



Benefits of inspiratory muscle training under indirect home supervision in patients with human T-cell lymphotropic virus type 1

Benefícios do treinamento muscular inspiratório sob supervisão indireta domiciliar em pacientes com vírus linfotrópico de células T humana tipo 1

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Abstract

Introduction: The presence of human T-cell lymphotropic virus type 1 (HTLV-1) associated with neuropathy (myelopathy/tropical spastic paraparesis - HAM/TSP), can generate morphological and functional changes in the respiratory system. As a preventive therapeutic possibility for respiratory dysfunctions, it is expected that the already conceptualized inspiratory muscle training, when performed at home, can be a therapeutic resource that favors adherence to treatment. **Objective:** To evaluate respiratory muscle strength in patients with HTLV-1 after participating in a home respiratory muscle training protocol under indirect supervision. **Method:** This was a clinical, longitudinal, prospective, quantitative, and single-center trial approved by the Research Ethics Committee of the State University of Pará, opinion no. 2.695.505 and registered in clinical trials NCT03829709. Six HTLV-1 patients participated in a 5-week home respiratory muscle training protocol lasting 30 minutes daily through a linear load inspiratory muscle trainer. For the characterization of the imposed load, they were submitted to manovacuometry during pre (T0), peri (T3), and post (T5) treatment. Results: Six individuals completed the program, of which 83.33% were female and

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16.66% male. With the application of respiratory muscle training, it was possible to achieve a significant increase ($p < 0.011$) of the maximum inspiratory pressure as shown when comparing T0 (66.8 ± 12.58) to T5 (115.08 ± 31.78). **Conclusion:** This study identified an increase in inspiratory muscle strength after HTLV-1 patients participated in a home muscle training protocol under indirect supervision.

Keywords: Human T-lymphotropic Virus 1. Physiotherapy. Respiratory Muscles. Tropical Spastic Paraparesis.

Resumo

Introdução: A presença do vírus linfotrópico de células T humana do tipo 1 (HTLV-1) associado à neuropatia (Paraparesia Espástica Tropical/Mielopatia - PET/MAH) pode gerar alterações morfológicas e funcionais no sistema respiratório. Como possibilidade terapêutica preventiva para disfunções respiratórias, vislumbra-se que o treinamento muscular inspiratório já conceituado, possa a nível domiciliar ser uma ferramenta terapêutica que favoreça a adesão ao tratamento. **Objetivo:** Avaliar a força muscular respiratória diante de um protocolo de treinamento muscular respiratório domiciliar, sob supervisão indireta em portadores do HTLV-1. **Método:** Estudo clínico, longitudinal, prospectivo, quantitativo e de centro único, aprovado pelo Comitê de Ética em Pesquisa da Universidade do Estado do Pará, parecer no. 2.695.505 e registrado no Clinical Trials NCT03829709. Seis pacientes com HTLV-1 participaram de um protocolo de treinamento muscular respiratório domiciliar por 5 semanas com duração de 30 minutos diários por meio de um treinador muscular inspiratório de carga linear. Para a caracterização da carga imposta, os mesmos foram submetidos a manovacuometria, pré (T0), peri (T3) e pós (T5) tratamento. **Resultados:** Seis indivíduos completaram o programa, dos quais 83.33% eram do sexo feminino e 16.66% do sexo masculino. Com a aplicação do treinamento muscular respiratório foi possível obter um aumento significativo ($p < 0,011$) da pressão inspiratória máxima ao comparar T0 (66.8 ± 12.58) ao T5 (115.08 ± 31.78). **Conclusão:** Este estudo identificou um aumento na força muscular inspiratória após pacientes com HTLV-1 participarem de um protocolo de treinamento muscular domiciliar sob supervisão indireta.

Palavras-chave: Vírus Linfotrópico T Humano 1. Fisioterapia. Músculos Respiratórios. Paraparesia Espástica Tropical.

Introduction

The silent contamination by the human T-cell lymphotropic virus type 1 (HTLV-1) which has as vectors sexual intercourse, contact with objects contaminated by infected blood, and vertically, passed from mother to child, has already infected 2.5 million people nationally, being the North and Northeast regions the most affected [1,2].

Most people infected with HTLV-1 remain asymptomatic throughout life, while 2-5% may present adult T-cell leukemia (ATL) and 0.25-3.8% may develop HTLV-1-associated myelopathy/tropical spastic paraparesis (HAM/TSP) [3].

