Therapeutic Pulmonary Telerehabilitation Protocol in patients affected by COVID-19, confined in their homes: Study Protocol for a Randomized Control Trial

Juan Jose Gonzalez-Gerez
Fisiosur i+D
Carlos Bernal Utrera (cbernal495@gmail.com)
Universidad de Sevilla https://orcid.org/0000-0002-6235-8353
Ernesto Anarte-Lazo
University of Birmingham School of Sport Exercise and Rehabilitation Sciences
Jose Antonio García-Vidal
Universidad CEU Cardenal Herrera - Campus Elche
José Martin Botella-Rico
Universidad de Murcia
Cleofas Rodriguez-Blanco
Universidad de Sevilla Facultad de Enfermeria Fisioterapia y Podologia

Study protocol

Keywords: Pandemics, Coronavirus Infections, Physical Therapy Specialty, Telerehabilitation, Exercise Therappy, Pulmonary Ventilation

Posted Date: May 7th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-24617/v1

Version of Record: A version of this preprint was published on June 29th, 2020. See the published version at https://doi.org/10.1186/s13063-020-04494-w.

Abstract

Background: In December 2019, 27 cases of pneumonia, of unknown cause, were identified in the province of Hubei (China). The WHO declared the situation as a Public Health emergency of International Concern and it was finally declared a global pandemic on March 11, 2020. Spanish Government obliges the entire population to remain confined to their homes, with exception of essential basic services, to stop the spread of COVID-19. Home isolation implies a notable physical deconditioning. Telerehabilitation methods have reported positive experiences and we propose to study in affected patients of COVID-19, due to the general house confinement of the entire Spanish population.

Methods: Patients will be recruited in the regions of Andalusia, Murcia and Valencia (Spain). Patients will remain confined to their homes, and there they will carry out their assigned exercise program, which will be controlled telematically. Evaluators will attend to carry out all measurements at the beginning, during, and end of the study, telematically controlled. The patients will be randomly divided into three groups, two of them will perform a home exercise program (breathing exercises or non-specific exercises for muscle toning) and the third group will perform sedentary activities, using mental activation techniques, and will act as a sham group. We will evaluate respiratory variables and other variables of physical state through physical tests, effort and perceived fatigue. The data will be statistically analyzed, and the hypotheses will be tested between the groups, using the SPSS software, v.20, considering a 95% confidence interval.

Discussion: We will analyze the results, in terms of level of fatigue and perceived exertion, physical health, and maintenance of respiratory activity of two types of exercise programs, toning and respiratory, applied in patients affected by COVID19 during the period of home confinement. We intend to investigate a field not previously studied, such as the repercussion of carrying out a toning and respiratory exercise program in these patients, in historical circumstances that no one had previously observed in Spain, since the general population has never been forced to remain confined in their homes, due to a pandemic infection, by coronavirus (COVID19). Observing the effects that these two home exercise programs could produce in patients infected with COVID19, we will try to better analyze and understand the mechanisms that are associated with worsening of breathing in this type of patient.

Background

This research is based on the current situation of pandemic due to coronavirus (COVID–19) that Spain suffers, with the house confinement of the entire population, decreed by the Government of Spain since last March 14, 2020. In December 2019, 27 cases of pneumonia, of unknown cause, were identified in Hubei (China). [1] On January 7, 2020, the Chinese authorities identified a new virus, which was called SARS-CoV–2, and since then it is commonly known as COVID–19. [2] Subsequently, on January 30, 2020, the WHO declared the situation as a Public Health emergency of International Concern [3] and it was finally declared a global pandemic on March 11, 2020. [4] Royal Decree 463/2020, of March 14, declaring the state of alarm for the management of the health crisis situation caused by COVID–19, obligates the

entire population to remain confined at home, with the exception of essential basic services, to stop the spread of COVID–19. [5]

