using public or private transportation, shopping, housekeeping, cooking, and doing laundry (the last three items were asked to both men and women if they reported having carried out such activities in the past).¹² For ADL, participants were asked if they needed help for any of the tasks on the Barthel ADL index (bathing, dressing, transferring from bed to chair, climbing stairs, toileting, continence, and feeding).¹³ Participants were considered as having IADL or ADL disability if they were unable to perform one or more activities, for each domain of disability, without help.

Covariates

Sociodemographic variables included age, sex, marital status, and educational level. Participants were asked whether they had a physician's diagnosis of diabetes, hypertension, dyslipidemia, cancer, myocardial ischemia, stroke, chronic obstructive pulmonary disease, cirrhosis, osteoarthritis, arthritis, osteoporosis, or chronic kidney disease. The presence of each of these diseases was summed up in a score ranging from 0 to 12 where a higher score indicates more chronic disease. A history of an AIDS-defining event was retrieved from medical charts (yes or no). Body mass index [BMI = weight (kg)/height (m)²] was calculated from direct measures. Smoking status (current-former or never) and alcohol intake (current-former or never) were also investigated.

Depressive symptoms were assessed using the Geriatric Depression Scale (GDS); a score of >5 points indicated their presence.¹⁴ The Mini-Mental State Examination (MMSE) (score ranging from 0 to 30) was used to assess global cognitive function, and cognitive impairment was considered when a score <24 points was found.¹⁵ The number of prescription drugs was also recorded. The measurement that was closer to the date of the CGA was included for primary analysis and considered as the current CD4⁺ cell count. Current CD4⁺ cell counts were treated as a continuous variable but also as a binary one (<200 cells/ml cutoff point). All CD4⁺ T-lymphocyte counts included in this study were no more than a month old. In addition, CD4⁺ cell nadir values (the lowest measure registered) were considered for analysis. HIV viral load (VL) was measured using the Roche Amplicor or Abbot real time PCR with a lower limit of detection of <40 or <20 copies/ml, respectively. HIV RNA levels were included as a binary variable [undetectable vs. detectable]. The closest determination of HIV RNA levels to the CGA (no more than a month old) was considered for the analysis. In addition, time from HIV diagnosis and time on highly active antiretroviral therapy (HAART), both in years, were used as continuous covariates.

Statistical analyses

Variables were described using arithmetic means and standard deviations (SD) or frequencies and proportions. We compared the characteristics between disabled and nondisabled patients using the χ^2 test, Fisher's exact test, or Student's *t* test as appropriate. To develop an explanatory model for both types of disability, we fitted several multivariate logistic regression models including four variable blocks: sociodemographic factors, health-related factors, geriatric syndromes, and HIV/AIDS-related information. Wald tests were used to eliminate from every model those variables judged not significant at the 10% level and then the variables considered significantly associated with disability were retained. Second, a new model including the variables significantly associated with disability from previous models was run and the cut-off level at this time was 5% in order to select a set of variables to be included in a last full model. Based on these results, and as an unplanned analysis we explored the association between CD4⁺ cell counts and HIV VL with disability.

We organized four mutually exclusive groups as follows: (1) CD4⁺ ≥ 200 and undetectable HIV VL, (2) CD4⁺ ≥ 200 and detectable HIV VL, (3) CD4⁺ <200 and undetectable HIV

VL, and (4) CD4⁺ <200 and detectable HIV VL. The groups were fitted in univariate and multivariate logistic regression models using disability as the dependent variable and the above-described categories as independent variables in order to explore the association of CD4⁺ cell counts and HIV VL with both types of disability adjusting for potential confounders (age, sex, chronic diseases, current smoking, current drinking, history of AIDS-defining event, time from HIV diagnosis, time on HAART, GDS score, and MMSE score). All comparisons were evaluated using 95% confidence intervals (CI). Statistical analyses were performed in SPSS software for Windows (SPSS Inc., Chicago, IL, version 20.0).