When its manifestations are triggered, HTLV-1 acts by altering the immune response of the host, making it susceptible to several infections, for example, HAM/

TSP [4]. This condition consists of chronic progressive myelopathy caused by HTLV-1 that females with high antibody titers and high proviral load are more likely to develop [5]. It is a deep chronic inflammation, of slow and progressive onset, and it is possible to observe cases of fast evolution or even improvement, but not of cure. This chronic inflammation is localized in the spinal cord, although the spread is often more extensive [6].

During the evolution of this condition, weakness of the lower limbs and muscle stiffening can be observed, causing spasticity, with chronic evolution causing difficulties with ambulation, disorders in sphincter control, sexual dysfunction, depletion of sensory signs, and functional loss of the lower limbs resulting from the involvement of motor axons [7,8].

Furthermore, within the possible complications of HAM/TSP, morphological and functional changes in the respiratory system resulting from an inflammatory process triggered by the virus, which develops lymphocytic infiltration and release of cytokines and chemokines that are harmful to lung tissue, can lead to bronchiectasis, pleural thickening, and pulmonary scars [9], in addition to motor changes, generating weakness and spasticity of the respiratory muscles. Thus, the need to perform pulmonary rehabilitation is justified, focusing on strengthening respiratory muscles in order to ensure ventilatory stability and uptake of oxygen to the body [10,11].

Within this context, the prescription of inspiratory muscle training (IMT) is important, as it aims to improve inspiratory muscle function, dyspnea, and exercise tolerance, attaining improvements in inspiratory muscle strength and endurance, and functional exercise capacity, as well as preventing pulmonary complication, and reducing peripheral and respiratory muscle fatigue with greater ventilation efficiency and a longer period of oxygen absorption [12,13].

Therefore, the treatment routine is important, both to minimize and prevent complications. In clinical practice, there is a high non-compliance to treatment which can be caused by multiple factors, such as financial conditions, illness, lack of family support, and even denial of diagnosis [14]. Reflecting on this situation, Moura [15] advocates the benefits of home treatment as a way to ensure continuity of treatment, since it presents greater convenience and does not require moving the patient.

Among the therapeutic possibilities, pulmonary rehabilitation stands out in respiratory muscle training and could be proficient when HTLV-1 is present, as well as for increasing ventilation, muscle strength, prevention of pulmonary complications, and reduction of hospitalizations [7,10]. Therefore, the aim of this study is to verify the influence of a home respiratory muscle training protocol, under indirect supervision, on the respiratory muscle strength of HTLV-1 patients.

Method

This is a clinical, longitudinal, prospective, quantitative, and single-center trial. Approved by the Research Ethics Committee of the State University of Pará, opinion no. 2.695.505 and registered in *clinical trials* NCT03829709. Volunteers of both genders aged 40 years or older, with HTLV-1 positive serology with definitive or probable HAM/TSP and who signed an informed consent form were included in the study. Exclusion criteria were pulmonary diseases, cognitive alterations, and severe comorbidities, such as heart disease and uncontrolled arterial hypertension, that could prevent the application of the protocol.

From the sample universe of 30 HTLV-1 patients registered at the Laboratory of Studies in Functional Rehabilitation (LAERF) of the Federal University of Pará, six patients completed the therapeutic proposal as shown in Figure 1.

