Middle East J Rehabil Health Stud. 2021 October; 8(4):e114607. doi: 10.5812/mejrh.114607.

Published online 2021 September 22. **Research Article**

Evaluation of the Relationship Between Daily Physical Activity Level and Laboratory Factors and the Length of Hospitalization in Patients with COVID-19

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Received 2021 March 14; **Revised** 2021 August 14; **Accepted** 2021 August 21.

Abstract

Background: Different degrees of disorders are reported in the respiratory, physical, and psychological functions of patients with corona virus disease 2019 (COVID-19). With the experience of improved and discharged COVID-19 patients, physical activity and sports are considered as one of the factors in controlling chronic mental and physical illnesses.
Objectives: This study was aimed at investigating the impact of the level of physical activity on some important clinical parameters and convalescence.
Methods: Overall, 71 patients with COVID-19 under the age of 65 years admitted to the hospital with positive PCR were included in the study. Based on Beck's questionnaire, patients were divided into two groups of (1) low and (2) moderate to high physical activity. The duration of hospitalization and some important clinical tests were examined at the time of hospitalization and discharge. The patients were then monitored until discharge.
Results: Statistical analyses showed that people with moderate to high physical activity were discharged earlier than the group with low physical activity ($P < 0.01$). Moreover, patients with moderate to high physical activity had lower erythrocyte sedimentation rate than the group with low physical activity at discharge ($P = 0.01$).
Conclusions: Moderate to high physical activity can significantly reduce the length of hospitalization by improving the immune system to fight COVID-19. However, the factors that can be examined in expressing the reason for this finding need further studies.

Keywords: COVID-19, Convalescence, Physical Activity

1. Background

More than 55 million confirmed cases of corona virus disease 2019 (COVID-19) have been reported so far. COVID-19 as a novel coronavirus infection can cause flu-like symptoms, such as fever (89%), cough (68%), fatigue (38%), sputum production (34%), dyspnea (19%), and pneumonia (1-5). Severe acute respiratory syndrome (SARS) following COVID-19 is an emerged respiratory disease that exacerbates the rate of mortality (2). Overall, the rate of mortality in this disease is reported 3 - 5%, which is severely higher than the rate of mortality of flu disease (0.1%). Therefore, the identification of preventive factors for decreasing the respiratory symptoms and the rate of mortality following COVID-19 is critical.

There is evidence that having regular physical activity and daily exercise is one of the main factors of controlling chronic diseases (6-8). Doing regular exercise can improve the cardiovascular system, respiratory capacity, and immune system (2, 6, 9). In addition, some studies reported that the rate of chronic diseases, the intensity of symptoms, and the rate of mortality are higher in immobilized individuals with low level of physical activities as compared to active people (2, 9). Accordingly, it seems that having high physical activity may decrease the severity of clinical symptoms in patients with COVID-19 and consequently, reduce the side-effects of the disease, the time of hospitalization, and the rate of mortality.

2. Objectives

This study was conducted to compare the clinical symptoms and the length of hospital stay in COVID-19 patients with low and high levels of physical activity.

3. Methods

Study design: This study was approved by the Human Ethics Committee of Semnan University of Medical Sciences (IR.SEMUMS.REC.1399.039), and it was performed in accordance with the ethical standards laid down by the Helsinki declaration.

In this cross-sectional study, the required data were collected from patients with COVID-19 hospitalized in the outpatient ward of Kowsar Hospital. The included patients were aged less than 65 years and had a positive RT_PCR test (10). If the patients were excluded from the study if they had a history of any systemic, neurological, respiratory, or cardiovascular disorders or were hospitalized in the intensive care unit. All the participants completed the informed consent form before entering the study. From a pool of 71 volunteers, the participants were assigned to two groups of patients with low level of physical activity and patients with moderate to high level of physical activity. The level of physical activity of patients was determined according to the Persian version of the International Physical Activity Questionnaire (IPAQ) (11). This questionnaire is a valid and reliable questionnaire, which includes five sections with 27 items on physical activity in different situations during last seven days (11). The patients who performed physical activity more than 600 met/cal/week were assigned to the moderate to high level of physical activity group. The patients with less than 600 met/cal/week physical activity, based on the IPAQ, were included in the low level of physical activity group (11). According to the matching group method, the two groups were matched based on age, gender, and body mass index.