Results

The study sample included 184 participants. Table 1 shows the sociodemographic characteristics and health status of

participants. The mean age was 59.3 years (SD=7.0; range 50 to 84) and 83.2% were men. All participants were receiving HAART at the moment of the study. Approximately 18% of participants (17.9%) had disability for IADL and 26.1% for ADL. Dyslipidemia (57%) and hypertension (33%) were the most frequent chronic diseases. The mean time from HIV diagnosis was 11 (SD=6.4) years, whereas the mean time on HAART was 8.0 (SD=5.7) years. The mean nadir of CD4⁺ cell count was 151.6 (SD=128.6; range 3 to 599). The mean current CD4⁺ cell count was 478.8 (SD=236.7; range 38 to 1,168). The current CD4⁺ cell count <200 was present in 11.4% of individuals and the current detectable HIV VL was found in 12.4% of them. The simultaneous current CD4⁺ cell count <200 and detectable HIV VL was present in only seven participants (3.8%).

Univariate analyses showed that the four mutually exclusive subgroups created according CD4⁺ cell count and VL

TABLE 1. COMPARATIVE ANALYSES OF PARTICIPANTS ACCORDING TO THE ACTIVITIES OF DAILY LIVING OR INSTRUMENTAL ACTIVITIES OF DAILY LIVING DISABILITY

Variable	All n=184	Without ADL disability n=136 (73.9%)	With ADL disability n=48 (26.1%)	p	Without IADL disability n=151 (82.1%)	With IADL disability n=33 (17.9%)	p
Age, mean (SD)	59.3 (7.0)	58.2 (6.8)	61.2 (7.4)	0.011	58.2 (6.5)	62.8 (8.1)	0.004
Male (%)	83.2	80.1	91.7	0.067	84.1	78.8	0.460
Educational level, mean (SD)	11.9 (5.1)	11.6 (5.1)	13.0 (4.9)	0.090	12.2 (4.9)	10.8 (5.4)	0.154
Stable partner (%)	30.4	30.1	31.3	0.886	29.8	33.3	0.690
High blood pressure (%)	33.2	58.2 (6.8)	61.2 (7.4)	0.011	29.8	48.5	0.039
Dyslipidemia (%)	57.1	58.1	54.2	0.637	57.6	54.5	0.747
Diabetes (%)	19.6	19.9	18.8	0.868	17.2	30.3	0.086
Number of chronic diseases, ^a mean (SD)	1.6 (1.4)	1.5 (1.3)	1.8 (1.7)	0.137	1.5 (1.3)	2.0 (1.8)	0.052
Body mass index, mean (SD)	24.7 (3.9)	24.9 (3.9)	23.9 (3.8)	0.145	24.8 (3.9)	24.0 (3.8)	0.329
Hepatitis C virus coinfection (%)	4.3	4.2	4.4	0.999	4.5	3.1	0.999
Current or former smoker (%)	21.3	20.6	23.4	0.684	22.0	18.2	0.628
Current or former drinker (%)	26.1	26.5	25.0	0.842	29.1	12.1	0.044
MMSE <24 (%)	10.4	10.4	10.4	0.999	7.9	21.9	0.028
Depressive symptoms (%)	12.0	11.0	14.6	0.514	9.9	21.2	0.080
Time from HIV diagnosis years, mean (SD)	11.0 (6.4)	10.9 (6.0)	11.4 (7.5)	0.713	11.3 (6.3)	9.7 (6.9)	0.205
Time on HAART, mean (SD)	8.0 (5.7)	8.3 (5.7)	7.2 (5.9)	0.233	8.3 (5.6)	6.8 (6.1)	0.167
Nadir CD4 ⁺ cell count, ^b mean (SD)	151.6 (128.6)	156.2 (128.4)	138.7 (129.7)	0.420	158.4 (126.6)	120.7 (135.2)	0.150
History of AIDS-defining event	32.2	29.0	41.3	0.125	29.0	46.9	0.050
Current HIV RNA <40 copies/ml (%)	88.0	92.6	75.0	0.001	91.4	72.7	0.006
Current CD4 ⁺ cell count <200 (%)	11.4	7.4	22.9	0.004	6.6	33.3	<0.001

^aChronic diseases: diabetes, hypertension, dyslipidemia, cancer, myocardial ischemia, stroke, chronic obstructive pulmonary disease, cirrhosis, osteoarthritis, arthritis, osteoporosis or chronic kidney disease.

^bLowest CD4⁺ cell count measurement registered.

SD, standard deviation; ADL, activities of daily living; IADL, instrumental activities of daily living; MMSE, Mini-Mental State Examination; HAART, highly active antiretroviral therapy.