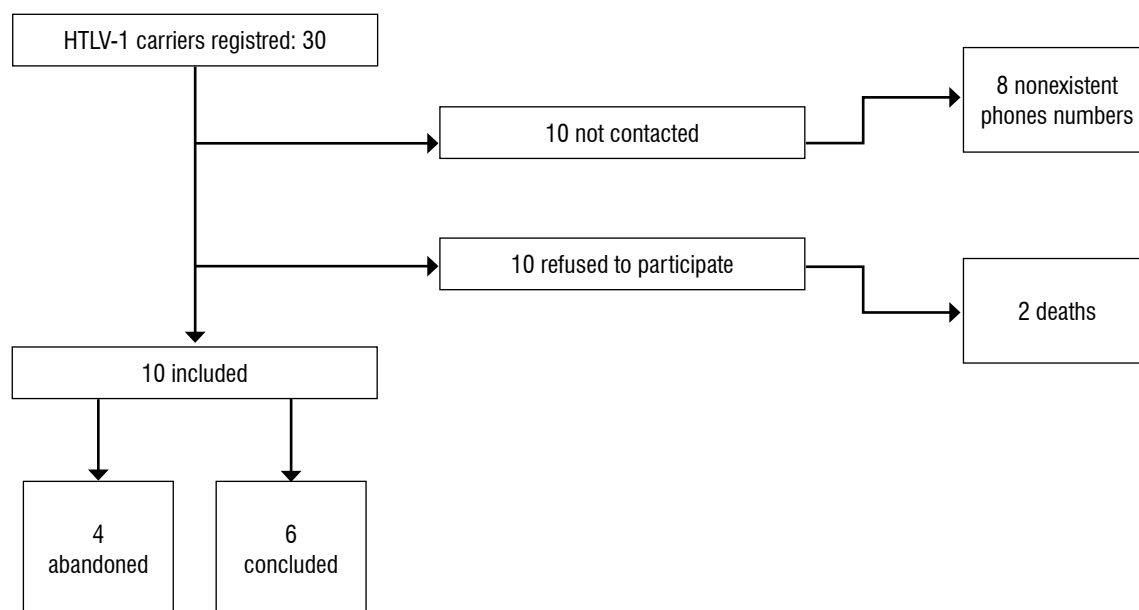


Figure 1 - Flowchart of inclusion/exclusion of HTLV-1 carriers in the study. Belém/PA, 2018-2019.

The primary aim of the evaluation was to analyze the overall health status of the patient, followed by a physiotherapeutic evaluation more directed to respiratory function. Respiratory muscle strength was evaluated by measuring maximal inspiratory pressure (MIP) using the GlobalMed® digital manovacuometer (+/- 300cm-H₂O - Porto Alegre - RS, Brazil), adopting theoretical values predicted by Neder et al. [16].

To measure MIP, which refers to the strength of the inspiratory muscles, volunteers were positioned in a chair with backrest. The manovacuometer was placed in an intraoral position using a mouthpiece with the nasal cavity sealed by a clip. The technique of measuring MIP consists of requesting the subject to make an inspiratory effort up to the total lung capacity (TLC), from the residual volume (RV), and recording the measurement by simply occluding the manovacuometer orifice. The measurement techniques were repeated until completing three (3) satisfactory measurements of MIP with a variation of up to 10% between them. The rest interval between each respiratory effort was one minute.

The technique consisted of a total of 45 ventilatory cycles administered orally through the linear resistance device, each being sustained for 10 seconds. The rest time was followed by 30 seconds between each cycle totaling an average duration of 30 minutes. The respiratory muscle training (RMT) occurred three times a week, on interspersed days, for five weeks, totaling 15 sessions [17].

The first training session of each week was held at LAERF under the direct supervision of the researcher and the home training sessions under distance supervision by the researcher. Participants received the Threshold IMT® linear load device and orientations regarding the proper hygiene of the instrument and its correct functioning. The Threshold IMT® device should be used sitting in a chair, upright column with feet well-supported, in front of a table for elbow support, and with nasal clip in place to perform the ventilatory cycle orally. A costo-diaphragmatic ventilatory pattern should be adopted throughout the training.

The initial training load for each participant was adjusted at 25% of MIP. Participants were trained to do the exercise program on their own at home. Once a week, in the laboratory, the researcher determined the new load values (1st week 25%; 2nd week 35%; 3rd week 40%; 4th week 45%; and 5th week 50%). The

device was covered with an insulating material so that participants would not have access to the controls and change the training load.

The data were stored in Excel™ 2007 software (Microsoft Corporation, Redmond, USA) and analyzed in GraphPad Prism® software, version 5.0 (GraphPad Software, Inc., San Diego, USA). Student's t-test and ANOVA test for paired samples were used in the treatment of variables with normal distribution. An α -level of 0.05 was adopted to reject the null hypothesis.

Results

Of the six volunteers in the study, five (83.33%) were women with a mean age of 58.8%, and one (16.66%) was a man, aged 66 years (Table 1).

Table 1 - Profile of the six HTLV-1 patients included in the study. Belém/PA, 2018-2019

Variables	N	%	Average
Gender			
Female	5	83.33	
Male	1	16.66	
Age (years)			60
Marital status			
Bachelor	2	33.33	
Married (a)	3	50	
Widower (a)	1	16.66	
Clinical form			
Likely HAM/TSP	1	16.66	
Definitive HAM/TSP	2	33.33	
No HAM/TSP + Tb*	2	33.33	

Note: * History of tuberculosis and no clinical signs of HAM/TSP.

