

Effects of Progressive Resistance Exercises on Quality of Life, Body Composition and Muscle Strength in Patients with HIV

(Kesan Latihan Rintangan Progresif terhadap Kualiti Hidup, Komposisi Tubuh dan Kekuatan Otot dalam Kalangan Pesakit HIV)

MOHAMAD SHARIFF A. HAMID* & STELLA JANE JOSEPH RAJAH

ABSTRACT

This study assessed the effects of progressive resistance exercise programmes on self-reported health related quality of life, body composition and muscle strength among patients with HIV. Twenty-nine men with HIV were randomly assigned to progressive resistance exercise programme using elastic band (PRE group) (n=14) or resistance exercise programme without elastic band (comparative group) (n=15). Both groups underwent exercise programmes for 12 weeks. Self-reported health related quality of life, body compositions and isometric shoulder lift strength were assessed at baseline and at week 12. Ten and nine men in the intervention and comparative groups, respectively, completed the 12-week programme. Participants in the comparative group showed significant improvements in the domain of mental health ($p<0.05$). No significant changes in all body composition parameters were found in both groups with time. Both groups showed significant improvements in peak and average shoulder lift strength (intervention, $p=0.001$; $p=0.001$; control, $p=0.008$; $p=0.016$). Progressive resistance exercise programmes significantly improves shoulder lift strength, showed positive effects on self-reported health related quality of life scores among patients with HIV.

Keywords: Health; HIV; physical; psychological; training

ABSTRAK

Kajian in menilai kesan program latihan rintangan progresif terhadap kualiti hidup, komposisi tubuh dan kekuatan otot dalam kalangan penghidap HIV. Dua-puluh sembilan lelaki yang menghidap HIV diperuntukkan secara rawak kepada kumpulan program latihan rintangan progresif menggunakan getah elastik (kumpulan PRE) (n=14) atau program latihan rintangan tanpa getah elastik (kumpulan perbandingan) (n=15). Kedua-dua kumpulan melalui program latihan selama 12 minggu. Laporan sendiri kualiti hidup, komposisi tubuh dan kekuatan angkatan otot bahu dinilai pada permulaan dan minggu ke-12. Sepuluh dan sembilan peserta daripada kumpulan PRE dan kumpulan perbandingan masing-masing menamatkan program selama 12 minggu. Peserta daripada kumpulan perbandingan menunjukkan peningkatan signifikan dalam domain kesihatan mental ($p<0.05$). Tiada perubahan signifikan pada kesemua parameter komposisi tubuh dengan masa dalam kedua-dua kumpulan. Kedua-dua kumpulan menunjukkan peningkatan signifikan pada puncak dan purata kekuatan angkatan otot bahu (PRE, $p=0.001$ & $p=0.001$; perbandingan, $p=0.008$ & $p=0.016$). Program latihan rintangan progresif meningkatkan kekuatan angkatan otot bahu dengan signifikan dan menunjukkan kesan positif terhadap kualiti hidup dalam kalangan pengidap HIV.

Kata kunci: Fizikal; HIV; kesihatan; latihan; psikologi

INTRODUCTION

Weight loss and muscle wasting are common complications of HIV infection and have long been shown as strong predictors of morbidity and mortality (Melchior et al. 1998; Süttmann et al. 1995; Wheeler et al. 1998). Muscle wasting among patients with HIV is generally characterised by a decrease in lean body mass (Coats 2002). Since skeletal muscle represents approximately 50% of lean body mass, wasting is often accompanied by decreased muscular strength and poor physical functioning (Grinspoon et al. 1998a).

Many research interventions have been carried out focusing on increasing and preserving lean body mass through various methods, including nutritional

manipulation (Clark et al. 2000; Shabert et al. 1999), hormonal therapy (Kong & Edmonds 2002; Schambelan et al. 1996a; Waters et al. 1996), androgen therapy (Strawford et al. 1999) and resistance exercises training (Roubenoff et al. 1999; Souza et al. 2008; Spence et al. 1990). Although certain pharmacological agents used to combat muscle wasting demonstrated some gains in lean body mass, these gains have not been consistently associated with improved physical functioning (Corcoran & Grinspoon 1999; Grinspoon et al. 1998b; Schambelan et al. 1996b; Waters et al. 1996). Collective evidence suggested that progressive resistance exercise (PRE) can increase skeletal muscle mass and strength in several study populations (Peterson 2010; Volaklis & Savvas

