The impact of multicomponent training on postural balance, cardiorespiratory capacity, and quality of life in individuals with Post-COVID-19 Syndrome: A randomized clinical trial

https://doi.org/10.56238/globalhealthprespesc-016

Karla Cybele Vieira de Oliveira
Master's Degree, Graduate Program in Physical Therapy, Department of Physical Therapy, Federal University of Pernambuco - UFPE
E-mail:karla.cybele@ufpe.br

Ana Paula de Lima Ferreira
PhD Professor of the Physical Therapy Course of the Federal University of Pernambuco - UFPE
E-mail: ana.lferreira@ufpe.br

Diana de Andrade Silva
Student of the Graduate Program in Physical Therapy, Department of Physical Therapy, Federal University of Pernambuco – UFPE
E-mail:diana.andrade@ufpe.br

Débora dos Santos Silva
Student of the Graduate Program in Physical Therapy, Department of Physical Therapy, Federal University of Pernambuco – UFPE
E-mail: debora.dss@ufpe.br

Janaina dos Santos Monteiro
Student of the Physical Therapy Course of the Federal University of Pernambuco- UFPE
E-mail: janaina.monteiro@ufpe.br

Kennedy Victor da Silva
Student of the Physical Therapy Course of the Federal University of Pernambuco – UFPE
E-mail: kennedy.victor@ufpe.br

Marcelo Renato Guerino
PhD Professor of the Physical Therapy Course of the Federal University of Pernambuco - UFPE,
E-mail:marcelo.guerino@ufpe.br

Shirley Lima Campos
PhD Professor of the Physical Therapy Course of the Federal University of Pernambuco – UFPE
E-mail:shirley.campos@ufpe.br

Larissa Coutinho de Lucena
PhD in Physical Therapy, linked to the International Institute of Neurosciences Edmond and Lily Safra (IINN/ELS)
E-mail: larissa.lucena@isd.org.br

Maria das Graças Rodrigues de Araújo
PhD Professor of the Physical Therapy Course of the Federal University of Pernambuco – UFPE
E-mail: maria.raraujo@ufpe.br

ABSTRACT

Introduction: individuals with Post-COVID-19 Syndrome have symptoms such as chronic fatigue, myalgia, cough and mental health problems, which can compromise postural balance, cardiorespiratory capacity and quality of life. Multicomponent training is an association of different types of therapeutic exercises that can promote a better physical-functional recovery from illnesses such as severe respiratory disease that can be generalized for people with COVID-19. Objective: to investigate the relationship between multicomponent training and its effects on postural balance, cardiorespiratory capacity and quality of life of individuals with Post-COVID-19 Syndrome. Methodology: randomized clinical trial, in a sample of 59 individuals, of both sexes and aged between 18 and 70 years. In the initial and final evaluation, a form with sociodemographic and clinical questions was used. Postural balance was assessed using the Berg balance scale; cardiorespiratory capacity by the 6MWT walking test and quality of life by the quality of life questionnaire - SF 36. The sample was divided into: intervention group (IG: n=31) and control group (GC: n=28). The IG received 24 training sessions, 60 minutes each, for 12 consecutive weeks, while the CG received educational guidance during the same training period. Significance level $p \leq 0.05$. Results: the sample consisted of 59 individuals, with a mean age of 52.3+11.9, 57.6% female. On the Berg scale, the GI obtained a change from 48.8+4 points (Pre) to 51.9+4.26 points (Post) and GC, 47.8+3.96 points (Pre) to 47.9+ 4.96 points (Post). As for the distance covered in the 6MWT, GI ranged from 464.4 +81.3

meters (Pre) to 518.6 +82.7 meters (Post), and GC from 441.2 + 118.7 meters (Pre) to 433.9 + 111.7 meters (Post). And as for quality of life, GI presented a raw score of 96.3+ 10.1 (Pre) to 102.6 + 5.5 (Post), and GC, 96.4+8.0 (Pre) to 97, 7+7.7 (Post). All variables studied did not show statistically significant difference in intragroup and intergroup analysis ($p \geq 0.05$). Conclusion: multicomponent training had a positive impact on the analyzed variables; however, it was not more effective than the educational guidelines given to individuals with Post-COVID 19 Syndrome.

