A six-month, supervised, aerobic and resistance exercise program improves self-efficacy in people with human immunodeficiency virus: A randomised controlled trial

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Question What is the effect of a six-month, supervised, aerobic and resistance exercise program on self-efficacy in men living with human immunodeficiency virus (HIV)? ***Design*** Randomised, controlled trial. ***Participants*** 40 (5 dropouts) men living with HIV, aged 18 years or older. ***Intervention*** The experimental group participated in a twice-weekly supervised aerobic and resistance exercise program for six months and the control group participated in a twice-weekly unsupervised walking program and attended a monthly group forum. ***Outcome measures*** The primary outcome measure was self-efficacy using the General Self-Efficacy Scale. Secondary outcome measures were cardiovascular fitness using the Kasch Pulse Recovery test, and health-related quality of life using the Medical Outcomes Study HIV Health Survey. Measures were taken by an assessor blinded to group allocation. ***Results*** By six months, the experimental group had improved their self-efficacy by 6.8 points (95% CI 3.9 to 9.7, $p < 0.001$) and improved their cardiovascular fitness by reducing their heart rate by 20.2 bpm (95% CI –25.8 to –14.6, $p < 0.001$) more than the control group. Health-related quality of life improved in only two out of the eleven dimensions: the experimental group improved their overall health by 20.8 points (95% CI 2.0 to 39.7, $p = 0.03$) and their cognitive function by 14 points (95% CI 0.7 to 27.3, $p = 0.04$) more than the control group. ***Conclusion*** The findings of this study add to the known benefits of exercise for the HIV-infected population. **[Fillipas S, Oldmeadow LB, Bailey MJ, Cherry CL (2006): A six-month, supervised, aerobic and resistance exercise program improves self-efficacy in people with human immunodeficiency virus: A randomised controlled trial. *Australian Journal of Physiotherapy* 52: 185–190]**

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Introduction

The introduction of highly active antiretroviral therapy has significantly decreased the morbidity and mortality associated with the human immunodeficiency virus (HIV) (Kress 2004). HIV-infected individuals are now living longer but with significant chronic illness. Active participation in the management of their disease with a strong sense of personal control is important for optimal health outcomes.

Sense of control or self-efficacy may be enhanced by participation in an exercise program (Holman and Lorig 1992). Exercise is well accepted as an adjunct therapy in the management of chronic illness (Ciccolo et al 2004) and therapeutic exercise among people with HIV has been shown to be both beneficial and safe (Ciccolo et al 2004). Exercise has been shown to increase cardiovascular fitness (Nixon et al 2005, Terry et al 1999), increase strength (O'Brien et al 2004, Roubenoff et al 1999), and improve mood (Terry et al 1999, Wagner et al 1998). There is some suggestion that it may also improve the metabolic and morphological features of lipodystrophy (Jones et al 2001, Thoni et al 2002). However, it is not known whether exercise improves self-efficacy in the HIV population.

Self-efficacy is defined as 'a global confidence in one's ability across a wide range of demanding or novel situations' (Schwarzer and Jerusalem 1995). Importantly, self-efficacy has been correlated with medication adherence (Schwarzer 1993) which is a critical determinant of outcome for people with HIV who are undergoing highly active antiretroviral therapy. Improving self-efficacy in the HIV-infected population may also reduce health-impairing habits and foster health-promoting behaviours. Although highly active antiretroviral therapy has improved longevity, known associated decreased physical activity has consequences for cardiovascular fitness and exercise endurance (Ciccolo et al 2004).

Before the introduction of highly active antiretroviral therapy, participation in exercise programs was known to improve health-related quality of life (Stringer et al 1998). However, since the introduction of this therapy, concerns have been raised that the treatment side effects and the burden of complex drug regimes may impair well-being (Wu 2000). It is possible that participation in an exercise program may modify the compromising side effects of highly active antiretroviral therapy and that health-related quality of life may benefit.

