Vol. XXV, Issue 2 / 2024

GYMNASIUM

Scientific Journal of Education, Sports, and Health

Determining the Effect of Breathing Exercises on Lung Function in Patients Affected by Long Lasting Covid-19

Rabinca Simona [1]
Popovici Cornelia [2*]
Grosu Emilia Florina [3]
Toma Andreea Carleta [4]
Grosu Vlad Teodor [5]

[1]*Municipal Hospital, Turda, Romania, Andrei Muresanu 12-16, 401103*Romania,
[2]*"Iuliu Hatieganu" University of Medicine and Pharmacy , Cluj-Napoca, Victor Babes 8, 400012, Romania,*
[1,3]*"Babeş-Bolyai" University, Cluj-Napoca, Pandurilor, 400376. Romania,*
[4]"Technical University of Cluj-Napoca", 62A Victor BABEȘ, Baia Mare 430083, *Romania*
[5]"Technical University of Cluj-Napoca", Romania, Muncii 103-105, 400641, *Romania*

DOI: 10.29081/gsjesh.2024.25.2.7

Keywords: *Covid -19, rehabilitation, daily activities, respiratory gymnastics*

Abstract

The long-term COVID-19 has a significant impact on the quality of life of patients infected with the SARS-CoV-2 virus, particularly those whose persistent symptoms, such as dyspnea, fatigue, muscle weakness, joint stiffness, cough, anxiety, and depression, have prevented them from returning to normal life. The study's objective is to demonstrate the importance of respiratory / musculoskeletal therapy in the physical and mental rehabilitation of long-term COVID patients. Chest circumference, spirometry (FEV1), pulse oximetry, and the TUG test were used to assess the patient. Following therapeutic intervention, all assessed parameters showed substantial increases in the experimental group (p:0.05). Following the implementation of physical activities in the experimental group, a significant improvement in the patients' quality of life was noted, as evidenced by efficient breathing, stable walking, and balance of all body functions.

1. Introduction

Severe acute respiratory syndrome, SARS-CoV-2 (or COVID-19) was first identified in December 2019 through a cluster of pneumonias of unknown etiology in Wuhan, China (Bhat, 2020).

The polymorphism of the clinical symptoms of the COVID-19 infection, starting with people affected with mild manifestations and continuing with complicated/severe cases, led to the damage of various organs and systems

* *E-mail:* popovicicornelia@yahoo.com

(respiratory, osteoarticular cardiac, ocular, motor, gastrointestinal, neurological and psycho- emotional, etc.) which ended in the long term with various degrees of disability. From thorough research into a relatively new disease, the implementation of respiratory rehabilitation in the recovery program of the patient affected by Long lasting Covid is a mandatory requirement (Lazzeri et. al., 2020), the condition of an early onset in medical recovery achieved after the treatment of acute phase and in the subacute and chronic phase of COVID-19 disease (Kim, Read & Fauci, 2020).

It is known and has been proven over time, through multiple studies that respiratory rehabilitation can be applied both on healthy man, for prevention in the occurrence of respiratory diseases, and, as well as the patient with already confirmed respiratory diseases, as a unique disease or associated with other pathologies (Hough, A., 2001). Preventing serious complications of SARS-CoV-2 infection through exercise may be of interest to high-risk categories, namely: obese, diabetic, inflammatory and elderly patients (Hagiu, 2022).

Respiratory kinesiotherapy addresses both the respiratory system in reeducating this function and implicitly in the recovery of other systems or organs with which the lung is closely related (Moldovan & Enoiu, 2018). It is an intervention with real benefits, based on a thorough evaluation of the patient, followed by therapies specially designed for him, including, but not limited to, exercise and the use of respiratory reeducation devices, with several breaths set in repetitive cycles to achieve favorable results. Respiratory physiotherapy involves the respiratory education of the patient and his family, encouraging movement in general, even walking, at a different pace, slow to accelerate. Proper and effective respiratory rehabilitation, applied using suitable methods and means to patients affected by the long-term Covid, will result in a significant improvement in pulmonary, osteoarticular, and finally muscle activity, restoring general well-being and returning to daily activities, ultimately reintegrating the patient with SARS-CoV-2 to a good physical, socio-professional, and emotional state.