This virus is characterized by its contagion capacity, through three routes: the respiratory route, by direct contact and through the feces (more research is needed in this route). [6] It has been estimated that the incubation period is 5.2 days for a 95% confidence interval (CI) [4.1–7.0] and the basic number of reproduction R0 is 2.2 for a 95% CI [1.4–3.9]. [7]

To this day, where the article is being written, March 30, 2020, countries most affected are considered USA (143,055 cases; 2,513 deceased), Italy (97,689 cases; 10,779 deceased), China (82,156 cases; 3,308 deceased), and Spain (80,110 cases; 6,803 deceased), being according to the WHO the total of 638,146 confirmed cases and 30,039 confirmed deaths by COVID–19, presenting cases in 203 countries or territories. [7,8] The main signs and symptoms described by recent studies [9–11] are fever (98%), cough (76%) and myalgia or fatigue (44%), with atypical symptoms (sputum (28%); pain from head (8%); hemoptysis (5%); vomiting (5%); diarrhea (3%) and dyspnea in approximately half of the patients, in addition to lymphopenia (63%) and pneumonia was present in all patients, and complications included acute respiratory distress syndrome (29%), acute heart injury (12%), and secondary infections (10%). Some patients had at least one underlying disease (such as hypertension, chronic obstructive pulmonary disease), and many of them require treatment in intensive care units (ICU).

It is estimated that 80% of the patients will present mild symptoms (without hospital admission) The remaining 20% will need medical care, and 5% of them will require admission to the ICU. [10, 12] The average time from onset of symptoms to recovery is 2 weeks when the disease has been mild, and 3–6 weeks when the disease has been severe or critical. [13] The WHO recommends, for 80% of patients who do not require hospital admission, the need for very restrictive home isolation and confinement in individual rooms within the home to avoid the spreading of the virus [14] The total isolation of these patients requires the non-face to face medical attendance, performing telematic control to monitor and control the evolution of the patient affected by COVID–19.

Home isolation implies a notable physical deconditioning, not only at the musculoskeletal level, but also implies negative changes at the metabolic level. [15,16] It could trigger peaks in Type II Diabetes, which could lead to worsening of the clinical picture in patients affected by COVID–19 [17] and repercussions on emotional state. [18] Physical activity programs have reported beneficial effects in maintaining muscle mass and strength [19] and prevents metabolic and nutritional decompensations caused by inactivity. [20] The implementation of a physical activity program in patients with mild symptoms of COVID–19 could achieve beneficial effects at the respiratory level, reducing the rate of aggravation and hospital admissions in these patients.

Our study aims to verify and validate the efficacy of a telerehabilitation program, through therapeutic exercise at the respiratory level, and the maintenance of vertebral and thoracic muscle tone, in patients affected by COVID–19. There is evidence on the efficacy of domiciliary exercise-based treatments in patients with respiratory disorders, and based on this, this could be the therapeutic method of choice to

allow the treatment and supervision of patients affected by COVID–19 in mandatory home confinement. [21–23] Telerehabilitation has begun to be implemented in other rehabilitation fields, such as cardiac rehabilitation, cancer rehabilitation, neurological rehabilitation, and spinal cord injuries. [24–26] Some studies have pointed out the effectiveness of these methods; [27, 28] however the last systematic reviews and meta-analyzes highlight the limited evidence, mainly due to the lack of high quality research studies. [29, 30] In general terms, telerehabilitation methods have been reported as positive experiences by patients [31], and can represent an important way to reduce associated healthcare costs [29]. Nonetheless, in this case the reasons for implementing telerehabilitation are not economic, but of necessity to avoid the spread of the virus, due to the general house confinement of the entire Spanish population.

Objectives

Primary Objective

The aim of our study is to analyze the respiratory effects of a therapeutic exercise program in patients affected by coronavirus (COVID–19), during the period of home confinement.

Secundary Objective

To compare the respiratory effects obtained among patients affected by coronavirus (COVID–19), after the application of a respiratory exercise program (REP), compared to those who perform a non-specific toning exercise program (NTEP), and a to sedentary control group permorming a sham program, during the period of house confinement.

