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REHABILITATION STRATEGIES NECESSARY TO IMPROVE THE QUALITY OF LIFE OF PATIENTS AFFECTED BY THE LONG COVID

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CONTENTS

I. INTRODUCTION

The chosen theme involves the development of general rehabilitation strategies, and in particular, the study of pulmonary rehabilitation as an essential factor in increasing the quality of life of patients affected by Long COVID or Long COVID. Long COVID, Long COVID-19) by applying a personalized recovery program according to the stage, duration, respiratory and multisystem damage of each individual following SARS-CoV-2 infection. Another aspect pursued in the research paper would be the monitoring and treatment as well as the observation of the evolution at home of patients affected by COVID-19 scaffolding, through a technology, so-called telerehabilitation (a subgroup of telehealth) – a method that is successfully applied, in various forms, in countries with well-developed health systems. (Thomas, Baldwin, Bissett, Boden, & Gosselink, 2020) (McDermott & Newman, 2021)

II. MOTIVATION FOR THE CHOICE OF THEME

The disability caused by COVID-19, through deconditioning and prolonged immobilization, causes varying degrees of disability, which makes it difficult for survivors to function normally. We are even talking here about mechanical ventilation, absolutely necessary in the vast majority of cases admitted to intensive care, which creates oxygen dependence after only 3 days of administration. (Baltaga, Civirjic, Arnaut, 2020)

III. PURPOSE OF THE TOPIC

The application of a complex medical rehabilitation program will take into account the pathology particularities and disabilities of COVID-19 patients, the continuation of medical rehabilitation will be done through careful monitoring, making it easier to restore the body's functionality and work capacity. The earlier the rehabilitation program is instituted, the shorter the time for patients to return to normal life (Martínez-Velilla, Valenzuela, & Zambom-Ferraresi, 2020).

IV. TOPICALITY OF THE THEME

The choice of the research topic, in itself, is current and is outlined as a necessity in the current context, regarding respiratory rehabilitation as an integral part of a process of return of patients infected with SARS-CoV-2 to a normal life.

PART I. THEORETICAL FOUNDATION OF THE WORK

CHAPTER 1. COVID-19 PANDEMIC

1.1. DEFINITION AND ETIOLOGY OF SARS-CoV-2

The new beta-coronavirus, known as severe acute respiratory syndrome, Coronavirus 2 (SARS-CoV-2) was initially discovered in December 2019 through a group of pneumonias with unclear causes. The virus that caused the disease, which had its beginnings in Wuhan, China, is currently known as Coronavirus disease 19 (COVID-19). As of March 11, 2020, the World Health Organization and others have classified it as a global pandemic, with a start date of April 2, 2020.

1.2. SYMPTOMATOLOGY

The clinical manifestation of COVID-19 ranges from symptoms to life-threatening pathologies such as: vasculitis, myocarditis, severe pneumonia or multi-organ failure. Although the virus most commonly attacks the respiratory tract, COVID-19 can, directly and indirectly, through cytokine storms or vascular inflammation and thrombosis, lead to numerous non-pulmonary complications. SARS-CoV-2 shares 80% sequence homology with its original SARS coronavirus counterpart (Tsutsui, Gerayeli, & Sin, 2021)

1.3. EVOLUTION OF THE COVID-19 DISEASE

Surveys were also conducted among young teenagers in high schools in the UK to see the signs and evolution of COVID-19. in Long covid. The so-called SCHOOLCOVID 19 Survey shows us the persistence of the symptoms clearly indicated the evolution of COVID-19 towards Long Covid, namely fatigue, headache and abdominal pain, the predominance of psychiatric symptoms - insomnia, sadness, anger, anxiety and depression. (J. Blankenburg, M. Wakenborg, 2021)

1.5. IMPACT OF THE COVID 19 PANDEMIC WORLDWIDE

Given the large-scale impact on the quality of life of patients affected by COVID-19, it is necessary to develop therapeutic strategies in terms of respiratory recovery and general rehabilitation by establishing a rehabilitation program in which the patient is evaluated complexly, with the

establishment of individualized management, with the gradual progression of the treatment applied and continuous monitoring (Thomas, Baldwin, Bissett, Boden, & Gosselink, 2020).

CHAPTER II. LONG COVID

2.1. DEFINITION OF LONG COVID

Long COVID or long COVID – [engl. Long COVID], is a term used to describe the long-term sequelae of COVID-19 disease present in people who either have not recovered from COVID-19 disease and continue to experience symptoms due to the persistence of SARS-CoV-2 infection, or in people who, although the virus is no longer active, show symptoms for longer than expected (Sivan, Rayner, & Brendan, 2021).

In January 2021, more than 93 million cases of LONG-COVID were reported worldwide. Although most people recover after a few weeks, many patients experience persistent symptoms, regardless of age and underlying living conditions - symptoms of Long-Covid. (Buttery & Philip, 2021)

Long Covid appears to be a multisystemic disease associated with complex respiratory, muscular, neurological, gastrointestinal, cardiology, dermatological, immunological symptoms of varying severity, frequency and duration.