TABLE 2. CORRELATES OF DISABILITY OF INSTRUMENTAL ACTIVITIES OF DAILY LIVING

Variable	Univariate		Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d		Model 5 ^e		Model 6 ^f	
	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p	OR (95% CI)	p
Age (years)	1.09 (1.03–1.14)	0.001	1.08 (1.03–1.14)	0.003							1.08 (1.01–1.15)	0.017	1.10 (1.04–1.17)	0.001
Male	0.70 (0.27–1.80)	0.461	1.06 (0.34–3.25)	0.924										
Educational level (years)	0.95 (0.88–1.02)	0.156	0.98 (0.90–1.07)	0.719										
Stable partner	0.85 (0.38–1.90)	0.690	1.08 (0.46–2.53)	0.863										
(vs. unstable)														
Number of chronic diseases	1.27 (0.99–1.63)	0.055			1.23 (0.95–1.60)	0.110					1.13 (0.84–1.51)	0.416		
Virus hepatitis C	0.68 (0.08–5.83)	0.723			0.87 (0.09–8.37)	0.904								
Current-former smoker	0.79 (0.30–2.07)	0.628			0.72 (0.22–2.36)	0.588								
(vs. never)														
Current-former drinker	0.33 (0.11–1.01)	0.052			0.30 (0.08–1.11)	0.072					0.54 (0.16–1.86)	0.331		
(vs. never)														
Body mass index	0.95 (0.86–1.05)	0.328			0.94 (0.84–1.04)	0.239								
Number of prescription drugs	1.07 (0.95–1.19)	0.253					1.06 (0.95–1.17)	0.297						
MMSE <24 (vs. ≥24)	3.24 (1.16–9.04)	0.024					1.88 (0.58–6.14)	0.296			1.27 (0.33–4.83)	0.725		
Depressive symptoms	2.44 (0.91–6.57)	0.077					1.90 (0.64–5.67)	0.247			1.75 (0.52–5.93)	0.369		
Time from HIV diagnosis (years)	0.96 (0.90–1.02)	0.205							0.96 (0.88–1.03)	0.291				
Time on HAART (years)	0.95 (0.89–1.02)	0.168							0.98 (0.90–1.08)	0.751				
History of opportunistic infection	2.16 (0.99–4.73)	0.053							1.93 (0.79–4.73)	0.149	1.48 (0.57–3.81)	0.417		
Current detectable VL	3.98 (1.53–10.3)	0.005							4.25 (1.53–11.8)	0.005	4.05 (1.30–12.6)	0.016	4.10 (1.37–12.3)	0.012
Current CD4 <200	7.05 (2.68–18.5)	<0.001							4.65 (1.56–13.8)	0.006	4.65 (1.53–14.2)	0.007	5.57 (1.95–15.9)	0.001

^aModel 1: age, sex, educational level, and marital status.^bModel 2: number of chronic diseases, virus hepatitis C infection, current-former smoker, current-former drinker, and body mass index.^cModel 3: number of prescription drugs, Mini-Mental State Examination <24, and depressive symptoms.^dModel 4: time from HIV diagnosis, time on HAART, history AIDS defining event, current detectable viral load, and current CD4+ < 200 cell counts.^eModel 5: statistically significant variables in models 1, 2, 3, and 4.^fModel 6: full model including statistically significant variables in the model 5.

OR, odds ratio; SD, standard deviation; CI, confidence intervals; VL, viral load; MMSE, Mini-Mental State Examination; HAART, highly active antiretroviral therapy.

were not statistically different regarding age, sex, educational level, number of chronic diseases, global cognitive function, depressive symptoms, and time from HIV diagnosis or time on HAART. As expected, those with $CD4^+ < 200$ and detectable HIV VL had more disability for IADL ($p < 0.001$) and ADL ($p = 0.002$) in comparison to their counterparts in the other three subgroups.

Participants with IADL disability were older ($p = 0.004$), had a lower MMSE score ($p = 0.028$), and reported more chronic diseases ($p = 0.052$) when compared with their nondisabled counterparts. Patients with IADL disability were also more likely to have a history of an AIDS-defining event (46.9% vs. 29.0% $p = 0.050$) and less likely to have undetectable HIV VL (72.7% vs. 91.4% $p = 0.006$). Likewise, those with IADL disability had lower current $CD4^+$ cell counts ($p < 0.001$). Similar results were found for ADL except for chronic diseases and a history of an AIDS-defining event, which were not statistically different. On the other hand, there were no differences regarding sex, educational level, marital status, hepatitis C virus coinfection, body mass index, depressive symptoms, nadir $CD4^+$ cell count values, time from HIV diagnosis, or time on HAART for both types of disability (Table 1).

