

Efficacy of Aerobic versus Resistance Training on Dyspnea and CRP levels in Post-COVID-19 patients.

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Abstract :

Objective: to compare the effect of aerobic versus resistance training on Dyspnea and CRP levels in post-COVID-19 patients.

Participants and methods: Sixty young adults volunteer patients of both sex (26 men & 34 women) with Past history of COVID-19 after recovery since 2 to 4 months, their age ranged from 18 to 35 years, their body mass index (BMI) ranged from 18.5 to 35 Kg/m², they were selected and referred from the Outpatient clinic and the Emergency department of Al-Mataria Teaching Hospital, Cairo, Egypt. They were subdivided into two groups equal in numbers; group A received an aerobic exercise (AE) program in form of cycle ergometer protocols for six weeks and group B received upper and lower body resistance training (RT) using free weights for six weeks, and evaluated through measuring Modified Borg Scale to measure Breathlessness (dyspnea score) & blood levels of C- reactive protein (CRP).

Results: It revealed that a statistical significant decrease ($P < 0.05$) in Modified Borg scale and CRP levels within each group. Comparison between groups (A) and (B) at the end of the study showed that, there was a statistically significant decrease in Borg scale in favor to group (A). On the other side, there wasn't statistically significant difference between them in CRP levels.

Conclusion: According to the findings of this study, both aerobic exercise and resistance training interventions are effective in improving CRP levels and Modified Borg scale score. But, aerobic training is more effective in improving dyspnea in post COVID-19 patients.

Key words: Post COVID-19, Aerobic exercise, Resistance training, modified borg scale, CRP.

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INTRODUCTION

The novel-Corona-Virus (COVID-19) is a seriously infectious respiratory disease which results in respiratory, psychological, as well as physical dysfunction (1).The infectious COVID-19 was detected in December 2019 in

the city of Wuhan in China, and almost immediately became a public health crisis of globalized interest (2).

The novel Corona Virus is known as an infectious disease arising from the corona-virus that causes severe acute respiratory syndrome, which can induce respiratory infections. The clinical Pathological conditions resulting from this disease range from mild to moderate and also at sometimes evolve into severe (3). This infection extends via droplets by coughing or sneezing. Patients can still be infectious to the extent that the symptoms continue and even during the clinical recovery. This viral infection spreads via inhaling these particles as well as by touching the mouth, nose, and eyes following contact with any contaminated surface (4).

COVID-19 has eventually proven more fatal such as it has globally spread to many more individuals than did the remaining Viruses, owing to quick human to human transmission and uncharacteristic symptoms at a primitive stage in particular patients (2-5). Infected people who are asymptomatic are thought to play a significant role in the current pandemic, but their relative impact and number are unknown (6).

The predominant symptoms are Cough, Fever, Headache, Sore throat, Dyspnea, Rhinorrhea, and sputum production. Pneumonia emerges to be the extremely frequent severe manifestation of the infection, which characterized mainly by cough, dyspnea, fever, and bilateral infiltrates on chest imaging (7). Accompanied by respiratory symptoms, and gastrointestinal symptoms (e.g., diarrhea and nausea) have additionally been reported (7). Neurological signs and symptoms also have been detected in patients with COVID-19 (8).

Diagnosis of COVID-19:

1-Laboratory diagnoses: need respiratory specimens collection including nasopharyngeal or oropharyngeal washes or aspirates, nasopharyngeal or oropharyngeal sputum, swabs, broncho-alveolar lavage and tracheal aspirates (9).

2-Laboratory examination: As common findings in the initial stages of the disease, the total-leucocyte-count (TLC) is normal or reduced and the count of the lymphocyte is reduced. Many patients have elevated levels of liver enzymes, muscle enzymes, myoglobin, and lactate dehydrogenase (LDH). Troponin levels are elevated in some critically ill patients. Many patients have elevated erythrocyte sedimentation rate (ESR) and (CRP) and normal level of

procalcitonin. In severe cases, peripheral blood lymphocytes incrementally decrease and D-dimer elevates. Critically and severely ill patients frequently have high levels of inflammatory factors **(10)**.