After grouping the participants, the clinical and experimental variables were recorded at the time of hospitalization and discharge by using specific blood tests and clinical instruments. The considered variables included duration of hospitalization, O_2 saturation, respiratory rate, blood pressure, temperature, and blood tests, including prothrombin time (PT), partial prothrombin time (PTT), international normalized ratio (INR), hemoglobin (Hb), hematocrit (HCT), white blood cell (WBC), lymphocytes (Lymph), erythrocyte sedimentation rate (ESR) and c-reactive protein (CRP).

3.1. Statistical Analysis

First, the Kolmogorov–Smirnov was used to investigate the normal distribution of data. Then, independent *t*-test was used to compare the variables of age, height, weight, and sex between the two groups. Finally, independent *t*-test was run to evaluate the differences between the two groups in terms of the studied parameters. A P-value of less than 0.05 was considered significant.

4. Results

The Kolmogorov–Smirnov showed that the studied parameters in the two groups had a normal distribution; thus, the parametric test was used to compare the two groups. Then, we compared the variables of age, height, weight, and sex. The results showed no significant differences between the two groups (Table 1).

In the next step, the studied parameters were compared between the two groups. The results showed a significant difference between the two groups in terms of the studied parameters. The patients' recovery time (hospitalization until discharge) or convalescence, with an average difference of 12.59 days, that is, the group with moderate to high physical activity were discharged earlier than the group with low physical activity ($P < 0.001$) (Table 2). In addition, patients with moderate to high physical activity had a lower ESR than the group with low physical activity ($P = 0.01$).

The results of analysis also showed that chest CT scan was performed for 71 of the patients, 56 of whom showed positive lung involvement in CT scan (including ground glass view) (Table 3). Of these, 26 were male patients (13 in the low activity group and 13 in the medium activity group), and 30 were female patients (21 in the low activity group and 9 in the medium activity group). Interestingly, the recovery periods in the group with low physical activity in men and women were 20.92 and 20.28 days, respectively, but in the group with moderate activity, they were 7.53 and 10.55 days in men and women, respectively. Therefore, regardless of gender, even with lung involvement, the group with moderate physical activity had a much shorter recovery period than the group with low activity. Fifteen patients, on the other hand, did not have a lung involvement on a chest CT scan. Of these, nine were men and six women who were discharged after a recovery period of 20 and 26 days for the group with low physical activity, respectively, and 7 and 5.6 days for male and female patients in the group with moderate physical activity, respectively. In general, regardless of lung involvement, the main factor of physical activity seems to be effective in early discharge and reducing the recovery period of the disease.

5. Discussion

This study investigated the impact of high physical activity on the clinical features of patients with COVID-19. In

Table 1. Comparison of Demographic Data of the Studied Samples

Variables	Groups		P-Value
	Low	Moderate to High	
Gender (N)			0.9
Male	16	19	
Female	22	13	
Age (y)	35.93 ± 10.3	32.62 ± 9.3	0.15
Weight (kg)	76.12 ± 14.8	74.41 ± 14.4	0.61
Height (cm)	168.05 ± 8.1	169.88 ± 18.3	0.56

