Feasibility and Preliminary Effects of a Telerehabilitation Program for People Living With HIV: A Pilot Randomized Study

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Abstract

We investigated feasibility and preliminary effects of telerehabilitation for people living with HIV (PLWH) and taking antiretroviral therapy. We randomized 25 PLWH to either an endurance and resistance training exercise (ERTE) group or a control group. Endurance and resistance training exercise sessions occurred in a public fitness center, with online guidance and weekly telephone advice. The primary outcome was feasibility (recruitment and retention rates and safety). Secondary outcomes were assessed at baseline and 6 weeks according to the three International Classification of Functioning, Disability, and Health domains. Nine patients completed the ERTE program. Recruitment and retention rates were 93% and 69%, respectively. No adverse events occurred. After 6 weeks, percentage change in D-dimer was lower in the ERTE group, but not significantly after the Bonferroni correction. Other parameters were not different between the groups. Therefore, telerehabilitation is feasible in PLWH taking antiretroviral therapy; however, the performance of the program is still questioned, and future research is warranted.

Key words: exercise therapy, feasibility study, HIV, telerehabilitation

Since the introduction of antiretroviral therapy (ART) in the mid-1990s, there has been a dramatic reduction in HIV-related morbidity and mortality worldwide. People living with HIV (PLWH) experience other comorbidities related to concomitant infections, the aging process, and risk factors for cardiovascular diseases and cancers (Lewden et al., 2005). Mortality is no longer driven by opportunistic infections but by comorbidities (Lewden et al., 2005; Mocroft et al., 2002). Moreover, metabolic abnormalities including diabetes, dyslipidemia, hypertension, and abdominal obesity occur commonly in PLWH and contribute to increased cardiovascular disease risk (Nix & Tien, 2014). Furthermore, many PLWH treated with the older forms of ART present with lipodystrophy, which is characterized by the redistribution of body fat from the limbs, face, and buttocks to the central region of the body (Falasca et al., 2007). These morphological changes may lead to impaired functional capacity and muscular atrophy, which may lead to disability and impaired capacities in daily life activities and social participation. Moreover, poor physical fitness has been related to a decreased quality of life (quality of life [QoL]; Erlandson, Schrack, Jankowski, Brown, & Campbell, 2014) and the physically adverse effects of ART-impaired psychosocial well-being (Mutimura, Stewart, Crowther, Yarasheski, & Cade, 2008). In addition, frailty and older age of the PLWH may also increase disability and reduce QoL.

The International Classification of Functioning, Disability, and Health (ICF) provides universal and standardized language to understand and study function, disability, and health (World Health Organization, 2001). It would be appropriate to use the ICF model and assess its three domains (body function and structure, activity, and participation and QoL) to capture all aspects of health in PLWH.

Physical exercise is considered an important intervention to reduce the risk of chronic illnesses. HIV-related disabilities have been related to a decrease in physical capacity and limitations in daily activities

Sponsorships or competing interests that may be relevant to content are disclosed at the end of this article.

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http://dx.doi.org/10.1097/JNC.0000000000000005

(Erlandson et al., 2014). Exercise training induces positive effects for the various problems of PLWH by controlling comorbidities related to treatment, disease, and physical inactivity and by improving morphological and metabolic parameters, aerobic capacity, and muscle strength (Kamitani, Sipe, Higa, Mullins, & Soares, 2017). Exercise also improves psychological well-being, social relationships, and QoL (Mutimura et al., 2008). Exercise programs incorporating both aerobic and resistance approaches may be more efficient than either modality alone, as recommended by the American College of Sports Medicine (Garber et al., 2011; Gomes-Neto, Conceicao, Carvalho, & Brites, 2013).

Most studies of PLWH have involved supervised and structured programs and have shown efficiency and feasibility (Cutrono et al., 2016; Paes Lda et al., 2015). However, time and resources to get to the hospital, expensive care, and privacy issues are often barriers for the patient. Therefore, these programs are at risk of low adherence. For these reasons, telerehabilitation, a rehabilitation program delivered remotely using telecommunication services, would be an attractive therapeutic option. The feasibility, effectiveness, and cost-effectiveness of telerehabilitation have been shown in various chronic diseases (Holland et al., 2013). Nevertheless, the impact of a telerehabilitation program on the three ICF domains for PLWH taking ART has not yet been investigated.

