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ORIGINAL ARTICLE

Benefits of Prostrate Position and Coughing Exercises in the Management of Cardiopulmonary Parameters Alteration among Patients with COVID-19

HAIDER NAWAF ABED-ALI[1], HASSAN ABDULLAH ATHBI[2]
[1]Registered Nurse/ Karbala health directorate/ Imam Hussein medical city
[2]Ass. Professor/Adult Nursing Department/College of Nursing/ University of Kerbala, Iraq.
Correspondence to: Haider Nawaf Abed-Ali, Email: haider84nawaf@gmail.com, Cell: 96407718575181

ABSTRACT

Method: A sixty patients with COVID-19 were randomly selected to conduct an experimental study to investigate the benefits of prostrate position and coughing exercises upon cardiopulmonary parameters among non-intubated patients with COVID-19.
Results: two-thirds of participants were >60 years old, 60% and 46.7% of the experimental and control group respectively were males, 36.7% of participants did not have any chronic diseases, but asthma was present in a third of them. The bilateral-peripheral and central area was the affected part of the lung in more than 40% of patients. More than 45% of the lung volume was affected in 80% of the experimental group and 50% of the control group. Finally, 96.7% of the experimental group and 90% of the control group did not take the COVID-19 vaccine. Furthermore, a statistically significant difference was found between the mean of cardiopulmonary parameters for the experimental group, while there was no statistical significance difference that was shown in the control group.
Conclusion: the application of prostrate position and coughing exercises have a positive effect on improving cardiopulmonary parameters among COVID-19 patients lasting for more than four hours.
Keywords: Prostrate Position, Coughing Exercises, Cardiopulmonary Parameters, COVID-19.

INTRODUCTION

The novel coronavirus disease (COVID-19) has become a global pandemic. The world health organization (WHO) reported that viral diseases continue as emergent transmissible infectious diseases. In January 2020, the WHO Emergency Committee assured that COVID-19 as an emergent health matter around the world (Faris, et al., 2021). The numbers of COVID-19 continued to increase since it appeared in China until its spread throughout the world, in February 22, 2022, more than 422 million cases, of which 98.6.2% (416,200,000) cured cases, and more than five million deaths (1.37%) (WHO, 2022). In Iraq, the total number of confirmed cases until March 1st, 2022, is 2,303,816 cases, including about 2,246,473 (95.5%) cured cases, and 24,999 (1.08%) deaths (Ministry of Health/Environment/Public Health Department. 2022).

COVID-19 is a respiratory disease caused by COV2 and causes clinical symptoms in all body systems and is not limited to the respiratory system only, as the severity of these symptoms ranges from minor, moderate, and severe cases (Balkheir 2020). It can cause serious respiratory and cardiovascular problems that may appear as fluctuations in the electrocardiogram, blood pressure, and pulse rate (Bajić, et al 2021). Behesht et al., (2021) stated that COVID-19 causes numerous problems and complications in all body organs. It causes alterations in cardiopulmonary parameters such as coughing, the difficulty of breathing, and hypoxia as well as a variation in peripheral oxygen saturation (SpO2) and/or arterial oxygen saturation (SaO2), respiratory rate (RR), partial pressure of oxygen (PaO2), partial pressure of carbon dioxide (PaCO2). Furthermore, it can cause alterations in cardiac work such as arrhythmias, tachycardia, hypertension or hypotension (Chen et al., 2020). Retucci, et al., (2020) indicated that changing the patient's position is one of the non-pharmacological nursing interventions that help to improve gas exchange and breathing process and thus positively reflected on the cardiovascular and pulmonary indicators. Since some studies indicated that there was a positive effect of prostration on some cardiopulmonary parameters. Mahrous and Aboelmagd (2022) exposed that the prostration position had an effect on improving the rate of blood saturation with oxygen and reducing the heart rate and the respiratory rate. Furthermore, Wadsworth, et al., (1996) reported that the prostrate position had an effect on reducing the heart rate and mean arterial pressure of patients undergoing different surgeries. Therefore, this position was adopted as an ideal way to reduce complications of COVID-19 infection, especially alterations in cardiopulmonary parameters.

