

Physical Activity Participation and Cardiovascular Fitness in People Living with Human Immunodeficiency Virus: A One- Year Longitudinal Study

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Abstract

Background: Physical activity and cardiovascular fitness are beneficial for HIV-infected individuals; however effects over a one year period are unknown. This study aimed to document habitual physical activity and cardiovascular fitness over a 12 month period in stable, HAART-treated individuals with HIV, explore relationships to body composition, body image and cardiovascular disease (CVD) risk and evaluate physical activity determinants.

Methods: Eighty adults participated. Physical activity was reported using the International Physical Activity Questionnaire and cardiovascular fitness assessed using the Kasch Pulse Recovery Test.

Results: 19-37% participants reported suboptimal physical activity levels at each study visit, while physical activity and cardiovascular fitness were largely stable over the study period. Higher cardiovascular fitness was associated with better body composition and this association persisted over time ($p < 0.03$ for all). Greater total energy expenditure was associated with improved body image ($r = -0.325$, $p = 0.027$) but not CVD risk. Being in a permanent relationship was independently associated with higher levels of physical activity.

Conclusions: This study found benefits for both physical activity and cardiovascular fitness performed over a one year period for chronic HIV-infection. Future endeavours, including larger cohorts and longer follow up are needed to further explore factors that influence physical activity and cardiovascular fitness in HIV.

Keywords: Physical activity; HIV; Cardiovascular fitness

Introduction

The introduction of highly active antiretroviral therapy (HAART) has reduced the morbidity and mortality associated with human immunodeficiency virus (HIV) [1]. However, patients still suffer a serious chronic disease, with a range of physical and psychological complications. Increased cardiovascular disease (CVD) risk and emerging metabolic and morphological complications associated with the virus and its treatment are of particular significance [2]. People living with HIV are also susceptible to a range of psychological problems, particularly related to the profound body composition changes commonly observed [3].

Pharmacological interventions may mitigate some HIV and HAART-related problems, but are associated with financial costs and potential toxicities. Optimizing physical activity and cardiovascular fitness are non-pharmacological strategies that can improve many physical and psychological outcomes in the general population [4] and the available data suggest likely benefits for those with HIV [5,6]. Physical activity is defined as "any bodily movement produced by skeletal muscles that results in energy expenditure" [7] whilst cardiovascular fitness is "a set of attributes that people have or achieve that relates to the ability to perform physical activity" [7]. These concepts are closely related, but may result in different health outcomes.

Data are lacking on relationships between longer-term patterns of physical activity and cardiovascular fitness and clinically relevant outcomes for the HAART-treated HIV patient. Truly evidence-based health recommendations/interventions require knowledge of the effects of sustained, habitual physical activity and an understanding of the determinants of and barriers to participation in physical activity in the relevant patient population.

This study aimed to document habitual physical activity participation and cardiovascular fitness over 12 months in a cohort of medically stable, HAART-treated, HIV-infected adults and explore relationships between physical activity and cardiovascular fitness and body composition, perceived body image and CVD 10-year risk, in this population. Determinants associated with physical activity in HIV-infected individuals were also explored.

Materials and Methods

This was a 12 month prospective, longitudinal cohort study. Ambulant HIV-infected adults (aged ≥ 18 years) on HAART were recruited from The Alfred Hospital Infectious Diseases clinic and local HIV community clinics in March-October 2007. All consecutive patients attending the hospital clinic were invited to participate and in addition promotional material was placed around the hospital and at the affiliated community clinics until the required sample size ($n = 80$) was achieved. Exclusion criteria were contraindications to submaximal exercise testing/training [8]. The study was approved by the local Human Ethics Committee and all participants gave written, informed consent to participate.

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Variables measured

All questionnaires and cardiovascular fitness testing were administered by a physiotherapist at baseline, six and 12 months.