The aims of our pilot study were to (a) establish the feasibility of telerehabilitation in PLWH taking ART and (b) explore the preliminary effects of telerehabilitation on the three ICF domains.

Methods

Ethics Statement

Our study was approved by the regional Ethics Committee of the Cliniques universitaires Saint-Luc and Université catholique de Louvain in Brussels (B403201421520) and was registered on ClinicalTrial.gov (NCT03335176). All eligible patients provided written informed consent before participation.

Study Design and Randomization

A pilot randomized controlled study was conducted for 6 weeks. Potentially eligible patients were identified by an infectious disease specialist during an office visit at the HIV reference center of Cliniques universitaires Saint-Luc in Brussels. Potentially eligible candidates received details of the study from the research coordinator. On completion of the explanation, consenting eligible patients were randomized on a 1:1 ratio by computer-generated numbers to be allocated either to an endurance and resistance training exercise group (ERTE) or to a control group (CON).

Participants

Between November 2014 and April 2015, PLWH regularly attending the HIV reference center of Cliniques universitaires Saint-Luc in Brussels were recruited. Eligibility criteria included the following: age 18 years or older, taking ART, and a native French speaker. Participants were not eligible if they had an AIDS diagnosis, physical and/or psychiatric problems that seriously impaired physical activity, pregnant, or if they were unstable (defined by any modification of health outcomes during the past 6 months).

Intervention

Participants in the ERTE group exercised for 6 weeks (3 sessions/week) in a public fitness center. The exercise program was based on the guidelines of the American College of Sports Medicine and combined aerobic and resistance training (Garber et al., 2011). Aerobic training (50 min) consisted of a 30-min cycle ergometer (10-min warm-up period + 20 min of interval training; 1:2 at 80% and 60% maximum heart rate), a 10-min walk on a treadmill (at the speed obtained at the 6-min walk test [6MWT]), and 10-min on a rowing machine (between 70% and 80% maximum heart rate). Resistance training (25 min) of large muscle groups (back, quadriceps, and chest) was performed with three sets of 10 repetitions at 60% to 80% of the participant's estimated 1 repetition maximum.

Participants in the CON group did not receive an exercise program. They were asked not to change their lifestyle habits regarding physical activity, including not joining a physical exercise group or going to a public fitness center.

Telerehabilitation

A website with all information needed to perform the resistance training was available for participants in the ERTE group. Explication on the use of this website was provided after completing the baseline assessment. For each exercise, initial position, execution of the movement, duration of exercise, number of repetitions, and rest time were described and illustrated by a video. A physiotherapist contacted participants weekly by telephone to encourage them, to check for adverse events, and to adapt the exercise program if necessary. Patients

could also contact this physiotherapist via the website or by phone at any time.

Outcome Measures

The primary outcome was the feasibility of the telerehabilitation program, which was determined by recruitment and retention rates and safety. The recruitment rate was defined as the percentage of participants who signed informed consent out of the total number of individuals invited to participate in the study. The retention rate was considered when the patient completed the intervention and the assessments. A score above 70% was considered feasible. Safety problems were determined as any adverse events during intervention.

Secondary outcomes were assessed at baseline and after 6 weeks to evaluate preliminary effects of the telerehabilitation program on the three ICF domains (World Health Organization, 2001). All parameters were collected by the research coordinator in the Department of Physical Medicine and Rehabilitation during the same session.

Body function and structure assessments. A bioelectrical impedance analysis was used to measure weight, lean body mass, and fat body mass. Markers of inflammation and coagulation (C-reactive protein [CRP] and D-dimer), CD4+ T-cell counts, and viral loads were measured in a sample of blood.