METHODOLOGY

A total of 60 confirmed patients with COVID-19 admitted in the COVID-19 ward at Imam Hussein Medical City/Karbala Governorate/Iraq, were randomly enrolled in this experimental study for the period from October, 21th, 2021 to April, 2ed, 2022. This study was performed to find out the benefits of prostrate position and coughing exercises on cardiovascular and pulmonary parameters among non-intubated COVID-19 patients, and to determine the association between the effect of prostrate position and coughing exercises with demographic characteristics and clinical data of patients. The study sample was selected by using a systematic random sampling method, 30 of them participated in this study as an experimental group and the other 30 patients as a control group. The cardiopulmonary parameters include systolic blood pressure (SBP), diastolic blood pressure (DBP), peripheral oxygen saturation (PaO2), respiratory rate (RR), pulse rate (PR), pulse pressure, mean arterial pressure (MAP), and cardiac output were measured four times. The interventional protocol was putting the patient in a prostrate position for a full one hour and the coughing exercises are performed for the patient at the first time of prostration. The cardiopulmonary parameters were measured in the following sequences, firstly the researchers measured them before implementing the interventional protocol; the second time, one hour after completing the protocol; then the researchers repeated the measurement of cardiopulmonary parameters four hours after the completion of the intervention, and finally after seven hours after the completion of the intervention.

A questionnaire form was prepared by the researchers in order to collect all the relevant data associated with demographic data and clinical data in addition to some of the cardiopulmonary parameters. This section for cardiopulmonary parameters includes SBP, DBP which was measured by a sphygmomanometer, the SpO2 was measured by using the pulse oximetry device, as for pulse pressure (PP) was measured by applying the following formula (PP= SBP - DBP), the researchers was calculating the RR by observing and calculating the number of times the patient's chest rose and fell during one minute. Furthermore, the cardiac output (CO) was measured by applying the following formula (CO= (PP x HR)*2ml) that was designed by Koenig et. al., (2015), while the MAP was measured by applying the formula of (MAP = ([DBP x 2] + SBP)÷3} (Farrell & Dempsey, 2010). The interviewing technique was used by the researchers to collect the relevant data. Finally, the data were analyzed by using the program of IBM Statistical Package of Social Sciences (SPSS) Version 23, and both descriptive statistical analysis procedures (frequency, percentage) and chi-square and inferential statistical analysis

(repeated measurement ANOVA) were used in order to analyze and assess the results of the study, a p-value <0.05 was considered statistically significant.

Ethical clearance: The approval of the implementation of interventional protocol on patients was obtained after reviewing it by the Ethical Committee of the Nursing College/ Karbala University.

RESULTS AND DISCUSSION

Table 1: Distribution of demographic data and smoking history of patients with COVID-19:

Demographic data		Control group		Experimental group	
		Frequency	Percentage	Frequency	Percentage
Age/years	20-39	2	6.7	3	10
	40 - 59	8	26.7	8	26.7
	≥ 60	20	66.6	19	63.3
	Total	30	100	30	100
Gender	Male	14	46.7	18	60
	Female	16	53.3	12	40
	Total	30	100	30	100
Smoking condition	Never	20	66.7	23	76.7
	Previous	9	30	4	13.3
	Currently	1	3.3	3	10
	Total	30	100	30	100
Second-hand smoke	Yes	23	76.7	24	80
	No	7	23.3	6	20
	Total	30	100	30	100
Body mass index (BMI)	Normal weight	5	16.7	7	23.3
	Overweight	7	23.3	1	3.3
	Obesity class I	14	46.7	16	53.3
	Obesity class II	3	10	3	10
	Obesity class III	1	3.3	3	10
	Total	30	100	30	100