Keywords: Post-COVID-19 Syndrome, Quality of Life, Walk Test, Physical Therapy.

1 INTRODUCTION

Post-COVID-19 Syndrome is defined as persistent signs or symptoms for more than 12 weeks, developed during or after COVID-19 infection (MAHASE, 2020). These persistent symptoms include chronic fatigue, dyspnea, anosmia, difficulty sleeping, chest pain, headache, cough, and mental health problems (GARRIGUES et al., 2020; Bellan et al., 2021). The persistence of these dysfunctions can occur in both individuals with severe and mild symptoms, and may cause limitation in quality of life, as well as post-traumatic stress disorder (ARAB-ZOZANI et al., 2020; BELLAN et al., 2021 MANDAL et al., 2021).

One way to measure the aerobic capacity and endurance of patients who have had COVID-19 is with testing of a six-minute walk (6MWT). The 6MWT measures the distance covered during 6 minutes of walking and this measure can be used to compare performance capacity, having been used as a predictor of mortality in patients with idiopathic pulmonary fibrosis (IPF) (DU BOIS et al., 2013; MANCUZO et al., 2018).

Effective rehabilitation of individuals with Post-COVID-19 Syndrome, according to the guideline of the *National Institute for Health and Care Excellence* (NICE), requires integrated multidisciplinary rehabilitation services to better treat fatigue and respiratory symptoms (NICE, 2022).

Exercise, early mobilization and multicomponent programs may improve recovery after ICU admission for severe respiratory illness that can be generalized to people with COVID-19 (GOODWIN et al., 2021). Multicomponent exercises combine muscle strength training, cardiovascular endurance, postural balance and gait, producing significant improvements in physical and functional deficit, and in hospitalized elderly patients the results were also favorable in improving frailty, cognitive status, gait and postural balance (CASAS-HERRERO et al., 2019; COUREL-IBÁÑEZ et al., 2022).

In view of the above, this study investigated the relationship between multicomponent training and its effects on postural balance, cardiorespiratory capacity and quality of life of individuals with Post-COVID-19 Syndrome.

2 METHODOLOGY

This is a randomized, randomized clinical trial and simple blind, developed at the Laboratory of Kinesiotherapy and Manual Therapeutic Resources (LACIRTEM), of the Federal University of Pernambuco (UFPE). This study is in accordance with Resolution 510/2016 of the National Health Council, approved by the Ethics Committee Opinion N0. 5,236,588 and registered with ReBEC n^0 RBR-7yh559g. The guidelines established by CONSORT 2010 (*Consolidated Standards of Reporting Trials*) were followed in the construction of this study.

Data collection took place from March to October 2022. We recruited individuals with Post-COVID-19 Syndrome, with ages ranging from ≥18 years to ≤ 70 years, of both sexes, residents in Recife-PE and metropolitan region.

Individuals were included.uos: affected by COVID-19 proven by laboratory examination, RT-PCR or serology; Sedentary; absence of neurological or vascular diseases, blindness, foot and/or spinal deformity; absence of uses of gait aids. Individuals with hypertension were excluded systemic arterial and uncontrolled arrhythmia; active myocarditis; signs of respiratory distress at rest; acute systemic disease or fever; nausea; dizziness; shortness of breath and/or severe dyspnea; excessive sweating; anxiety crisis; Palpitations; pain or tightness in the chest; presented muscle pain during training. The participants read and signed the free and informed consent form (ICF).

2.1 RANDOMIZATION

The randomization of thea was performed by a blind researcher, using a website *www.randomization.com*. In the masking of the research, two researchers were responsible: one responsible for the evaluation/reevaluation and the other for the application of the intervention protocol. The participants were randomly distributed into 2 groups: Intervention Group (IG) and Control Group (CG). The IG performed two weekly intervention sessions for 12 consecutive weeks, lasting 60 minutes each. The CG did not undergo training, however it received only educational guidance in the same training period and at the end of the IG training was reassessed (Post-intervention).

2.2 PHYSICAL-FUNCTIONAL ASSESSMENT

In the initial evaluation, all participants answered a form with questions of a sociodemographic, anthropometric and clinical nature. Next, the equipostural libido (Berg balance scale), cardiorespiratory capacity (6MWT) and quality of life (SF-36 questionnaire). At the end of the 12 weeks of training, Both groups were reassessed with the instruments mentioned above.