2. Material and methods

The hypothesis of this pilot study's research began with the premise that an individualized, personalized kinesiotherapy program, applied for a minimum of 8 weeks of exercises, efficiently implemented, and tailored to the patients affected by the long-term Covid, will help improve breathing, joint mobility, and, implicitly, the quality of life of the subjects subjected to the experiment.

The study involved 24 patients both males and females with symptoms of Lung Covid aged 40 to 70 years, divided evenly and randomly into the two lots: control and experimental. All the patients in the study signed an informed consent form outlining the duration of their experiment and their engagement in the research, bringing the experiment to an end.

The gender of the patients was not an inclusion or exclusion criterion in the study, the only inclusion criterion at the beginning of the study was the diagnosis of long lasting Covid, and the general data and tests carried out led to the implementation of the recovery plan.

Methods of investigation:

- measurement of the thoracic perimeter;
- measurement of systolic and diastolic blood pressure;
- measurement of respiratory rate – number of breaths per minute;
- measurement of pulse and oxygen saturation by means of pulse oximeter;
- TUG test;
- measurement of the parameters of VEMS, FVC, by means of spirometry;
- other physical symptoms associated with COVID-19: dyspnea, cyanosis and increased fatigue;
- other emotional symptoms associated with COVID-19, respectively: anxiety and depression;
- the presence of dyspnea when performing respiratory exercises;
- the presence of joint or muscle pain when performing physical exercises.

3. Results and Discussions

The experimental group did the exercises for four weeks at the gym and four weeks at home via telerehabilitation under the supervision of a physiotherapist. The patient intervention plan was individualized according to age, stage of the disease, degree of dyspnea, pain and fatigue. Patients' exercise tolerance was a good factor in coordinating exercise execution and the number of repetitions for each exercise.

The exercise program took 15-30 minutes daily. Execution conditions: oxygen saturation greater than 92%; any desaturation would have been sufficient to terminate the endeavor, but this was not the case. The exercises were performed up to 60% of the maximum heart rate or 6/10 on the Borg exercise perception scale and a controlled value of 3 MET. (Melnic, et. al., 2021)

The following types of exercises were practiced: control exercises and breathing direction, breathing with tight lips, costal, diaphragmatic, (Awan, 2013), oropharyngeal exercises, stretching exercises, gravity exercises, CORE + exercises, exercises with gym ball, dynamic and balance plate, exercises with dumbbells, scarves, ergometric bicycle exercises, etc, but also encouraging walking 20-25 minutes a day (Lock et. al., 2020).

The exercises were included in the rehabilitation program, and we have used respiratory rehabilitation devices such as: Fly-Gym, Tri-gym, Pulmovol and Powerbreath, ball machines of different resistance.

Chest clapping between breathing exercises were performed by tapping the chest box and led to ease breathing by draining existing bronchial secretions (Mirza-Dănilă, 2011).

The results atfer eight weeks of exercises were compared with the initial ones, and there was a real improvement in respiratory and vital capacity, decreased dyspnoea, increasing the maximum expiratory volume per second and reducing musclo-articular pain, decreasing agitation, more restful sleep, thus reducing respiratory stress. (Rabinca, Morosanu & Grosu, 2023).

We did vigorous diaphragmatic breathing, which helps to use the diaphragm correctly and has a direct impact on oxygen demand by assisting the lungs. Breathing is deeper, and the respiratory rate decreases leading to the normalization of pulse and tension (Sbenghe, 1987). The energy consumed by the patient through respiratory work is greatly reduced, there is no rapid depletion of the body's reserves (Moldovan & Enoiu, 2018).

By fully expanding the diaphragm, these workouts cause the lungs to expand during inhalation and the abdominal muscles to release air during expiration, boosting oxygenation. The primary benefit of performing breathing exercise programs is that ventilation becomes simpler, oxygen intake increases, and doing so daily oxygenates the lungs and increases the amount of oxygen reaching the critical organs of the brain and heart, assisting in the oxygenation of their tissues. Practicing diaphragmatic breathing as part of a respiratory recovery program improves respiratory muscle strength and flexibility.