2.2. SYMPTOMS OF LONG COVID

The persistent symptoms reported by patients are extensive and can involve the entire body, as follows:

- breathing problems – 92.1%;
- fatigue – 83.3% (Kim, Read, & Fauci, 2020);
- muscle weakness, myalgia / joint stiffness – 50.6%;
- sleep disorders – 46.2%; (S.Batool-Anvar, R.Robbins, et al 2021)
- concentration problems – 45.9%;
- mood swings, anxiety, depression – 43.1%; (Buttery & Philip, 2021) cough – 42.3%;
- other symptoms would also be: anosmia and ageusia, (Havervall, Rosell, & Phillipson, 2021);

- gastrointestinal disorders, headache, alopecia, skin changes, tachycardia, retrosternal pain, visual disturbances or increases in glycemic values. (Wynberg, van Willigen, & Dijkstra, 2021)
- Hair loss in women – alopecia (Herdman, Gudex, Yoyd, & M.Janssen, 2020)

2.3. STRATEGIES ON MANAGING THE RECOVERY OF PATIENTS AFFECTED BY THE LONG COVID

Thus, we have some strategies to put into practice in the future period, depending on the challenges of managing SARS-CoV-2 infection, namely:

1. Study how patients struggled with drastically reduced physical function, aggravated by the cognitive and physiological effects of COVID-19 (APTA);
2. highlighting the challenges associated with carrying out and interpreting physical rehabilitation programs that have been appropriately adapted, deepening personal approaches to managing symptoms, including fatigue and "brain fog", while attempting to resume daily activity (Humphreys, Kilby, Kudiersky, & Copeland, 2021);
3. patients' struggle with the very concept of accepting reduced respiratory and organic function, even temporarily, and the fear of a permanent reduction in physical and cognitive capacity (Jamoussi, Besbes, 2020);
4. carry on the program by the patient and at home him, in different periods of time, under the guidance of the physiotherapist; APTA- American Physical Therapy Association;
5. identifying the best means of physical therapy, respectively devices and aids that contribute to increasing the quality of life (Chen, Li, Gong, & Zhang, 2020);
6. telerehabilitation, as a new means of communication in establishing long-term therapeutic behavior, by the physiotherapist at the patient's home (Swarnakar, Yadav, & Srikumar, 2021);

2.4. GENERAL NOTES IN THE LONG- COVID RECOVERY PROGRAM

1. Passive, passive-active and active postures and mobilizations, adapted to the level of muscle deconditioning;
2. Gymnastic exercises with or without apparatus (elastic bands, stick, dumbbells weighing from 0.5 to 2 kg, gym ball);

3. Exercises for training balance, breathing training, walking exercises, transfer and stability, aerobic training, functional training, elements of Yoga and Pilates;
4. Exercises at the physical therapy room with stepper, ergometric bike, TRX, treadmill;
5. Thoracic clapping - for draining bronchial secretions;
6. Electrotherapy - using the "BTL 4000 SMART - PREMIUM" combination for analgesia and reduction of costo-vertebral pain, intercostal and articular, along with the effects of muscle electrostimulation in the limbs;
7. Magnetotherapy - using the MAGNETRONIC MF 12 device by creating a magnetic field with a de-constriction, muscle relaxing and sedative effect;
8. Polarized and polychromatic light therapy using "BIOPTRON PRO 1" for bio-stimulating effects. "BIOPTRON PRO 1" has a stimulating action on the regenerative and reparative processes, as well as the body's defense processes, stimulating it to trigger its healing potential.

CHAPTER III - RESPIRATORY REHABILITATION IN THE LONG COVID

3.1. RESPIRATORY REHABILITATION IN LUNG DISEASES, INCLUDING COVID-19

Respiratory rehabilitation is an intervention that encompasses very broad therapeutic aspects and begins with a thorough evaluation of the patient. Further to the evaluations, patient-friendly therapies are implemented, which may involve physical exercises, training, reeducation devices, physical therapies, education and modification of the behavior and lifestyle of the respiratory patient, and, aimed at improving long-term adherence to programs beneficial to health and physical and mental well-being, addressing in particular people with respiratory diseases or chronic tendencies. (Busneag C. 2006).

3.2. COMPONENTS OF RESPIRATORY REHABILITATION

1. Respiratory education of the patient and the family.
2. Complementary means to the main therapy:
3. Specific pharmacotherapy;(not the subject of this work)
4. Objectives of respiratory kinesiotherapy (Enoiu & Moldovan, 2018)

3.3. METHODS OF RESPIRATORY KINESIOTHERAPY

1. Positioning and breathing facilitation postures:
2. Respiratory manipulation techniques (Busneag C., 2006):
3. Respiratory gymnastics:
4. Speech education - The degree of dyspnea that the patient presents determines how the technique of speech instruction changes.
5. Workout with dosed effort: During a training session, the effort level should not be higher than 60–70% of the level causing dyspnea (Felten, van Oorsoouw, Klooster, etc ,2020)

CHAPTER IV. - PHYSICAL EXERCISE

4.2. RULES FOR PRACTICING POST-COVID-19 EXERCISE

1. The aim is to gradually increase the ADL – Activity Daily Living and physical function. (Thomas, Baldwin, Bissett, Boden, & Gosselink, 2020)
2. Exercise with moderate or even low intensity will be done, attention to patients who come after a period in ICU. (Liu,.Chen 2020)
3. Patient needs and physical capabilities & pre-disease level of physical activity will be taken into account when determining exercise parameters in COVID-19 disease (Thomas, Baldwin, Bissett, Boden, & Gosselink, & Gosselink, 2020).
4. In the post-COVID-19 rehabilitation, the Borg scale for dyspnea and fatigue will be taken into account - 4/10 (Gonzalez , Boucontent , & Edit, 2020)
5. Exercise recipes will always be completed, detailing the type of activities as well as specifications for frequency, intensity and duration (Sher & Fusco, 2021).