IronEvaluation Scale: Berg's balance scale, which is composed of 14 items, containing activities such as transfers, reach, turning and unloading weight in a single leg graded on a scale

ranging from 0 (incapable/insecure) to 4 (independent/efficient/safe) (BERG, 1992). The scale was adapted for application in Brazil by Miyamoto (2004) presenting in each item scores of 0-4 and a determined time for each task; The 6-minute Walk Test (6MWT) is a test that reflects the level of physical activity, cardiopulmonary capacity, as well as provides valuable information about blood pressure (BP), heart rate (RR) and oxygen saturation (SpO2) (HAMILTON & HAENNEL, 2000; Solway et al., 2001; MOALLA et al., 2005); The Brazilian version of the SF-36 quality of life questionnaire was applied, with 36 items that measure: physical functioning (10 items), social functioning (two items), function limitations due to physical (four items) and emotional (three items) problems, mental health (five items), energy and vitality (four items), pain (two items), general perception of health (five items) and a question about health a year ago (BRAZIER et al., 1992).

2.3 INTERVENTION

The therapeutic intervention was based on the protocol adapted from Marques et al. (2015) whose intervention covered multicomponent exercises, and was applied twice a week, for 60 minutes each, for a period of 12 consecutive weeks, totaling 24 training sessions.

The multicomponent exercises were subdivided into: (I) Warm-up (10 minutes): joint mobility, global stretching, breathing techniques, such as breathing with pursed lips, body positions, diaphragmatic breathing; (II) Resistance (20 minutes): walking; (III) Strength (15 minutes): 7 exercises, with 2 sets of 10 repetitions for muscle groups of the upper and lower limbs, using elastic bands, free and ankle weights, the weight was progressively increased according to the participant's capacity; (IV) Balance (5 minutes): postures with gradual reduction of the support base; dynamic movements that disturb the center of gravity; post – stress of muscle groups; dynamic movements when performing secondary tasks individually; (V) Relaxation (10 minutes) (MARQUES et al., 2015).

2.4 STATISTICAL ANALYSIS

Data analysis for categorical variables was expressed as absolute and relative frequencies, while continuous frequencies were expressed as mean and standard deviation. For verificationthe normality of quantitative data was applied to the test *Kolmogorov-Sminorv;* In the comparison of the groups, in categorical variables, the chi-square test was used. Descriptive analysis for sociodemographic, anthropometric and clinical characterization. In the comparison of the Berg, the 6MWT and the SF-36, an intention-to-treat analysis approach was used, considering all participants and groups until the end, regardless of what happened to each of them (AMATUZZI et al., 2006). The mean comparison analysis corresponded to the moment before the intervention and ANOVA was performed *one-way*, to confirm starting homogeneity for the three groups. Statistical analysis was

performed using SPSS software *(Statistical Package for Social Science)* version 20.0 for Windows *(SPSS Inc, Chicago IL, USA)* and significance level p<0.05 for all analyses.

3 RESULTS AND DISCUSSION

We selected 59 individuals with Post-COVID-19 Syndrome with an average age of 52.3+11.9 (Table 1). The participants in this study had a mean BMI of +28.9 kg/m2, not corroborating the study by Eksombatchai et al. (2021) that found, in 87 individuals with COVID-19, BMI of +23.8 kg/m2.

Table 1 - Characterization of the sample regarding sociodemographic, anthropometric and clinical data.

Variables	Total (n= 59)	Intervention group (n= 31)	Control group (n= 28)	p*
Age (years), M(DP)	52,3 (11,9)	53,7(11,2)	50,7(10,1)	p≥0,05
Height (m), M(DP)	1,6 (0,1)	1,66(0,1)	1,64(0,1)	p≥0,05
IMC (kg/m²), M(DP)	28,9 (7,9)	27,5(4,5)	30,7(7,2)	p≥0,05
Female, n (%)	34 (57,6)	17 (54,8)	17(60,7)	p≥0,05
Comorbidade, n (%)				
Hypertension	26 (44,1)	12(38,7)	14(50)	p≥0,05
Cardiopathy	8(13,6)	2(6,5)	6(21,4)	p≤0,05
Diabetes mellitus	6 (10,6)	3(9,7)	3(10,7)	p≤0,05
Other	19(31,7)	14(54,9)	5(17,9)	p≥0,05

* Mean (M); Standard deviation (SD); Body Mass Index (BMI); Metro(m2); Kilogram (kg); Significance value=p*. Source: Authors (2022).