Trial Design:

Randomized, controlled, parallel, double-blind, three-arm clinical trial of treatment.

Methods / Design

Sample Selection

Patients will be recruited through a text message transmitted on social networks in the regions of Andalusia, Murcia and Valencia (Spain). Therefore, any patient resident in the autonomous communities of Andalusia, Murcia and Valencia may participate in this research. They will be selected according to the listed eligibility criteria. The study will take place at the selected patients' home, where the evaluators will attend to carry out all measurements at the beginning, during, and end of the study. All measurements

will be instructed and telematically controlled by the study evaluator, who will provide patients the necessary assessment materials, which are described below (outcomes measurements section).

Inclusion criteria

- Age 18–75 years
- Patients who are affected by coronavirus (COVID–19), and are in home confinement.

Exclusion criteria

- Patients with chronic lung conditions
- Patients with chronic kidney disease
- Patients affected with chronic neurological disorders
- Patients suffering from hypertension and cardiovascular conditions without medical treatment
- Patients affected with grade III osteoporosis
- Patients affected with acute outbreaks of rheumatologic disorders
- Patients affected with acute outbreaks disc abnormalities
- Patients who have had respiratory conditions in the last 12 months
- Patients who have recent musculoskeletal disorders, and who are not fully recovered from their injuries
- Patients who have received physical therapy treatment in the last 3 months
- Patients affected with chronic mental and / or psychological disturbances
- Red Flags (Night pain, severe muscle spasm, loss of involuntary weight, symptom mismatch)

Interventions

Patients will perform exclusively assigned therapeutic exercises or sedentary activities (depending on randomized allocation to study groups) and may not combine with other physical therapy or physical activity. Any interference in the treatment will be grounds for exclusion. If participats require combine the intervention with medications, it will be registered.

Group 1: Respiratory Exercise Program (REP)

The REP will consist of 10 exercises based on the recommendations made by the official Physiotherapy organizations at the institutional level (College of Physiotherapists of the Community of Madrid, Spain), with scientific evidence. The REP will be taught to patients telematically in the first session, and it will be carried out once a day, for 21 days, at the patient's home, between 11 a.m. and 12 a.m., in the morning,

and is described in Annex 1, at the end of this document. The REP will be reinforced by a physical therapist daily, through telematic control by videoconference with each patient.

Group 2: Non-specific Toning Exercise Program (NTEP)

The NTEP will consist of 10 exercises based on the recommendations about toning exercises, made by the official Physiotherapy organizations at the institutional level (College of Physiotherapists of the Community of Andalusia, Spain), with scientific evidence. The NTEP will be taught to patients in the first session, and it will be carried out once a day, for 21 days, at the patient's home, between 11 a.m. and 12 a.m., in the morning, and is described in Annex 1, at the end of this document. The NTEP will be reinforced by a physical therapist daily, through telematic control by videoconference with each patient.

Group 3: Sham Program (SP)

The Sham Program consists of 10 sedentary exercises based on sophrology and meditation, with mental exercises of visualization, concentration and mental activity. The SP will be taught to patients in the first session telematically, and it will be carried out once a day, for 21 days, at the patient's home, between 11 a.m. and 12 a.m., in the morning. The SP will be reinforced by a physical therapist daily, through telematic control by videoconference with each patient. After the study, patients in the SP group will carry out the exercise program that has shown the greatest benefits in the state of health (REP or NTEP), which we consider ethically necessary.

Procedure for adverse effects

A telephone number will be provided to participants. If any complication, they should notice of their health status, and in function of episode features, they will be informed of the procedure to follow. In addition, participants will be in contact with a member of the study team daily.

Outcomes Measures

- Visual Analog Scale Fatigue (VASF), for fatigue measurement [32, 33]. Patients participating in the study will indicate the intensity of their fatigue by means of the VAS through the Smartphone application called "Visual Scale" (Apple Store and Google Play). They will have to signal in a horizontal line where they would place their fatigue, being 0 "no fatigue" and the 10 would be "the worst imaginable fatigue". VASF will be controlled telematically by the evaluators through the Smartphone application. The evaluator will ask the patient to indicate their level of VASF in the "Visual Scale" application, and to take a screenshot of the smartphone to obtain the established value for VASF, which is calculated as the average value of two attempts. The patient must send the VASF screenshot daily to the evaluator, via WhatsApp or email.