Table 2: Distribution of clinical data of patients with COVID-19

Clinical data		Control group		Experimental group	
		Frequency	Percentage	Frequency	Percentage
Chronic diseases	Hypertension	7	23.3	4	13.3
	Asthma	9	30.0	8	26.7
	DM	3	10	7	23.3
	Non	11	36.7	11	36.7
	Total	30	100	30	100
Infected part of the lung	Bilateral - peripheral & central	12	40	13	43.3
	Bilateral-central	8	26.7	12	40
	Bilateral-peripheral	7	23.4	4	13.4
	Left lung- peripheral	1	3.3	1	3.3
	Right lung central	1	3.3	0	0
	Bilateral - lateral	1	3.3	0	0
	Total	30	100	30	100
Percentage of the affected area	15 - 24%	5	16.7	0	0
	25 - 34%	5	16.7	3	10
	35 - 44%	5	16.7	3	10
	≥ 45 %	15	50	24	80
	Total	30	100	30	100
Method of oxygenation therapy	Face mask	20	66.7	18	60
	Re-breather mask	10	33.3	12	40
	Total	30	100	30	100
COVID-19 vaccination status	Yes	3	10	1	3.3
	No	27	90	29	96.7
	Total	30	100	30	100

Table 3: Comparison of the effect of prostrate position and coughing exercises on the cardiopulmonary parameters for the experimental group and the control group:

Cardiopulmonary parameters	Experiment group (mean of 30 patients)				Control group (mean of 30 patients)			
	Before	After 1	After 2	After 3	Before	After 1	After 2	After 3
SBP (mm Hg)	145.43	124.16	132.50	150.16	140.83	138.83	139.16	138.86
DBP (mm Hg)	86.03	79.16	77.00	86.16	87.16	87.33	87.00	85.33
SaO2(%)	82.63	95.13	92.80	82.66	84.43	84.86	85.16	84.96
RR (breath\ minute)	35.20	22.80	25.06	30.16	31.46	30.83	30.43	29.73
HR (beats\minute)	114.23	83.36	85.76	105.43	103.30	100.03	100.16	100.63
PP (mm Hg)	56.63	48.43	55.83	59.16	53.33	51.00	50.50	51.50
MAP (mm Hg)	104.16	94.10	95.93	105.93	107.60	106.40	106.46	105.63
CO (Liter)	16.13	7.23	9.86	12.13	15.86	14.76	14.76	15.03

Before: before implementing the intervention; After 1: one hour after implementing the intervention; After 2: four hours after implementing the intervention; After 3: seven hours after implementing the intervention.

By using a repeated measurement ANOVA, the result in table (3) shows that there a difference between the mean scores of the cardiopulmonary parameters for the experimental group, while there were no differences in the control group.