Table 2. Comparison Between the Groups for the Study Variables

Variable	Groups		Mean Difference	P-Value
	Low	Moderate to High		
Convalescence time (days)	20.62 ± 3.25	8.03 ± 2.79	12.59	0.000
O_2sat %	94.98 ± 1.77	94.94 ± 3.2	0.034	0.9
RR (per minutes)	18.74 ± 3.42	18.12 ± 2.85	0.61	0.4
Systolic blood pressure (mmHg)	112.69 ± 12.86	111.97 ± 20.79	0.723	0.8
Diastolic blood pressure (mmHg)	72.95 ± 8.16	69.85 ± 13.17	3.1	0.2
T (°C)	37.75 ± 0.93	37.72 ± 0.77	0.023	0.9
PR	83.32 ± 20.4	91.74 ± 19.8	-8.41	0.07
PT (s)	14.36 ± 4.5	13.55 ± 3.1	0.81	0.4
PTT (s)	32.50 ± 6.3	33.76 ± 5.9	-1.265	0.4
INR (s)	1.04 ± 0.07	1.03 ± 0.07	0.008	0.6
Hb (g/dL)	12.77 ± 1.56	17.43 ± 22.08	-4.65	0.2
HCT %	38.82 ± 3.92	37.167 ± 9.28	1.65	0.3
WBC (*1000)	11.87 ± 15.31	44.14 ± 179.4	-32.2	0.3
Lymphocyte (*10)	150.11 ± 352.6	101.87 ± 283.3	48.4	0.5
ESR	26.65 ± 18.9	15.97 ± 12.8	10.6	0.01
CRP (mg/dL)	5.15 ± 8.01	8.40 ± 12.2	-3.2	0.3
AST (UL)	39.86 ± 34.04	33.30 ± 23.3	6.55	0.6
ALT (UL)	47.36 ± 55.6	30.00 ± 21.6	-17.2	0.4
ALP (UL)	145.80 ± 77.6	180.00 ± 181.6	34.4	0.5

this study, there was a significant difference in terms of recovery time parameters and ESR between the two groups.

The most important result of this study was that the time required to recover in patients with COVID-19 with moderate to high physical activity was much less than that of the group with low physical activity. On the other hand, the mean recovery period in patients with positive lung involvement was the same for both men and women. In expressing the reason for these results, we examine the studied parameters. As noted in Table 2, the studied clinical parameters on the first day of hospitalization in both groups were very close to each other, and most of these parameters did not show a significant difference. Among these, the only parameter that was lower in the patient group with high level of physical activity was ESR.

In patients with COVID-19, laboratory indicators of inflammation, including commonly used erythrocyte sediments, reactive protein C, and procalcitonin, were only moderately elevated in viral infections such as COVID-19. However, it has been suggested that the host inflammatory response to COVID-19 may be widespread, even leading to a cytokine storm that can cause subsequent complications of the disease and dysfunction of several organs. Among the laboratory tests used to assess the acute phase response reflecting inflammatory status, ESR is considered one of the weakest specific markers. Studies show that severe cases of COVID-19 are associated with a marked increase in ESR, which reflects a deeper inflammatory response and protein expression. Therefore, according to the results of the present study, patients with moderate to high physical activity had lower ESR rates than the other group, which is consistent with the justification that mod-

Table 3. Comparison Between the Groups According to the Computed Tomography, Gender, and the Level of Physical Activity

Variables	Values	Convalescence
	Positive (+)[a]	
Gender		
Male		
Low	13	20.92
Moderate to high	13	7.53
Total	26	
Female		
Low	21	20.28
Moderate to high	9	10.55
Total	30	
Total	56	
	Negative (-) [b]	
Gender		
Male		
Low	3	20
Moderate to high	6	7
Total	9	
Female		
Low	1	26
Moderate to high	5	5.6
Total	6	
Total	15	
Total	71	

[a] Lung involvement is seen.
[b] Lung involvement is not seen.

erate physical activity increases the efficiency of the immune system (9). This is because exercise causes significant changes in hemodynamics (e.g., increased cardiac output, dilation of blood vessels, and blood flow) that exert mechanical forces on the endothelium. This causes leukocytes to cross the border and enter the bloodstream due to the activation of the sympathetic nervous system and the hypothalamic-pituitary-adrenal axis along with the secretion of catecholamines and glucocorticoids. This coordinated response causes a significant two to four-fold increase in total leukocytes (leukocytosis) and redistribution of so-called effective cells between blood vessels and lymphatic and peripheral tissues.

In fact, exercise preferentially stimulates leukocyte subtypes with tissue migration characteristics and rapid action capacity, such as natural killer cells, CD8 + T cells, and neutrophils (11). Rapid redistribution of immune cells with each exercise session is likely to increase immune monitoring, reduce the likelihood of pathogens settling, and activate the immune system rapidly in athletes in the face of diseases. In addition, studies have shown that exercise affects the antiviral defense system both for the short and long term exercises protocols.