- Forced Expiratory Volume in one second (FEV1). The Piko–1 spirometer device will be sent to the home of each patient by post and a telematic control of its use will be carried out. The evaluator will ask the patient to indicate their level of FEV1 assessed by Piko–1 device, twice each time. FEV1 obtained values by patients must send to the evaluator, via WhatsApp or email. We will calculate means of each 2 measurements, assessed by patients every day. [34,35]
- Peak Expiratory Flow (PEF). The evaluator will ask the patient to indicate their level of PEF assessed by Piko–1 device, twice each time. After obtaining values, patients will send them to the evaluator, by WhatsApp or email. We will calculate means of each 2 measurements, assessed by patients every day. [35]
- Six Minute Walk Test (6MWT). The 6MWT will be performed by all patients in their home, under the telematically supervision of a physiotherapist. All patients will receive the same instructions before the walk, and will be encouraged by the physiotherapist who repeated set phrases every minute during the walk. The distance covered during the test will be recorded in meters telematically by patient smartphone. Patients will be allowed to stop and rest during the test but they will be instructed to resume walking as soon as they felt able to do so. Patients will send the results of 6MWT screenshot daily to the evaluator, via WhatsApp or email. [34]
- Thirty Seconds Sit-To-Stand Test (30STST). Evaluators will ask patients to place a straight-backed armless chair, with a hard seat, which will be stabilized by placing it against a wall, considering floor to seat height will be between 45 - 50 cm. Seated participants will asked to come forward on the seat until their feet will be flat on the floor, and to fold their upper limbs across the chest, without moving it during all test. Patients will be then instructed to stand up all the way and sit down once without using the upper limbs. Patients will start in the seated position on the chair and, upon command telematically, they will stand up, and then they will return to sitting as many times as they could, in a 30-second time period. [33,36,37]. The evaluators will control this test telematically by videoconference.
- Multidimensional Dysphnoea–12 (MD12) Spanish version [38]. The MD12 questionnaire will be self-administered and will be performed at the end of the 6MWT. Patients will send the results of MD12 screenshot daily to the evaluator, via WhatsApp or email.
- Borg Scale (BS). The Borg scale, of perceived effort, measures the entire range of effort that the individual perceives when exercising. This scale gives criteria to make adjustments to the intensity of exercise, that is, to the workload, and thus forecast and dictate the different intensities of exercise in sports and medical rehabilitation. The BS will be completed by patients at the beginning of each session, and after completing the exercise program, as well as at the end of the tests, every day (6MWT, 30STST). Patients will send the results of BS screenshot daily to the evaluator, via WhatsApp or email. [39,40]

Participants' timeline

A brief Standard Protocol Items: Recommendations for Interventional Trials (SPIRIT) flow diagram is provided in Fig. 1, and a populated SPIRIT checklist is provided in Additional file 1.

Sampling and Sample Size Calculation

The sampling of our research will be non-probabilistic, since we will contact the patients through social networks, and not the entire population belongs to these networks, so the selection of the sample will be possible only among those who voluntarily respond to our request.

The sample size will be calculated using the Granmo calculator v.7.12, based on the analysis of the variance of means, and estimating an alpha risk of 5% (0.05), a beta risk of 10% (0.10), in a unilateral contrast, a typical deviation of 12,5% (0.125), a minimum difference to detect of 10% (0.10) which is based as the minimum clinically important differences in VASF [33], and a rate of follow-up losses of 8%, for which 30 subjects are required in each group, assuming that there are three groups. Finally, we will include 99 patients who will be divided into three groups, each group of at least 33 subjects, being able to overcome this value to assume the possible loss of follow-up.