The means of MIP collected before the application of the protocol (T0) and after treatment (T5) of the individuals studied were compared with the values predicted by the equations of Neder et al. [16]. The values measured in the sample at T0 were lower than the predicted values, while in T5 the values overlapped those that were predicted. (Figure 2).

Comparison between MIP measured and predicted

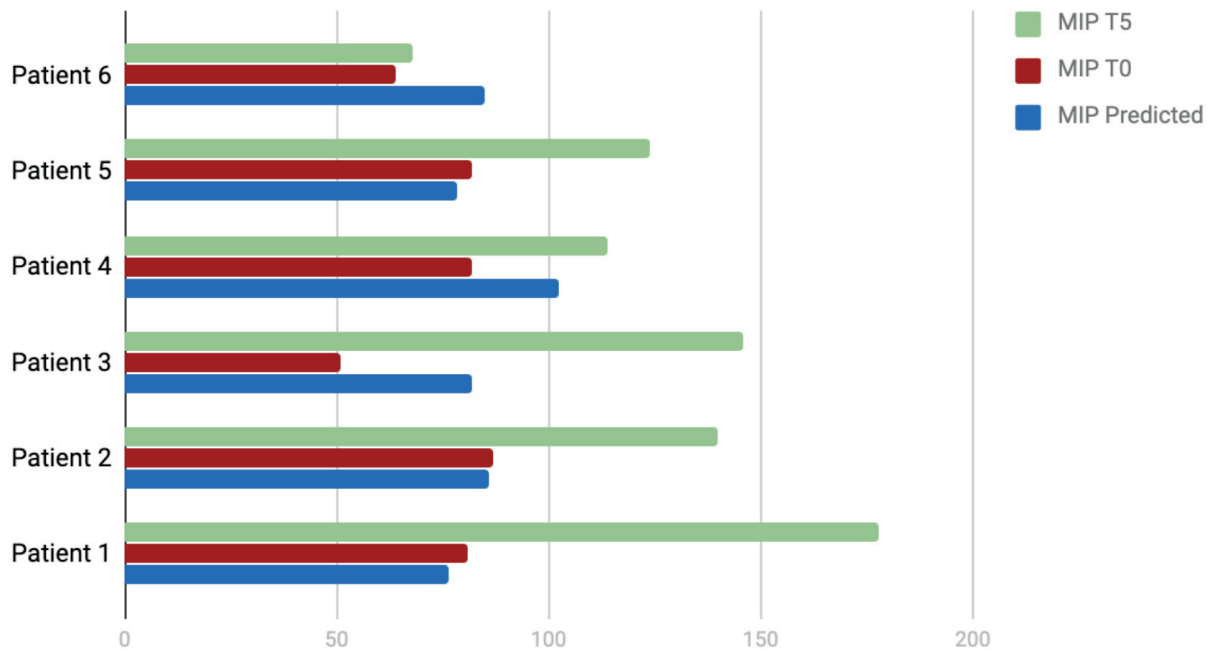


Figure 2 - Comparison between the parameters obtained and predicted for HTLV-1 patients included in the study, as well as maximal inspiratory pressure (MIP). Belém/PA, 2018-2019

Table 2 shows the evolution of the variables studied after the RMT with a significant increase in MIP from T0 to T5, with an average of 66.8 (± 12.58) and 115.08 (± 31.78), respectively. These results suggest that the training was

able to cause a significant improvement in the respiratory muscle strength of the patients studied ($p=0.011$). In this regard, significant results were found when comparing T0 to T3 ($p=0.049$) and T3 to T5 ($p=0.021$).

Table 2 - Distribution of information on MIP values collected at T0, T3, and T5 for the six HTLV-1 carriers included in the study. Belém/PA, 2018-2019

Variables	T0	T3	P-value	T0	T5	P-value	T3	T5	T3
MIP	66.8 \pm 12.58	94.03 \pm 33.27	0.049*	66.8 \pm 12.58	115.08 \pm 31.78	0.011*	94.03 \pm 33.27	115.08 \pm 31.78	0.021#

Note: Source = Research Protocol, 2018-2019. Data expressed as mean \pm standard deviation. Paired Student's t-test ($p<0.05^*$). ANOVA ($p<0.05\#$). MIP: Maximum inspiratory pressure. T0: initial evaluation. T3: evaluation in the third week of reigning. T5: final evaluation.