There are rising number of patients suffering from long-term symptoms post COVID infection, which called “long hauler” as symptoms of post-COVID or COVID-19 syndrome **(11-12-13)**.

A highly frequent consequence in severely ill patients is that ICU-acquired weakness, which related to suboptimal glycemic control, immobility, and iatrogenic use of neuromuscular blocking agents and steroids. Other likely subsequent changes are myopathy and critical illness polyneuropathy. Uncommon physical consequences of prolonged immobility possibly will also happen, including muscle shortening, cardio-respiratory deconditioning, contractures (neurogenic, myogenic, arthrogenic) postural instability, pressure injuries, and venous thromboembolism **(14)**.

Although not much is known about the COVID-19 long-lasting physical consequences, patients who require mechanical ventilation in the critical acute stage of disease can experience critical side effects, causing the known as post-intensive care syndrome (PICS) that affects the COVID-19 survivors of all ages. That PICS is mainly characterized by long-lasting disability, associated with fatigue, pain, muscle dysfunction, and dyspnea as secondary effects **(15)**.

Physical activity (PA) can improve the strength & endurance of the respiratory & breathing muscles, improving them to be more efficient **(16)**. Exercise training (ET) enhances the "health-related-quality-of-life" (HR-QoL) in many patient people. That also boosts and strengthens the immune reaction to viral antigens, reducing the viral infections incidence throughout the lifespan **(17)**. Muscle weakness is common in those patients, and AE has slight effect on this problem. Various studies proved that not only can Resistance training (RT) improve muscle strength and QOL, but it can also improve exercise capacity **(18)**. Strength training techniques that are commonly used include free weights (e.g., dumbbells, weight lifting, lead balls, etc.) or training with machines for legs and arms **(19)**. We should encourage patients to perform multi-joint exercises in their daily activities. Furthermore, single-joint exercise may be necessary to correct muscular imbalances and strengthen lumbar extensors **(20)**. Regular training gives beneficial properties on the heart in addition to the entire body. This happens partly as ET improves the work capacity of skeletal muscle & reduces resistance, accordingly increases the peripheral circulation

conductance, Cardiac external modification changes and enhances the ability of the heart's auto-pump (21).

SUBJECT AND METHODS

This study was carried out on sixty young adults volunteer (26 men & 34 women) patients their age ranged from 18 to 35 years their Body mass index ranged from 18.5 to 35 Kg/m² referred with Past history of COVID-19 after recovery since 2 to 4 months and they were selected from the Outpatient clinic and the Emergency department of AL-Mataria Teaching Hospital.

Ethical considerations:

- Each patient has signed the informed consent form before starting the interventions.
- Before starting the interventions, complete description about what would going to be done during the treatment sessions was given to each patient in both groups.
 - **Inclusive criteria**

All men and women volunteers with past history of COVID-19 and after recovery (negative swab results since 2 to 4 months), suffered from mild to moderate symptoms, their age ranged between 18 to 35 years old (young adults), their oxygen saturation at room air more than 90%. Their body mass index (BMI) less than 35 kg / m², their gender male and females Patients

- **Exclusive Criteria**

Lack of patient's informed consent, Patients with severe symptoms, Fever more than 38 degrees, obese patients with BMI ≥ 35 kg / m², Patients with orthopedic or neurological limitations to exercise Patients with multiple co morbidities, Patients with past history of pulmonary diseases and Patients with any pathological conditions as cardiovascular diseases or hypertension.