Randomization

Patients will be divided into three groups by means of balanced randomization, carried out with free software (http://www.randomized.org/). The randomization sequence will only be performed by the Principal Investigator and Auditor. No participant in the study will have access to the randomization sequence, which will be hidden and saved, to guarantee a correct randomization with security.

Blinding

Evaluator and patients in the study will be blinded during the entire process. Evaluator will be unaware of the study objectives, the randomized distribution of patients to study groups, and will not have access to the randomization sequence.

Statistical Analysis

The statistical analysis will be carried out through the IBM-SPSS Statistics 24 software, considering the Kolmogorov-Smirnov test as standart normality test. We will analyze the intragroup hypothesis contrast inference by Student's t test for paired variables with parametric distributions, and Kruskal-Wallis H for non-parametric distributions. We will analyze the intragroup hypothesis contrast inference by one factor ANOVA in the case of parametric distributions, and Kruskal-Wallis H for nonparametric distributions. We will apply a posteriori analysis (Post-Hoc) through Bonferroni's contrast for parametric distributions and Mann-Whitney's U for nonparametric ones. The confidence level used will be 95% (0'05) and the power of the study will be 90% (0'1).

Discussion

This article presents a detailed description of a randomized controlled trial designed to analyze the results in terms of level of fatigue and perceived exertion, physical health, and maintenance of respiratory activity of two types of exercise programs, toning and respiratory, applied in patients affected by COVID19 during the period of home confinement. We intend to investigate a field not previously studied: the repercussion of carrying out a toning and respiratory exercise program in these patients, in historical circumstances that no one had previously observed in Spain, since the general population had never been forced to remain confined at home due to a pandemic infection. Because some of these patients develop severe symptoms associated with respiratory distress, we consider that this study could be of interest in public health, to prevent worsening of the respiratory status of these patients, and so that we could understand the mechanisms that produce these serious alterations, which in many cases require hospitalization and the use of mechanical ventilation. We propose two types of treatments, one using breathing exercises exclusively and the other based on non-specific muscle toning exercise.

Measuring the effects that these two home exercise programs could produce in patients infected with COVID19, we will try to better analyze and understand the mechanisms that are associated with worsening of breathing in this type of patient. Our results seek to analyze whether respiratory muscle stimulation, or vertebral / thoracic tonic musculature, are protective factors in maintaining the health of these patients, and if together with cardiovascular stimulation they could have a specific influence on the prevention of severe respiratory disturbances suffered by some of these patients.

We have designed a randomized, controlled, double-blinded clinical trial, with the aim of contributing to increase scientific knowledge on this matter, so new lines of future research could be developed.

Trial status

This is the first and definitive protocol versión. Participants will be recruited between March 31, 2020—April 30, 2020. Study completion is expected to be May 2020. Study protocol have been submitted before the end of recruitment and before last patient.

List Of Abbreviations

SPIRIT: Standard Protocol Items Recommendations for Interventional Trials

W: Week

REP: Respiratory Exercise Program

NTEP: Non-specific Tonic Exercise Program

SP: Sham Group

VASF: Visual Analogue Scale Fatigue

FEV1: Forced Expiratory Volume in one second

PEF: Peak Expiratory Flow

6MWT: Six Minute Walk Test

30STST: Thirty Seconds Sit-To-Stand Test

BS: Borg Scale

MD12: Multidimensional Dysphnoea–12.

Declarations

Ethics approval and consent to participate

This study complies with the Helsinki guidelines for human research and it has been approved by the experimental ethics committee of the Scientific European Federation of Osteopaths (SEFO). All study participants signed an informed consent approved by the ethics committee. The identification of each individual will remain concealed based on the ethical principles of confidentiality and privacy. Any reason for compensation will be covered by professional liability insurance.

Consent for publication

Not applicable.

Availability of data and material

Not applicable.

Competing interests

The autors declare that they have not competing interests.

Funding

There are not sources of funding.

