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Relationship of Physical Function and Quality of Life among Persons Aging with HIV Infection

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Abstract

Objective—Physical function impairments are seen among aging, HIV-infected persons on effective antiretroviral therapy (ART). The impact of physical function impairments on health related quality of life (QoL) during ART is unknown.

Design—This was a cross-sectional study including 359 HIV-infected subjects, aged 45-65 years, on ART >6 months.

Methods—Subjects completed the SF-36 QoL questionnaire, 400-m walk, 5-time chair rise, and grip strength. HIV-associated mortality risk was calculated using the Veterans Aging Cohort Study (VACS) Index. Physical function, physical activity (>500 versus ≤500 Kcal/week), and VACS scores were used to estimate QoL in multivariable linear regression.

Results—For every 1 m/sec increase in gait speed, we saw an estimated 11.8 (95% CI 8.4, 15.2) point increase in the physical function scale with smaller differences across all subscales. For every 1 rise/sec faster chair rise pace, we saw an estimated 16.0 (95% CI 9.1, 22.9) point increase in the physical function scale with smaller differences across all subscales. SF-36 scores were between 2.8 and 5.7 points higher among more physical active compared to less active subjects. A 1 kg increase in grip strength was associated with a 0.2 (95% CI 0.01, 0.3) higher mental health score, but no differences in other subscales. VACS scores did not improve the model.

Conclusions—Faster gait speed and chair rise time, and greater physical activity were associated with greater QoL, independent of HIV-related mortality risk. Targeted exercise programs to increase physical activity and improve speed and power should be evaluated as interventions to improve QoL during ART.

MeSH terms

HIV; physical conditioning, human; physical activity; quality of life

AIDS Classifications

Psychiatry; neuropsychological; psychosocial

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Conflicts of Interest: None noted.

Background

Antiretroviral therapy (ART) has dramatically extended the life expectancy of those living with HIV and is changing the demographics of the HIV epidemic. Currently, nearly one-half of the people living with HIV in the United States are age 50 or older [1]. The success of ART is partially offset by a higher than expected prevalence of age-associated complications including neurocognitive decline [2], osteoporosis and fractures [3-5], impaired physical function [6-8], frailty [9-13], and falls [14], conditions that can have a detrimental effect on an individual's quality of life (QoL). Maintaining independence, preventing functional decline, and preserving health-related QoL are considered the tenets of care for older adults, and overarching goals of the Healthy People 2020 [15]. Thus, a comprehensive understanding of the impact of HIV, ART, and age-associated comorbidities on QoL and physical function of persons aging with HIV is needed to improve HIV treatment in the coming decades.

Among older, HIV-uninfected adults, better performance on objective physical function tests including gait speed [16-19] and handgrip [18, 20, 21] or leg-extensor strength [20] is associated with higher QoL, oftentimes independent of underlying comorbidities. Furthermore, persons with greater self-reported or objectively measured physical activity tend to report higher QoL [18, 22].

Physical function limitations are seen in older adults with effectively treated HIV infection [6-8] and are associated with underlying comorbidity. Similarly, underlying morbidity and mortality are strong predictors of health-related QoL, but the effects on QoL may differ between persons aging with or without HIV infection [23-25]. We hypothesized that impairment in objective measures of physical function and greater HIV-related morbidity or mortality would be associated with lower QoL.

Methods

Study population

The study population has been previously described [8]. Briefly, persons who received HIV-1 care in the Infectious Diseases clinic at the University of Colorado Hospital within 12 months prior to February 2010 were evaluated for participation. Eligibility criteria included: 1) 45-65 years of age; 2) able to consent and participate in procedures; and 3) taking effective combination (two or more) ART for at least six months with one undetectable plasma HIV-1 RNA (<48 copies/mL) and no plasma HIV-1 RNA >200 copies/mL in the prior six months. Approval was obtained from the Colorado Multiple Institutional Review Board, and informed consent was obtained from all participants.