Physical activity: The International Physical Activity Questionnaire- long form (IPAQ) was used to estimate physical activity [9]. Participants were classified as 'active' when their energy expenditure met the moderate and highly active IPAQ category definitions and 'inactive' if energy expenditure was in the low category [9].

Cardiovascular fitness: The Kasch Three Minute Step Test [10] was used as an estimate of cardiovascular fitness. The score of the test was the one-minute post recovery heart rate, measured in beats per minute (bpm).

Body composition: Height, weight, waist to hip ratio (WHR) and waist circumference (cm) were measured with subjects standing wearing light clothing and no shoes [11]. Height and weight were measured to the nearest 0.1cm and 0.1 kg, respectively. Body Mass Index (BMI) was calculated (weight/height²) (kg/m²).

Body image: The Body Image Scale (BIS) is a 12-item; disease-specific, valid and reliable tool that measures perceived body image along five dimensions (comfort, competence, appearance, predictability, existential self). Each item utilises a five point visual analogue scale and scores range from 12 to 60 (higher scores reflect poorer body image) [12].

Cardiovascular Disease Risk: CVD 10-year risk score was estimated using the Framingham equation [13] incorporating age, gender, systolic blood pressure (mmHg), total cholesterol (TC) (mg/dL) and high-density lipoprotein cholesterol (HDL-cholesterol) (mg/dL), treatment for hypertension (yes/no) and current smoking status (yes/no). The Framingham score estimates 10-year risk for cardiac events and has been widely used in HIV-infected populations [14].

Demographic: Clinical and laboratory details were collected by patient questionnaire and medical record review. Self-report data included education level (<11th grade versus ≥ high school graduate), race/ethnicity (Caucasian or other), CVD (past history of CVD event), diabetes, current relationship status (stable relationship versus single), current depression, current smoking status, current recreational drug use and employment (full-time/ part-time or unemployed). Data collected from the medical record included CD4 cell count (cells/mm³), HIV RNA viral load (copies/mL), time living with HIV (years), HIV acquisition risk (males who have sex with males (MSM), heterosexual, unknown and other) and current HAART use (yes/no).

Statistics

Outcome variables were assessed for normality and active and inactive participants compared with Mann-Whitney U or chi-square tests as appropriate. Relationships between physical activity and cardiovascular fitness and dependent variables were assessed using Spearman's correlations, adjusting for age where appropriate. Multivariate analyses used generalised linear modelling and repeated measures (Friedman's Test was used with non parametric data). A two-sided p-value of 0.05 was considered statistically significant. All analyses were performed individually at the study's three time points and also using the entire data set, a repeated measures analysis of variance for continuous normal data or repeated measures non linear modelling for binomial or non linear data were performed. Analyses were performed using SPSS (standard version 18.0, SPSS, Chicago, IL, USA).

Results

Eighty individuals participated. At six months, five participants (four males, one female) withdrew from study. One subject died before his 12 month assessment, so 74 individuals completed all study visits. Demographics are shown in Table 1. Participants who completed the study were demographically similar to those who withdrew (data not shown).

Almost one fifth of participants were classified as inactive at baseline (low levels of physical activity reported on the IPAQ) with a greater proportion of inactive participants at both six and 12 months (37% and 27% respectively) (Table 2).

Characteristic	n=80
Age years mean [SD]	49.3 [9.8]
Gender males n [%]	75[93.8]
Height [metres] mean [SD]	1.76 [0.09]
Weight [kg] mean [SD]	78.3[16.1]
Waist [cm] mean [SD]	93.1 [16.1]
Waist to hip ratio [WHR] mean [SD]	0.98 [0.06]
Body Mass Index [BMI] median[range]	25[15.5-35.9]
Duration of HIV years median [range]	13.75[0.6-25]
CD4 count [cells/mm ³] median [range]	429[7-1145]
Undetectable HIV RNA viral load [less than 50 copies/ml] n [%]	58[72.5]
Race n [%]	
Caucasian	73 [91.3]
Other ^b	7 [8.8]
HIV risk group n [%]	
Males who have sex with males	11[13.5]
Other ^c	
Depression n [%]	30 [37.5]
Diabetes n [%]	7[8.8]
Cardiovascular Disease 10- year risk mean[%] [SD]	8.9 [6.9]
Cardiovascular disease n [%]	4[5]
Recreational drug use n [%]	30[37.5]
Employment n [%]	29[36.3]
Relationship n [%]	33[41.3]
Education n [%]	
11 th grade or less	34/80[42.5]
High school graduate or above	46/80[57.5]
Smoker n [%]	40 [50]
Body Image Scale mean [SD]	30.6 [8.2]