TUG TEST

The TUG test is a simple and reliable, valid and responsive test in the application of medical rehabilitation programs in general and respiratory exercises. The test consists of timing (m/s) of the patient's journey from getting up from a chair and walking 3 meters, at a comfortable and safe pace, followed by the return to the chair and seating. Is used to evaluate functional mobility, dynamic balance, walking ability and the risk of falling. Timing begins when the patient's back leaves the seat back and stops when he returns to his original position.

The choice of this test was motivated by the relevance of the result in relation to the health status of the subjects, it can be adapted in clinical and research settings. Higher execution times indicate poorer health outcomes.

Results of the TUG test

Table 1. *TUG test results – control and experimental lot*

No.	The control group	Initial (s)	Final (s)	No.	The experimental group	Initial (s)	Final (s)
1	#CF26070ID	10.72	10.5	1	#EF26070BV	10.1	8.6
2	#CM16070PV	9.41	9.55	2	#EM25060MM	8	6.41
3	#CM15060KL	8.4	8.22	3	#EF25060VC	8.7	7.79
4	#CF15060KM	8.1	7.96	4	#EM26070BoM	9	7.64
5	#CM14050SV	7.12	7	5	#EF15060BoV	7.8	6.3
6	#CF14050AA	8	7.44	6	#Ef24050SA	8.9	8.4
7	#CM24050AV	7.1	7.2	7	#EF16070RM	13	11.5
8	#CM25060FaA	8.6	8.4	8	#EM14050SS	10.1	8.1
9	#CF24050BM	8.32	8.21	9	#EF14050GA	6.1	5.8
10	#CF25060MA	10.14	10.4	10	#EM15060HI	13.2	10.95
11	#CF16070FA	11	10.8	11	#EM16070FV	14.8	12.6
12	#CM26070BE	13.4	13.1	12	#EM24050RC	6.5	6

The results of the final TUG test in the control group show minimal variations from the reference values recorded in the initial test, thereby showing that the subjects' lives proceeded in the same characteristics as before the start of the pilot study. The times obtained in the experimental group are significantly improved on the second test, reflecting the benefits of the intervention program.

Statistics descriptive tug test

Table 2. *Descriptive statistics – Test Timed Up & Go*

	Group	Arithmetic average	Standard deviation	N
Initial TUG test	Experimental control	9, 1925	1, 84090	12
		9, 6833	2, 71857	12
Final TUG test	Experimental	9, 0650	1, 83054	12
	control	8, 3408	2, 24985	12

Table 3. *Anova Mixed – Test Timed Up & Go*

Measure: MEASURE_1						
	Square amount	Degrees of freedom	Fluctuation	F	P	Eta Partially square
TUG test	6, 483	1	6, 483	53, 483	, 000	, 709
Group TUG * test	4, 429	1	4, 429	36, 537	, 000	, 624
Error (TUG test)	2, 667	22	, 121			

Table 4. *Tests of Between-Subjects Effects – Testul Timed Up & Go*

Measure: MEASURE_1						
	Square amount	Degrees of freedom	Fluctuation	F	P	Eta Partially square
Intercept	3949, 078	1	3949, 078	416, 793	, 000	, 950
Group (Control vs Experimental)	, 163	1	, 163	, 017	, 897	, 001
Error	208, 448	22	9, 475			