CHAPTER V.- TELEREHABILITATION

An implemented and viable telerehabilitation system consists of applying a coherent rehabilitation program adapted to the needs of the patient by a physiotherapist to follow him and explain him pulmonary rehabilitation exercises or general, depending on organic damage (Swarnakar, Yadav, & Srikumar, 2021)

Remote coordinated rehabilitation via internet-connected multimedia devices and software applications that create call or video conferencing connections („Zoom”, „Messenger”, „WhatsApp”, „Skype”)

PART II. RESEARCH IN PULMONARY REHABILITATION AND INCREASE THE QUALITY OF LIFE OF PATIENTS WITH LONG COVID

CHAPTER VI. STUDY I. EXERCISE-BASED PULMONARY REHABILITATION: A CRUCIAL FACTOR FOR PATIENT RECOVERY IN A POST-COVID-19 WORLD

COVID-19 is a highly contagious respiratory tract infection that can lead to physical, psychological and respiratory problems in its victims. (Kim, Read, & Fauci, 2020). Consequently, respiratory rehabilitation plays a critical role in the recovery of hospitalized patients with mild, moderate or severe forms, as well as those with sequelae that occur later. (Vitacca, et al., 2020).

To create an effective model of general rehabilitation, we looked at techniques and strategies for pulmonary rehabilitation, as well as musculoskeletal rehabilitation. This was done on the basis of published guidelines for the pulmonary rehabilitation of COVID-19 patients and evidence from case studies of patients treated for SARS-Cov-2 infection, but with the pulmonary sequelae of COVID-19 (Schlemmer, et al., 2020). Since COVID-19 patients have respiratory, physical and psychological problems, it is essential to recover in order to resume their previous social and physical activities and improve their quality of life. (Yang & Yang, 2020).

The goals of pulmonary rehabilitation are to prevent muscle deconditioning, which results in loss of muscle mass and strength, as well as improve pulmonary ventilation, cleanse bronchial secretions and restore the patient's quality of life.

All muscle groups, but especially respiratory muscles, will be worked during respiratory physical training. Specific respiratory muscle training (MRT), which is divided into two categories: exhaling muscle training (EMT - Expiratory Muscle Training) and inspiring muscle training (IMT - Inspiratory Muscle Training), which is the training of the breathing muscles (EmT), which is a crucial component. Patients are more likely to stick to a workout training routine that involves intervals rather than one continuous when it comes to exercising their respiratory muscles. Training of the respiratory

muscles can be forced or based on resistance, involving either a forced inspiration held for a few seconds, or repetitive inhalations and exhales against resistance. (Jimborean, Ianosi, Croitoru, & Szasz, 2017).

6.2. MATERIAL AND METHODS

6.2.1 Purpose of research

The aim of the study is to review and aggregate all important data from global research on COVID-19 and in particular, lung disease COVID-19, which is, to develop the best exercise-based intervention program possible, prioritizing patient rehabilitation and real improvement of daily activities. (Beom, et al., 2020).

6.2.2 Hypotheses of research:

- How should medical recovery be done for chronic COVID - 19 patients?
- How long will the intervention take place at home and in ambulatory?
- What intervention programs are available?
- To what extent has media consumption helped in rehabilitation?
- Did the intervention plan help patients feel less depressed and anxious?
- How long did it take to return to the surmisable state of well-being?

6.2.4. The subject of the study

It consists of specialized articles about the effects of exercise on COVID-19 disease and respiratory rehabilitation. The articles that were chosen included review pieces, case studies, meta-analyses and rehabilitation guides that were presented by European groups and around the world appreciated. These articles originally laid the foundation for the medical recovery of people affected by the SARS-CoV-2 virus.

6.2.6 Description of the experimental process

To carry out the current work, 400 publications from PubMed, Elsevier, Research Gates, Sci-Hub, British Medical Journal and COVID-19 rehabilitation guides have been searched using Google Scholar and Google Academy search engines. Using the inclusion and exclusion criteria, a total of 50 articles were found containing the information sought by the keywords or key phrases: COVID-19,

pulmonary rehabilitation, exercise and Covid Lung. This research paper and the development of intervention programs is based on articles that have been preserved after screening.

6.3. RESULTS AND DISCUSSIONS

We offer two rehabilitation exercises for each type of rehabilitation (musculoskeletal, neurological and respiratory), with varying degrees of difficulty, and, to help organize a rehabilitation plan that can be continued at home with the patient, depending on his condition and the challenges of life, and be as close as possible to the practical side of recovery.

6.3.1 Respiratory re-education

Suggested breathing exercises are used in accordance with the pulmonary exchange, the ability to exhale, the limitations of the respiratory muscles and the time of coughing.

After prolonged intubation, it is necessary to retrain deglutition and voice due to weakness of the respiratory muscles, low pharyngeal sensitivity and laryngeal edema after extubation. Reeducation involves targeting the muscles of the face and neck, in addition to using devices such as „TRI-GYM" and „PULMOVOL" for training. (Lazzeri, Lanza, Bellini, Bellofiore, & Cecchetto, 2020).

6.3.2 Musculoskeletal re-education

Among the various forms of rehabilitation, musculoskeletal reeducation is preferred because muscle deconditioning occurs rapidly in COVID-19 patients, especially for those who are bedridden and need to recover or preserve the amplitude of the joints by passive, passive-active mobilization and posture that promote breathing positions.