Discussion

The pathologies caused by the HTLV-1 virus, especially neurological ones, are progressive and can compromise various functions of the human organism. Therefore, holistic follow-up and treatment of the individual are necessary. The present study was based on respiratory muscle training since it has shown to

provide adequate pulmonary ventilation along with the prevention of pulmonary complications and functional disabilities that can be developed through longitudinal course [18].

In this study, it was observed that 33.33% of the individuals assessed presented HTLV/tuberculosis

co-infection, as immunological alterations induced by HTLV-1 may precede a high susceptibility to tuberculosis (TB) co-infection [19]. The literature shows a higher prevalence of this co-infection, especially in countries endemic to both infections such as Brazil and Peru [20]. Grassi [21], in his retrospective cohort study, evaluated the risk of TB development in HTLV-1-infected individuals, and found that the incidence was 3.3/1.000.

The prevalence of women in this study confirms the results found in the literature [4,22].

Studies have revealed that the relationship between HTLV-1 and changes in the pulmonary system occurs from an inflammatory process caused by the virus with lymphocytic infiltration and release of cytokines harmful to lung tissue, similar to what occurs at the level of the spinal cord in HAM/TSP patients [23].

It is evident that in asymptomatic people and in patients with HAM/TSP, pathologies such as T-lymphocytic alveolitis, interstitial pneumonia, bronchiolitis, and diffuse panbronchiolitis can be observed, in addition to an increased risk pulmonary cryptococcosis, pulmonary tuberculosis, and community-acquired pneumonia [24].

Changes in the pulmonary system caused by the virus can cause lung lesions such as centrilobular nodules, bronchiectasis, thickening of the bronchial wall, and fibrosis. These changes are insidious with predominantly subclinical pulmonary signs and symptoms and, thus, many individuals are diagnosed when exacerbation of the disease occurs [9].

In the study by Falcão et al. [24] two types of pulmonary symptoms were found: dyspnea with higher predominance and bronchial hypersecretion. These data are similar to those of the present study, in which the volunteers verbally pointed out dyspnea in the initial evaluation as the main complaint during their daily life activities.

HTLV-1 has several similarities with multiple sclerosis (MS) disease lesions and, as in both conditions, chronic demyelination of the central nervous system occurs, it can be suggested that symptomatic patients with evolution of the disease present respiratory muscle impairment. Thus, with the progress of the disease, the inspiratory muscles can be affected in their ability to generate strength or endurance. In the present study, the first evaluation found a decrease in muscle strength for MIP obtained in relation to what would be ideal for individuals [25].

It is known that respiratory muscle weakness in individuals with chronic muscle system disease can also lead to limitations in strength performance during

coughing, which can result in pneumonia, caused by aspiration or even acute ventilatory insufficiency, complications that often cause death [26].

Significant progression in MIP was observed in the three moments analyzed: first (T0), third (T3), and fifth (T5) week of training. This increase in inspiratory muscle strength is considered as a protective factor for tolerance to efforts and consequent prevention of pulmonary complications [27].

Thus, the increase of MIP in individuals follows the principle of progressive load elevation. Inspiratory muscles as well as skeletal muscles can be physiologically reshaped when stimulated with exercises and frequencies of greater intensity. [28]

Unsupervised rehabilitation, also known as rehabilitation at home or home training, has as main objective to exercise patients under indirect supervision and promote the maintenance of benefits obtained during supervised phases of training, in a simple, effective, viable, and safe way [29].

Studies [30,31] on cardiovascular and respiratory rehabilitation at home have demonstrated that the results can be as effective as those obtained under hospital supervision. This research showed the positive effects that distance training provided to patients. In this regard, significant results were obtained, both clinically as observed in the significant increase in MIP, and through patient reports of improvement during face-to-face care that expressed a greater willingness to perform daily activities.

Regarding home training, the importance of professionals motivating their patients during supervision to properly perform the rehabilitation program and obtain positive results during this process needs to be emphasized. Telephone follow-up and response to questions and doubts about the program as well as verbal persuasion are necessary to reinforce training and ensure patient commitment [32]. During the weeks of follow-up, the researchers kept in touch via telephone to monitor how the training took place at patients' homes. Additionally, on the day of home training, it was verified if patients had any doubts, besides being observed if they were performing RMT correctly.

Limitations of the study were factors related to stigma about the disease. As this is a sexually transmitted pathology, patients can be in denial or not share information about their condition with their families, and consequently, reject the treatment. This limitation was reflected on the small number of participants in the present study.