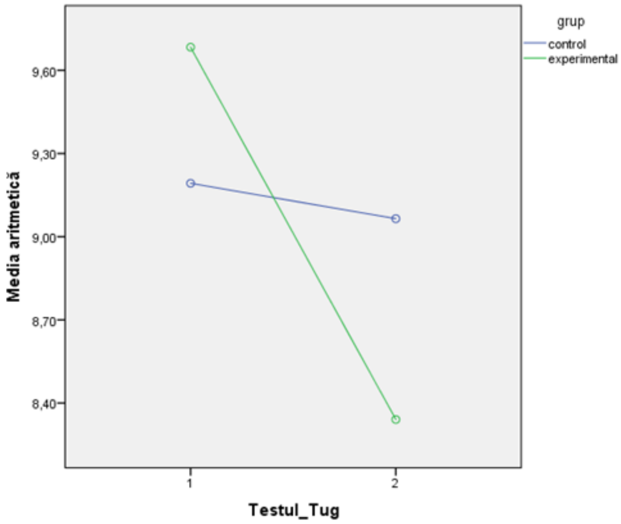

Figure 1. *Group interaction plot in the TUG test*

Regarding the TUG test, we can see that the interaction effect is statistically significant (F=36.53, p=0.000, η2=0.624). Analyzing the interaction graph, we can see that while the control group records a slight decrease in the times obtained between pre-test and post-test, the experimental group records a very large decrease from pre-test to post-test. Thus, the effect of the intervention plan led to an important decrease in the average times of the experimental group, but not of the control group. In terms of effect size, this value is very large.

VEMS test

Among ventilatory rates (volumes/time) Maximum Expiratory Volume per Second is the most important spirometry parameter. It represents the volume of air exhaled in the first second through a forced expiration, after a maximum inspiration, that is, it represents the volume of air in the first second of a forced vital capacity (Sbenghe, 1987).

VEMS, like the Vital Capacity, have standard values to which we relate the current values obtained during spirometry testing. VEMS is the most widely used test for the diagnosis of obstructive dysfunction. It is said that a VEMS below 70% of its theoretical value is pathological and shows obstructive syndrome (Sbenghe, 1987).

Comparing the VEMS values from the final testing with those from the initial testing, a minimal positive or negative variation is observed, which tells us that there were no changes in the volume of air exhaled in the first second, during the reference period in the control group. After carrying out the intervention plan, a more consistent improvement of the VEMS values is observed in the experimental group, which is an indicator of the improvement of the subjects' breathing.

Table 5. *VEMS values in the spirometry test – control and experimental lot*

No.	The control group	Initial (liter)	Final (liter)	No.	Experimental group	Initial (liter)	Final (liter)
1	#CF26070ID	2.38	2.25	1	#EF26070BV	1.7	1.85
2	#CM16070PV	3.42	3.34	2	#EM25060MM	3.25	3.37
3	#CM15060KL	3.81	3.9	3	#EF25060VC	2.15	2.45
4	#CF15060KM	2.84	3.02	4	#EM26070BoM	3.68	3.94
5	#CM14050SV	4.33	4.76	5	#EF15060BoV	2.36	2.39
6	#CF14050AA	3.3	3.84	6	#Ef24050SA	2.45	2.65
7	#CM24050AV	3.95	4.11	7	#EF16070RM	1.78	2.36
8	#CM25060FaA	3.2	3.08	8	#EM14050SS	2.63	2.85
9	#CF24050BM	3.98	3.47	9	#EF14050GA	2.32	2.9
10	#CF25060MA	3.2	2.71	10	#EM15060HI	2.99	3.41
11	#CF16070FA	2.05	2.12	11	#EM16070FV	2.18	2.31
12	#CM26070BE	2.11	2.3	12	#EM24050RC	3.85	4.23

Descriptive statistics
Spirometry test, VEMS Parameter

Table 6. *Descriptive statistics – Spirometry (VEMS)*

	Group	Arithmetic average	Standard deviation	N
Spirometry VEMS Initial	Control	3, 2142	, 75006	12
	experimental	2, 6117	, 69561	12
Spirometry VEMS Final	Control	3, 2417	, 82013	12
	experimental	2, 8925	, 71355	12

Table 7. *Anova mixt – Spirometry (VEMS)*

Measure: MEASURE_1						
Source	Square amount	Degrees of freedom	Fluctuation	F	P	Eta Partially square
Spirometry VEMS	, 285	1	, 285	8, 593	, 008	, 281
Spirometry VEMS * grup	, 193	1	, 193	5, 801	, 025	, 209
Error (Spirometry VEMS)	, 730	22	, 033			