6.3.3 Neurological re-education

Neurological rehabilitation is carried out through programs dedicated to neurological disorders, taking into account comorbidities (arterial hypertension, obesity). COVID-19 has led to a significant increase in pathologies such as ischemic and thrombotic seizures, an increase in the number of de-myelitic lesions (sclerosis in the plaque) in seemingly healthy patients, as well as dizziness accompanied by severe migraine.

6.3.4. Rehabilitation at home

It will involve adhering to the recommendations of the physiotherapist for returning to low-intensity physical activity, which should be below 5 MET at first, and scoring an 8 out of 10 on the Borg scale for perceived effort.

6.4. CONCLUSIONS

The need for patients with Covid's pulmonary sequelae to undergo respiratory, musculoskeletal and neurological rehabilitation in physical medicine laboratories, as well as continuous home care under the supervision of a physical therapist and with the application of contemporary techniques.

CHAPTER VII- STUDY 2 - PRELIMINARY STUDY ON THE EFFECT OF APPLYING DIFFERENT RESPIRATORY REHABILITATION PROGRAMS IN IMPROVING THE QUALITY OF LIFE OF PATIENTS AFFECTED THROUGHOUT THE COVID

7.1 PRELIMINARY RESEARCH PREMISES

We start the preliminary research from the premise that in COVID-19 disease, by its novelty, a careful and thorough study is needed to bring clarity to the therapeutic approach of the disease at all stages, as well as to assess the patient's reactivity to the intervention of the physical therapist through exercise programs.

7.2. PURPOSE OF PRELIMINARY RESEARCH

The purpose of the preliminary research is to show that the application of personalized rehabilitation programs can improve respiratory function and bring real benefits to the entire organism affected by SARS-CoV-2 infection. Identification of new methods and means of evaluation and treatment, contributing to increasing the quality of life and returning to the daily activities of patients with the Long COVID sequelae, given that COVID-19 disease is a new condition with so many unknowns (Sagar, Rathinavel, & Lutz, 2021).

7.3. OBJECTIVES OF PRELIMINARY RESEARCH

1. Building a personalized, efficient medical rehabilitation program, centralized on the implementation of this complex, personalized program, which we suggestively called *LONG RECOVERY TRAINING SYSTEM 1*. Exercising joint mobility;
2. Implementation of a medical rehabilitation program and at the patient's home *LONG RECOVERY TRAINING SYSTEM 2,* which involves the consolidation of the skills gained, remotely controlled via internet-connected multimedia devices and some software applications „Messenger", „WhatsApp", „Zoom" or „Skype".

7.5. PRELIMINARY RESEARCH HYPOTHESES

Is a respiratory rehabilitation program aimed at increasing the strength and endurance of the respiratory muscles in COVID-19 disease useful?

Can better results be achieved in terms of increasing the quality of life by improving dyspnea and increasing effort tolerance by joining the original *LONG RECOVERY TRAINING SYSTEM* respiratory rehabilitation program?

Compilation of exercise programs for respiratory and general rehabilitation, with the use of respiratory reeducation and physiotherapy devices leads to superior results in improving daily activities and functional independence of COVID-19 patients?

Can respiratory telerehabilitation also complete /or successfully replace rehabilitation in the clinical and outpatient environment/?

7.7. TESTS USED IN PRELIMINARY RESEARCH

1. CHEST CIRCUMFERENCE
2. „TIMED UP AND GO" TEST;
3. „SIT TO STAND" TEST;
4. TEST OF „MERS - 10 METERS";
5. SPIROMETRY
6. PULSOXIMETRY
7. BARTHEL
8. QPCR - QUESTIONS FOR POST-COVID-19 RECOVERY.

7.12. RECOVERY PROGRAMS „LONG RECOVERY TRAINING SYSTEM”

7.12.1. „LONG RECOVERY TRAINING SYSTEM 1” (in ambulatory)

Duration: 10 – 14 days, 15 – 30 minutes daily; exercises are performed in a number of 2 – 3 series x 6 – 8 repetitions.

Execution conditions: SPO2 ≥ 92%, any desaturation will induce effort stoppage. Below 88% we stop movement. Exercises will be performed up to 60% of the maximum heart rate (Melnic, Pascal, Tabirta, & Plesca, 2020)

7.12.2 „LONG RECOVERY TRAINING SYSTEM 2” (at the patient's home by telerehabilitation)

Duration: 10 – 14 days, 35 – 45 minutes daily, 3 series of 10 – 15 repetitions.

Execution conditions: oxygen saturation ≥ 95%, the exercise is done up to 70 % of the maximum heart rate. Between series or if needed insert breaks of 30 – 60 seconds (Felten-Barentsz, Van Oorsouw, & Klooster, 2020)

Types of exercises:

- Respiratory, costal, diaphragmatic and control exercises, and, direction and coordination of breathing – increasing the number to 30 breathing cycles 2 times a day for the first 2-4 weeks then 25 breathing cycles once to 4 – 6 hours; next 2-4 weeks.
- Exercises with medical breathing reeducation devices: „POWERbreathe KH2”, „PULMOVOL” or „FLO-GYM” / „TRI-GYM”, minimum 2 – 3 repetitions intercalated during the meeting; (3 0 cycles of repeaters 2-3 times daily)
- Exercises with resistance (yellow elastic band, dumbbells, discs); 3 series x 12 – 15 reps.
- Exercises at stepper 3 series x 25 -50 repetitions, with a break of 45-60 seconds between repetitions
- Ergometric bike; we start with 2 minutes pedaling with a 60-second break between pedals and climb to 4 minutes of pedaling with a 60-second break 6, then 6 minutes of pedaling with a 30-second break between pedals ending with 10 minutes of pedaling with a 30-second break then pedaling 15 minutes without a break.
- Exercises on the balance plate and dynamic pillow; 3 series x 10 reps then break 30 seconds we continue with 15 reps with break 30 seconds then 15-20 raises on pillow/plate without repetitions.
- Variable distance walking exercises according to effort tolerance and SPO_2. We start on the surface of the hall respectively 30 meters then 2 laps of 30 meters to 5 laps of hall of 30 meters

We can practice walking with girl, with back, side, side, on tips/heats. In the middle of the laps a 60-second break.