- **Instrumentation**

Evaluative equipment:

1. **Fingertip pulse oximeter:** It was used to assess each patient's oxygen saturation and heart rate for all volunteer in both groups (A&B).
2. **Cycle ergometer (bicycle):** It was used to measure PHR from the self-paced graded exercise testing for each patient required to calculate the target heart rate and prescription of AE program intensity.
3. **Free weights:** It was used to evaluate One-repetition maximum (1-RM) for each selected muscle groups in both groups (A&B).
4. **Modified Borg Scale:** It was used to measure dyspnea score.
5. **Lab analysis:** Blood samples were collected for all patients in both groups to measure the levels CRP were measured by using Vitros 350 with model number ET1529L-7SWA-1-RNBCG which made in Rochester.
6. **Weight and height scale:** It was used to calculate BMI for each patient before and after the study by measuring weight and height.

▪ **Treatment equipment:**

1. **Cycle ergometer (bicycle):** Cycle ergometer was used for aerobic exercise program application. Its Model was 955 Ergo Cycle (Stationary Bicycle-Upright Bike).
2. **Free weights:** Free weights such as (dumbbells, sand bags, or any weight) can be picked up and moved around to exercise muscles. The weights in form of 0.5Kg, 1Kg, 2Kg, 3Kg, 4Kg and 5Kg.

Procedures of study:

1. **The Evaluative Procedures:**

- A comprehensive medical history was obtained and recorded in the datasheet for both groups (A&B).
- Each patient in both groups (A&B) had their weight and height measured at the start while wearing light clothing and bare feet. BMI was calculated

- **Modified Borg Scale:** For dyspnea evaluation, this scale includes descriptors that are both verbal (10) and numerical (12). Patients were asked to check the boxes that best represented their dyspnea perception (Boas et al., 2013).
- **The Blood samples** were collected before and after the study to measure CRP levels.
- **Self-Paced Graded Exercise Testing :** This test was done by using a bicycle to measure the PHR for each patient required for calculating the target heart rate and prescription of aerobic exercise intensity.
- **One-repetition maximum (1-RM):** it was tested for each muscle group involved in the study for calculating the load and prescription of Resistance training intensity.

2. Therapeutic Procedures:

1-Aerobic exercise (group A): Patients in group A were given an aerobic program in the form of cycle ergometer protocols for 40 minutes, which included low intensity warming-up exercises for 10 minutes prior to training and a 5-10 minute cool down after training. For six weeks, the exercise was done three times a week at a moderate effort of 65-75 percent PHR.

2- Resistance training (group B): Patients in group B were trained in lower body resistance exercises using free weights (e.g.; weight lifting, sandbags). For six weeks, the training consisted of three sessions per week. Patients began gradual training in sessions with 1 set of exercise for a maximum of 3 sets and 10 to 15 repetitions at 70% of 1-RM.

3. Statistical analysis:

For the collected data, descriptive statistics was used to calculate the means and standard deviations (SD). The data will be analyzed using inferential statistical analysis; the independent t-test will be used to compare the mean values of the two groups before and after the end of the interventions, and the

dependent t-test will be used to analyze the within-group changes after the intervention. All statistical tests in this study were conducted with a significance level of $p < 0.05$. All statistical calculations were done using the statistical package for the social sciences (SPSS) computer program (IBM Corp, SPSS Statistics Company, Chicago, and U.S.A).

RESULTS

1. Modified Borg scale.

i) Within Subjects:

Group (A) (Aerobic training): the mean of pre-treatment the Modified Borg scale score was 6.00 and post-treatment was 1.75 that showing significant decreases ($t= 29.65$ and $P < 0.01$) at post-treatment with percentage of changes= 70.8%.

Group (B) (Resistance training): the mean of pre-treatment the Modified Borg scale score was 5.7 and post-treatment was 2.9 that showing significant decreases ($t= 21.47$ and $P < 0.01$) at post-treatment with percentage of changes= 49.1%.

ii) Between Groups:

As shown in table (1) and (Fig. 1), the independent t-test showed no significant changes ($t= 0.821$ and $P= 0.420$) in pre-treatment values. But, significant changes were in the post treatment values ($t= 4.761$ and $p < 0.01$) in favor to group (A).