2005). Accordingly, PRE can result in increased muscle strength, body weight, lean body mass and improvements in quality of life (ACSM 2010). However, these studies were conducted in the western, developed countries using weight resistance machines. Data among Asians are lacking, since the natural history of HIV varies between different parts of the world (Ruxrungtham et al. 2004), there is a possibility that patients' response to treatments may vary. Also, patients' access to weight resistance machines among Asians is often restricted as this would require both facilities and financial resources. An alternative to weight resistance machine is to use the elastic resistance band. Elastic resistance bands are portable, light, relatively cheap, require less maintenance and less bulky compared with gym equipments. They are increasingly used in resistance training to increase muscle strength and lean body mass (Anderson et al. 2008; Hostler et al. 2001). Researchers had shown that elastic resistance bands are safe, acceptable and efficacious for strength training in the elderly who are prone to sarcopenia (muscle wasting) secondary to ageing (Hirshc et al. 1996). So far, there are no published studies on progressive resistance exercise (PRE) using elastic resistance bands among patients with HIV. The aim of this study was to assess the use of elastic resistance bands during PRE in patients with HIV and to explore its effect on health related quality of life, body composition and selected muscle strength.

METHODS

ETHICAL APPROVAL

The University of Malaya Medical Centre Ethics Committee approved the study (MEC Ref no. 823.21). Information leaflets about the study were given to all participants, including details about the study and its objectives. Participation was voluntary and written informed consent was obtained before recruitment.

STUDY DESIGN

Men over 18 years of age with HIV living in Positive Living Community homes in Selangor, Malaysia were invited to take part in this study. These community homes provide shelter and nursing care to men with HIV who were fit enough to be discharged from hospital after acute care but still needed time to recuperate further and may not be able to live independently. Inclusion criteria were men with HIV who were interested, able to give informed consent and were able to perform exercises or movements with their upper and lower limbs. Exclusion criteria included participation in PRE within the past six months, total inability to use upper and/or lower limbs, a contraindication to PRE (e.g. myocardial infarction within six months, unstable angina, uncontrolled congestive cardiac failure and uncontrolled hypertension) and those who are receiving anabolic or hormonal therapy.

Participants underwent physical medical assessments and baseline testing before randomisation. Allocation into either the PRE or comparative group was performed by Stella Jane Joseph Rajah (co-author) using a simple randomisation process (draw from an opaque containers). Participants in the PRE group were prescribed with PRE using elastic resistance bands (Thera-Band®). Whereas the comparative group performed similar exercises as the PRE group without the use of elastic bands. Both groups underwent a 12-week exercise training programme. Upon completion participants in the comparative group were offered the PRE using the elastic resistance band programme.

SELF-REPORTED QUALITY OF LIFE

The primary outcome of the study was a change in the quality of life score assessed using the Medical Outcomes Study Short Form 36v2 (MOS SF-36) at baseline and at the end of the study (week 12). All participants completed the MOS SF-36 questionnaires before physical assessments to avoid the actual process of assessment influencing their responses. The MOS SF-36 is one of the commonest self-administered questionnaires that measures health-related QOL (Clayson et al. 2006). This questionnaire covers eight domains, measuring physical, emotional and social limitations due to disease, with higher scores indicative of better QOL (Wolfe 1995). Three scales (physical functioning, role-physical and bodily pain) correlate most highly with the physical component and contribute to the physical component summary (PCS) measure (Ware et al. 1994). The mental component correlates most highly with the mental health, role emotional and social functioning scales, which therefore contribute to the mental component summary (MCS) measure. The MOS SF-36 had good internal consistency, reliability, construct validity and responsiveness to treatment in studies among patients with HIV (Arpinelli et al. 2000; Call et al. 2001; Carrieri et al. 2003; Hsiung et al. 2005).

BODY COMPOSITION ASSESSMENT

Body weight (kg) was measured using a portable mechanical scale (Osim, Singapore) and height (cm) was measured using a portable stadiometer (San Donato Milanese, Italy). The body mass index (BMI in kg/m²) was calculated using the standard equation of weight (kg)/height² (m²). Body fat, lean body mass and basal metabolic rate (BMR) by body weight were determined using the Bodystat®1500 bioelectric impedance analyser (Douglas, British Isles). Body composition assessments were performed at baseline and again at the end of the 12-week. All measurements were taken at least 12 h after the last exercise session. Participants were advised to avoid food and fluid 4 to 5 h before the body composition test.