The rehabilitation program was executed progressively, fractionally in the form of a circuit under the careful supervision of the physical therapist. We used this program for a re-training of outstanding functions in patients affected by Lung COVID (Felten-Barentsz, Van Oorsouw , & Klooster, 2020).

7.17. CONCLUSIONS OF THE PRELIMINARY STUDY

1. General physical rehabilitation is recommended for all patients, but especially for those with reduced functionality, with daily activities that have become a real challenge for the patient affected by the SARS-CoV-2 virus.
2. Long-term COVID disorders are increasingly present in the share of diagnoses that require kineto-therapy, thus increasing the addressability to rehabilitation services.
3. The statistical compilation and interpretation of data using the Anova program was useful in preliminary research.
4. Deepening personal approaches to managing long-term symptoms by improving applied tests.
5. Identifying the applicability of the newest and most advanced physiotherapy devices as means of supporting the original Long Recovery Training System, initiating the disability assessment through the Wodas questionnaire, proposed by W.H.O.
6. We support the early initiation of the therapeutic act in curing COVID-19 patients.
7. Initiation of medical rehabilitation treatment starting with the implementation of the personalized questionnaire QPCR – Questions for Post-COVID-19 Rehabilitation repeated at the end of the rehabilitation program, monitoring patients, and, establishing the efficiency of rehabilitation and treatment directions.
8. Physiotherapist / physiotherapist will support the fight of COVID-19 patients and with the concept of the disease itself, which means the ability to accept reduced respiratory function (even only temporarily) and overcome the fear of a permanent reduction in physical and cognitive ability.
9. Supporting the importance of an interdisciplinary collaboration by co-opting pulmonologists and cardiologists in the rehabilitation process, to evaluate and follow the evolution of patients affected by the LONG COVID.
10. Increasing accessibility to rehabilitation programs for patients affected by the LONG COVID who cannot move for various reasons.

CHAPTER VIII - STUDY 3- CONTRIBUTIONS ON INCREASING THE QUALITY OF LIFE AND IMPROVING THE DAILY ACTIVITIES OF PATIENTS AFFECTED THROUGHOUT COVID THROUGH EXERCISE

8.1 PURPOSE

The main purpose of this experimental research is to determine the effectiveness of recovery programs in patients affected by the LONG Covid, both at the gym, and at the, as well as the continuation of the exercises recommended by the physiotherapist at the patient's home (Betschart, Rezek, Unger, & Beyer, 2021).

8.2. PREMISES

In this study we started from the following premises: the long-term sequelae – LONG COVID – have significantly decreased the quality of life and the performance of their daily activities, and on the other hand, the high incidence of LONG COVID-19 cases with persistence in all age categories. (Butterie & Philip, 2021)

8. 3. OBJECTIVES

The main objectives are to identify the effects of exercise programs, identify physical procedures with beneficial effects on breathing function, musculoskeletal and physical exercises useful in carrying out daily activities, among patients aged between 30 and 69 years, affected by LONG COVID. (Gonzalez, Boucontent , & Edit, 2020)

We added stretching exercises and those with small weights, but with an increased number of repetitions, plus Core exercises. It is also important to use physiotherapy through electrostimulation, TENS, Ultrasound and Laser procedures, using Combina „BTL 4000 SMART – PREMIUM" and contract reduction using „BIOPTRON PRO 1". It is also mandatory to continue the exercises at the home of the patient with the further involvement of the physiotherapist using the means WEB.

Long Recovery Training System PLUS

The experimental group, on which we implemented the Long Recovery Training System PLUS program, had at the final tests the results of the study, which were enjoyable, superior, especially in the walking tests, spirometry and improving the quality of daily life. We introduced intense training

on the bike, in the halves, then the treadmill at low speeds, over longer and longer distances. At two weeks I re-evaluated and increased the duration and intensity of the exercises to the cyclergometer and treadmill. On the tape we continued walking (H.Demeyer, M.Koeckx ,K.Mars et alt 2020

We decided to customize the exercise programs to the experimental group, using the general respiratory rehabilitation device „POWERBREATHE Medic Plus IMT" instead of „PULMOVOL" and „TRI-GYM"/ „FLO-GYM" to increase the efficiency of the inspiratory muscles. The novelty of the study is the use of the elliptical bike joining walking sessions at your own pace on the treadmill. Simultaneously with the use of respiratory rehabilitation devices („POWERBREATHE Medic Plus IMT") we introduced exercises for muscle strength, stability and balance. Resistance exercises (using dumbbells and scarves) will have a large number of repetitions, with low weight. We also insisted on reeducating diaphragmatic breathing by controlling the diaphragm increasing lung function. (Kale, M. Vijaya & Kumar, 2013).