^aNormally distributed variables are shown as mean [standard deviation] and non normally distributed variables as median [range]; ^bother racial groups were Aboriginal, Asian and other; ^cother HIV transmission groups were heterosexual, unknown and other

Table 1: Baseline characteristics of participants^a.

IPAQ CATEGORY	BASELINE %	6 MONTHS ¹ %	12 MONTHS ² %
LOW	19	37	27
MODERATE	31	34	21
HIGH	50	28	51
ACTIVE ³	81	63	73

¹75 participants remaining in study, IPAQ data available in 67[participants left in study did not differ from those who withdrew or who did not provide data];

²74 participants remaining in study, IPAQ data available in 70[participants left in study did not differ from those who withdrew or who did not provide data];

³Active =moderate or high levels of physical activity reported by the IPAQ

Table 2: International Physical Activity Questionnaire [IPAQ] physical activity categories.

Both physical activity levels and cardiovascular fitness (post step test heart rate) were relatively stable over the 12 months of study (Table 3). Reported levels of physical activity (total energy expenditure) were somewhat lower at six month visits, most of which occurred at the hottest time of year in Melbourne, than at baseline and 12 month visits, which were generally during cooler months ($p=0.017$) (Table 3).

Greater cardiovascular fitness was associated with better body composition measures at baseline. These relationships persisted at 12 months (Table 4) and were independent of patient age. Repeated measures analysis of variance did not reveal any further possible associations.

No association between cardiovascular fitness and body image was observed, however the longitudinal study design demonstrated an inverse correlation between change in total energy expenditure and change in body image ($r=-0.325$, $p=0.027$). Increases in physical activity were associated with improvements (lower numbers) in body image.

We found no association between any self-reported physical activity variable or cardiovascular fitness and calculated CVD 10-year risk ($p>0.05$ for all).

Neither HIV disease markers (CD4 cell count and HIV RNA viral load) nor known determinants of physical activity in the general population (education, age, smoking and depression[15]) were associated with self-reported physical activity level in this cohort. At baseline, the proportion of subjects in a permanent relationship was higher among active versus inactive participants (47.7% versus 13.3% ($p=0.032$)). A similar trend was seen at six and 12 months.

Discussion

This is the first study to describe physical activity participation and cardiovascular fitness in a medically stable cohort of HAART-treated HIV-infected adults over a one year period. It identifies benefits for both physical activity and cardiovascular fitness for those with HIV. We found a concerning sub-set of patients who persistently reported inactivity, while habitual physical activity participation and cardiovascular fitness were generally stable over 12 months. Higher levels of cardiovascular fitness were associated with better body composition. Moreover, we demonstrated that increasing total energy expenditure was associated

with improving body image. Conversely, we found no association between either physical activity and cardiovascular fitness and 10-year CVD risk. Exploration of physical activity determinants was limited due to most participants being active; nonetheless being in a permanent relationship was associated with higher levels of physical activity.

Habitual physical activity participation levels changed little over 12 months in this medically-stable cohort of HIV-infected patients. Energy expenditure compared favourably to that reported in healthy adults in a previous study of IPAQ validity/reliability (2514METmins/wk) [9]. Nonetheless, a concerning 19-37% of participants were inactive at each study visit, consistent with rates of physical inactivity we and others have previously reported in cohorts with HIV [16-18]. This inactive subset could benefit most from physical activity interventions aiming to prevent or ameliorate a range of HIV-associated morbidities.