ISOMETRIC SHOULDER LIFT STRENGTH

Isometric shoulder lift strength was assessed using the Jackson strength evaluation system (Model#32628,

Lafayette Instrument, Indiana, USA). Participants were asked to perform the test at half effort as warm-up and to allow familiarisation with the equipment and test procedure. This was then followed by two attempts at maximum effort. Both participant's peak and average scores were recorded.

EXERCISE PROGRAMME

The exercise programmes consisted of four upper (double chest press, overhead press, seated row and lateral pull-down) and four lower body exercises (leg press, knee squat, knee extension and knee curl). Upper and lower body exercises were alternately performed from Monday to Saturday for 12 weeks, with Sundays as rest day.

A 4-week conditioning phase was assigned, during which participants were trained through one-day session by Stella Jane Joseph Rajah to perform both upper and lower body exercises. Also each participants received an exercise logbook for reference. Participants started by performing 1 set of 25 repetition-to-fatigue (RTF) at the beginning of the phase and gradually progressed to 3 sets of 12 RTF by the end of that phase. Fatigue was recognised as the point where the participants begins to experience burning sensation in the muscle or begins to alter their mechanics by compensating motion to complete the repetition (Page & Ellenbecker 2003).

Following the conditioning period, participants in the PRE group performed their exercises using elastic band for eight weeks using 3 sets of 8 to 12 RTF with 2 min rest between sets. As the participants progressed, the volume was increased before intensity in keeping with the principle of progressive overload. Intensity was increased by either using a higher resistance band, shortening up the band or to double or combine the different resistance bands. All participants were asked to continue with their unsupervised daily exercises as prescribed and to keep a record of these sessions in their exercise logbook.

No progression of volume or intensity was applied in the comparative group. For each exercises, the participants in the comparative group performed two sets of 25 repetitions, with the similar speed and rest periods as the PRE group. Participants in the comparative group performed their exercises as a group under the guidance of a trainer.

STATISTICAL ANALYSIS

The study was powered to detect a change in lean body mass of $\geq 2\%$ as suggested by previous study (Spence et al. 1990). The sample size calculation determined a sample size of seven participants in each group would be adequate to detect changes in body composition and shoulder lift strength. With a 50% estimation of attrition rate a total of 29 participants was recruited in this study. The distribution of data for normality was assessed using the Shapiro-Wilk test. The primary outcome of the study was the change in health related quality of life score as assessed by MOS

SF-36v2. Secondary outcomes were changes in body composition and shoulder muscles strength. Accordingly, inter-group (within groups) differences were compared using *t*-test or Mann-Whitney U while intra-group (between groups) differences were explored using the two-way repeated measure ANOVA or Wilcoxon Sign Rank test. All statistical analysis was performed using SPSS 19.0 (SPSS Inc., Chicago, IL) and statistical significance was set at $p < 0.05$.

RESULTS

CHARACTERISTICS OF PARTICIPANTS

Twenty-nine men with HIV were recruited and randomly assigned to the PRE (resistance exercise programme with elastic band) ($n=14$) and comparative (resistance exercise programme without elastic band) ($n=15$) groups.

A total of 19 participants completed the study representing 65.5% retention from baseline. Ten participants withdrew from the study. Nine participants left the home as they had secured jobs and were well enough to live independently. One developed hemiparesis and had difficulty using the elastic bands despite adjustment and asked to be excluded from the study. No significant differences in participant's characteristics between those who completed and withdrew from the study was noted ($p > 0.05$). The median age of participants in the study was $37.00 \pm \text{IQR} 17.00$ (range: 29-60 years). Median duration of HIV infection was $3.00 \pm \text{IQR} 7.00$ (range: 1-month to 29 years). The mean body-mass index (BMI) was $18.8 \pm \text{SD} 2.3$ kg/m^2 , with 43% ($n=12$) classified as underweight (Barba et al. 2004). Twelve of the participants had contracted HIV through sexual contact (42%), nine through intravenous drug use (32%) and eight reported both exposures (26%) (Table 1).

SELF-REPORTED QUALITY OF LIFE (MOS-SF36)

Participants in the comparative group showed significant improvements ($p < 0.05$) in mental component scores (MCS) at the end of the 12-week programme (Table 2). Participants in the PRE group showed increase physical component (PCS) and mental component MCS) scores with time. These changes however were not significant ($p = 0.05$; $p = 0.13$). Inter-group comparison at the end of week 12 yielded no significant difference in changes on self-reported health function parameters.