Clinical Assessment

A single study visit included medical record review, standardized interview, health-related QoL questionnaire (SF-36 ® Health Survey), physical activity questionnaire (2-week recall of Minnesota Leisure Time Physical Activity [LTPA] questionnaire), and a physical function assessment[8]. The SF-36 ® yields 8 subscales of health and well-being that range from 0 (poorest) to 100 (highest) quality of life [26]. Activity Metabolic Index (AMI) units/

week were computed from the LTPA questionnaire by combining light, moderate, and heavy activities, and provided an estimation of Kcal/week [27, 28]. An equivalent weekly activity of five 20 minute walks for pleasure (500 Kcal/week) or greater was used to dichotomize physical activity.

Grip strength was assessed by the average of three dominant hand grip measurements using a single Lafayette dynamometer. Chair rise time was measured by five repetitions of sit-to-stand without use of the arms and reported as rises/second (i.e., pace). 400-m gait speed was measured on a set walking course by asking the participant to walk as quickly as possible to complete the distance. The outcome was reported as gait speed in meters/second with a zero assigned for a failure to walk 400 meters.

The Veterans Aging Cohort Study (VACS) Index was calculated using the following parameters, as previously described: CD4 count, viral load, age, aspartate aminotransferase, alanine aminotransferase, platelets, hemoglobin, hepatitis C, and estimated glomerular filtration rate [29]. Laboratory values were the most recent values available in the medical record. Time since HIV diagnosis and CD4+ lymphocyte nadir were by self-report and confirmed by medical records if available. Of a possible 164 points, higher values indicate greater mortality risk, and scores of ≤ 34 are associated with the lowest mortality [29]. All subjects in the current study had plasma HIV-1 RNA viral load < 500 copies/mL, thus the highest possible VACS score was 150.

Statistical Analysis

Data were collected and managed with Research Electronic Data Capture (REDCap) hosted at the University of Colorado [30]. Analyses were performed in SAS v9.3. Study population characteristics were summarized with frequency and percent for categorical measures, and mean with standard deviation (or median with 25th and 75th percentiles) for continuous measures. Correlations between each SF-36 domain and measures of physical function were described with Pearson (400-m walk, chair rise, grip) or Spearman (physical activity, VACS Index) coefficients. For each SF-36 subscale, a multivariable linear regression model was estimated parameterized with the following covariates: 400-m gait speed, chair rise pace, grip strength, dichotomized physical activity, and VACS Index.

Results

A total of 359 subjects completed the study visit, of whom 85% were male, 74% Caucasian, 18% Hispanic or Latino, 65% were men who reported having sex with other men, 21% reported prior intravenous drug use, and less than one percent reported current intravenous drug use. Mean age was 52 ± 5.2 years, the mean CD4+ lymphocyte count was 594 ± 303 cells/μL, and 95% had plasma HIV-1 RNA below the limits of detection. Other characteristics of the study population are provided in Table 1.

Mean grip strength was 39.0 ± 9.3 kg, mean chair rise pace was 0.51 ± 0.19 rise/second, and mean 400-m walk time was 1.43 ± 0.37 m/second. Eleven participants (3%) were unable to complete the 400-m walk and assigned a pace of zero. Eleven percent reported no leisure-time physical activity in the prior 2 weeks, 19% had at least some physical activity but averaged less than 500 Kcal/week, 42% reported 500 to 2500 kcal/week, and 29% reported more than 2500 kcal/week. VACS Index scores were calculated for each subject and ranged from 0 to 78 (mean 18.2 ± 0.7).

Median SF-36 QoL summary and subscale scores are summarized in Table 2. Physical health summary scores were weakly to moderately correlated with gait speed (r = 0.50; 95% CI 0.42, 0.57), chair rise pace (r = 0.44; 95% CI 0.35, 0.52), grip strength (r = 0.14; CI 0.04, 0.24), physical activity (r = 0.39; 95% CI 0.29, 0.47), and VACS Index score (r = −0.16; 95% CI −0.26, −0.06), all p <0.003. Mental health summary scores were weakly to moderately correlated with gait speed (r = 0.24; 95% CI 0.14, 0.33), chair rise pace (r = 0.26; 95% CI 0.16, 0.35), grip strength (r = 0.22; 95% CI 0.12, 0.32), and physical activity (r = 0.32; 95% CI 0.22, 0.41), all p <0.001, but not VACS Index score (r = −0.002; 95% CI −0.11, 0.10).

