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Long COVID Sequelae on Cardiopulmonary Parameters Among Different Body Mass Indices

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Abstract:
Purpose: to determine long COVID sequelae on cardiopulmonary parameters among different body mass indices.
Methods: Ninety participants from both sexes with history of COVID-19 aged 23.4±4 were assigned according to their BMI into three groups as Group A included thirty participants with BMI 18.5 to 24.9 with history of COVID-19 infection 8-12 months ago. Group B included thirty participants with BMI 25 to 29.9 with history of COVID-19 infection 8-12 months ago. Group C included thirty participants with BMI 30 to 34.9 with history of COVID-19 infection 8-12 month ago. The 12-Minute walk test was applied for three groups. Heart rate, Heart rate recovery, O_2 Saturation and VO_2 max were measured before and after 12MWD.
Results: the study results revealed that significant differences in the participants' features, including weight, waist circumference, BMI, hip circumference and waist/hip ratio (W/H) ($P<0.05$). Analysis of Post hoc showed significant variations among each group and other, except regarding the W/H ratio; statistical differences were observed among groups A and B also groups B and C with ($p>0.05$), and no statistical variation have been detected between the three groups regarding pulse rate per and post-test, O_2 saturation before and after test, 12-minute walk distance, and VO_2 max ($p>0.05$).
Conclusion: The study results demonstrated that COVID-19 has the same effect on cardiopulmonary parameters among different body mass indices.
Key words: COVID-19, cardiopulmonary, body mass index, Vo_2 max.

1.Introduction:

Coronavirus disease 2019 (COVID-19) is an infectious illness caused by coronavirus 2, which results in intense acute respiratory syndrome (SARS-CoV-2). With the disease's first discovery in December 2019 in Wuhan, the capital of Hubei, China, it has spread throughout the world and is currently causing a pandemic outbreak (1).

After the acute phase of infection, COVID-19 survivors may continue to have symptoms that affect various organ systems, according to a growing body of research (also known as long-COVID) (2).

The clinicians quickly realized how significant the COVID-19 pandemic's effects would be on functional exercise ability. Indeed, a significant number of hospitalized patients also developed multi-organ disorders that affected this ability and decreased their quality of life (3).

A third of the individuals reached the VO_2 peak 80% predicted 3 months following COVID-19 hospital discharge. Due to obesity, the exercise capacity and ventilatory efficiency were decreased in the dyspneic subjects. For participants who received ICU treatment and those who did not, ventilation and ventilatory efficiency were comparable (4).

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Although obesity and morbid obesity increase the risk of both COVID-19-related hospitalizations and death, being overweight increases the risk of COVID-19-related hospitalizations but not the risk of death. In order to protect this susceptible group, quick access to COVID-19 care, prioritization for COVID-19 vaccination, and other preventive measures are necessary (5).

There is a link between BMI and COVID-19 outcomes, as shown by the fact that moderately and severely obese individuals experienced COVID-19 symptoms for a longer period of time than other patients (6).

To our knowledge, there are no researchers established to investigate the effect of different body mass indices and the effect of COVID 19.

2.Patients and Methods:

2.1. Participants:

Ninety participants from both sexes with history of COVID-19 with different body mass index aged 23±5 years have been selected from Ahram Canadian University; they were assigned into three equal groups based on their BMI.

Each participant was fully aware of the study's objectives and ethically sound procedures, and they all agreed with them. The Ethics Committee of Cairo University's physical therapy faculty in Egypt gave its clearance to this study, **NO:P.T.REC/012/004016** Egypt. Each participant signed a consent form after receiving full information. Participants were included and excluded based on the following standards.

2.2. Inclusion criteria:

Ninety participants from both sexes, their age between 18-30 years old, Their BMI ranging from 18.5 and 35 kg/m^2, 8-12 months post COVID recovery

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2.3. Exclusion criteria:

The following patients were barred from participating in the study: chronic diseases such as diabetes and hypertension, history of cardiovascular disease, previous chronic chest disease or smokers.

2.4. Measures and Materials:

2.4.1. Evaluating materials and procedures

Informed consent form, International physical activity questionnaire it was applied for all participants to detect their sedentary lifestyle, Pulse Oximeter (RH03) to estimate the oxygen saturation of the blood and the pulse rate for every participant before and after test, Tape Measurement was used to measure circumference of waist and hip for each participant before and after the study.

From the midway between the last rib and iliac crest Waist circumference was measured. From the hip's widest point, the hip circumference was calculated.

Then By dividing the waist circumference by the hip circumference, the waist to hip ratio was determined, BMI will be calculated by dividing weight on Hight square [Weight (kg) ÷ height^2 (meters)], one of the widely used indirect field tests for VO_2max prediction is the Cooper's 12-minute walk test. After 12 minutes, the overall distance covered was recorded in kilometers.

The formula below was used to predict VO_2 max: VO_2 max (ml/kg/min) = (22.351 × the number of kilometers covered) -11.288 **(7).**

Data analysis

Through utilizing SPSS version 22, All statistical analyses were performed. ANOVA was employed to compare the characteristics between the three groups regarding post-COVID period, age, waist circumference, hip circumference, waist/hip ratio, weight, height, BMI, heart rate pre and post-test, O_2 saturation before and after study, 12MWD, and VO_2 max while chi-squared analysis was employed to compare the three groups regarding sex. All statistical tests had a significant level at $P < 0.05$.