BODY COMPOSITION

Overall, the PRE group recorded an increase in weight, BMI, percentage of lean body mass and BMR by body weight, as well as a decline in body fat. In contrast, the comparative group showed declines in these parameters including increased in body fat. However, these changes were not statistically significant when intra- and inter-group comparison were made.

TABLE 1. Demographic and clinical characteristics of patients at baseline

	Mean \pm SD / Median (IQR)* / (Frequency,%)		<i>t</i> -test/Mann-Whitney U* / Chi square test [‡]	
	PRE (<i>n</i> = 10)	Comparative (<i>n</i> = 9)	<i>t</i> / <i>z</i> / χ^2	<i>p</i> value
Age (year)*	37.3 \pm 6.62	46.1 \pm 12.0	-1.82	0.086
Duration of HIV	8.0 \pm 7.3	4.8 \pm 3.2	1.21	0.242
Antiretroviral therapy [‡]			2.76	0.252
None	(2, 20.0%)	(3, 33.3%)		
Mono/Dual	(1, 10.0%)	(3, 33.3%)		
HAART	(7, 70.0%)	(3, 33.3%)		
CD4 (count/mL)	114.0 (269.0)	360.0 (233.0)	-1.92	0.053
Body composition				
Weight (kg)	51.8 \pm 8.7	50.8 \pm 6.1	0.29	0.773
BMI (kg/m ²)*	19.0 \pm 2.7	18.4 \pm 1.9	0.56	0.585
Lean body mass (kg)	42.8 \pm 9.5	40.6 \pm 7.7	0.56	0.587
Body fat (kg)	10.6 (3.8)	10.9 (4.5)	-0.94	0.347
Muscle strength				
Average shoulder lift	13.0 (24.0)	6.0 (29.8)	-0.86	0.390
Peak shoulder lift	15.5 (25.5)	11.0 (32.0)	-0.57	0.567
MOS SF-36v2				
PCS	41.4 \pm 8.3	45.1 \pm 10.5	-0.86	0.403
MCS	46.2 \pm 13.5	42.3 \pm 10.2	0.71	0.486

SD = standard deviation; IQR = Interquartile range; HAART = highly active antiretroviral therapy; BMI = body mass index; MOS SF-36v2 = Medical Outcomes Study Short Form-36 version 2; PCS = physical component score; MCS = mental component score

ISOMETRIC SHOULDER LIFT STRENGTH

Both groups showed statistically significant ($p < 0.05$) improvement in average and peak shoulder lift strength by the end of week 12. Participants in the PRE group had higher mean values for the average and peak shoulder lift at the end of the study. The difference observed between groups however was not statistically significant.

DISCUSSION

To the best of our knowledge, this is the first randomised trial to explore the effects of PRE using elastic resistance bands among patients with HIV.

Using the MOS SF-36v2, a significant increase in the overall mental component score (MCS) in the comparative group was noted. No significant changes were found in the intervention group. This contrasting result was noteworthy. A possible explanation could be the exercises carried out in the comparative group, was conducted under the guidance of a trainer and performed together as a group. The social interaction among participants during these sessions could increase their mental and emotional well-being. In contrast, participants in PRE group carried out exercises at their own pace because of the varying strength of the elastic bands and adjustments designed to suit individual fitness level, thus losing out in social interaction and peer support. Similar observation was reported by Filipas et al. (2006), who noted significant improvement in health-related quality of life scores (overall health and cognitive function) in adult men with

HIV following 6 months supervised exercise programme (Fillipas et al. 2006).

An increasing trend on physical and mental component domains scores were observed in PRE group. The changes however were not statistically significant. A possible explanation could be attributed to participants' disease progression. Patients in the comparative group had a better disease stage, with 78% ($n=7$) of patients in early and mid-stage of the disease with a mean CD4 cell count = 360 ± 233 (SD) cells/mm³, whereas 70% ($n=7$) of the intervention group were in the later stages of the disease (mean CD4 count = 114 ± 269 (SD) cells/mm³). Previous study reported worse perceived mental and physical health scores (SF-36) among men with HIV who's CD4 count below 200 cells/mm³ (Bing et al. 2000).