The potential benefits of any exercise program, however, are dependent on optimal adherence to the program (Kramer et al 2002). Exercise adherence may be enhanced by the presence of an experienced supervisor (Anthony 1991), so the presence of a physiotherapist with knowledge and expertise in HIV management may contribute to improved adherence to the program.

We conducted a randomised controlled trial to investigate the effect of two six-month exercise programs for HIV-infected individuals on self-efficacy, cardiovascular fitness, health-related quality of life, and health status. We hypothesised that participation in a supervised aerobic and resistance exercise program would improve self-efficacy, cardiovascular fitness, health-related quality of life, and health status more than an unsupervised walking program.

Method

Design We conducted a single-blind, randomised, controlled trial to determine the effect of two six-month exercise programs for HIV-infected individuals. Participants were randomised into either the experimental (supervised aerobic and resistance exercise program) group or the control (unsupervised walking program) group. The concealed randomisation process used a random number table (Jadad 1998) and was performed by an independent investigator. After baseline assessment, the treating physiotherapist accessed the allocation schedule from a centrally-located, locked desk. An assessor who was blinded to group allocation collected outcome measures for each participant. The study was approved by the Alfred Hospital Ethics Committee and all participants gave signed informed consent to participate. Upon completion of the study, participants in the control group were invited to undertake the experimental intervention.

Participants Participants were recruited from The Alfred Hospital's infectious diseases outpatient clinic, inpatient admissions, and local HIV specialist clinics. Participants were included if they were male with HIV, aged 18 years or older. Participants were excluded if: there were contraindications to exercise testing and training (ACSM 2000), there was significant cognitive impairment or inability to follow instructions, or they were already involved in a regular exercise program (defined as two or more structured exercise sessions weekly for more than, or equal to, six months prior to enrolment).

Intervention Participants allocated to the experimental group undertook a six-month program consisting of group aerobic and resistance exercises performed twice-weekly either at the Alfred Hospital or at an affiliated, community gymnasium. Supervision was provided by a physiotherapist experienced in managing people with HIV. The groups consisted of approximately eight to ten participants supervised by one physiotherapist. Each 60-minute session began and ended with a five minute warm up/cool down, including a standard flexibility regime to minimise the risk of injury (Pollock et al 1998). The warm up was followed by 20 minutes of aerobic exercises performed using physiotherapist-led exercises, an exercise bike, a treadmill, a stepper, or a cross-trainer. These exercises followed the guidelines established by the American College of Sports Medicine (Pollock et al 1998). The intensity of exercise was set initially at 60% of maximum heart rate and progressed gradually to 75% as improvement occurred. The aerobic exercises were followed by resistance exercises which complied with the recommendations established by the American College of Sports Medicine (Kraemer et al 2002). A combination of machine and free weights was used. Major muscle groups were trained by performing latissimus dorsi pull down, elbow flexion, shoulder elevation, knee extension, knee flexion, chest press, and abdominal exercises. The dosage of each exercise was three sets of 10 repetitions. There was a rest period of 2 seconds between repetitions, 1–2 minutes between sets, and 2–4 minutes between each exercise. The initial intensity was set at 60% of the one repetition maximum (1 RM). The intensity was gradually increased to 80% of 1 RM. Progression of both the aerobic and resistance exercises was based on the Borg Relative Perceived Effort Scale, where participants were asked to rate their perceived exertion (Borg and Linderhold 1970). If it was less than 16 out of a possible 20, the intensity was increased by approximately 10%. Attendance at exercise sessions was recorded. Adherence to the exercise program was calculated as the percentage of sessions attended out of a possible 48.

Participants allocated to the control group undertook a six-month program consisting of walking performed twice-weekly in the community and attending a forum monthly. Walking sessions were 20 minutes, starting at 60% of maximum heart rate and progressing to 75% as improvement occurred. Attendance at the physiotherapist-led forum provided peer support and allowed examination of any additional benefits of the presence of supervision during exercise. Attendance at the forum was recorded and participants completed a diary recording their walking program. Adherence to the exercise program was calculated as the percentage of self-reported walking sessions undertaken out of a possible 48 and monthly forum sessions attended out of a possible six.