The impact of demographics, HIV characteristics, physical function, physical activity, and morbidity/mortality risk (VACS Index) on QoL was assessed in univariate (Supplemental Table) models. The final multivariable linear regression models included physical function, physical activity, and the VACS Index (Table 2). 400-m gait speed was a significant predictor in all of the eight multivariable models for the SF-36 subscales (Table 2). For every 1 m/sec increase in gait speed on the 400-m walk, there was an estimated 11.8 point mean increase in the physical function subscale and an 8.4 point mean increase in the role physical subscale.

Chair rise pace and physical activity were significant in seven of the subscale models. For every increase of 1 rise/sec on chair rise pace, there was an estimated 16.0 point increase in physical function scores and 15.0 point increase in social function scale with weaker but significant relationships across all subscales. Subjects reporting greater physical activity had QoL scores between 2.8 and 5.7 points higher than those with lower physical activity.

In all 8 models, estimates of the effect of grip strength and VACS Index were small in magnitude, and had narrow 95% confidence intervals including zero. Thus, for this population, grip strength and the VACS Index were not predictive of QoL outcomes. (Table 2).

Discussion

Although impairments in physical function have been reported among older adults with HIV infection, no prior studies have evaluated the impact of physical function impairments on QoL, independent of mortality risk. Similar to studies among older adults without HIV infection, we found significant correlations between gait speed, chair rise time, and grip strength with both physical and mental QoL. In regression models, the association between gait speed and chair rise time with both physical and mental health QoL domains remained stronger than demographic or HIV variables (VACS index).

Our findings highlight several important issues among persons aging with HIV infection. First, we demonstrate that gait speed is a key measure of health and wellness among adults aging with HIV infection, similar to older HIV-uninfected adults where self-selected gait speed is a strong predictor of loss of independence, disability, and mortality [31-35]. Second, although closely related [25, 36, 37], mortality risk is not correlated to QoL, as demonstrated by the strong association of QoL with gait speed or chair rise but not VACS index. This finding is reassuring because gait speed and chair rise time may be improved by exercise or strength training interventions. Conversely, many measures of the VACS Index are non-modifiable. Next, physically active older adults have greater QoL in both physical and mental health domains, independent of physical function. Lastly, our findings demonstrate that objective physical function measures provide an assessment of QoL in aging adults beyond the mortality risk estimated by the VACS Index.

Our study describes a large cohort of well-characterized middle-aged men and women on effective ART but does have several limitations. First, as a cross-sectional study, we are unable to demonstrate causality in the relationships between QoL and physical function or physical activity. The range of VACS Index scores was relatively small, thus the findings may not be applicable to persons with higher VACS Index scores. Similarly, the age range of twenty years may have limited our ability to detect associations with age and QoL seen in the youngest and oldest patients. Alternatively, the lack of association with age and QoL may illustrate “decreasing aspiration”, where increasing age is associated with lower health expectations [38]. The physical activity assessment in our study was by self-report and persons with higher QoL may report higher levels of physical activity.

In summary, faster gait speed and chair rise time, and greater physical activity were associated with greater QoL among adults aging with effectively controlled HIV, independent of HIV-related mortality risk. Our findings suggest that measures of physical function and mortality risk may provide a complementary and more inclusive assessment of health and disease, although longitudinal studies are needed to confirm these relationships over time. Targeted exercise programs to increase physical activity and improve lower extremity muscle speed and power should be evaluated as interventions to improve QoL in adults aging with HIV infection.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

KME developed and led the study protocol. AAA, CMJ, SM, WMK, and TBC assisted with study development and implementation. AAA and SM conducted the study analysis. KME assisted with the data analysis plan and prepared the initial draft of the manuscript. All authors reviewed and edited the manuscript.