According to Klanidhi et al. (2022), who conducted a prospective observational study in patients with COVID-19, the mean age (SD) of the population studied was 68.76 (7.4) and 41% was female, partially corroborating our study, as the mean (SD) age was 52.32 (11.9) and 57.6% was female (Table 1), however, not corroborating a study by Yanamandra et al. (2022), because the mean age of 54.54 ± 14.35 years, with a predominance of males 60.38%.

As for the comorbidities, according to Klanidhi et al. (2022), Hypertension (58%) and diabetes (46%) were the two most prominent, partially corroborating our study, since hypertension was present in 44.1% of the cases, followed by heart disease (13.6%) and diabetes (10.6%) (Table 1).

The IG showed improvements in the variables examined. Table 2 shows the comparison of intra- and intergroup performance after 12 weeks of follow-up.

Table 2 – Inter- and intra-group comparison of the variables 6MWT, Berg and SF-36 after 12 weeks of follow-up.

	GI (n=31)		Difference	CG (n=28)		Difference	p-value*		p-value**
	Pre	Post	Average (Post-Pre)	Pre Post	T	Average (Post-Pre)	GIVE	GC	
TC6m (m), M(DP)	464,5 (81,3)	518,6 (82,7)	54,1	441,2 (118,7)	33,9 (111,7)	-7,3	0,5523	0,6123	0,1294
Berg, M(DP)	48,8(4)	51,9 (4,26)	3,1	47,8 (3,96)	47,9 (4,96)	0,1	0.6799	0.5630	0.8694
SF-36, M(DP)	96,3 (10,1)	102,6 (5,5)	6,3	96,4 (8,05)	97,7 (7,74)	1,3	0.0553	0.9005	0.8078

* Intervention Group = GI; Control Group= CG; Pre-intervention=Pre; Post-intervention = Post; Meters= m; Mean=M; Standard deviation (SD); 6-minute Walk Test=6MWT; Berg Balance Scale (Berg); Quality of Life Questionnaire (SF-36); p-values obtained from the Kolmogorov-Smirnov normality test= p-value*; p-values obtained from the Levene test for homogeneity of variance= p-value**. Source: Authors (2022).

The p-value obtained with one-factor ANOVA for the variables Berg, 6MWT and SF36 shows that there is no statistically significant differenceicative ($p \geq 0.05$), between the groups, with normality between the data and homogeneity of variances (Table 2).

Regarding postural balance, this study observed that after the 12-week intervention, the mean score on the Berg scale between the pre-intervention (Pre-intervention) and post-intervention (Post) period increased from 48 to 51.9, respectively, although it was not statistically significant with $p \geq 0.05$, not corroborating the study by Giardini et al. (2022), who observed dynamic balance deficit and increased oscillation during static posture in critically ill patients in the acute phase of COVID-19, which may be related to the length of hospitalization. According to Miyamoto (2004) score below 45 can represent high risk of falling.

With regard to the 6MWT, it was found that, initially, the participants covered an average of 464.5 $\pm$ 81.3 meters, after 12 weeks of intervention, they went on to walk an average of 518.6 $\pm$ 82.7 meters, demonstrating a mean difference (Pre - Post) of 54.1 meters.

When analyzing the results of the 6MWT, we confirmed the findings of Ferioli et al. (2021), demonstrating that the 6MWT is a useful test in the post-COVID-19 follow-up, correlating with the severity of the acute phase and losses in the chronic phase, offering the possibility of evaluating improvements in exercise capacity, corroborating the performance of our IG, because through the 6MWT it was possible to perceive an increase in the average distance covered from 464.4 (Pre) to 518.6 (Post) meters. In the study by Eksombatchai et al. (2021), in the COVID-19 groups with mild symptoms and non-severe pneumonia, there was a decrease from 538±56.8 to 527.5±53.5 meters, corroborating our CG, which showed a decrease in the average distance traveled between the Pre- and Post-intervention decreasing from 441.2 to 433.9 meters, respectively.