Outcome measures Self-efficacy was measured using the General Self-Efficacy Scale (Schwarzer and Jerusalem 1993) which is a 10-item (eg, *I am confident that I could deal efficiently with unexpected events*) self-administered questionnaire with a 4-point response scale. Summation of the 10 items yields a score ranging from 10 to 40, with a higher score representing better self-efficacy. Age-adjusted norms have been established in over 1500 subjects.

Cardiovascular fitness was measured using the Kasch Pulse Recovery test (Golding et al 1989) which is widely used clinically. The test is scored as the heart rate in beats per minute over one-minute, taken five seconds post-cessation of a three-minute step test, with a lower heart rate representing better cardiovascular fitness.

Health-related quality of life was measured using the Medical Outcomes Study HIV Health Survey (Wu et al 1991) which is a 35-item questionnaire covering 10 dimensions of health and one item covering health transition. Subscales are scored on a 0–100 scale with a higher score representing better health-related quality of life. It has been shown to be reliable and valid in populations with HIV (Burgess et al 1993).

Health status was measured as CD4 count in cells/mm^3, HIV viral load in copies/ml, and weight in kg by questioning and accessing the HIV computer database and medical files.

Data analysis Based on a previous study by Schwarzer and Jerusalem (1995), the standard deviation for the primary outcome of self-efficacy was 4.6 out of 40. A difference of 4.6, ie, one standard deviation, was perceived to be of clinical importance. A total of 16 subjects per group were required to have 80% power to detect a difference in continuous, normally-distributed outcomes equivalent to one standard deviation with a two-sided p value of 0.05. Allowing for a drop out rate of 20%, a total of 40 subjects were recruited.

Table 1. Number (%) or mean (SD) of baseline characteristics of participants.

	Experimental group n = 20	Control group n = 20	*p* value
Age (SD, range) (years)	43.3 (7.7, 31–61)	43.7 (10, 31–71)	0.81
HIV (years)	6.5 (5.8)	9.9 (6.4)	0.12
HIV transmission risk group			
Homosexual	17 (85%)	18 (90)	0.59
Heterosexual	1 (5%)	0 (0)	
Other	2 (10%)	2 (10)	
Antiretroviral use			
Yes	12 (60%)	13 (65)	0.70
No	8 (40%)	7 (35)	
Ethnicity			
Caucasian	20 (100%)	18 (90)	0.15
Indigenous/Aboriginal	0 (0%)	2 (10)	
Employment status			
Full/part time/casual work	9 (45%)	9 (45)	0.53
Studying and not working	1 (5%)	0 (0)	
Studying and working	1 (5%)	0 (0)	
Pension	9 (45%)	11 (55)	
Relationship status			
Relationship	9 (45%)	10 (50)	0.59
Single	11 (55%)	10 (50)	
Depression status			
Currently depressed	5 (25%)	4 (20)	0.61
Past depressed	5 (25%)	3 (15)	
Never depressed	10 (50%)	13 (65)	
Education status			
Primary	2 (10%)	7 (35)	0.29
Secondary incomplete	7 (35%)	6 (30)	
Secondary completed	7 (35%)	3 (15)	
Some additional training	2 (10%)	2 (10)	
Tertiary	2 (10%)	2 (10)	
Smoking status			
Yes	12 (60%)	15 (75)	0.31
No	8 (40%)	5 (25)	
Self-efficacy (10–40)	30.0 (4.7)	32.0 (5.1)	0.22
Cardiovascular fitness (bpm)	110 (4.39)	101 (2.76)	0.15
Health-related quality of life (0–100)			
Overall health	31.0 (7.8)	42.0 (7.8)	0.64
Cognitive function	48.0 (8.6)	69.0 (8.6)	0.06
Quality of life	38.8 (8.1)	42.0 (7.8)	0.58
Energy/fatigue	38.3 (7.4)	45.8 (3.4)	0.88
Pain	46.8 (9.5)	57.8 (9.3)	0.51
Physical function	43.3 (9.5)	59.0 (9.3)	0.30
Social function	44.2 (9.5)	59.0 (9.3)	0.42
Mental health	45.4 (15.2)	60.8 (15.2)	0.18
Role function	17.5 (15.2)	60.8 (7.5)	0.18
Health distress	51.8 (8.7)	58.8 (8.7)	0.74
Health transition	47.5 (9.4)	56.3 (9.4)	0.67
Health status			
CD4 count (cells/mm^3)	498 (273)	424 (274)	0.43
HIV RNA viral load (copies/ml)	105 300 (232 650)	30 800 (56 270)	0.24
Weight (kg)	76.3 (11.3)	73.2 (15.9)	0.73