8.4. HYPOTHESES

1. The TUG test indices will improve as a result of the implementation of the original Long Recovery Training System Plus program, in the context of the decrease of the effort capacity given by Long Covid.
2. Sit To Stand test values will improve as a result of practicing the Long Recovery Training System Plus program in the context of decreasing muscle strength in COVID-19 sequel patients.
3. The 10-meter test values will improve as a result of the exercise used in the LRTS Plus program (eliptical exercises and treadmill), thus increasing the patient's effort tolerance with Long Covid.
4. The usefulness of walking exercises, practicing physical exercises at elliptical and running lane from the Long Recovery Training System Plus program to increase Oxygen Saturation by also joining the respiratory exercises with assistive devices (POWERbreathe Medic Plus IMT).
5. Demonstrating the usefulness of breathing exercises and exercise with assistive devices („POWERbreathe Medic Plus IMT") in increasing spirometry values (VEMS /Vital Capacity).

6. The usefulness of the Questionnaire Questions For Post-COVID-19 Rehabilitation is important in assessing the independence of patients in the practice of ADL, emotional and mental health, besides the physical one, after the Long Covid sequelae.
7. Increasing the quality of life by regularly practicing Long Recovery Training System exercises and respiratory training. Continuation of treatment at home /telerehabilitation.

8.7. SETTING UP THE MAIN RESEARCH

The main research was set up over two years (October 2022 – September 2024) and covers both patient sellection, including, as well as the application of initial evaluation tests and the implementation of respiratory and musculoskeletal re-education programs. In the continuation of the research, we conducted the final testing, followed by the interpretation and analysis of the obtained results. At the time of introduction of patients into the study, the RT-PCR test should be negative even if the persistence of symptoms remains troublesome.

A number of 42 patients with sequelae of Long Covid were recruited from the presentation in the Balneological Ambulatory of the Turda Municipal Hospital, by voluntary written agreement and signed between the patient and the physical therapist. Patients' data were coded under a private code number and were informed about the study and what steps they would take in the research, followed by the signing of the informed agreement.

Assessing patients by allocating the selection of seven of the 13 tests originally proposed. The evidence of the initial and final evaluation of patients was recorded on individual sheets containing anthropometric data.

8.8. TESTS APPLIED IN THE MAIN RESEARCH

A. Walking, balance, stability and transfer tests:

1. TUG - *Timed Up & Go*;
2. *The 10-meter* test;
3. *Sit to Stand* test.

B. Breathing tests:

4. Pulse oximetry;
5. Spirometry.

C. Questioner

6. *QPCR – Questions for Post-COVID-19 Rehabilitation.*

8.10. STRUCTURE OF REHABILITATION MEETINGS:

- Physiotherapy: 15 – 30 minutes.
- Laser sessions 5 min.
- Sessions of ultrasound 10 min-15 minutes on the painful area
- TENS - 10 minutes on areas with contracts.
- „BIOPTRON PRO 1" or with a duration of 3-5-10 minutes, alternating with exposure to the electromagnetic field of the apparatus „MAGNETRONIC MF 12"
- LONG RECOVERY TRAINING SYSTEM PLUS – on average 50 minutes, as follows:
    - Heating: 5 – 7 minutes;
    - Exercises themselves: 30 minutes-45 minutes:
    - Elliptical bike /Running tape (alternative) 10 minutes-20 minutes
    - Return after effort: 3 – 5minutes.
- Chest clapping: 5 minutes.
- Dorso-lumbar sedative massage, upper and lower limbs.

For the proper conduct of the research, a firm schedule and a serious collaboration were established with each patient to continue at home the breathing exercises program with the „ POWERBREATHE Medic Plus IMT" which replaced the devices „PULMOVOL" and „TRI-GYM" from the preliminary research.

Compared to the preliminary study, in the main research, the duration of the exercises was increased from 30 minutes to 45 minutes, and the duration of the breathing cycles was increased to 35-40 respiratory cycles, once a day, then every 6 hours for 35-40 respiratory cycles, at 4 hours and finally at 2 hours, in order to make the respiratory results more efficient and maintain progress.

8.12. APPLICATION OF THE ORIGINAL LONG RECOVERY TRAINING SYSTEM PLUS PROGRAM ON THE BODY OF PATIENTS WITH LONG COVID

„POWERBREATHE Medic Plus IMT" – is a portable, easy-to-use device necessary for breathing training through inspirational muscle training (IMT), which is, suitable for people with very weak respiratory muscles as a result of an existing disease, post-hospitalization, or respiratory condition such as COPD or Bronchial Asthma. Also applicable to a large extent lung sequelae Long Covid. For this reason it is a device that offers the lowest input level load than any other threshold

IMT device. It is easy to use by patients including at their home, the manufacturer recommending training organized in two series of 30 breaths /day for increased respiratory strength and resistance. [Fig. 30]

Fig. 30. POWERbreathe Medic Plus IMT
www.powerbreathe.com

Effects of IMT respiratory exercises with the device „ POWERBREATHE Medic Plus IMT”

A recovered lung capacity provides the amount of O_2 required for an effective respiratory act, which ultimately leads to increased quality of life, normal performance of Activity Daily Living (daily activities).

With the use of the device „ POWERBREATHE Medic Plus IMT” we will gain a correct breathing technique, good inhale/exhale ratio, a properly directed airflow. The whole body, by making breathing more efficient, will also move at the muscular level. After a few days of training the respiratory muscles will be stronger, in 3 weeks of use the breathing will improve, and after 4 weeks the physical and respiratory exercises will be performed easily.