Activity assessments. Functional walking capacity was evaluated by the distance covered during a 6MWT in a 20-m hallway. This submaximal test had been validated (Holland et al., 2014) and is a valuable measure of fitness in adult PLWH (Oursler et al., 2009). The sit and reach test and the toe touch test, reproducible and valid tools, were used to assess hamstring flexibility as previously described (Ayala, Sainz de Baranda, De Ste Croix, & Santonja, 2012). The handgrip strength tool is an easy, reliable, and valid test to measure upper limb strength (Mathiowetz, Weber, Volland, & Kashman, 1984). The Jamar dynamometer was set in the standard position (at position 3) as recommended by the American Society of Hand Therapists. Three maximal isometric contractions were recorded for each hand. Each contraction lasted 3 s and was interrupted with a 1-min rest. Grip strength was quantified as the average of three trials for each hand. The 30-s chair-stand test, a reliable and valid test, was used to assess lower body muscular strength (Jones, Rikli, & Beam, 1999). The test started with the participant seated on a chair with arms crossed over the chest and feet parallel on the floor. After familiarization, participants were then instructed to complete as many sit-to-stand cycles as possible within 30 s without the help of their upper limbs.

Participation and quality of life assessment. Quality of life was assessed with the French version of the World Health Organization Quality of Life HIV Instrument (World Health Organization [WHO]QOL-HIV; (Reychler, Caty, Vincent, Billo, & Yombi, 2013). It is a valid and reproducible self-reported questionnaire including six domains (physical, psychological, level of independence, social relationships, environment, and spirituality) covering 29 facets (157 questions in total). Each item is scored on a five-point Likert scale. The higher the score, the better the QoL. A score was calculated for each facet and domain.

Statistical Analysis

The WHOQOL-HIV was chosen as the main outcome for computing the sample size. The sample size consisted of 12 participants (6 in each group), which provided 80% power and a 5% significance level for detecting a 20% improvement in the WHOQOL-HIV. The normality of distribution was assessed by the Shapiro–Wilk test. Baseline characteristics were compared between the groups with chi-square analysis (categorical variables) and the Student *t*-test for independent samples (continuous variables) with a normal distribution. To analyze the effect of the 6-week intervention, changes within groups (before and after training) were assessed with a paired Student *t*-test or a Wilcoxon test, as appropriate. Values are presented as number (%) for categorical variables and mean ± standard deviation for continuous normally distributed variables or median (Q1–Q3) for non-normally distributed variables. Percentage change differences (Δ = [post − pre]/pre × 100) between the groups for body composition, inflammation and coagulation markers, and physical fitness and change differences (post − pre) of the WHOQOL-HIV were assessed with independent Student *t*-tests or Mann–Whitney tests. Values are expressed as mean (95% confidence interval) and median (95% confidence interval), respectively. Significance level was set at $p = .05$. The Bonferroni correction was used for multiple comparisons, and the alpha level was accordingly adjusted (.0025). SPSS 24 (IBM Corporation, Armonk, NY) was used for all analyses.

Results

Participants and Feasibility

A total of 27 patients were approached to participate in the study, of which 25 patients provided consent and were randomized (recruitment rate = 93% [83.4–100%], Figure 1). Eight patients failed to complete the study (four [F1]