Table 8. *Tests Between-Subjects Effects – Spirometry (VEMS)*

Measure: MEASURE_1
Transformed Variable: Average

	Square amount	Degrees of freedom	Fluctuation	F	P	Eta Partially square
Intercept	429, 125	1	429, 125	396, 999	, 000	, 947
Grup (Control vs Experimental)	2, 717	1	2, 717	2, 514	, 127	, 103
Error	23, 780	22	1, 081			

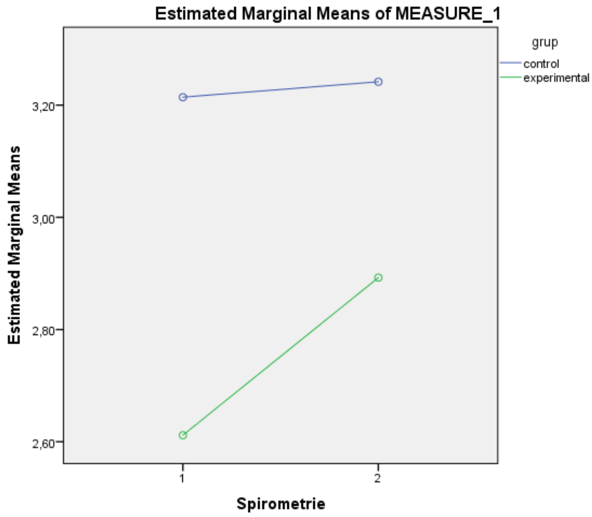

Figure 2. *Group interaction graph in Spirometry (VEMS)*

Spirometry results show a significant rise in the experimental group. Thus, we can conclude that the intervention plan has a considerable influence in the experimental group, but we must remember that the starting contexts are different.

Discussions

Parameters assessed in COVID-19 disease were organized in dossiers belonging to each of the subjects, and personal data were collected and processed based on the informed agreement signed by both parties, the patient receives a copy. We decided to assign an alphanumeric code of identification to each patient to protect their identity.

COVID-19 causes the patient to experience several functional and neuropsychiatric alterations that impair his quality of life. The effort capacity is reduced because of the onset and persistence of certain disease symptoms, which, when combined with effort dyspnoea, increased fatigue, loss of stability, and vertigo, force the patient to significantly reduce his displacement.

Following COVID-19 disease and the remaining symptoms, the patient's motions may be slow, tiring, and influenced by overdue muscle and joint discomfort; the respiratory act is difficult with impaired breathing and exhalation; and breathing, including respiratory muscles that will not be employed at full capacity. Thus, the high respiratory requirement of these patients impacted by the long-term Covid leads on the one hand to a drop in oxygen saturation and on the other hand to an increase in respiratory rate, neuromotor agitation, and this might be reflected in elevated pulse and blood pressure. (Awan, Ansani & Babur, 2020).

Respiratory superficiality results in a drastic decrease in the muscles of the whole organism, leading to the inability to perform normal movements. The need to recover this respiratory need, implicitly leading to the need to improve the motor function by performing passive, passive-active and active mobilization exercises (Rabinca, Morosanu & Grosu, 2022).

Respiratory exercises can be done simply with or without respiratory reeducation devices such as: fly-gym, power breath, resistive ball exercises, (Jimboreanu, et. al., 2017)

Carrying out the spirometry of all patients, it was observed that the spirometry values are initially low, which shows us, indisputably, the obstruction of the airways (Braggion, et. al., 2007), pulse oximetry also varies towards the lower limit, and lung damage is also confirmed by imaging means previously carried out, which are somewhat mandatory in the diagnosis of COVID-19.

According to the mixed ANOVA statistical analysis, the TUG and VEMS values are increasing, showing a significant improvement in the health of the patients affected by the long lasting COVID, who benefited from the intervention plan (Cedeno-Veloz, et.al., 2024).