With regard to quality of life, the IG showed an increase in the mean raw score from 96.3 (Pre) to 102.6 (Post), although it was not statistically significant with $p \geq 0.05$ (Table 2). According to Brazier et al. (1992), a score of 100 points in the SF-36 represents a better state of health. However, in the

study by Sousa et al. (2022), participants with Post-COVID-19 Syndrome had worse results in the SF-36, not corroborating our study.

4 CONCLUSION

O tReigning with multicomponents provided a positive impact on the variables studied, although it was not statistically significant. However, due to the small sample used in this study, it is not yet possible to affirm that the protocol applied may provide greater benefits to the population observed, making it necessary to continue in order to expand the results. Given the challenge of studying this population, it is important to have new studies to make a greater contribution to the clinic and science of this disease.

REFERENCES

MAHASE E. Covid-19: What do we know about "long covid"? BMJ. 2020;370:m2815.

GARRIGUES E, JANVIER P, KHERABI Y, et al. Post-discharge persistent symptoms and health-related quality of life after hospitalization for COVID-19. J Infect. 2020;81(6):e4ÿe6.

BELLAN M, SODDU D, BALBO PE, et al. Respiratory and Psychophysical Sequelae Among Patients With COVID-19 Four Months After Hospital Discharge. JAMA Netw Open. 2021;4(1):e2036142.

ARAB-ZOZANI M, HASHEMI F, SAFARI H, YOUSEFI M, AMERI H. Health-Related Quality of Life and its Associated Factors in COVID-19 Patients. Osong Public Health and Research Perspectives. 2020;11(5):296ÿ302

MANDAL S, BARNETT J, BRILL SE, BROWN JS, DENNENY EK, HARE SS, et al. "Long-COVID": a cross-sectional study of persisting symptoms, biomarker and imaging abnormalities following hospitalisation for COVID-19. Thorax. 2021 Apr;76(4):396–8.

DU BOIS RM, ALBERA C, BRADFORD WZ, COSTABEL U, LEFF JA, NOBELPW, et al. 6Minute walk distance is an independent predictor of mortality in patients with idiopathic pulmonary fibrosis. Eur Respir J 2014;43(5):14219. [doi: 10.1183/09031936.00131813.] EPub 2013 Dec 5. PMID: 24311766

MANCUZO EV, SOARES MR, PEREIRA CA. Six minute walk distance and survival time in patients with idiopathic pulmonary fibrosis in Brazil. J Bras Pneumol 2018;44:26772.

NICE. COVID-19 Rapid Guideline: Managing the Long-Term Effects of COVID-19. Available online: https://www.nice.org.uk/guidance/ng188 (accessed on 20 January 2022).

GOODWIN VA, ALLAN L, BETHEL A, COWLEY A, CROSS JL, DAY J, DRUMMOND A, HALL AJ, HOWARD M, MORLEY N, THOMPSON COON J, LAMB SE. Rehabilitation to enable recovery from COVID-19: a rapid systematic review. Physiotherapy.2021 Jun;111:4-22. doi: 10.1016/j.physio.2021.01.007. Epub 2021 Feb 24.

CASAS-HERRERO A, ANTON-RODRIGO I, ZAMBOM-FERRARESI F, SÁEZ DE ASTEASU ML, MARTINEZ-VELILLA N, ELEXPURU-ESTOMBA J, et al. Effect of a multicomponent exercise programme (VIVIFRAIL) on functional capacity in frail community elders with cognitive decline: study protocol for a randomized multicentre control trial. Trials. 2019 Jun;20(1):362.

COUREL-IBÁÑEZ J, BUENDÍA-ROMERO Á, PALLARÉS JG, GARCÍA-CONESA S, MARTÍNEZ-CAVA A, IZQUIERDO M. Impact of Tailored Multicomponent Exercise for Preventing Weakness and Falls on Nursing Home Residents' Functional Capacity. J Am Med Dir Assoc. 2022 Jan;23(1):98-104.e3.