SD = standard deviation

Table 2. Mean (SD) differences within groups, and mean (95% CI) differences between groups for all outcome measures.

Outcome	Within-group difference Post minus Pre		Between-group difference Post minus Pre
	Experimental (n = 17)	Control (n = 18)	Experimental minus Control
Self-efficacy (10–40)	5.3 (3.7)	–1.5 (4.5)	6.8 (3.9 to 9.7)++
Cardiovascular fitness (bpm)	–19.6 (11.7)	0.6 (2.9)	–20.2 (–25.8 to –14.6)++
Health-related quality of life (0–100)			
Overall health	14.0 (17.4)	–6.8 (37.5)	20.8 (2.0 to 39.7)+
Cognitive function	13.5 (22.0)	–0.5 (19.5)	14.0 (0.7 to 27.3)+
Quality of life	16.3 (23.3)	8.8 (33.7)	7.5 (–11.1 to 26.1)
Energy/fatigue	6.0 (24.0)	1.5 (18.3)	4.5 (–9.2 to 18.2)
Pain	1.1 (46.6)	3.3 (20.1)	–2.2 (–25.2 to 20.7)
Physical function	16.7 (29.7)	1.3 (21.0)	15.4 (–1.1 to 31.9)
Social function	–1.0 (87.2)	10.0 (38.7)	–11.0 (–54.2 to 32.2)
Mental health	8.2 (14.1)	2.4 (17.8)	5.8 (–4.5 to 16.1)
Role function	7.5 (40.6)	47.5 (215)	–40.0 (–139.3 to 59.3)
Health distress	6.0 (24.7)	4.8 (18.7)	1.3 (–12.8 to 15.3)
Health transition	11.3 (41.7)	–1.3 (35.8)	12.5 (–12.4 to 37.4)
Health status			
CD4 count (cells/mm$^{3)}$ (n = 34)	–31.5 (148.9)	4.1 (191.5)	–35.6 (–156.6 to 85.3)
HIV RNA viral load (copies/ml) (n = 32)	–91 885 (23 3151)	53 135 (234 598)	–145 022 (–316 950 to 26 908)
Weight (kg)	2.0 (3.5)	–0.1 (2.9)	2.1 (–0.1 to 4.3)

++ = Significant difference between groups $p < 0.001$; + = Significant difference between groups $p < 0.05$

Statistical analysis was performed using SAS version 8.2 on an intention-to-treat basis. Baseline comparisons were conducted using chi-square tests for equal proportion and Student t-tests, and validated using Wilcoxon rank sum tests. Differences between groups were determined using student t-tests. Data are presented as mean (SD) and mean between-group difference (95% confidence intervals). A two-sided p value of 0.05 was considered statistically significant.

Results

Flow of participants through the trial The study was conducted between September 2002 and December 2004. Forty-three adult men with HIV were identified as eligible. Three declined to participate. The reasons for not participating were: did not want to be randomised to the control group (n = 2), and enrolled in too many studies (n = 1). Therefore, 40 men consented and were randomised – 20 participants into the experimental group and 20 into the control group. The experimental and the control group were similar on all baseline measures (Table 1). Five participants failed to complete the study – three from the experimental group and two from the control group. The reasons for not completing were: returning to work (n = 1), lack of motivation (n = 1), depression (n = 2) and unknown (n = 1).