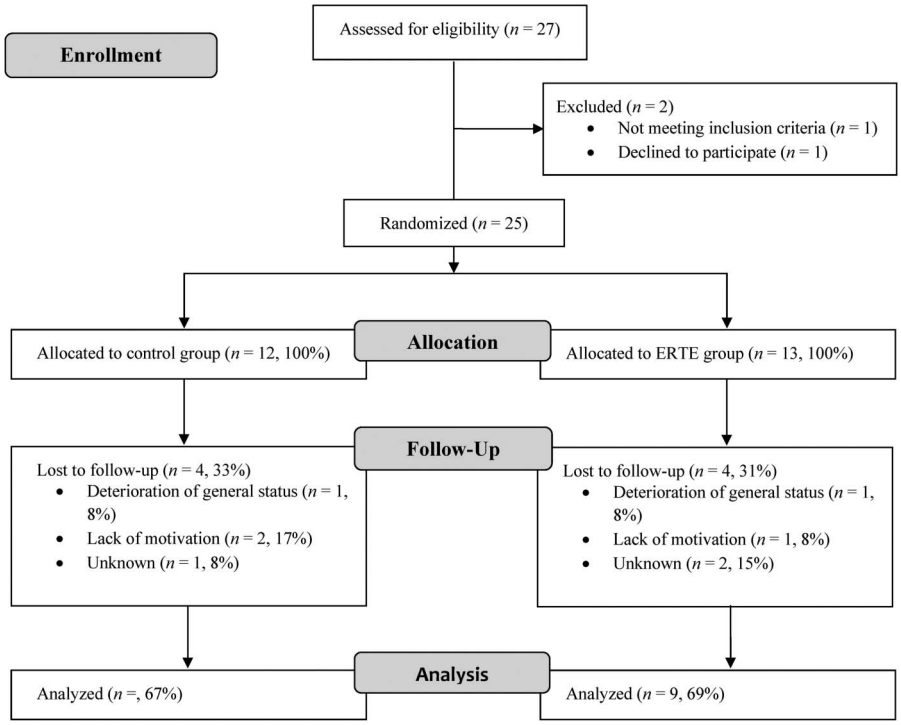

Figure 1. Flowchart showing a summary of participant recruitment, retention, and analysis.

from the ERTE group and four from the CON group). Reasons for dropout are listed in Figure 1. Therefore, a total of 17 patients completed the study. Nine patients in the ERTE group completed the intervention and the postintervention assessment (retention rate = 69% [43.9–94.1%]), and eight patients in the CON group were assessed after 6 weeks. No adverse events due to the intervention were recorded.

Baseline Characteristics

Sociodemographic variables and HIV-related information of the participants were comparable between the groups (Table 1). The ERTE and CON groups were comparable for body composition, inflammation and coagulation markers, physical fitness, and the WHOQOL-HIV questionnaire at baseline, except that participants in the ERTE group had a higher body mass index (BMI), a higher score on the 30-s chair-stand test (Table 2), and a lower score on the spirituality domain of the WHOQOL-HIV than the CON group (Table 3).

Results After 6 Weeks

No significant differences between the groups were observed in BMI, fat body mass, or lean body mass (Table 2). Body mass index was slightly, but not significantly, higher after 6 weeks in the CON group ($p = .043$, significance level = .0025 after the Bonferroni correction). Within and between the groups, CD4+ T-cell count and CRP were not significantly different ($p > .05$). Similarly, percentage change in D-dimer was lower in the ERTE group compared with the CON group, but not significant after the Bonferroni correction ($p = .036$). There was no significant difference of the intervention on physical fitness between the groups or in each group. For all WHOQOL-HIV domains, participant values worsened from baseline and decreased slightly, but not significantly, within both groups. After 6 weeks, we were not able to confirm change in any specific domain.

Discussion

We assessed the feasibility and preliminary effects of ERTE on PLWH taking ART in the setting of telerehabilitation. Studies of other chronic diseases have shown the feasibility of this program (Holland et al., 2013). However, our study was the first to examine a telerehabilitation approach in PLWH. Our results confirm the feasibility of telerehabilitation in this specific context. The recruitment rate was high (93% [83.4–100%]), and nine patients completed the ERTE program and were assessed after the intervention (retention rate = 69% [43.9–94.1%]). The reasons why

Table 1. Sociodemographic Variables and HIV-related Information of the Sample ($N = 17$)

Variable	ERTE Group ($n = 9$)	Control Group ($n = 8$)	p-Value
Gender			.858
Male	6 (66.7)	5 (62.5)	
Female	3 (33.3)	3 (37.5)	
Age, years	47.2 ± 10.6	46.1 ± 11.4	.841
Viral load < 40 copies/mL	7 (77.8)	6 (75.0)	.685
Education			.141
Primary school	0 (0)	1 (12.5)	
Secondary school	3 (33.3)	5 (62.5)	
Second cycle	4 (44.4)	0 (0)	
Third cycle	2 (22.2)	2 (25.0)	
Marital status			.257
Unmarried	5 (55.6)	2 (25.0)	
Married/co-habiting	1 (11.1)	4 (50.0)	
Separated/divorced	2 (22.2)	2 (25.0)	
Widowed	1 (11.1)	0 (0)	
Health status			.560
Poor	1 (11.1)	0 (0)	
Neither good nor poor	3 (33.3)	3 (37.5)	
Good	4 (44.4)	5 (62.5)	
Very good	1 (11.1)	0 (0)	
HIV status			.624
Asymptomatic	7 (77.8)	7 (87.5)	
Symptomatic	2 (22.2)	1 (12.5)	
Route of infection			.854
Sexual intercourse with a man	6 (66.7)	4 (50.0)	
Drug use	1 (11.1)	1 (12.5)	
Blood contamination	1 (11.1)	1 (12.5)	
Other	1 (11.1)	2 (25.0)	