Conclusion

This study identified an increase in inspiratory muscle strength in carriers of human T-cell lymphotropic virus type 1 who participated in an inspiratory muscle training protocol performed at home under indirect supervision.

References

1. Glória LM, Damasceno SA, Rodrigues LR, Santos MSB, Medeiros R, Dias GAS, et al. Perfil clínicoepidemiológico de pacientes infectados pelo HTLV-1 em Belém/Pará. *Cad Saude Colet*. 2015;23(2):157-62.
2. Takatani M, Crispim ME, Fraiji N, Stefani MMA, Kiesslich D. Clinical and laboratory features of HTLV-I asymptomatic carriers and patients with HTLV-I-associated myelopathy/tropical spastic paraparesis from the Brazilian Amazon. *Rev Inst Med Trop S Paulo*. 2017;59(e5):1-9.
3. Brandão E, Lorena VM, Fernandes AR, Romero S, Araújo PS, Bottasso O, et al. Impacto da infecção por HTLV-1 nas manifestações clínicas e no tratamento de pacientes com espongiloidíase. *Rev Soc Bras Clin Med*. 2018;16(1):70-3.
4. Corrêa VAC, Rocha ACB, Almeida PS, Pinto DS, Falcão LFM, Fuzii HT. Capacidade funcional em indivíduos com paraparesia espástica tropical/mielopatia associada ao HTLV-1. *Rev Fam Ciclos Vida Saude Contexto Soc*. 2018;6(1):7-14.
5. Fuzii HT, Simões JA, Dias GAS. Immunopathogenesis of HTLV-1 associated myelopathy/tropical spastic paraparesis (HAM/TSP). *Life Sci*. 2014;104(1-2):9-14.
6. Virgolino RR. Análise multivariada de características clínicas de PET/MAH e níveis de expressão gênica e derivação de modelos de predição diagnóstica em pacientes infectados com o HTLV-1. 2017 [master's thesis]. Belém: Universidade Federal do Pará; 2017. 129 p.
7. Melo AL, Santos SS, Cavalcante S. Diagnóstico e tratamentos de doenças associadas à infecção por vírus linfotrópico da célula T humana 1-HTLV 1. *Rev Cient Fac Educ e Meio Ambiente*. 2017;8(1):111-23.
8. Santos ACC, Soares, DJ, Rivemales, MCC. (Un)Familiarity, illness and limitations imposed by HTLV: experiences of HIV positive women. *Cad Saude Colet*. 2017;25(1):45-50.
9. Falcão LFM. Alterações no sistema pulmonar de pacientes com paraparesia espástica tropical ou mielopatia associada ao HTLV-1 (PET/MAH) [dissertation]. Ananindeua (Pará): Instituto Evandro Chagas; 2016. 95 p.
10. Colla L, Peternella FN, Mendes FCV. Proposta de Tratamento Fisioterapêutico Para uma Paciente Portadora de Paraparesia Espástica Tropical: Estudo de Caso. *UNINGA Rev*. 2014;18(3):17-20.
11. Nepomuceno Jr BRV, Gómez TR, Gomes Neto M. Use of Powerbreathe® in inspiratory muscle training for athletes: systematic review. *Fisioter Mov*. 2016;29(4): 821-30.
12. Bittar OJNV, Magalhães A, Martines CM, Felizola NBG, Falcão LHB. Absenteísmo em atendimento ambulatorial de especialidades no estado de São Paulo. *BEPA*. 2016;13(152):19-32.
13. Kock KS, Caiônico JC, Luiz AR, Arent YA, Fernandes I. Análise da pressão inspiratória com alto e baixo fluxos em resistor alinear. *ASSOBRAFIR Cienc*. 2015;6(1):13-20.
14. Tzelepis GE, Mccool FD. Respiratory dysfunction in multiple sclerosis. *Respir Med*. 2015;09(6):671-9.
15. Moura DS, Andrade IS, Hora BBS, Ferraz APSP, Pereira AJ, Facchinetti JB, et al. Fisioterapia no atendimento domiciliar: enfrentamento e desafios dos profissionais. *Rev Mult Psic*. 2018;12(39):71-83.
16. Neder JA, Andreoni S, Lerario MC, Nery LE. Reference values for lung function tests. II. Maximal respiratory pressures and voluntary ventilation. *Braz J Med Biol Res*. 1999;32(6):719-27.
17. Ray AD, Udhoji S, Mashtare TL, Fisher NM. A combined inspiratory and expiratory muscle training program improves respiratory muscle strength and fatigue in multiple sclerosis. *Arch Phys Med Rehabil*. 2013;94(10):1964-70.
18. Gessain A, Mahieux R. Tropical spastic paraparesis and HTLV-1 associated myelopathy: clinical, epidemiological, virological and therapeutic aspects. *Rev Neurol (Paris)*. 2012;168(3):257-69.