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Table 1

Characteristics of the Study Population

Characteristic	N= 359
Age (years)[*]	52.0 (5.2)
Age (years)[^]	50.8 (47.7, 55.8)
Female[†]	54 (15)
Hispanic or Latino[†]	65 (18)
Caucasian[†]	265 (74)
Current Smoker[†]	123 (34)
Current CD4 T-cell count (cells/μL)[*]	594 (303)
CD4 nadir (cells/μL)[^]	130 (32, 260)
HIV-1 viral load <48 copies/mL[†]	17 (5)
HIV diagnosis prior to 1996[†]	193 (54)
Body mass index[*]	26.4 (6.0)
400-m walk pace (m/sec)[*]	1.4 (0.37)
Chair rise pace (rises/sec)[*]	0.5 (0.2)
Grip strength (kg)[*]	39.0 (9.3)
Physical activity >500kcal/wk[†]	249 (70)
Veterans Aging Cohort Study Index score[^]	18 (6, 24)

[*]Data presented as mean (standard deviation),

[†]number (%), or

[^]median (25^{th}, 75^{th} percentile)

Table 2

SF-36 Subscale Summary Statistics and Relationship to Physical Function/Comorbidity Assessments by Multivariable Linear Regression Analysis

	Physical Function	Role Physical	Bodily Pain	General Health	Vitality	Social Function	Role Emotional	Mental Health
Median SF-36 Score (Q1, Q3)	50.9 (36.2, 57.1)	56.2 (35.0, 56.2)	46.5 (37.5, 55.9)	48.6 (36.8, 53.2)	46.7 (39.6, 58.5)	46.3 (35.4, 57.1)	55.3 (34.3, 55.3)	50.4 (39.1, 55.0)
Mean difference (95% CI) in SF-36 score per unit difference* in physical function/comorbidity assessment								
400-m walk pace	11.8‡ (8.4, 15.2)	8.4‡ (4.5, 12.3)	7.3‡ (3.3, 11.3)	8.2‡ (4.6, 11.8)	5.1^ (1.4, 8.8)	4.4† (0.3, 8.4)	6.9^ (2.6, 11.2)	4.6† (0.6, 8.6)
Chair rise pace	16.0‡ (9.1, 22.9)	13.8‡ (6.2, 21.5)	11.8^ (3.8, 19.7)	8.77^ (1.6, 16.0)	13.4‡ (6.1, 20.8)	15.0‡ (6.8, 23.2)	12.0^ (3.3, 20.7)	5.4 (−2.7, 13.4)
Grip Strength	0.01 (−0.1, 0.1)	−0.07 (−0.2, 0.06)	−0.1 (−0.4, 0.01)	0.04 (−0.08, 0.2)	0.02 (−0.10, 0.2)	0.01 (−0.2 0.2)	0.1 (−0.01, 0.3)	0.2† (0.01, 0.3)
Physical Activity	4.0‡ (1.7, 6.3)	5.7‡ (3.1, 8.3)	3.5^ (0.8, 6.2)	5.2‡ (2.8, 7.6)	6.1‡ (3.7, 8.6)	4.9‡ (2.2, 7.6)	2.8 (−0.2, 5.7)	4.9‡ (2.2, 7.6)
VACS Index	−0.10 (−0.8, 0.6)	0.08 (−0.7, 0.9)	0.3 (−0.4, 1.3)	−0.2 (−1.0, 0.5)	0.7 (−0.09, 1.4)	0.4 (−0.5, 1.2)	0.2 (−0.8, 1.2)	0.4 (−0.4, 1.2)
Intercept	17.5 (12.0, 23.1)	25.2 (18.9, 31.4)	31.6 (25.2, 38.0)	24.7 (18.9, 30.5)	27.6 (21.7, 33.5)	26.4 (19.8, 32.9)	21.4 (14.5, 28.4)	27.3 (20.8, 33.7)

Multivariate regression model includes the variables above: 400-m walk pace, chair rise pace, grip strength, physical activity, and VACS Index.

* Units used for the above variables : 400-m walk (1 m/sec), chair rise (1 rise/sec), grip strength (1 kg), physical activity (>500 activity /wk), VACS Index (per 10 points);

† $p<0.05$;

^ $p<0.01$;

‡ $p<0.001$; VACS, Veteran Aging Cohort Study