Note. ERTE = endurance and resistance training exercise. Values are presented as mean ± standard deviation for continuous variables and number (%) for categorical variables.

patients failed to complete the intervention were a deterioration of general status ($n = 1$), lack of motivation ($n = 2$), and unknown ($n = 1$). Finally, safety was indicated because no patient reported any adverse events. Telerehabilitation can be a key strategy to increase access to exercise programs and improve HIV along the care continuum.

The ICF is a relevant model to capture all facets of health among PLWH. Our results did not show any effect on the body function and structure domain, maybe partially resulting from the post hoc conservative Bonferroni correction. For the potential effect of ERTE, we expected the D-dimer change because the D-dimer level decreased in another study after a 16-week exercise program (Bonato et al., 2017). The D-dimer level has been shown to be elevated in PLWH and significantly associated with the severity of cardiovascular disease (Neuhaus et al., 2010). The Strategies for the Management of Antiretroviral Therapy (SMART) study reported that elevated D-dimer levels were predictive of all-cause mortality (Kuller et al., 2008) and cardiovascular events (Duprez et al., 2012) in PLWH. There was a 2.14-fold greater risk of cardiovascular events in SMART patients within the highest quartile of D-dimer levels compared with the risk in patients within the lowest quartile (Duprez et al., 2012). When D-dimer levels in uninfected donors in the Multi-Ethnic Study of Atherosclerosis and levels from participants in SMART were compared, patients from SMART had D-dimer levels that were nearly twice as high as the levels found in patients from the Multi-Ethnic Study of Atherosclerosis, compatible with increased ongoing coagulation in PLWH (Neuhaus et al., 2010). Physical activity programs that reduce D-dimer concentration should be, therefore, implemented systematically in the management of patients with HIV to reduce the increased risk of death attributable to a high D-dimer level. AQ:2

Although D-dimer may predict overall morbidity in PLWH, it is an incomplete assessment of the coagulation profile (Funderburg & Lederman, 2014). The inflammatory profile can be measured with CRP, a proinflammatory mark that increases over time in PLWH (Lau et al., 2006). Similar to D-dimer levels, the baseline plasma level of CRP has been strongly related to all-cause mortality and to the risk of cardiovascular disease (Duprez et al., 2012). In our study, the CRP level was not different after intervention as shown in Cutrono et al. (2016). We can hypothesize that a longer exercise program or higher intensity during the aerobic component is necessary to have an impact on systemic inflammation. AQ:3

Immunological markers such as the CD4+ T-cell count provide information about HIV prognosis, but are

Table 2. Body Function and Structure and Activity Assessments at Baseline and at 6 Weeks