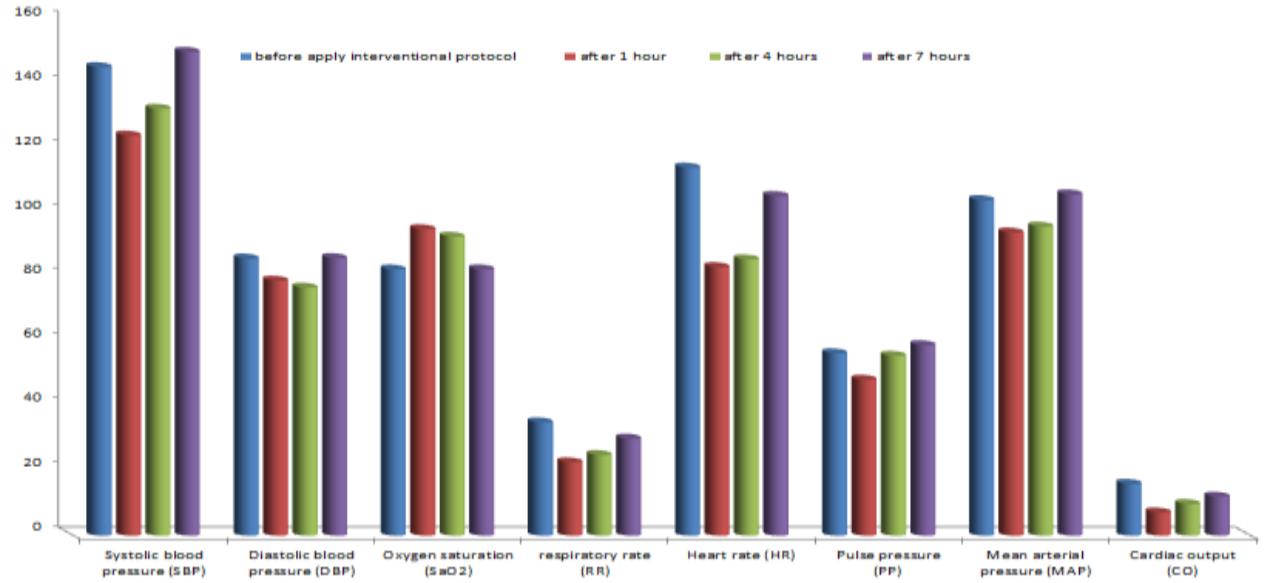

Figure 1: The effect of prostrate position and coughing exercises on the cardiopulmonary parameters among the experimental group.

Table 4: Association between the effect of prostrate position and coughing exercises on the cardiopulmonary parameters among COVID-19 patients with their demographic data

Cardiopulmonary parameters	Age		Gender		Smoking condition		Second-hand smoke		BMI	
	P-value	Sig.	P-value	Sig.	P-value	Sig.	P-value	Sig.	P-value	Sig.
SBP	0.001	S	0.078	NS	0.039	S	0.065	NS	0.001	S
DBP	0.009	S	0.043	S	0.132	NS	0.018	S	0.002	S
SpO2	0.410	NS	0.451	NS	0.015	S	0.206	NS	0.152	NS
RR	0.005	S	0.020	S	0.204	NS	0.541	NS	0.013	S
HR	0.013	S	0.052	S	0.033	S	0.108	NS	0.002	S
PP	0.089	NS	0.078	NS	0.098	NS	0.112	NS	0.227	NS
MAP	0.061	NS	0.135	NS	0.074	NS	0.250	NS	0.007	S
CO	0.163	NS	0.144	NS	0.007	S	0.012	S	0.000	S

NS: Non-Significant (P value >0.05); S: Significant (P value ≤ 0.05).

Table 5: Association between the effect of prostrate position and coughing exercises on the cardiopulmonary parameters among COVID-19 patients with their clinical data:

Variables	Chronic diseases		Drugs that use now						Infected part of the lung		Percentage of the affected area		The period since the first appearance of symptoms		Hospitalization period		Method of oxygenation therapy		Take vaccine condition	
			Antitussive		Bronchodilator		Antipyretic													
	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.	P. Value	Sig.
SBP	0.036	S	0.154	NS	0.032	S	0.209	NS	0.060	NS	0.025	S	0.031	S	0.011	S	0.397	NS	0.008	S
DBP	0.010	S	0.018	S	0.088	NS	0.254	NS	0.002	S	0.008	S	0.002	S	0.008	S	0.067	NS	0.018	S
SpO2	0.020	S	0.769	NS	0.536	NS	0.977	NS	0.016	S	0.051	NS	0.055	NS	0.155	NS	0.387	NS	0.811	NS
RR	0.001	S	0.209	NS	0.016	S	0.769	NS	0.000	S	0.034	S	0.028	S	0.004	S	0.049	S	0.945	NS
Pulse rate	0.008	S	0.052	NS	0.091	NS	0.286	NS	0.003	S	0.013	S	0.028	S	0.035	S	0.052	NS	0.052	NS
PP	0.001	S	0.008	S	0.023	S	0.455	NS	0.011	S	0.231	NS	0.009	S	0.050	S	0.049	S	0.945	NS
MAP	0.126	NS	0.915	NS	0.091	NS	0.052	NS	0.017	S	0.041	S	0.087	NS	0.106	NS	0.052	NS	0.052	NS
CO	0.003	S	0.109	NS	0.132	NS	0.012	S	0.003	S	0.017	S	0.007	S	0.001	S	0.087	NS	0.012	S

NS: Non-Significant (P value >0.05); S: Significant (P value ≤ 0.05).