Table (1): Comparing of Modified Borg scale level between both groups:

Independent t-test	Borg scale level			
	Pre-Treatment		Post-Treatment	
G.	Group (A)	Group(B)	Group(A)	Group(B)
Means	6.00	5.7	1.75	2.9
\pm SD	± 1.4	± 1.14	± 0.9	± 0.98
MD	0.267		1.18	
T	0.812		4.761	
P	0.420		P < 0.01	
S	NS		S	

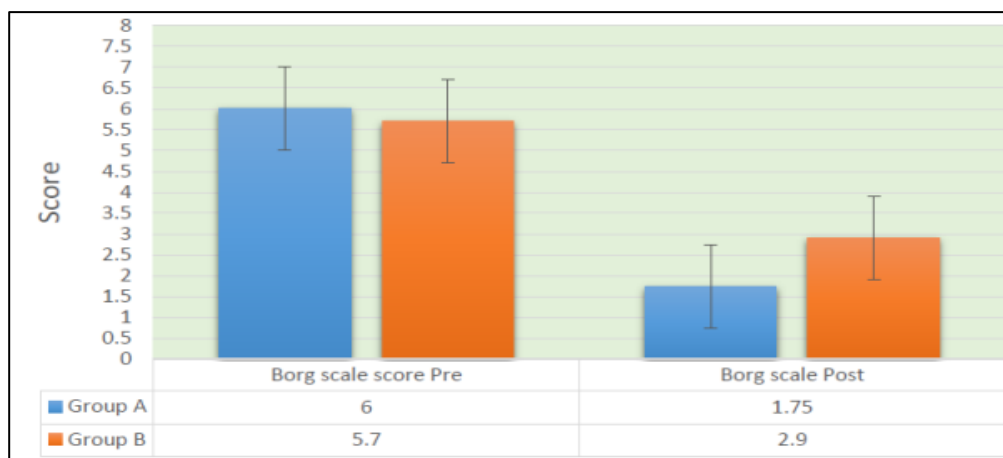


Fig. (1): Mean values of Modified Borg scale level of both groups

2. Blood CRP.

i) Within Subjects:

Group (A) (Aerobic training): the mean of pre-treatment CRP was 4.3 and post-treatment was 3.06 that showing significant decreases ($t= 2.359$ and $P= 0.003$) at post-treatment with percentage of changes= 29.5 %.

Group (B) (Resistance training): the mean of pre-treatment CRP was 4.14 and post-treatment was 3.1 that showing significant decreases ($t= 2.89$ and $P= 0.007$) at post-treatment with percentage of changes= 24.6 %.

ii) Between Groups:

As shown in table (2) and (Fig. 2), the independent t-test showed no significant changes ($t= 0.220$ and $P= 0.827$) in pre-treatment values. Also, non-significant changes were in the post treatment values ($t= 0.141$ and $p= 0.888$).

Table (2): Comparing of CRP between both groups:

Independent t-test	CRP			
	Pre-Treatment		Post-Treatment	
G.	Group(A)	Group(B)	Group(A)	Group(B)
Means	4.3	4.14	3.06	3.1
±SD	±3.3	±3.2	±1.8	±1.7
MD	0.185		0.063	
T	0.220		0.141	
P	0.827		0.888	
S	NS		NS	