19. Cachay R, Schwalb A, Mora R, Cáceres T, Gotuzzo E. Infección por virus linfotrópico de células T humanas tipo 1 em pacientes con diagnóstico de tuberculosis multidrogorresistente. *Rev Peru Med Exp Salud Publica*. 2019;36(1):148-50.
20. Carvalho NB, Bastos ML, Neves Y, Souza A, Martins Netto E, Santos S, et al. HTLV-1 infection interferes with immune responses to *Mycobacterium tuberculosis* antigens. *Retrovirology*. 2015;12(Suppl 1):O24.
21. Grassi MFR, Santos NP, Lírio M, Kritski AL, Almeida MCC, Santana LP, et al. Tuberculosis incidence in a cohort of individuals infected with human T-lymphotropic virus type 1 (HTLV-1) in Salvador, Brazil. *BMC Infect Dis*. 2016;16:491.
22. Silva, IC, Pinheiro BT, Nobre AFS, Coelho JL, Pereira CCC, Ferreira LSC, et al. Moderada endemicidade da infecção pelo vírus linfotrópico-T humano na região metropolitana de Belém, Pará, Brasil. *Rev Bras Epidemiol*. 2018;21:e180018.
23. Honarbakhsh S, Taylor GP. High prevalence of bronchiectasis is linked to HTLV-1-associated inflammatory disease. *BMC Infect Dis*. 2015;15(1):258.
24. Falcão LFM, Falcão ASC, Sousa RCM, Vieira WB, Oliveira RTM, Normando VMF, et al. CT Chest and pulmonary functional changes in patients with HTLV-associated myelopathy in the Eastern Brazilian Amazon. *PloS One*. 2017;12(11):e0186055.
25. Levy J, Prigent H, Bensmail D. Respiratory rehabilitation in multiple sclerosis: A narrative review of rehabilitation techniques. *Ann Phys Rehabil Med*. 2018;61(1):38-45.
26. Rietberg MB, Veerbeek JM, Gosselink R, Kwakkel G, van Wegen EE. Respiratory muscle training for multiple sclerosis. *Cochrane Database Syst Rev*. 2017;12(12):CD009424.
27. Ferreira GD, Costa AC, Plentz RD, Coronel CC, Sbruzzi G. Respiratory training improved ventilatory function and respiratory muscle strength in patients with multiple sclerosis and lateral amyotrophic sclerosis: systematic review and meta-analysis. *Physiotherapy*. 2016;102(3):221-8.
28. Dipp T, Macagnan FE, Schardong J, Fernandes RO, Lemos LC, Plentz RDM. Short period of high-intensity inspiratory muscle training improves inspiratory muscle strength in patients with chronic kidney disease on hemodialysis: a randomized controlled trial. *Braz J Phys Ther*. 2020;24(3):280-6.
29. Seixas MB, Ramos PS, Ricardo DR. Reabilitação domiciliar com exercício não supervisionado na DPOC: revisão sistemática. *Rev Bras Med Esp*. 2016;22(4):320-5.
30. Souza CA, Santos RZ, Lineburger AA, Benetti M. Reabilitação cardiopulmonar e metabólica na atenção primária em saúde: é possível? *R Bras Ci Mov*. 2015;23(1):164-71.
31. Gonçalves RL, Santana JE, Azevedo MV. Avaliação da qualidade de vida e da funcionalidade de um paciente com DPOC grave antes e após reabilitação cardiopulmonar e metabólica domiciliar: Relato de caso. *ASSO-BRAFIR Cienc*. 2012;3(1):57-64.
32. Khoshkesht S, Zakerimoghdam M, Ghyasvandian S, Kazemnejad A, Hashemian SM. The effect of home-based pulmonary rehabilitation on self-efficacy in chronic obstructive pulmonary disease patients. *rehabilitation, J Pak Med Assoc*. 2015;65(10):1041-6.

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