Variable	ERTE Group				Control Group				*p*-Value, Baseline, Between Groups	*p*-Value, Δ, Between Groups
	Baseline	Week-6	Δ (95% CI)	*p*-Value	Baseline	Week-6	Δ (95% CI)	*p*-Value		
Body function and structure										
BMI (kg/m^2)	27.8 [26.8; 31.4]	28.2 [26.9–31.5]	.9 (−0.3; 2.0)	.110	25.9 [23.6; 26.5]	26.4 [25.0–27.4]	2.8 (0.0; 5.6)	.043	.015	.157
Fat body mass (kg)	28.9 [25.7; 49.3]	34.3 ± 15.3	−2.8 (−13.6; 8.0)	.917	31.0 [26.7; 39.2]	32.5 ± 8.1	2.21 (−4.7; 9.1)	.400	1.000	.359
Lean body mass (kg)	32.3 [21.7; 34.6]	34.1 [19.7–36.0]	−0.9 [−12.4; 12.4]	.735	31.0 [24.8; 34.9]	32.1 [25.2–34.3]	−0.3 [−34.0; 32.2]	.612	.867	.902
CD4+ T-cell count (cells/mm^3)	679.8 ± 267.5	746.4 ± 201.7	6.7 [−93.4; 106.8]	.148	592.0 ± 214.8	612.5 ± 200.3	4.2 [−30.4; 38.7]	.616	.515	.529
CRP (mg/L)	2.0 [1.0; 5.5]	3.0 [1.5–4.5]	.0 [−349.1; 349.1]	.750	1.5 [1.0; 2.3]	2.0 [1.0–3.0]	25.0 [−123.7; 173.7]	.317	.272	.607
D-dimer (ng/mL)	275.0 [250.0; 544.5]	250.0 [250.0–402.8]	−9.1 [−89.7; 71.5]	.068	416.5 [258.3; 511.8]	464.5 [258.3–526.5]	4.4 [−30.5; 39.4]	.465	.607	.036
Activity										
6MWD (m)	545.9 ± 100.7	596.7 ± 121.8	10.0 (−2.7; 22.7)	.096	505.1 ± 85.2	593.8 ± 138.0	17.5 (3.6; 31.5)	.030	.385	.365
Sit and reach test (cm)	3.6 ± 6.6	3.7 ± 6.6	.0 [−318.0; 318.0]	.653	1.4 ± 5.0	1.3 ± 5.0	.0 [−322.6; 322.6]	.139	.439	.743
Toe touch test (cm)	4.3 ± 7.3	4.3 ± 7.0	.0 [−304.1; 304.1]	1.000	2.8 ± 5.2	2.9 ± 5.1	.0 [−96.2; 96.2]	.844	.644	.758
30-s chair-stand test (number)	24.6 ± 4.9	25.6 ± 8.4	5.2 (−23.0; 33.5)	.698	19.6 ± 3.9	21.3 ± 6.2	7.9 (−10.4; 26.3)	.303	.037	.858
Right hand grip strength (kg)	32.3 ± 14.2	33.3 ± 14.0	5.4 (−5.5; 16.4)	.458	32.1 ± 9.1	30.9 ± 10.1	−3.1 (−17.8; 11.5)	.590	.961	.285
Left hand grip strength (kg)	29.5 ± 12.6	28.1 ± 12.9	−3.3 (−21.9; 15.4)	.561	33.8 ± 8.0	29.2 ± 8.7	−14.2 (−24.8;−3.5)	.019	.413	.272

Note. CI = confidence interval; CRP = C-reactive protein; BMI = body mass index; ERTE = endurance and resistance training exercise; 6MWD = 6-minute walk distance. Values are presented as mean ± standard deviation and mean (95% CI) for normally distributed data and median (Q1–Q3) and median (95% CI) for non-normally distributed data.

Table 3. Participation and Quality of Life Assessment With the WHOQOL-HIV Questionnaire at Baseline and at 6 Weeks