Cardiovascular fitness was associated with improved body composition measures, a finding that persisted over time. This is consistent with short-duration intervention studies demonstrating positive effects on body composition from improved cardiovascular fitness in HIV [6]. Our finding implies that improving cardiovascular fitness, not just increasing energy expenditure, may be a useful long-term strategy to improve body composition in HIV.

We demonstrated an association between increasing energy expenditure and improved body image in HIV-infected individuals. This is consistent with the limited findings available from HIV-negative cohorts, [19] and the only previously published trial evaluating effects of exercise training on body image in HIV-infected adults [20]. Morphological changes associated with HIV and HAART profoundly affect body image and influence health-related quality of life [3,21]. Further exploration of the role of physical activity in improving body image in HIV is warranted.

Physical activity and cardiovascular fitness are beneficial in the general population, reducing CVD risk through their effect on several modifiable risk factors [22]. Similar benefits for those with HIV have also been proposed [23,24], however, relationships between physical activity and estimated CVD 10-year risk per se have not been investigated. Physical activity is not included in the Framingham Equation. Nonetheless, we hypothesized that overall physical activity and cardiovascular fitness may be associated with estimated CVD

IPAQ VARIABLE	BASELINE median [range]	6 MONTHS median [range]	12 MONTHS median [range]
Total PA METmins/week	3000.7 [0-39,408]	1937 [0-27,888]	3125.25 [0-39,408]
Vigorous METmins/week	0 [0-14,400]	0 [0-20,160]	0 [0-22,320]
Moderate METmins/week	1470 [0-14,160]	750[0-15120]	1320 [0-16,080]
Leisure METmin/week	918 [0-5508]	462 [0-4794]	565.5 [0-5508]
Walk METmins/week	717.5 [0-13,860]	528 [0-5544]	750.75 [0-13,860]
Sitting weekly duration [minutes]	2280 [70-7560]	2520 [0-5880]	2400 [70-7140]
Post test heart rate [beats per minute]	113.1 [21.6]	113.3 [20.4]	109.6 [17.9]

¹IPAQ data show median [range] and cardiovascular fitness post test heart rates show mean [SD]

Table 3: International Physical Activity Questionnaire [IPAQ] [continuous data] and cardiovascular fitness post test heart rate¹.

	Baseline				12 months			
	Weight [kg]	BMI ² [kg/m ²]	Waist [cm]	WHR ⁴	Weight [kg]	BMI [kg/m ²]	Waist [cm]	WHR
Total PA METmins/week	0.144 P=0.213	0.163 P=0.157	0.024 P=0.836	-0.031 P=0.791	0.141 P=0.287	0.118 P=0.373	-0.034 P=0.799	-0.061 P=0.648
Post-test heart rate [HR] [bpm]	0.324 p=0.005*	0.354 p=0.002*	0.046 P=0.000*	0.416 p=0.000*	0.306 P=0.012*	0.270 p=0.027*	0.316 p=0.015*	0.553 p=0.000*

¹ Cardiovascular fitness [post-test HR] but not reported level of physical activity was associated with improved body composition, a relationship that was stable over time;

² Partial correlations performed adjusting for age; ³BMI [body mass index]; ⁴WHR[waist to hip ratio]

Table 4: Relationship between baseline physical activity/cardiovascular fitness [post test heart rate] and body composition measures at baseline and 12 months¹.

risk through their expected influence on included variables, notably blood lipids and blood pressure [22]. In this study, no clear association between physical activity and cardiovascular fitness and CVD risk was observed in a medically-stable cohort. However, this does not preclude possible benefits from an exercise intervention as part of an overall strategy to improve CVD risk among inactive individuals.