The percentages obtained and analyzed by ANOVA statistical method are more than encouraging. Collaboration with patients was good, and the expression of informed agreement managed to introduce them easily and directly into the procedure used.

As the cases of the long lasting Covid are increasing, the study carried out is useful in demonstrating the importance and benefits of practicing physical exercise and the need to continue doing it at home, under the guidance of a physiotherapist (Ortiz, et. al., 2023). The long lasting Covid affections are increasingly present in the share of diagnoses that require kinetotherapy, this fact increasing the addressability to rehabilitation services, persistent symptoms remaining in the patient's body and 100 days after infection with SARS-CoV-2 virus. (Garrigues, et. al., 2020).

The patients expressed their trust in the therapeutic act of rehabilitation and were cooperative and supportive of the proposed activity. For the smooth running of the tests and evaluations, we scheduled the participants in the experimental and control groups during the morning to prevent fatigue states, and the treatments were performed fluently.

The initial and final assessment was explicit, the subjects were measured, tested and treated safely, without incident. In this pilot study, from a statistical point of view, small variations are observed in the control group, and in the experimental group the notable improvement of post-test versus pre-test results.

The exercises were conducted in the following positions: laying down, sitting sideways, and orthostatism, all while the patient was evaluated using the Borg scale of perception of dyspnoea, the get up and go (TUG) test, and pulse oximetry monitoring. (Rabinca, Morosanu & Grosu, 2023) The study showed that patients who had dyspnea, shortness of breath and inability to perform daily activities showed real improvements (Arzani, et. al., 2020).

Other scientists investigated the link between body composition and chronic respiratory illnesses. (Cavallari, 2022). The obligation to obtain optimal results in increasing the quality of life, consists in continuing the treatment at home under the supervision of the physiotherapist (Fardoun, et. al., 2020).

5. Conclusions

This pilot study provides us with disease correlations, health implications, and rehabilitation methods, as respiratory rehabilitation is understudied and has findings that can be improved.

Physiotherapy has the essential arsenal in the evaluation and therapeutic management of complicated disabilities caused by SARS-CoV-2 infection, which has a significant impact on quality of life; thus, it should be employed as early as possible in the progression of the COVID-19 disease.

Addressing all these components in COVID-19 patients instills optimism and trust in the therapeutic act, physiotherapy, and the medical act in general. The physiotherapist's early involvement will help the patient develop well, reduce the effects of the long-term Covid, and allow the patient to return to normal life.

The conclusion of the study is that respiratory therapy, along with long-term exercise therapy, can improve the patient's quality of life. Physical exercises with the stimulating spirometer lead to the opening of the pulmonary alveoli and thus, the decrease in respiratory function, atelectasis is prevented and the improvement of pulmonary perfusion, the improvement of the tidal volume, the function of the diaphragm and inspiration, increases the tolerance to the effort, decreases the dyspnea: the results are similar with other results obtained by other authors (Figueira-Gonçalves, et. al., 2023).

Maintaining exercise capacity and functional independence in COVID-19 disease is essential for maintaining good mental and emotional health. (Humphreys, et. al., 2021).

Limitations of the study

1. Failure to adapt some evaluation methods to the patient with long lasting Covid.

2. The possibility of the patient's level of participation in the study and research, abandonment during the program - which was not the case.

3. Some respiratory physiotherapy devices are not well tolerated during the treatment, leading to the cancellation of the procedures.

4. Given the dynamics of the virus, there are changes in the health status of

the patient with COVID-19, with relapses and readmissions due to some complications that occurred independently of the performed study.