BERG KO, WOOD-DAUPHINEE SL, WILLIAMS JI, MAKI B. Measuring balance in the elderly: validation of an instrument. Can J Public Health. 1992;83 Suppl 2:S7-11.

HAMILTON DM, HAENNEL RG. Validity and reliability of the 6-minute walk test in a cardiac rehabilitation population. J Cardiopulm Rehabil. 2000;20(3):156–64.

MOALLA W, GAUTHIER R, MAINGOURD Y, AHMAIDI S. Six-minute walking test to assess exercise tolerance and cardiorespiratory responses during training program in children with congenital heart disease. Int J Sports Med. 2005 Nov;26(9):756–62.

SOLWAY S, BROOKS D, LACASSE Y, THOMAS S. A qualitative systematic overview of the measurement properties of functional walk tests used in the cardiorespiratory domain. Chest. 2001 Jan;119(1):256–70.

BRAZIER JE, HARPER R, JONES NM, O'CATHAIN A, THOMAS KJ, USHERWOOD T, et al. Validating the SF-36 health survey questionnaire: new outcome measure for primary care. BMJ. 1992 Jul;305(6846):160–4.

MIYAMOTO ST, LOMBARDI JUNIOR I, BERG KO, RAMOS LR, NATOUR J. Brazilian version of the Berg balance scale. Brazilian J Med Biol Res [Internet]. 2004

MARQUES A, JÁCOME C, CRUZ J, GABRIEL R, FIGUEIREDO D. Effects of a pulmonary rehabilitation program with balance training on patients with COPD. J Cardiopulm Rehabil Prev. 2015;35(2):154–8.

AMATUZZI MLL, BARRETO M DO CC, LITVOC J, LEME LEG. Linguagem metodológica: parte 2. Acta Ortopédica Bras [Internet]. 2006 [cited 2022 Nov 30];14(2):108–12.

KLANIDHI K.B, CHAKRAWARTY A, BHADOURIA S.S, GEORGE S.M, SHARMA G, CHATTERJEE P, KUMAR V, VIG S, GUPTA N, SINGH V, DEY A.B, MOHAN A, BHATNAGAR S. Six-minute walk test and its predictability in outcome of COVID-22. patients. J Educ Health Promot. 2022 Feb 26;11:58. doi: 10.4103/jehp.jehp_544_21. eCollection 2022.

YANAMANDRA U, SAXENA P, SRINATH R, SAWANT A, SINGH A, AGGARWAL N, PAVAN B, DUHAN G, AGGARWAL B, KAUR P. Assessment of Six-Minute Walk Test Among Discharge-Ready Severe COVID-19 Patients: A Cross-Sectional Study. Cureus. 2022 May 18;14(5):e25108. doi: 10.7759/cureus.25108. eCollection 2022 May.

EKSOMBATCHAI D, WONGSININ T, PHONGNARUDECH T, THAMMAVARANUCUPT K, AMORNPUTTISATHAPORN N, SUNGKANUPARPH S. Pulmonary function and six-minute-walk test in patients after recovery from COVID-19: A prospective cohort study. PLoS One. 2021;16(9):e0257040.

GIARDINI M, ARCOLIN I, GUGLIELMETTI S, GODI M, CAPELLI A, CORNA S. Balance performance in patients with post-acute COVID-19 compared to patients with an acute exacerbation of chronic obstructive pulmonary disease and healthy subjects. Int J Rehabil Res Int Zeitschrift fur Rehabil Rev Int Rech Readapt. 2022 Mar;45(1):47–52.

DE SOUSA KCA, GARDEL DG, LOPES AJ. Postural balance and its association with functionality and quality of life in non-hospitalized patients with post-acute COVID-19 syndrome. Physiother Res Int J Res Clin Phys Ther. 2022 Oct;27(4):e1967.

FERIOLI, M.; PREDILETTO, I.; BENSAR, S.; DANIELE, F.; SCIOSCIO, V.D.; MODOLON, C.; RIMONDI, M.R.; NAVA, S.; FASANO, L. The role of 6MWT in COVID 19 follow up. Paper presented at. ERS 2021. The European Respiratory Society International Congress. Eur. Respr. J., v.58, n.0A4046,2021.