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ORIGINAL RESEARCH

Knee extension and flexion strength asymmetry in HIV-positive subjects: a cross-sectional study

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Strength imbalance;
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Abstract
Background: HIV-positive subjects present impairment in muscle function, neural activation, balance, and gait. In other populations, all of these factors have been associated with muscle strength asymmetry.
Objective: To investigate the existence of muscle strength asymmetry between dominant (D) and non-dominant (ND) lower limbs and to determine the hamstrings-to-quadriceps strength ratio in HIV-positive subjects.
Methods: In this cross-sectional study, 48 HIV-positive subjects were included (22 men and 26 women; mean age 44.6 years), all of them under highly active antiretroviral therapy. They performed isokinetic strength efforts at speeds of 60°/s and 180°/s for knee extension and flexion in concentric-concentric mode.
Results: Peak torque was higher ($p < 0.01$) at 60°/s for quadriceps (193, SD = 57 vs. 173, SD = 55% body mass) and hamstrings (97, SD = 36 vs. 90, SD = 37% body mass) in D compared to ND. Similarly, peak torque was higher at 180°/s (quadriceps 128, SD = 44 vs. 112, SD = 42; hamstrings 64, SD = 24 vs. 57, SD = 26% body mass) in D. Average power was also higher for all muscle groups and speeds, comparing D with ND. The hamstrings-to-quadriceps ratio at 60°/s was 0.50 for D and 0.52 for ND, and at 180°/s, it was 0.51 for both limbs, with no significant difference between them. The percentage of subjects with strength asymmetry ranged from 46 to 58%, depending upon muscle group and speed analyzed.
Conclusion: HIV-positive subjects present muscle strength asymmetry between lower limbs, assessed through isokinetic dynamometry.

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Introduction

The human immunodeficiency virus (HIV) attacks the immune system of its host and may cause acquired immunodeficiency syndrome (AIDS). However, the course of the HIV infection changed dramatically with the introduction of highly active antiretroviral therapy (HAART), which reduced patient mortality and morbidity and transitioned AIDS from an acute to a chronic disease.[1] In a 2010 study, an examination of the specific causes of mortality in HIV-positive patients found that only 49.5% of deaths were AIDS-related, and the proportion of deaths classified as AIDS-related decreased with increasing duration of HAART.[2] In contrast, HAART promotes several adverse effects, such as muscle atrophy, weight loss, and neurological dysfunction, which can lead to decreased muscle strength and functional capacity,[3,4] and negatively influences the treatment and quality of life of HIV-positive subjects.[5]

Van As et al.[6] studied 45 South African HIV-positive subjects and reported that 27% of the subjects presented diminished muscle power. Richert et al.[7] analyzed the French Agency for AIDS and Hepatitis Research CO3 Aquitaine Cohort ($n = 324$) and demonstrated that 50% of the HIV-positive subjects had poor performance on locomotor tests related to balance, aerobic endurance, and lower limb muscle strength, when compared to data established from the general population. In addition to the reduced muscle strength, a high percentage of HIV-positive subjects experience different types of neuropathies[8] and impaired neuromuscular activation. Scott et al.[9] demonstrated that decreased strength is associated with low muscle activation and not with muscle thickness in HIV-positive subjects submitted to HAART.

Muscle weakness, neurological dysfunction, and frailty index have been associated with muscle strength asymmetry[10–14] in several populations including Parkinson's disease,[14] aging[10], multiple sclerosis,[12] and traumatic brain injury.[11] It has been established that force asymmetry in joints or extremities can lead to improper control of body movement and postural instability, being predictive of poorer balance and a more asymmetric gait[11,15] and related to occurrence of injuries.[16–18] When detected early, muscle strength asymmetry may predict locomotor impairment and frailty[10]; however, to the best of our knowledge, there are no studies that evaluated the occurrence of muscle strength asymmetry in HIV-positive subjects. Therefore, the aim of this study was to investigate the existence of muscle strength asymmetry between dominant (D) and non-dominant (ND) lower limbs and to determine the hamstrings-to-quadriceps strength ratio (H:Q ratio) in HIV-positive subjects. Since HIV infection is associated with muscle weakness[6] and neurological dysfunction,[9] we hypothesized that this population presents some degree of muscle strength asymmetry between limbs.

Methods

Research design

A cross-sectional study was designed to measure lower limb muscle strength through isokinetic evaluation of knee extension and flexion. Each leg was tested on a dynamometer to determine muscle strength asymmetry between the D and ND lower limbs and between hamstrings and quadriceps muscles. Leg dominance was determined by asking the subjects which leg they preferred to use to kick a ball or to perform any other motor task. Procedures were conducted in two separate visits, the first to familiarize subjects with the equipment and the second to familiarize them with the testing procedures.

Table 1 General characteristics and clinical parameters of the sample.

Variables	HIV-positive ($n = 48$)
Age (years)	44.6 (7.4)
BMI (kg/m²)	26.2 (5.9)
Time since HIV diagnosis (years)	13.1 (5.7)
Time of HAART use (years)	11.3 (5.4)
CD4+ lymphocytes (cells/mm³)	693.3 (423.1)
CD8+ lymphocytes (cells/mm³)	1059.3 (573.2)
HIV viral load	
Undetectable	32 (66.7%)
40–5000 copies/mL	13 (27.1%)
>5000 copies/mL	3 (6.2%)
HAART regimen composition	
NRTI + NNRTI	17 (35.4%)
NRTI + PI	22 (45.8%)
Other drug classes	9 (18.8%)

BMI, body mass index; HIV, human immunodeficiency virus; HAART, highly active antiretroviral therapy; NRTI, nucleoside reverse transcriptase inhibitor; NNRTI, non-nucleoside reverse transcriptase inhibitor; PI, protease inhibitor. Data for age, BMI, time, and lymphocyte counts are presented as mean (SD).

Subjects

Forty-eight HIV-positive subjects (22 men and 26 women, mean age 44.6, SD = 7.4 years, body mass index 26.2, SD = 5.9 kg/m²) were enrolled in the study. Subjects were recruited at Hospital das Clínicas da Universidade Estadual de Londrina and Centro Integrado de Doenças Infecciosas, Londrina, PR, Brazil. To be included in the study, the subjects should be aged 18–60, undergoing HAART for at least one year, not involved in any exercise program in the last six months, not taking hormones or anabolic steroids, and not presenting systemic infection (e.g., influenza, pneumonia, throat infection) within 30 days prior to the start of testing, and not having any other medical contraindication. The general characteristics and clinical parameters of the sample are presented in Table 1.

The study was conducted at Universidade Estadual de Londrina (UEL), Londrina, PR, Brazil, and was initiated only after approval by the Human Research Ethics Committee of this university (protocol number 349512) from August 12, 2013. Subject participation was voluntary and all procedures took place after they signed an informed consent form.

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