References

1. ARZANI, P., ZAVIEH, M.K., KHADEMI-KALANTARI, K., BAGHBAN, A.A. (2021). Opportunities and barriers for telerehabilitation during Coronavirus outbreak, *Medical journal of the Islamic Republic of Iran* 35, 100.
2. AWAN, W., ANSAN, M., & BABUR, M.N. (2020). *Effect of deep brething exercises healthy smoker a pilot study*, J Pak Med Assoc.;70(7):1209-1213.doi: 10.5455/JPMA.16551.
3. BHAT, A.I. (2020). *Impact of covid-19 on India and how India respond*, IOSR Journal of Humanities and Social Science (IOSR-JHSS), 25(4), 2020, pp. 33-37. DOI: 10.9790/0837-2504063337.
4. BRAGGION, C., CARLI, M., MENIN, L., FEDRIGO, E. (2007). Spirometry in office practice: Methods and interpretations, *Quaderni* ACP 14(2):75-80.
5. CEDENO-VELOZ, B.A., CASADAMON-MUNARRIZ, I., RODRÍGUEZ-GARCÍA, A., LOZANO-VICARIO, L., ZAMBOM-FERRARESI, F., GONZALO-LÁZARO, M., HIDALGO-OVEJERO, Á.M., IZQUIERDO, M., & MARTÍNEZ-VELILLA, N. (2024). Effect of a Multicomponent Intervention with Tele-Rehabilitation and the Vivifrail© Exercise Programme on Functional Capacity after Hip Fracture: Study Protocol for the ActiveFLS Randomized Controlled Trial. *Journal of Clinical Medicine*, *13*(1), 97. https://doi.org/10.3390/jcm13010097
6. FARDOUN, H., GONZÁLEZ, C., COLLAZOS, C.A., & YOUSEF, M. (2020). Estudio exploratorio en iberoamérica sobre procesos de enseñanza-aprendizaje y propuesta de evaluación en tiempos de pandemia. *Education in the Knowledge Society (EKS)*, *21*, 9. https://doi.org/10.14201/eks.23537
7. FIGUEIRA-GONÇALVES, J.M., GARCÍA-BELLO, M.Á., RAMALLO-FARIÑA, Y., MÉNDEZ, R., LATORRE CAMPOS, A., GONZÁLEZ-JIMÉNEZ, P., PECES-BARBA, G., MOLINA-MOLINA, M., ESPAÑA, P. P., GARCÍA, E., DOMÍNGUEZ-PAZOS, S.J., GARCÍA CLEMENTE, M., PANADERO, C., DE LA ROSA-CARRILLO, D., SIBILA, O., MARTÍNEZ-PITARCH, M.D., TOLEDO-PONS, N., LÓPEZ-RAMIREZ, C., ALMONTE-BATISTA, W., MACÍAS-PAREDES, A., … Recovid. (2023). Persistent Respiratory Failure and Re-Admission in Patients with Chronic Obstructive Pulmonary Disease Following Hospitalization for COVID-19. *International journal of chronic obstructive pulmonary disease*, *18*, 2473–2481. https://doi.org/10.2147/COPD.S428316
9. GARRIGUES, E., JANVIER, P., KHERABI, Y., LE BOT, A., HAMON, A., GOUZE, H., DOUCET, L., BERKANI, S., OLIOSI, E., MALLART, E., CORRE, F., ZARROUK, V., MOYER, J.D., GALY, A., HONSEL, V., FANTIN, B., & NGUYEN, Y. (2020). Post-discharge persistent symptoms