Increasing trend in body weight, BMI and lean body mass were observed in the intervention group while the control recorded declines on these parameters. Although comparisons between and within groups did not yield significant results, there was a subtle pattern of synchrony with the expected outcomes seen in both groups. These patterns were also observed in previous PRE studies using weight machines (Bhasin et al. 2000; Grinspoon et al. 2000; Spence et al. 1990). Differences in the prescribed resistance exercise (previous studies used weight machines) and duration of the programme could explain significant improvement in physical parameters observed in previous studies (Bhasin et al. 2000; Grinspoon et al. 2000).

Both groups showed significant increases in the average and peak shoulder lift strength at the end of 12

TABLE 2. Within-group comparison of changes in self-reported health scores (MOS SF-36v2), body composition and muscle strength between week 0 and week 12, using two-way repeated measures ANOVA

	PRE		<i>p</i>	Comparative		<i>p</i>
	Baseline (SD)	Week 12 (SD)		Baseline (SD)	Week 12 (SD)	
MOS SF-36v2						
PCS	41.4 (8.3)	46.4 (9.1)	0.055	45.1 (10.5)	44.1 (8.5)	0.830
MCS	46.2(13.5)	54.0 (8.6)	0.134	42.3 (10.2)	53.8 (9.8)	0.027*
Body composition						
Weight (kg)	51.8 (8.7)	53.3 (8.0)	0.220	50.8 (6.1)	50.2 (5.4)	0.697
BMI (kg/m ²)	19.0 (2.7)	19.7 (2.7)	0.185	18.4 (1.9)	18.3 (2.2)	0.733
Lean body mass (kg)	42.8 (9.5)	44.3 (7.6)	0.981	40.6 (7.7)	39.8 (7.5)	0.770
Body fat (kg)	9.0 (3.1)	9.0 (1.8)	0.314	10.4 (2.8)	10.6 (2.9)	0.555
Muscle strength						
Average shoulder lift	17.8 (16.3)	35.6 (20.6)	0.001*	14.4 (14.9)	29.7 (20.6)	0.008*
Peak shoulder lift	20.8 (18.5)	42.8 (25.2)	0.001*	19.1 (20.3)	35.9 (23.2)	0.016*

SD = standard deviation; MOS SF-36v2 = Medical Outcomes Study Short Form-36 version 2; PCS = physical component score; MCS = mental component score; BMI = body mass index; **p*<0.05

weeks. In contrast with the current study, Spence et al. (1990) reported decrease in lower and upper limb muscle strength in their control group at the end of 6 weeks. One possible reason could be the control group in previous study did not exercise beyond their daily living activities, whereas in the current study, participants in the comparative group performed exercises that mimic the movements of the intervention group without the use of elastic bands. Hence the exercises were inevitably exercises against gravity and therefore had certain elements of resistance training, although non-progressive in nature. Additionally, strength gained by participants in the PRE groups could have been confounded by higher percentage of patients in the later stages of disease with majority treated with highly active anti-retroviral treatment (HAART). Toxic mitochondrial myopathy has been reported among patients treated with HAART which could affects muscle adaptation and function (Dalakas et al. 1990).

Few limitations in our study should be considered. First, the number of participants enrolled in this study was small because of time and financial constraints. A larger sample size could have yielded better clinical significance with higher effect size. However the minimum sample size of seven patients in each group was estimated based on previous study. Second, there was a mixture of wasted and non-wasted patients who are on different antiretroviral therapy, as well as patients at different stages of HIV infection in both groups, which, to a certain extent, may have affected the results observed. Finally, the length of intervention may have been too short as adaptation to physical activities may take longer period to occur among patients with HIV (Baigis et al. 2002).

CONCLUSION

In conclusion, our study demonstrated that both PRE using elastic resistance bands and resistance exercise against gravity has a positive effect on body composition,

improve health function and increase lift strength. These exercises should therefore be incorporated as part of total rehabilitation programme in individuals with HIV. Further studies to address the above mentioned shortcomings are needed to corroborate our preliminary findings.

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Stella Jane Joseph Rajah
Department of Sports Medicine
Cheras Rehabilitation Hospital
56000 Cheras
Selangor

*Corresponding author; email: ayip@um.edu.my

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Mohamad Shariff A. Hamid*
Unit of Sports Medicine
Faculty of Medicine
University of Malaya
50603 Kuala Lumpur
Malaysia