We present the correlates of IADL disability in Table 2. In the unadjusted logistic regression analysis we found that age ($p = 0.001$), lower MMSE ($p = 0.024$), detectable HIV VL ($p = 0.005$), and lower $CD4^+$ cell count ($p < 0.001$) were significantly associated with prevalent IADL disability. Similarly, age ($p = 0.013$), detectable HIV VL ($p = 0.002$), and current $CD4^+ < 200$ ($p = 0.005$) were associated with ADL disability (Table 3). In both models, current $CD4^+$ cell counts, as continuous variable, were inversely associated with prevalent disability (results not shown).

In the multivariate model only age, detectable HIV VL, and current $CD4^+$ cell count < 200 were independently associated with both types of disability regardless of the number of chronic diseases, sex, body mass index, smoking status, alcohol intake, global cognitive function, or depressive symptoms, which were not statistically significant in any of the fitted models. In addition, educational level was also independently associated with disability for ADL.

Considering these results, we decided to separately assess the association between $CD4^+$ cell counts < 200 cells/ μ L and detectable HIV VL with disability and their interaction (see Table 4). The results show that participants with current $CD4^+$ cell counts < 200 and detectable HIV VL were more likely to suffer from ADL or IADL disability when compared with participants with current $CD4^+$ cell counts ≥ 200 and undetectable HIV VL. Similarly, the subgroup of participants characterized only by detectable HIV VL was more likely to show ADL disability whereas those characterized only by current $CD4^+$ cell counts < 200 were more likely to have IADL disability. After adjusting for multiple potential confounders, only patients in both categories of detectable HIV VL (regardless of $CD4^+$ cell count status) retained a statistically significant association with both types of disabilities. The association between the simultaneous presence of current $CD4^+$ cell count < 200 and detectable HIV VL and both types of disability was, however, remarkably stronger (OR = 48.2, 95% CI 5.41 to 429.59; $p = 0.001$, and OR = 35.6, 95% CI 4.70 to 269.35; $p = 0.001$, for ADL and IADL, respectively) when compared with the strength of association ob-

tained among participants showing only one of the conditions (current $CD4^+$ cell count < 200 or detectable HIV VL).

Discussion

In this study to estimate the prevalence of disability and associated factors among HIV-infected subjects aged 50 years and older, we observed that 17.9% of patients had IADL disability and 26.1% had disability for ADL. The prevalence of disability has been described as varying in different populations; in a cohort of Mexican community-dwelling elderly living in one of the districts of Mexico City, the reported prevalence of ADL and IADL disability was 13.3% and 35%, respectively,¹⁶ while in the first round of Mexico's National Study on Health and Aging, ADL disability and IADL disability were found in 7.3% and 8.4% of community dwelling adults 60 years of age or older.¹⁷ The prevalence of disability found in the present study seems higher than that reported in community-dwelling older adults, particularly in the case ADL. On the other hand, as expected, well-known factors associated with disability such as age or educational level were more frequent and significantly associated with IADL and ADL disability or both.

Remarkably, we observed that markers of HIV disease progression such as low $CD4^+$ cell count and detectable HIV viral load have a stronger and independent association with both types of disability than other factors, including age. In particular, the simultaneous presence of $CD4^+$ cell count < 200 cells/ μ L and detectable HIV VL was robustly associated with ADL and IADL disability. To our knowledge, this is one of the few studies to explore, with the use of validated tools and in a cohort study specifically designed for this purpose, the determinants of disability, including biomarkers of HIV disease progression, among HIV-infected elderly subjects.