Authors' contributions

CRB contributed to the protocol development, provided clinical expertise and he is responsible for designing statistical procedures. CBU contributed to the protocol development and provided clinical expertise. EA contributed to the protocol developmen and statistical procedures. JJGG is the principal investigator and has contributed to the concept and study design, provided clinical expertise and

manuscript development. JAGV and JMBR contributed to the protocol development and provided clinical expertise. All authors read and approved the final manuscript.

Acknowledgements

Not applicable.

References

1. Pneumonia of unknown cause ¿ China: disease outbreak news. Geneva: World Health Organization, January 5, 2020. Available from: [https:// www.who.int/csr/don/05-january-2020-pneumonia-of-unkown - cause-china/en/] [Pubmed]
2. Naming the coronavirus disease (COVID-19) and the virus that causes it. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/naming-the-coronavirus-disease-(covid-2019)-and-the-virus-that-causes-it
3. Statement on the second meeting of the International Health Regulations (2005) Emergency Committee regarding the outbreak of novel coronavirus (2019-nCoV). Available from: https://www.who.int/news-room/detail/30-01-2020-statement-on-the-second-meeting-of-the-international-health-regulations-(2005)-emergency-committee-regarding-the-outbreak-of-novel-coronavirus-(2019-ncov)
4. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Available from: https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19---11-march-2020
5. Royal Decree 463/2020, of March 14, declaring the state of alarm for the management of the health crisis situation caused by COVID-19. Ministry of the Presidency, Relations with the Courts and Democratic Memory. Available from: https://www.boe.es/eli/es/rd/2020/03/14/463
6. Special Expert Group for Control of the Epidemic of Novel Coronavirus Pneumonia of the Chinese Preventive Medicine Association. An update on the epidemiological characteristics of novel coronavirus pneumonia (COVID-19). Chinese Journal of Epidemiology, 2020, 41(2): 139-144.
7. Li Q, Guan X, Wu P, et al. Early Transmission Dynamics in Wuhan, China, of Novel Coronavirus-Infected Pneumonia. The New England journal of medicine 2020. DOI: 10.1056/NEJMoa2001316[publishedOnlineFirst:2020/01/30]
8. Coronavirus disease (COVID-19) Pandemic. Available from: https://www.who.int/emergencies/diseases/novel-coronavirus-2019
9. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. Lancet (London, England) 2020. DOI: 10.1016/s0140-6736(20)30183-5[publishedOnlineFirst:2020/01/28]
10. Guan W NZ, Hu Y, et al, . Clinical characteristics of 2019 novel coronavirus infection in China. medRxiv preprint 2020 DOI: http://dx.DOI.org/10.1101/2020.02.06.20020974.