Domains	ERTE Group				Control Group				*P*-Value, Baseline, Between Groups	*P*-Value, Change, Between Groups
	Baseline	Week-6	Change (95% CI)	*P*-Value	Baseline	Week-6	Change (95% CI)	*P*-Value		
Physical	71.0 ± 9.1	60.0 [51.0; 69.5]	−8.5 [−15.3; −1.7]	.027	77.6 ± 11.5	66.0 [65.0; 69.0]	−12.1 [−20.8; −3.5]	.028	.252	.435
Psychological	97.0 [91.5; 118.0]	69.6 ± 21.7	−33.0 [−58.1; −7.9]	.012	116.0 [112.0; 117.0]	75.4 ± 5.5	−38.0 [−54.5; −21.5]	.018	.408	.779
Level of independence	70.3 ± 14.8	55.5 [51.0; 64.5]	−11.6 [−20.1; −3.2]	.017	77.3 ± 11.1	61.0 [56.0; 63.0]	−17,6 [−26.6; −8.5]	.018	.319	.270
Social relationships	72.4 ± 8.6	55.8 ± 7.2	−16.3 [−21.8; −10.7]	.000	73.0 ± 7.9	62.1 ± 5.7	−10.9 [−15.2; −6.5]	.001	.896	.099
Environment	164.0 [136.0; 169.5]	116.0 [99.8; 136.0]	−36.4 [−46.1; −26.7]	.012	161.0 [153.0; 169.0]	127.0 [125.0; 136.0]	−33,9 [−39.5; −28.2]	.018	1.000	.617
Spirituality	66.8 ± 5.8	61.5 ± 3.9	−4.1 [−8.2; −0.1]	.046	79.6 ± 9.3	61.0 ± 5.5	−18,6 [−28.9; −8.2]	.005	.005	.005
Overall QoL and general health perception	21.9 ± 2.9	18.0 [16.3; 20.0]	−3.6 [−5.7; −1.5]	.020	24.3 ± 1.7	20.0 [15.0; 21.0]	−5,3 [−8.6; −1.7]	.016	.055	.353

Note. CI = confidence interval; ERTE = endurance and resistance training exercise; QoL = quality of life. Values are presented as mean ± standard deviation and mean (95% CI) for normally distributed data and median (Q1–Q3) and median (95% CI) for non-normally distributed data.

also related to HIV-related illness and mortality (Hogg et al., 2001). Our results showed no significant improvements in CD4+ T-cell counts. This result was consistent with studies that incorporated endurance and resistance training (Dolan et al., 2006; Gomes, Borges, Lima, & Farinatti, 2010). In our participants, mean BMI was increased at baseline, indicating overweight (27.8 vs. 25.9 kg/m^2 for the ERTE group and for the CON group, respectively); 82% of the participants were classified as overweight (including obese), and 24% were classified as obese. These results suggested that PLWH taking ART are often overweight/obese (Crum-Cianflone, Tejidor, Medina, Barahona, & Ganesan, 2008). Nevertheless, the percentage of patients who were already overweight or obese at the time of HIV diagnosis was unknown. This high proportion of overweight might have influenced our results. The excellent recruitment rate observed in our study could be explained by the motivation of these patients to lose weight in addition to other benefits of exercise on the side effects of ART. On the other hand, the retention rate could have been influenced by the difficulties faced by these overweight people to undertake physical activity. Studies have shown lower retention rates ranging from 45% to 61% in PLWH (Amorosa et al., 2005; Boodram et al., 2009; Crum-Cianflone et al., 2008; Tate et al., 2012). Although BMI did not show significant changes in our ERTE group, a slight decrease in fat body mass was observed. Since the introduction of ART, especially with protease inhibitors, PLWH have been at high risk to accumulate visceral fat and, consequently, are at greater risk to develop metabolic abnormalities associated with cardiovascular disease and diabetes.

Our ERTE program followed the recommendations established by the American College of Sports Medicine; it has been established that an exercise program incorporating both aerobic and resistance approaches may be more efficient in improving functional status than either modality alone in PLWH (Gomes-Neto et al., 2013). Aerobic training is the most effective method to increase cardiorespiratory fitness. Resistance training enhances the beneficial effects of aerobic training by optimizing the oxidative capacity of the muscle. A meta-analysis has reported that PLWH have low cardiorespiratory fitness compared with the general population, which is a strong predictor of cardiovascular diseases and premature mortality in this population (Vancampfort et al., 2016). In addition, resistance training decreases adverse events of ART, including muscular atrophy and lipodystrophy. Therefore, it seems essential to incorporate both components in an exercise program.

After 6 weeks of ERTE, the results of the activity domain within and between the groups were not statistically different. Compared with our results, Cobbing, Hanass-Hancock, and Myezwa (2016) did not find any significant difference between the groups for the 6MWT. On the other hand, Dolan et al. (2006), who studied a home-based supervised aerobic and resistance training in 40 women for 16 weeks, showed a significant improvement in cardiorespiratory fitness, functional fitness, and strength in patients assigned to the intervention group. The Participation and QoL domains were assessed using the French version of the WHOQOL-HIV (Reychler et al., 2013). The ERTE and CON groups were not statistically different at baseline for any domain with the exception of a tendency in the spirituality domain ($p = .005$). However, a previous study reported that spirituality domains might be less important for PLWH than other components of the QoL (Canavarro, Pereira, Simoes, & Pintassilgo, 2011).