8.13. RESPIRATORY EXERCISES WITH THE „POWERBREATHE MEDIC PLUS IMT" DEVICE

Exercise 1. Sitting facing the trellis, with the IMT device attached to the mouth, there are left foot elevations on the lath 1 of the trellis, with inhale /exhale descent. Gradually the opening of the lower limbs will be increased, stepping on the 2nd and 3rd shingles (2 x 10 repetitions).

Exercise 2. Sitting facing the trellis, with the IMT device attached to the mouth, right foot elevations are made on the lath 1 of the trellis, with inhale /exhale descent. Gradually the opening of the lower limbs will be increased, stepping on the 2nd and 3rd shingles (2 x 10 repetitions).

Exercise 3. From the position lying on the back on the inflatable ball, with the hands at the neck, inhale exercises are done with the lateral extension of the arms and the exhale return (3 series x 15 reps)

Exercise 4. From the seated position, with the back straight and the palm lying on the abdomen, the patient inhales heavily through the IMT device, controlling the respiratory cycle (2 x 30 respiratory cycles).

Exercise 5. Standing with his back glued to the trellis raises his right foot to 90˚ inhale /exhale descent using the respiratory device (3 x 15 reps).

Observations

On breathing exercises with the device „ POWERBREATHE Medic Plus IMT" a 2-minute break between exercises is required, for explanations and rest!

8.14. RESPIRATORY AND MUSCULOSKELETAL EXERCISES WITHOUT RESPIRATORY DEVICES

Exercise 1. The patient sitting, puts pressure with the index of the right hand, on the right nostril, is made deep inhale on the left nostril, with prolonged exhale through the mouth, on the right nostril, then the part is changed and the respiratory cycle is repeated. (2 x 15 cycles).

Exercise 2. The seated patient, bent forward, with his elbows supported on his knees, performs a breath „lit" (3 series x 15 repetitions).

Exercise 3. The patient sits in the sitting → raises his arms one at a time, they go side left / right and above his head in inhale, and, then comeback with expiration – for educating each hemitorace (3 x 15 reps).

V. DEBATES

In the debates on the importance of practicing physical exercise in COVID-19 disease and our attitude towards disease, the, reputed teacher Zhang Yan had the following words „We cannot isolate ourselves forever (from COVID-19 disease)" and we know that „The physical activity practiced regularly has multiple health benefits that is why a we practice regularly, but with the maintenance of social distance".

The Chinese Association of Rehabilitation Medicine, in collaboration with the Italian one, proposed a minimum of 6 weeks of respiratory rehabilitation for improving respiratory function, increasing quality of life, and, reducing anxiety and depression (Demeco, Marotta, Barletta, Pino, & Marinaro, 2020). In this research, the recovery threshold has been raised at a maximum of 10-12 weeks, being the sequel of COVID-19, which is, following that the patients perform at home the exercises of the recovery program learned at the kinesiotherapy room – Long Recovery Training System 2.

Conducted over the course of 4-6 weeks, preliminary research is able to confirm that there has been a significant improvement in the physical, mental and emotional state of patients. Starting from the premise that through an individualized, gradual and safe intervention plan, through a thorough evaluation and compliant testing, significant changes will be achieved in increasing the quality of life and daily ADL activities. (C.Baldwin, P.Thomas, B.Bissett, 2021).

Luca Richeldi, director of the Pneumology department of Gemelli Roma Polyclinic, spoke openly about the long legacy of COVID, the emergence of multiple forms of COVID-19 and sequelae, mainly pulmonary, pulmonary fibrosis, even 3-6 months after contacting SARS-CoV-2. Loss of pulmonary elasticity, fatigue and dyspnea destabilize the body by reducing mobility and the ability to participate in daily tasks.

Thus, the quality of life is jeopardized, the ability to participate as a resource in family income, and the reduction of responsibilities in society by the absence of the person, the, it leads to an inner sense of worthlessness and lack of identity. (W.J. BRYON 2020)

The collaboration with patients was good, and the expression of informed agreement managed to introduce them easily and directly into the procedure used. I mention that I also had specialized help from the medical staff at the pneumology department of the hospital and the balneologist of the institution.

The large number of cases sent for respiratory gymnastics at the Balneology Ambulatory Physical Therapy Hall of the Turda Municipal Hospital recorded a peak of growth during the year

(e.g.: 50 Patients in the first 3 months of the year). Long-term COVID disorders are increasingly present in the share of diagnoses that require kinetotherapy, thus increasing the addressability to rehabilitation services (Domingo & Waddell, 2021).

The patients expressed their confidence in the therapeutic act of rehabilitation and were cooperative and solidarity with the proposed activity. For a good run of tests and evaluations, we programmed the participants from the experimental and control group in the morning, to prevent fatigue, distributed over hours to avoid cluttering, and the treatments carried out with cursivity have given the results pursued in the main research.

The initial /final evaluation was explicit, the subjects were measured, tested and treated safely, without incident.

HYPOTHESIS 1

The TUG test indices will improve as a result of the implementation of the original Long Recovery Training System Plus program in the context of the decrease of the effort capacity given by Long Covid.

Visible improvements were achieved in the gait tests, and I can say that the TUG test felt the favorable evolution of patients from the first 10 days of treatment. We noticed a significant increase in orientation in space because, at first, patients seemed not to know what the threshold of 3m, they were going forward /they stopped a step behind. As a result of muscle contractions, the strength of the lower limbs increased. Weight-bearing exercises in the lower limbs strengthened the quadriceps and calf muscles and increased stability and balance when lifting.