Adherence to intervention High rates of adherence to the exercise programs were observed in both groups. Participants in the experimental group attended an average of 81% of the exercise sessions. Those in the control group carried out an average of 85% of the walking sessions and attended an average of 60% of the forums.

Effect of intervention Over the six months, the experimental group improved their self-efficacy while the control group stayed much the same so that the between-group difference was 6.8 points (95% CI 3.9 to 9.7, $p < 0.001$). Similarly, the experimental group improved their cardiovascular fitness while the control group stayed much the same so that the between-group difference in heart rate was –20.2 bpm (95% CI –25.8 to –14.6, $p < 0.001$). Health-related quality of life showed a between-group difference in only two out of the eleven dimensions. The experimental group improved their overall health while the control group reduced theirs slightly so that the between-group difference was 20.8 points (95% CI 2.0 to 39.7, $p = 0.03$). The experimental group improved their cognitive function while the control group stayed much the same so that the between-group difference was 14 points (95% CI 0.7 to 27.3, $p = 0.04$). CD4 T cell counts were available at baseline and at 6 months for 34 and HIV RNA viral load results for 32 of the 40 participants. No changes were observed in either of these variables in either group. However, there was a trend towards an increase in weight in the experimental group compared with the control group so that between-group difference was 2.1 kg (95% CI –0.1 to 4.3, $p = 0.06$) (Table 2).

Discussion

The results of this study provide evidence that participation in a six-month supervised aerobic and resistance exercise program improves self-efficacy in adult men with HIV. Importantly, these results show that, despite high levels of

adherence, a six-month, unsupervised walking program is insufficient to enhance self-efficacy or cardiovascular fitness. These findings are relevant in an era of highly active antiretroviral therapy, where high self-efficacy is strongly correlated with medication adherence (Bandura 1997) and low self-efficacy is associated with non-adherence to the therapy (Ammassari et al 2002). It has been found that highly active antiretroviral therapy requires 95% adherence to be effective (Chesney 2003). Furthermore, improving self-efficacy has been associated with better immunological outcomes for individuals with HIV (Kress 2004).

Another significant finding was improvement in cardiovascular fitness, reflected in the 20 bpm difference between those in the supervised aerobic and resistance exercise program and those in the unsupervised walking program. This is encouraging since impaired physical endurance is frequently observed in this population (Ciccolo et al 2004).

This study evaluated the effect of exercise on health-related quality of life in adult men living with HIV in the era of highly active antiretroviral therapy. Similarly, studies have reported the beneficial effect of exercise in the pre-highly active antiretroviral therapy era (eg, Stringer et al 1998). Eleven dimensions of health-related quality of life were evaluated. Overall health, which explores general health perceptions and feelings of well being as well as cognitive function, improved in the experimental group compared with the control group. The improved sense of self-efficacy may have contributed to improved overall health.

In our study, high adherence rates were achieved by both groups, although only the experimental group improved in self-efficacy. The HIV-trained physiotherapist delivered an appropriate aerobic and resistance exercise program specific to this community. The supervision provided by a physiotherapist with knowledge and expertise in the management of HIV may have been a factor in enhancing self-efficacy, although this cannot be separated from the effect of the exercise program.

Twice-weekly participation in an exercise program for six months was sufficient to produce benefits. Two to three sessions per week is recommended for novice training in healthy adults (Kramer et al 2002). Most previous studies among HIV-infected populations have utilised thrice-weekly exercise programs. HIV treatment centres may be better able to afford and sustain programs run on a twice-weekly basis than programs run more frequently.

In conclusion, our results indicate that a six-month supervised aerobic and resistance exercise program improves self-efficacy and cardiovascular fitness more than an unsupervised walking program in adult men with HIV.

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