11. Wang D, Hu B, Hu C, et al. Clinical Characteristics of 138 Hospitalized Patients With 2019 Novel Coronavirus–Infected Pneumonia in Wuhan, China. *JAMA*.2020;323(11):1061–1069. doi:10.1001/jama.2020.1585
12. Wu Z, McGoogan JM. Characteristics of and Important Lessons From the Coronavirus Disease 2019 (COVID-19) Outbreak in China: Summary of a Report of 72 314 Cases From the Chinese Center for Disease Control and Prevention. *JAMA*.Published online February 24, 2020. doi:10.1001/jama.2020.2648
13. World health Organization. Report of the WHO-China Joint Mission on Coronavirus Disease 2019 (COVID-19) [Internet]. 2020. Disponible en: https://www.who.int/docs/defaultsource/coronaviruse/who-china-joint-mission-on-covid-19-final-report.pdf
14. https://www.who.int/publications-detail/home-care-for-patients-with-suspected-novel-coronavirus-(ncov)-infection-presenting-with-mild-symptoms-and-management-of-contacts
15. Bowden Davies KA, Pickles S, Sprung VS, et al. Reduced physical activity in young and older adults: metabolic and musculoskeletal implications. *Ther Adv Endocrinol Metab*. 2019;10:2042018819888824. Published 2019 Nov 19. doi:10.1177/2042018819888824
16. Montero D, Dandanell S, Oberholzer L, et al. Combined effects of physical inactivity and acute hyperglycemia on arterial distensibility. *Vasc Med*. 2017;22(4):285–291. doi:10.1177/1358863X17712103
17. Stavrou NAM, Debevec T, Eiken O, Mekjavic IB. Hypoxia Exacerbates Negative Emotional State during Inactivity: The Effect of 21 Days Hypoxic Bed Rest and Confinement. *Front Physiol*. 2018;9:26. Published 2018 Feb 8. doi:10.3389/fphys.2018.00026
18. Fang L, Karakiulakis G, Roth M. Are patients with hypertension and diabetes mellitus at increased risk for COVID-19 infection? [published online ahead of print, 2020 Mar 11]. *Lancet Respir Med*. 2020;S2213-2600(20)30116-8. doi:10.1016/S2213-2600(20)30116-8.
19. Devries MC, Breen L, Von Allmen M, et al. Low-load resistance training during step-reduction attenuates declines in muscle mass and strength and enhances anabolic sensitivity in older men. *Physiol Rep*. 2015;3(8):e12493. doi:10.14814/phy2.12493
20. Walhin JP, Richardson JD, Betts JA, Thompson D. Exercise counteracts the effects of short-term overfeeding and reduced physical activity independent of energy imbalance in healthy young men. *J Physiol*. 2013;591(24):6231–6243. doi:10.1113/jphysiol.2013.262709
21. De Roos P, Lucas C, Strijbos JH, van Trijffel E. Effectiveness of a combined exercise training and home-based walking programme on physical activity compared with standard medical care in moderate COPD: a randomised controlled trial. Physiotherapy. 2018;104(1):116–121. doi:10.1016/j.physio.2016.08.005
22. Del Corral T, Cebrià I Iranzo MÀ, López-de-Uralde-Villanueva I, Martínez-Alejos R, Blanco I, Vilaró J. Effectiveness of a Home-Based Active Video Game Programme in Young Cystic Fibrosis Patients. Respiration. 2018;95(2):87–97. doi:10.1159/000481264

23. Wakabayashi R, Kusunoki Y, Hattori K, et al. Effectiveness of home-based exercise in older patients with advanced chronic obstructive pulmonary disease: A 3-year cohort study. Geriatr Gerontol Int. 2018;18(1):42–49. doi:10.1111/ggi.13134
24. Noe E, Colomer C, Instituto CB, Carlos DS, I UJ. Effectiveness , Usability , and Cost-Benefit of a Virtual Reality e Based Telerehabilitation Program for Balance Recovery After Stroke : A Randomized Controlled Trial. 2015;
25. Straaten MG Van, Cloud BA, Morrow MM, Ludewig PM, Zhao KD. Effectiveness of Home Exercise on Pain , Function , and Strength of Manual Wheelchair Users With Spinal Cord Injury : A High-Dose Shoulder Program With Telerehabilitation. Arch Phys Med Rehabil. 2014;95(10):1810-1817.e2.
26. Piotrowicz E, Piotrowicz R, Opolski G, Pencina M. Hybrid comprehensive telerehabilitation in heart failure patients (TELEREH-HF): A randomized , multicenter , prospective , open- label , parallel group controlled trial — Study design and description of the intervention.
27. Head BA, Studts JL, Bumpous JM, Gregg JL, Wilson L, Keeney C,*et al.* Development of a telehealth intervention for head and neck cancerpatients. Telemed J E Health 2009;15:44–52.
28. Thompson DA, Leimig R, Gower G, Winsett RP. Assessment of depres-sive symptoms during post-transplant follow-up care performed viatelehealth. Telemed J E Health 2009;15:700–6.
29. Laver KE, Adey-Wakeling Z, Crotty M, Lannin NA, George S, Sherrington C. Telerehabilitation services for stroke. Cochrane Database of Systematic Reviews 2020, Issue 1. Art. No.: CD010255. DOI: 10.1002/14651858.CD010255.pub3.
30. Egmond MA Van, Schaaf M Van Der, Vredeveld T. Effectiveness of physiotherapy with telerehabilitation in surgical patients: a systematic review and meta-analysis. Physiotherapy. 2018;104(3):277–98.
31. Hwang R, Phty MC, Hons B, Mandrusiak A, Hons B, Higher G, et al. Exploring patient experiences and perspectives of a heart failure telerehabilitation program : A mixed methods approach. Hear Lung J Acute Crit Care. 2017;46(4):320–7.
32. Stendardi L, Grazzini M, Gigliotti F, Lotti P, Scano G. Dyspnea and leg effort during exercise. Respir Med. 2005;99(8):933–942.
33. Zanini A, Aiello M, Cherubino F, et al. The one repetition maximum test and the sit-to-stand test in the assessment of a specific pulmonary rehabilitation program on peripheral muscle strength in COPD patients. *Int J Chron Obstruct Pulmon Dis*. 2015;10:2423–2430. Published 2015 Nov 11. doi:10.2147/COPD.S91176
34. Beaumont M, Mialon P, Le Ber-Moy C, et al. Inspiratory muscle training during pulmonary rehabilitation in chronic obstructive pulmonary disease: a randomized trial. Chron Respir Dis 2015; 12: 305–312.
35. Rodriguez-Pascual L, Cordero-Guevara J, Viejo-Banuelos JL. Agreement between pneumotachograph and PiKo-1 measurements of PEF and FEV1. Arch Bronconeumol. Spain; 2006 Mar;42(3):144–7.
36. 36. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport. 1999;70(2):113–119.