The questionnaire used in our study assessed physical activity during the last seven days; therefore, we examined the acute effects of exercise on the laboratory profile. The tests performed on animals using the influenza virus, and herpes simplex virus (HSV-1) in the respiratory tract have shown that moderate exercise before infection or after infection (a few days before the onset of symptoms) improves complications and mortality from infection. Conversely, clinical studies have shown that strenuous exercise leads to poor outcomes in response to respiratory viral infections (8). Follow-up studies have shed light on some understanding of the mechanisms responsible for these observations. An early epidemiological study showed that intense, prolonged exercise was associated with an increase in upper respiratory tract infections. This led to the inverse J theory, according to which moderate exercise reduces viral infection of the upper respiratory tract and prolonged exercise increases susceptibility to infection with high intensity. Since then, several studies have supported this theory with respect to individual safety parameters, including specific cases for viral defense. For example, salivary lactoferrin and its secretion increase up to 2 hours after moderate exercise.

Mucosal lactoferrin is important because it can prevent DNA and RNA viruses by binding to and blocking host

receptors. Conversely, low levels of salivary immunoglobulin A secretion, which can bind to and inactivate viruses, have been shown to be associated with upper respiratory tract infections in some highly trained athletes. In addition, because physical activity and exercise have profound implications for the movement of leukocytes in the blood and tissues, many researchers theorize that physical activity enhances immune monitoring against infectious pathogens, including viruses.

Public health recommendations (e g, home stay guidelines, closure of parks, gyms, and fitness centers) to prevent the spread of SARS-CoV-2 can lead to reduced daily physical activity. These recommendations are unfortunate because daily exercise can strengthen the immune system and counteract some common diseases, such as obesity, diabetes, hypertension, and serious heart diseases that predispose individuals to severe COVID-19 disease.

This was a retrospective study; therefore, it was not possible to measure physical strength and performed fitness tests at the time of hospitalization. Therefore, the patient's level of physical activity was evaluated based on the patients' statements, which can be slightly variable. On the other hand, lack of information about the studied parameters at the time of discharge is another limitation of the study. Another point is that the use of vitamins (vitamins C, D, E, selenium) is also effective in controlling COVID-19 disease. However, we aimed to examine the effects of level of physical activity on the COVID-19, nutritional issues were not considered in our study, which should be addressed in future studies.

This manuscript was extracted from a research project submitted to Semnan University of Medical Sciences. We would like to thank all staff at Kowsar Hospital who helped us in conducting this study.

Acknowledgments

The authors appreciate the Neuromuscular Rehabilitation Research Center of Semnan University of Medical Sciences, where this research was performed.

Footnotes

Authors' Contribution: Study concept and design, Dr Fatemeh Ehsani; Acquisition of data, Dr Sara Reshadat and Dr Noushin Masoudian; Analysis and interpretation of data, Dr Rasool Bagheri and Dr Fatemeh Ehsani; Drafting of the manuscript, Dr Rasool Bagheri and Dr Fatemeh Ehsani; Critical revision of the manuscript for important intellectual content, Dr Rasool Bagheri and Dr Fatemeh Ehsani; Statistical analysis, Dr Rasool Bagheri and Dr Fatemeh Ehsani; Administrative, technical, and material support, Dr Rasool Bagheri and Dr Fatemeh Ehsani; Study supervision, Dr Rasool Bagheri and Dr Fatemeh Ehsani.

Conflict of Interests: The authors do not have any conflicts of interest.

Ethical Approval: This study was approved by the Human Ethics Committee of the Semnan University of Medical Sciences (IR.SEMUMS.REC.1399.039), and was performed in accordance to the ethical standards laid down by the Helsinki declaration. Link for ethical code: ethics.research.ac.ir/EthicsProposalView.php?id=135715

Funding/Support: The authors have not received any funding for writing this manuscript.

Informed Consent: The authors received informed consent from the participants.

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