and health-related quality of life after hospitalization for COVID-19. *The Journal of infection*, *81*(6), e4–e6. https://doi.org/10.1016/j.jinf.2020.08.029
10. HAGIU, B.-A. (2022). Considerations on the prophylaxis of severe forms of covid-19 through endurance exercises. *Educatio Artis Gymnasticae*, 67(1), 47–53. https://doi.org/10.24193/subbeag.67(1).05
11. HOUGH A. (2001). Physiotherapy in respiratory care – an evidence-based approach to respiratory and cardiac management. *Nelson Thornes*, 3rd Edition, UK.
12. HUMPHREYS, H., KILBY, L., KUDIERSKY, N., & COPELAND, R. (2021). LONG COVID and the role of physical activity: a qualitative study. *BMJ open*, *11*(3), e047632. https://doi.org/10.1136/bmjopen-2020-047632
13. JIMBOREAN, G., IANOȘI E.S., CROITORU, A., SZASZ, S., POSTOLACHE, P. (2017). Respiratory muscle training in chronic obstructive pulmonary disease/ Antrenamentul mușchilor respiratori în boala pulmonară obstructivă cronică, *Pneumologia*, 66(3):128-130.
14. KIM, P.S., READ, S.W., & FAUCI, A.S. (2020). Therapy for Early COVID-19: A Critical Need. *JAMA.* 324(21):2149–2150. doi:10.1001/jama.2020. 22813.
15. LAZZERI, M., LANZA, A., BELLINI, R., BELLOFIORE, A., CECCHETTO, S., COLOMBO, A., D'ABROSCA, F., DEL MONACO, C., GAUDIELLO, G., PANERONI, M., PRIVITERA, E., RETUCCI, M., ROSSI, V., SANTAMBROGIO, M., SOMMARIVA, M., FRIGERIO P. (2020). Respiratory physiotherapy in patients with COVID-19 infection in acute setting: a Position Paper of the Italian Association of Respiratory Physiotherapists (ARIR). *Monaldi Arch Chest Dis*. 26;90(1). doi: 10.4081/monaldi.2020.1285. PMID: 32236089.
16. LOECKX, M., RABINOVICH, R., DEMEYER, H., LOUVARIS, Z., TANNER., R, RUBIO. N., FREI. A., JONG. C., GIMENO-SANTOS. E., RODRIGUES. M.F., BUTTERY, S.C., HOPKINSON, N.S. BÜSCHING. G., STRASSMANN, A., SERRA. I., VOGIATZIS. I., GARCIA-AYMERICH, J., POLKEY, M.I. & TROOSTERS, T. (2018). Evaluation of a 12-Week Smartphone-Based Physical Activity Tele coaching Intervention in Chronic Obstructive Pulmonary Disease: Patient Experiences and Lessons for Implementation, *JMIR mHealth and u Health,* 6(12): 9774. https://mhealth.jmir.org/2018/12/e200
17. MINA ORTIZ, J. B., VILLACRESES, F., A., E., QUIMIS VENTURA, G. J., & QUIMIS REYES, G.M. (2023). Prevalencia de secuelas post COVID-19 en adultos de América y Europa. *Revista Investigación Y Educación En Salud*, *2*(2), 51–69. https://doi.org/10.47230/unesum-salud.v2.n2.2023.51-69

18. MÎRZA, D. DOBRECI, L. (2011). *Masaj transversal profund*, Edit. Alma Mater, Bacău, ISBN 978-606-527-120-3.
19. MELNIC, A., PLEȘCA, S., PASCAL, O., BILAN, A., SANGHELI, M. (2021). Pain after stroke - mechanisms, clinical manifestations and rehabilitation interventions. *CZU*:616.831-009.11-083 https: //doi.org/10. 52692/1857-0011.2021.3-71.27, Buletin AȘM.
20. MOLDOVAN, E., & ENOIU, S.R. (2018). *The role of respiratory kinetotherapy in respiratory diseases*, Gymnasium - Scientific Journal of Education, Sports, and Health, XIX*(1)*. DOI: 10.29081/gsjesh.2018.19.1.
21. RABÎNCĂ, S., MOROȘANU, S., & GROSU, V.T. (2022). *Pulmonary rehabilitation through physical exercise essential factor for patient recovery in a world post COVID-19*, Gymnasium - Scientific Journal of Education, Sports and Health, XXIII *(2):*7-22. DOI: 10.29081/gsjesh.2022.23.2.01
22. SBENGHE, T. (1987). *Kinetologie profilactica, terapeutica si de recuperare*, București: Editura Medicală, 637 pg.
23. VILAÇA CAVALLARI MACHADO, F. (2022). *Body composition abnormalities in chronic respiratory disease*. [Doctoral Thesis, Maastricht University]. Maastricht University. https://doi.org/10.26481/dis.20220927fm
24. YANG, D., TU, C.-C., & DAI, X. (2020). The effect of the 2019 novel coronavirus pandemic on college students in Wuhan. *Psychological Trauma: Theory, Research, Practice, and Policy, 12*(S1), S6–S14. https: //doi.org /10.1037 /tra0000930.