Considering the limitations of the study, we do not have a clear explanation for the strong association observed between low $CD4^+$ cell counts and detectable HIV VL and disability. A possible explanation is the loss of muscle mass.¹⁸ $CD4^+$ cell count decline and HIV replication have been previously implicated in the loss of muscle mass,¹⁹ and the improvement of $CD4^+$ T-lymphocyte count has been associated with gains of lean mass.²⁰ Moreover, changes in body composition due to HIV infection are similar to those observed during the aging process and include a decline in lean muscle mass, augmented protein catabolism, accumulation of visceral adipose tissue, and loss of bone mineral density.^{21–23}

These changes have been associated with decreased muscle strength^{24,25} and with an elevated mortality risk in subjects with HIV infection,²⁶ even among those on HAART,²⁷ and could have a negative impact on muscle function and contribute to poor physical performance.²⁸ The impairment in skeletal muscle repair, loss of muscle precursor cells, and the presence of fibrosis could promote functional impairment and disability in subjects > 50 years old with HIV/AIDS.²⁹ We consider that the stronger association between detectable HIV VL and disability, regardless of $CD4^+$ cell count levels, may give support to this hypothesis. Muscle mass determinations were not available for this study population and we acknowledge this as a limitation.

Another limitation of the present study is its cross-sectional nature precluding the establishment of direction regarding the association between current low $CD4^+$ cell

TABLE 3. CORRELATES OF DISABILITY FOR ACTIVITIES OF DAILY LIVING

Variable	Univariate		Model 1 ^a		Model 2 ^b		Model 3 ^c		Model 4 ^d		Model 5 ^e		Model 6 ^f	
	OR (95% IC)	p	OR (95% IC)	p	OR (95% IC)	p	OR (95% IC)	p	OR (95% IC)	p	OR (95% IC)	p	OR (95% IC)	p
Age (years)	1.06 (1.01–1.11)	0.013	1.07 (1.03–1.14)	0.001							1.08 (1.02–1.15)	0.008	1.9 (1.03–1.15)	0.001
Male	2.72 (0.90–8.24)	0.076	2.65 (0.77–0.91)	0.123										
Educational level (years)	1.06 (0.99–1.14)	0.092	1.07 (0.99–1.16)	0.087							1.13 (1.04–1.23)	0.005	1.10 (1.01–1.19)	0.015
Stable partner (vs. unstable)	1.05 (0.52–2.15)	0.886	1.12 (0.52–2.39)	0.778										
Number of chronic diseases	1.18 (0.95–1.48)	0.138			1.20 (0.95–1.52)	0.122					1.16 (0.88–1.52)	0.284		
Virus hepatitis C	1.06 (0.20–5.67)	0.945			1.02 (0.18–5.62)	0.985								
Current-former smoker	1.18 (0.53–2.60)	0.685			1.22 (0.50–2.97)	0.663								
(vs. never)														
Current-former drinker	0.93 (0.43–1.97)	0.842			1.19 (0.50–2.79)	0.691								
(vs. never)														
Body mass index	0.94 (0.85–1.02)	0.146			0.95 (0.86–1.04)	0.950								
Number of prescription drugs	1.07 (0.95–1.19)	0.252					1.07 (0.96–1.19)	0.231			1.05 (0.97–1.13)	0.200		
MMSE <24	1.00 (0.34–2.96)	0.993					0.73 (0.21–2.48)	0.612						
(vs. ≥24)							1.55 (0.56–4.29)	0.392						
Depressive symptoms	1.38 (0.52–3.61)	0.515												
Time from HIV diagnosis (yrs)	1.01 (0.96–1.06)	0.680							1.04 (0.97–1.10)	0.278				
Time on HAART (years)	0.96 (0.91–1.02)	0.232							0.95 (0.88–1.03)	0.198				
History of opportunistic infection	1.72 (0.86–3.46)	0.127							1.70 (0.77–3.76)	0.189	1.49 (0.65–3.4)	1.49		
Current detectable VL	4.20 (1.68–10.5)	0.002							3.96 (1.53–10.2)	0.005	4.41 (1.57–12.37)	0.005	3.99 (1.48–10.81)	0.006
Current CD4 <200	3.75 (1.48–9.5)	0.005							3.10 (1.08–8.93)	0.036	2.60 (0.84–8.06)	0.098	3.05 (1.09–8.53)	0.033

^aModel 1: age, sex, educational level, and marital status.^bModel 2: number of chronic diseases, virus hepatitis C infection, current-former smoker, current-former drinker, and body mass index.^cModel 3: number of prescription drugs, Mini-Mental State Examination <24, and depressive symptoms.^dModel 4: time from HIV diagnosis, time on HAART, history AIDS-defining event, current detectable viral load, and current CD4⁺ <200 cell counts.^eModel 5: statistically significant variables in models 1, 2, 3, and 4.^fModel 6: full model including statistically significant variables in model 5.