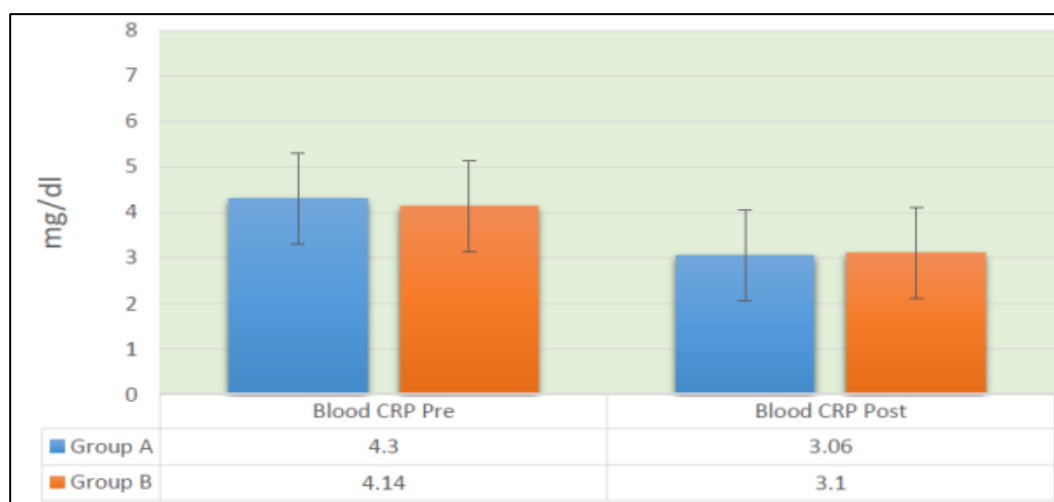


Fig. (2): Mean values of CRP of both groups

DISCUSSION

This study was conducted to determine efficacy of aerobic versus resistance training on dyspnea and CRP levels in post-covid-19 patients

In both groups (A) & (B), the study's results revealed that there were statistical significant decreases ($P < 0.05$) in, Modified Borg scale and CRP levels.

Comparison between both groups (A&B) before starting, there wasn't a statistically significant difference between them at all measured parameters. At the end of the study, there was a statistically significant decrease in Modified Borg scale in favor to group (A). On the other side, there wasn't statistically significant difference between them in CRP levels.

So, this current study comes along with **da Silveira et al., (22)** who studied "the physical exercise as a tool to help the immune system against COVID-19" and showed that Physical activity reinforces the immune system, suggesting a benefit in the response to viral infectious diseases. Accordingly, consistent training of tolerable intensity is recommended as a supplementary tool in strengthening & organizing the resistant of the immune system against COVID-19.

Also, this study outcomes in conformity with **Mohamed and Alawna, (23)** who studied "the role of increasing the aerobic capacity on improving the function of immune and respiratory systems in patients with coronavirus

(COVID-19)" and reported that Improving aerobic capacity is indicated because it has the potential to improve respiratory and immunological systems, which could help with COVID-19 prevention. COVID-19 morbidity and mortality rates could be reduced as a result of this. Furthermore, increasing people's aerobic capacity during the lockdown period is strongly advised in order to reduce COVID-19 risk factors and increase respiratory and immune system performance in the face of COVID-19 to allow for greater body functioning. As a result, patients with mild pulmonary symptoms and all people should adhere to a routine of 10 to 30 minutes of mild to moderate AE performance.

Also, the outcomes of this study supported by other studies that concluded that RT, which involves voluntary muscular contractions in response to some sort of external resistance, is particularly interesting; it has since been shown to be a viable and safe technique for improving functional capacity in both acute and chronic respiratory disorders (**Troosters et al., (24); Liao et al., (25); Li et al., (26); Rice et al., (27).**

Moreover, this study showed a significant decrease in CRP levels, this decrease comes in conformity with **Fedewa et al., (28)** who studied "the Effect of exercise training on C - reactive protein" and stated that exercise training provides a small but significant reduction in CRP levels. This result indicates that this effect seems to be largely motivated by the decrease in BMI and Fat that can happen as a consequence of exercise training, and is reliable for all individuals disregarding for age and sex.

CONCLUSION

So, According to the findings of this study, both aerobic exercise and resistance training interventions are effective in improving CRP levels and Modified Borg scale score. But, aerobic training is more effective in improving dyspnea in post COVID-19 patients.

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