3.Results:

Ninety participants were allocated into 3 equal groups. **Table 1** illustrates no significant differences in post-COVID period, age, height, and gender (p-value was 0.937, 0.404, 0.847, and 0.142, respectively).

According to **Table 2**, findings indicated significant differences in the participants' features, including hip circumference, waist circumference, waist/hip ratio, weight and BMI with P value <0.05. significant variations were revealed by Post hoc analysis among all groups, except regarding the W/H ratio; statistical differences were observed among groups A and B also groups B and C (p-value: 0.160 and 0.398, respectively).

According to ANOVA results, no statistical differences were detected between the three groups regarding pulse rate per and post-exercising, O_2 saturation before and after the study, walking distance, and VO_2 max as p-value was 0.360, 0.115, 0.951, 0.629, and 0.762, respectively.

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Table (1): Comparison of characteristics between groups A, B, C:

	Group A $\bar{x} \pm SD$	Group B $\bar{x} \pm SD$	Group C $\bar{x} \pm SD$	F-value	p-value
Post COVID period (months)	7.8±3.9	7.5±3.6	7.7±3.2	0.065	0.937
Age (years)	23.4±4	23.2±3.8	24.4±3.5	0.915	0.404
Height (cm)	165.1±7.7	165.4±10.1	164.2±5.9	0.166	0.847
Sex	**N (%)**	**N (%)**	**N (%)**		
Male	7(23.3%)	9(30%)	14(46.7%)		0.142
Female	23(76.7%)	21(70%)	16(53.3%)		

$\bar{x}$ **: Mean, SD: Standard deviation, p-value: Probability value, *: significance.**

Table 2. comparison within and between groups A, B, and C.

Variables	Group A $\bar{x} \pm SD$	Group B $\bar{x} \pm SD$	Group C $\bar{x} \pm SD$	Comparison between Groups P-value	Comparison between Groups F-value
Weight (kg)	60.8±7.9	74.4±10.5	89.6±8.6	P<0.05*	75.69
BMI (kg/m²)	22.2±1.5	26.8±1.5	33.3±1.1	P<0.05*	94.21
Waist circumference (cm)	72.1±6.3	82.9±7.7	96.4±12.4	P<0.05*	52.46
Hip circumference (cm)	94±5.8	102.6±7	115.2±8.9	P<0.05*	62.15
W/H Ratio	0.77±0.07	0.8±0.07	0.84±0.09	0.006*	5.500
Resting heart rate	84.1±11.7	84.03±10.4	87.4±8.4	0.360	1.035
O2 saturation Pre-test	98.6±0.68	98.1±0.6	92.2±22.6	0.115	2.221
MHR Post-test	110.3±17.4	111.7±18.8	110.7±16.2	0.951	0.050
O2 saturation Post-test	97.8±0.68	97.7±0.8	97.6±0.72	0.766	0.267
12 MWD	0.97±0.2	0.94±0.13	0.9±0.13	0.629	0.466
VO_2 MAX	10.1±4.1	9.8±2.8	9.4±2.8	0.762	0.272

$\bar{x}$ **: Mean, SD: Standard deviation, MD: mean difference, p-value: Probability value, *: significance, change%: percentage of change.**

4.Discussion:

In this study, there was no marked difference in VO_2max among different body mass index, indicating that the sequel of COVID 19 is severe enough to affect all groups by the same effect, contrary to Pataky et al. (8) who demonstrated that obese subjects showed lower gait velocities matching with shorter stride lengths.

These results agreed with Parpa et al. (9) who exhibited a statistically significant decrease in VO_2max and treadmill running times 60 days after COVID-19 recovery ($p<0.05$).

Santarém et al. (10) who demonstrated that BMI was not a strong mark of functional capacity in males when obesity was classified, complement the findings of this study.

The results of this study revealed that there is no difference in vo_2 max between three different BMI, these results are in consistent with Ekelund et al. (11) who showed there is no difference in resting and submaximal Vo_2 and Vo_2max between obese and averaged-weight adolescents after adjusting for free fat mass, fat mass, and body weight. Resting Vo_2 needs to be modified for both free fat mass and fat mass when comparing groups who differ in their body size. Submaximal Vo_2 (percentage Vo_2max) during performing weight-bearing activities is higher in obese adolescents due to their greater fat mass, but this is not due to lowered Vo_2. Free fat mass is strongly affected by Vo_2max, and dividing Vo_2max by free fat mass seems to be a best procedure when comparing groups who differ in body size .

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These results were accepted by Praveen et al. (12) who revealed there was a significant negative correlation between obesity and VO_2max, exhibiting excessive amount of body fat on cardiorespiratory functions and oxygen uptake by activated working muscles. There was a significant positive correlation between BMI and HR during the Treadmill Jogging test .

These results are in consonant with Shete et al. (13) who investigated usual physical activity firmly shows a higher aerobic capacity which was accomplished in this study. The females showed a higher VO_2 max levels in our study. Concerning the co-relation between VO_2 max and body fat percentage; although there was a negative correlation, it is not statistically significant .

5.Conclusion:

The study results demonstrated that COVID-19 has the same effect on cardiopulmonary parameters among different body mass indices.

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Declaration of interest:

There is no conflict of interest.

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