OR, odds ratio; SD, standard deviation; CI, confidence intervals; VL, viral load; MMSE, Mini-Mental State Examination; HAART, highly active antiretroviral therapy.

TABLE 4. LOGISTIC REGRESSION OF ACTIVITIES OF DAILY LIVING AND INSTRUMENTAL ACTIVITIES OF DAILY LIVING DISABILITY ACCORDING TO THE CD4⁺ CELL COUNT AND HIV VIRAL LOAD

	ADL disability			IADL disability		
	OR	95% CI	p	OR	95% CI	p
Unadjusted						
CD4 ⁺ cell count ≥200 and undetectable VL (ref)	1	—	—	1	—	—
CD4 ⁺ cell count ≥200 and detectable VL	3.4	1.57 to 10.24	0.026	2.6	0.75 to 9.13	0.129
CD4 ⁺ cell count <200 and undetectable VL	2.9	0.95 to 9.15	0.061	5.4	1.68 to 17.41	0.005
CD4 ⁺ cell count <200 and detectable VL	9.8	1.82 to 53.19	0.008	18.1	3.26 to 100.1	0.001
		p-global 0.005			p-global 0.001	
Adjusted ^a						
CD4 ⁺ cell count ≥200 and undetectable VL (ref)	1	—	—	1	—	—
CD4 ⁺ cell count ≥200 and detectable VL	4.0	1.16 to 13.75	0.028	4.13	0.92 to 18.54	0.064
CD4 ⁺ cell count <200 and undetectable VL	2.2	0.56 to 9.09	0.254	3.0	0.73 to 11.99	0.129
CD4 ⁺ cell count <200 and detectable VL	48.2	5.41 to 429.6	0.001	35.6	4.70 to 269.3	0.001
		p-global 0.001			p-global 0.002	

^aAdjusted by age, sex, number of 12 chronic diseases, current smoking, current drinker, history of opportunist AIDS-associated infection, time from HIV diagnosis, time on HAART, current viral load, geriatric depression scale, and Mini-Mental State Examination score.

OR, odds ratio; SD, standard deviation; CI, confidence intervals; VL, viral load.

counts and detectable VL with disability. While we tend to think that low CD4⁺ cell counts, but particularly persistent viral replication, is associated with chronic immune activation and persistent inflammation causing corporal structural changes and bringing about changes that promote disability, we cannot rule out that disability itself caused by other factors hinders antiretroviral treatment adherence and promotes treatment and immunological failure. Another possible confounding factor is the association between delayed diagnosis and treatment initiation, which is common in our center and in other countries in the region,³⁰ and could lead to poor CD4⁺ recovery and disability associated with sequels of opportunistic infections.

Although we did not formally assess the role of delayed diagnosis, through the use of multivariate regression models, we controlled for the possible confounding effect of disability associated with opportunistic infections or its sequels that occur more frequently among patients with low CD4⁺ cell counts. In addition, the sample size, particularly in the assessment of the association between CD4⁺ and HIV VL, led to the formation of small groups in each category. On the other hand, the validity of our results is supported by the use of previously validated tools for the assessment of disability in the context of recent (no more than a month old) determinations of CD4⁺ cell counts and viral loads. It is also worth emphasizing that other factors classically associated with disability did not show an independent association in this population or, if present, the strength of such an association was considerably lower in comparison with age, educational level, or HIV/AIDS markers.

In conclusion, in this cross-sectional study age, educational level, low current CD4⁺ cell counts, and detectable viral loads are independently and robustly associated with prevalent disability in individuals > 50 years of age with HIV/AIDS. Since both CD4⁺ cell counts and VL are indicators of the effectiveness of treatment in patients receiving HAART, the results of the present study might suggest that the risk of disability could be reduced in this population by optimal antiretroviral treatment. Disability is a predictor for adverse health-related outcomes including institutionalization, falls,

and mortality; therefore, to be able to identify the correlates of this geriatric syndrome provides new insight into the significance of evaluating ADL and IADL disability in adults with HIV infection and AIDS regardless of their age, and should be further investigated to clarify its nature.

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Author Disclosure Statement

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