37. 37. Ozalevli S, Ozden A, Itil O, Akkoclu A. Comparison of the sit-to-stand test with 6 min walk test in patients with chronic obstructive pulmonary disease. Respir Med. 2007;101(2):286–293.
38. Amado Diago CA, Puente Maestu L, Abascal Bolado B, et al. Translation and Validation of the Multidimensional Dyspnea-12 Questionnaire. Traducción y validación del cuestionario multidimensional Disnea-12. *Arch Bronconeumol*. 2018;54(2):74–78. doi:10.1016/j.arbres.2017.08.001
39. Koppers RJH, Vos PJE, Boot CRL, et al. Exercise performance improves in patients with COPD due to respiratory muscle endurance training. Chest 2006; 129: 886–892.
40. Burkhalter N. Evaluación de la escala Borg de esfuerzo percibido aplicada a la rehabilitación cardiaca. Rev.latino-am.enfermagem, Ribeirão Preto, 1996,4(3):65- 73.

Figures

	STUDY PERIOD							
	Enrollment	Allocation	Post-allocation (treatment)			Follow-Up (evaluations)		
TIMEPOINT	*0 W*	1 W	*1 W*	*2 W*	*3 W*	*1W*	*2W*	*3W*
ENROLLMENT:								
Eligibility screen	X							
Informed consent	X							
Clinical Evaluation and Inclusion -Exclusion Criteria	X							
Allocation		X						
INTERVENTIONS:								
REP Protocol			X	X	X			
NTEP Protocol			X	X	X			
SP Protocol			X	X	X			
ASSESSMENTS:								
Demographic Data	X							
VASF						X	X	X
FEV1						X	X	X
PEF						X	X	X
6MWT						X	X	X
30STST						X	X	X
BS						X	X	X
MD12						X	X	X

Figure 1

SPIRIT flow diagram. W: Week; REP: Respiratory Exercise Program; NTEP: Non-specific Tonic Exercise Program; SP: Sham Group; VASF: Visual Analogue Scale Fatigue; FEV1: Forced Expiratory Volume in one second; PEF: Peak Expiratory Flow; 6MWT: Six Minute Walk Test; 30STST: Thirty Seconds Sit-To-Stand Test; BS: Borg Scale; MD12: Multidimensional Dysphnoea-12.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- INFORMEETICO.pdf
- Anexo1.HomeExercises.pdf
- SPIRITchecklist.doc