Being in a permanent relationship was the only determinant of higher physical activity levels observed in this study. Few studies have evaluated factors associated with physical activity behaviours in people with HIV [25, 26], but social support is known to help sustain physical activity participation in other chronic diseases [27]. It is possible that being in a permanent relationship may have been a surrogate marker of greater levels of social support among study participants, however this needs further study. We did not observe associations between physical activity and known general population physical activity determinants (age, education, smoking) [15, 28] or HIV disease markers (CD4 count, HIV viral load, years living with HIV). This relative lack of variation in physical activity patterns in our cohort may have limited our power to observe such relationships, if they exist.

Limitations of this study include the modest sample size and observational design (precluding assessment of causality). Although we had a high follow-up rate, our results may have suffered from a type II error. Even a small number of withdrawals may have reduced power to detect changes in our main outcome measures. Some measurement error may have occurred due to use of self report methods of physical activity and submaximal exercise testing of cardiovascular fitness. The generalizability of results is limited by low numbers of female participants. Additionally, longer follow up may be required to detect changes in a medically-stable population

In this stable, HAART-treated HIV-infected cohort a sub-optimal level of physical activity participation was observed in more than one-fifth of participants. Cardiovascular fitness was associated with improved body composition, suggesting HIV-infected individuals should be encouraged to improve and maintain cardiovascular fitness. Similarly, increasing physical activity levels were associated with improved perceived body image, supporting use of physical activity to improve this aspect of psychological well being. Despite convincing evidence that physical activity and cardiovascular fitness are associated with reduced CVD risk in the general population, we did not confirm this in medically-stable HIV patients over 12 months. Finally, our finding that being in a permanent relationship was associated with higher physical activity levels suggests social isolation may be risk factor for inactivity in those with HIV. Further work, including larger cohorts and longer follow up is needed to explore factors that influence physical activity and cardiovascular fitness in HIV. Intervention studies are required to define the benefits obtainable for improving long-term physical activity uptake and cardiovascular fitness in this population.