HYPOTHESIS 2

Sit To Stand test values will improve as a result of practicing the Long Recovery Training System Plus program, in the context of decreasing muscle strength in COVID-19 sequel patients.

Regarding the diversification and improvement of the stability and balance test methods, we proposed this test, which is recommended according to the recent guidelines and we noticed the applicability in the good results obtained. Next to the Sit to Stand test, I believe that I can also join the 5 Sit to Stand test to increase the duration of the simple test and increase the difficulty of the test conditions (Guarlnik, 2000).

HYPOTHESIS 3

The values of the 10-meter test will improve as a result of practicing the physical exercises used in the Long Recovery Training System Plus program (exercises on elliptical cycling and treadmill), thus increasing the tolerance to effort of the patient with Long Covid.

We encouraged walks, walking, and exercise at the cycloergometer was essential in the rehabilitation plan, observing the maintenance of oxygen saturation within normal limits. It has been concluded that the walking distance is strongly correlated with the level of physical activity and inversely proportional to dyspnea.

Walking is less stressful than riding a bike in terms of effort-induced desaturation alongside dyspnea. (Lovin, 2007). In conclusion, we started the recovery at the cycloergometer trying to gradually increase the travel distance. These aspects were taken into account and we continued to apply them for good results.

24 30-minute pedaling sessions at your own pace, then with the resistive load (sand bags weighing 1 kg) can increase the body's tolerance to physical exertion and a good flow of walking on short distances, and then increasingly longer.

HYPOTHESIS 4

The usefulness of walking exercises, practicing physical exercises at elliptical and running lane from the Long Recovery Training System Plus program to increase the Oxygen saturation by also joining the respiratory exercises with assistive devices (POWERBREATHE Medic Plus ITM).

Gladly, the pulse oximetry underwent notable changes during the applied tests and was very useful in applying the interventional plan. Of course, the customization of the exercises applied from the individualized intervention plan made the oxygen requirement used to be well used and the effort tolerance a good one.

HYPOTHESIS 5

Demonstrating the usefulness of breathing exercises and exercise with assistive devices (POWERBREATHE Medic Plus IMT) in increasing spirometry values (VEMS /Vital Capacity).

Practicing deep breathing exercises shows the benefits through the data compared after 2-4 weeks of exercises in the experimental group, with patients experiencing an improvement in the capacity of the inspiratory, which is, a VEMS (Maximum Exhalation Volume per Second) and Vital Capacity. Breathing techniques with raised lips (exhaling with tight lips and inhaling through the

nose) facilitate air movement in the airways by decreasing the activity of the respiratory muscles, and diaphragmatic breathing at the correct use of the diaphragm that leads to increased strength and flexibility of the respiratory muscles.

HYPOTHESIS 6

The utility of the QPCR – QUESTIONS FOR POST-COVID-19 RECOVERY questionnaire in assessing patient independence in the ACTIVITY DAILY LIVING practice, emotional and mental health besides physical health after the Long Covid sequelae.

The choice of Barthel Scale is good for assessing functional independence of patients, but not relevant enough in testing of respiratory patients. Accordingly, for the main research it is necessary to join the questionnaire in having personal data about patients with Long Covid 19. The questionnaire brings questions from the emotional sphere, human interaction, as well as neuropsychic stability. According to the statistical data it is very sensitive, and in terms of utility I consider it necessary.

HYPOTHESIS 7

Increasing the quality of life by regularly practicing Long Recovery Training System exercises and respiratory training. Continuation of treatment at home/telerehabilitation.

Objectively and visibly the quality of life is endangered in patients with COVID-19 sequelae due to fatigue, generalized depression/anxiety.

Long Recovery Training System Plus is an easy, easy to tolerate program designed to help cover these needs. The use of this original program must, however, be done by combining and integrating everyday activities.

Continuation at the patient's home is a form of combining daily activities with regular physical exercise and supervised by a physiotherapist.

Telerehabilitation, the branch of telemedicine, so used today, must be incorporated into the routine of everyday life over a longer period of time. This is about the patient's involvement and resources.

VI. CONCLUSIONS

1. The main conclusion of the research is that respiratory therapy, along with long-term physical exercise therapy, can improve the quality of life of the patient.

2. Exercise together with physiotherapy, with the stimulating spirometer, leads to the opening of the pulmonary alveoli, which prevents the decrease of respiratory function, atelectasis and the occurrence of improved reports of pulmonary infusion.
3. It improves tidal volume, diaphragm muscle function and inspiration, increases exercise tolerance, decreases dyspnea.
4. Maintaining exercise capacity and functional independence in isolation situations, such as COVID-19, is essential for maintaining good mental and emotional health.
5. The obligation to obtain optimal results for increasing the quality of life, consists in the continuation of home treatment under the supervision of the physiotherapist. (Gonzalez , Boucontent , & Edit, 2020)
6. Approaching all of these issues in COVID-19 patients is clearly hopeful and trusting in the therapeutic act, physiotherapy and the medical act in general.
7. Early intervention of the physiotherapist is indispensable in the membership of the professional team involved in the management and care of patients affected by COVID-19. (Gaspari, Assumption, Freire, Silva, & Santiso, 2020)

VII. LIMITATIONS OF THE STUDY

1. The implemented methods do not adapt to the patient in the study.
2. Decreased patient involvement in the study.
3. Some physiotherapy devices were not well tolerated during treatment, leading to cancellation of procedures (Hypertension or Hypotension).
4. Given the dynamics of the disease, there are changes in the health of the COVID-19 patient, with relapses and re-intern due to complications arising independently of the study conducted.