After 6 weeks in our study, no changes in any domain were significantly different between the groups. Other studies have examined the effect of aerobic and resistance training on outcomes related to QoL (Fillipas, Oldmeadow, Bailey, & Cherry, 2006; Mutimura et al., 2008). Mutimura et al. (2008) used the WHOQOL-BREF, whereas Fillipas et al. (2006) measured HRQoL with the Medical Outcomes Study HIV Health Survey. Both studies showed statistically significant improvement on QoL for PLWH in the intervention group compared with the CON group. Some explanations could underlie these results. First, participants also improved their physical fitness in these studies while we did not observe any impact on body composition and physical fitness. Second, a nonsupervised program in a fitness center did not seem to meet the expectations of patients. Patient desire to perform the exercise program was important because the program was time consuming and required adaptations to their daily lives. In addition, we did not include pain in our outcome measure, and it has been reported that pain contributes to a decrease in QoL (da Silva et al., 2017)

Some hypotheses could explain the lack of significant results on the three WHO-ICF domains. First, the study included a small sample size that limited definitive conclusions on the effects of the ERTE program in the setting of telerehabilitation. Nevertheless, our preliminary results warrant further investigation. Second, delivering a program in a public fitness center may offer the advantage that the exercise program could be carried out at any time of the day. However, risk of stigma from other gym attendees can be difficult for PLWH. Change in body composition may divulge a person's serostatus,

resulting in stigmatization and a negative impact on psychological well-being (Reynolds, Neidig, Wu, Gifford, & Holmes, 2006). Therefore, future studies should explore other telesupervised settings to resolve this problem (e.g., home based). Third, the length of our exercise intervention may have been too short. Most studies have an application period of at least 12 weeks (Gomes-Neto, Ogalha, Andrade, & Brites, 2013). Nevertheless, one study recommended a combination of endurance and resistance for at least 6 weeks to improve cardiovascular, metabolic, and muscle function in PLWH (Yahiaoui, McGough, & Voss, 2012). Fourth, the lack of encouragement from a patient's family and friends and the low belief in physical activities may have affected the ability to participate in the ERTE program. Fifth, physical activity level was not taken into account in randomization and could be considered a confounding factor. However, PLWH are increasingly less involved in physical activity (Frantz & Murenzi, 2013). Finally, phone calls, a subjective measure, were used to ensure that patients followed the ERTE program properly. In future studies, adherence should be measured with a tool that has the ability to objectively record the patient's session. For instance, the patient could wear a heart monitor that has the advantage of recording the patient's mean heart rate. In addition, the patient could self-monitor his/her effort during the session.

Conclusions

Telerehabilitation based on ERTE was feasible in most PLWH in our study. However, the performance of the program still needs to be questioned. Further research on telerehabilitation programs with a larger sample and a longer duration of intervention are needed to determine the exact benefits of such programs. Moreover, studies comparing telerehabilitation with other settings (e.g., traditional center–based rehabilitation program, home-based rehabilitation program) are also required.

Key Considerations

- ❍ Telerehabilitation, a rehabilitation program delivered remotely on telecommunication services, is feasible for people living with HIV infection.
- ❍ Telerehabilitation, by circumventing barriers such as travel distance, poor timing, and financial aspects, can be a key strategy to increase access to exercise programs and delay progress through the HIV care continuum.
- ❍ Health care providers should encourage the practice of physical exercise in patients living with HIV and taking antiretroviral therapy to promote health and quality of life.

Disclosures

The authors report no real or perceived vested interests that relate to this article that could be construed as a conflict of interest.

Acknowledgments

The authors thank Deleu Gaetane, Janvier Chloé, and Scieur Charlotte for their help recruiting patients.

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