References

1. Antiretroviral Therapy Cohort Collaboration (2008) Life expectancy of individuals on combination antiretroviral therapy in high-income countries: a collaborative analysis of 14 cohort studies. *Lancet* 372: 293-299.
2. Grinspoon S, Carr A (2005) Cardiovascular risk and body-fat abnormalities in HIV-infected adults. *N Engl J Med* 352: 48-62.
3. Huang JS, Lee D, Becerra K, Santos R, Barber E, et al. (2006) Body image in men with HIV. *AIDS Patient Care STDS* 20: 668-677.
4. Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, et al. (1995) Physical activity and public health. A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *JAMA* 273: 402-407.
5. O'Brien K, Nixon S, Glazier RH, Tynan AM (2004) Progressive resistive exercise interventions for adults living with HIV/AIDS. *Cochrane Database Syst Rev*: CD004248.
6. O'Brien K, Nixon S, Tynan AM, Glazier RH (2010) Aerobic exercise interventions for adults living with HIV/AIDS. *Cochrane database of systematic reviews*: CD001796.
7. Caspersen CJ, Powell KE, Christenson GM (1985) Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep* 100: 126-131.
8. Thompson WR, Medicine ACoSM, Gordon NF, Pescatello LS (2000) Guidelines for Exercise Testing and Prescription. (6th Edn.). Lippincott Williams & Wilkins, Baltimore, Maryland.
9. Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, et al. (2003) International physical activity questionnaire: 12-country reliability and validity. *Med Sci Sports Exerc* 35: 1381-1395.
10. Golding LA, Myers CR, Sinning WE (1989) The Y's way to physical fitness. (2nd Edn) Human Kinetics Publishers, Champaign, IL
11. Gibson RS (2005) Principles of Nutritional Assessment. (2nd Edn.) Oxford University Press, Inc; New York.
12. Martinez SM, Kemper CA, Diamond C, Wagner G; California Collaborative Treatment Group (2005) Body image in patients with HIV/AIDS: assessment of a new psychometric measure and its medical correlates. *AIDS Patient Care STDS* 19: 150-156.
13. Law M, Friis-Møller N, Weber R, Reiss P, Thiebaut R, et al. (2003) Modelling the 3-year risk of myocardial infarction among participants in the Data Collection on Adverse Events of Anti-HIV Drugs (DAD) study. *HIV Med* 4: 1-10.
14. Friis-Møller N, Sabin CA, Weber R, d'Arminio Monforte A, El-Sadr WM, et al. (2003) Combination antiretroviral therapy and the risk of myocardial infarction. *N Engl J Med* 349: 1993-2003.
15. Trost SG, Owen N, Bauman AE, Sallis JF, Brown W (2002) Correlates of adults' participation in physical activity: review and update. *Med Sci Sports Exerc* 34: 1996-2001.
16. Fillipas S, Bowtell-Harris CA, Oldmeadow LB, Cicuttini F, Holland AE, et al. (2008) Physical activity uptake in patients with HIV: who does how much? *Int J STD AIDS* 19: 514-518.
17. Clingerman EM (2003) Participation in physical activity by persons living with HIV disease. *J Assoc Nurses AIDS Care* 14: 59-70.
18. Ramírez-Marrero FA, Rivera-Brown AM, Nazario CM, Rodríguez-Orengo JF, Smit E, et al. (2008) Self-reported physical activity in Hispanic adults living with HIV: comparison with accelerometer and pedometer. *J Assoc Nurses AIDS Care* 19: 283-294.
19. Hausenblas HA, Fallon EA (2006) Exercise and body image: a meta analysis. *Psychology and Health* 21: 33-47.
20. Mutimura E, Stewart A, Crowther NJ, Yarasheski KE, Cade WT (2008) The effects of exercise training on quality of life in HAART-treated HIV-positive Rwandan subjects with body fat redistribution. *Qual Life Res* 17: 377-385.
21. Corless IB, Nicholas PK, McGibbon CA, Wilson C (2004) Weight change, body image, and quality of life in HIV disease: a pilot study. *Appl Nurs Res* 17: 292-296.
22. Thompson PD, Buchner D, Pina IL, Balady GJ, Williams MA, et al. (2003) Exercise and physical activity in the prevention and treatment of atherosclerotic cardiovascular disease: a statement from the Council on Clinical Cardiology [Subcommittee on Exercise, Rehabilitation, and Prevention] and the Council on Nutrition, Physical Activity, and Metabolism [Subcommittee on Physical Activity]. *Circulation* 107: 3109-3116.
23. Yarasheski KE, Roubenoff R (2001) Exercise treatment for HIV-associated metabolic and anthropomorphic complications. *Exerc Sport Sci Rev* 29: 170-174.
24. Roubenoff R, Weiss L, McDermott A, Heflin T, Cloutier GJ, et al. (1999) A pilot study of exercise training to reduce trunk fat in adults with HIV-associated fat redistribution. *AIDS* 13: 1373-1375.

25. Petróczi A, Hawkins K, Jones G, Naughton DP (2010) HIV Patient Characteristics that Affect Adherence to Exercise Programmes: An Observational Study. *Open AIDS J* 4: 148-155.
26. Pavone RM, Burnett KF, La Perriere A, Perna FM (1998) Social cognitive and physical health determinants of exercise adherence for HIV-1 seropositive, early symptomatic men and women. *Int J Behav Med* 5: 245-258.
27. Beverly EA, Wray LA (2010) The role of collective efficacy in exercise adherence: a qualitative study of spousal support and type 2 diabetes management. *Health Educ Res* 25: 211-223.
28. King AC, Blair SN, Bild DE, Dishman RK, Dubbert PM, et al. (1992) Determinants of physical activity and interventions in adults. *Med Sci Sports Exerc* 24: S221-236.