Table (1) shows that approximately two-thirds of the sample within the age group of ≥ 60 years, from them there were 60% from the experiment group and 46.7% from the control group were males. In addition, and regarding the smoking status, this table

reveals that 76.7% and 66.7% were never smoked in both experimental and control groups respectively, while more than three-quarters of the sample were exposed to second-hand smoke. Finally, approximately one-half of the patients enrolled in this study had obesity class I that had BMI=30-34.9.

Table (2) indicates that 30.0% and 26.7% of patients have had asthmatic conditions, and 23.3%, 13.3% of them have hypertension from both control and experimental groups respectively. Concerning the infected part of the lung, this table exposed that 40.0% of the control group and 43.3% of the experimental group were effected in the bilateral-peripheral and central parts of the lungs, while 80% of the experimental group and 50% of the control group were effected more than 45 percentage of the lungs. In addition to that, the result in this table reveals that 60% of the experimental group and 66.7% of the control group were used a face mask as a method of oxygenation therapy. Finally, the greater (96.7%) percent of the experimental group and 90% of the control group did not take the COVID-19 vaccine.

By using the chi-square test this table shows that are a statistically significant association are found between SBP and patients' age, smoking condition, and BMI, that is also a significant association between DBP and patients 'age, gender, second-hand smoke, and BMI. Also, there is an association between the improvement in the SpO2 level with smoking condition, while there is an association between RR and patients' age, gender, and BMI. The level of improvement in the heart rate is associated with patients 'age, smoking condition, and BMI.

DISCUSSION

This is the first study that aims to investigate the benefits of prostrate position and coughing exercises upon cardiopulmonary parameters among non-intubated patients with COVID-19. Concerning the demographic characteristics as presented in table (1), the results reveal that approximately two-thirds (63.3%) and (66.6%) of the experimental and control groups respectively were within the age group of ≥ 60 years, these findings disagree with the result of the study that was done by Boehmer, et al., (2020), indicates that most of the patients were elderly in the sample because the old age had a weak immunity, Mueller, et al., (2020) exposed that the aging innate the immune system. The researchers show that the hospitalization of the elderly is increased because of their decreased immunity, old age intolerance the disease severity, unlike young people who have a good immune system.

The researchers attribute the convergence in the gender representation of the sample to the fact that the Coronavirus does not exclude a specific gender in infection, as it affects both genders equally. Our results agree with the study of James, et al., (2021) was indicated that from a total of 634 participants involved in their study, 59.3% were male and the other were female, and the median age of patients was 50 years for 60% of the sample.

Because of the high rate of infection in the sample among non-smokers, it was approximately three-quarters of the sample, the researchers believe that the Coronavirus is not specific to infected smokers only. This result comes along with the findings of the study was done by Yang, et al., (2020) indicated that only 4% of patients infected with COVID-19 were smoking. The researchers show that the reason for the small number of smokers in the sample related to the fact that half of the sample was women, and also because the percentage of smoking among women in the eastern community is very limited, this was confirmed by Khattab et al., (2012) indicates that 54.4% of the patients participating in the study do not smoke, 53.2% of those infected with COVID-19 were smokers, while the smokers of non-COVID-19 patients were 55.4%. regarding second-hand smoke exposure, the study result reveals that 80 % of the experimental group and 76.7% of the control group were exposed to second-hand smoke. The researchers believe that this percentage was of infected persons among second-hand smoke because they inhale smoke containing dust particles, this increases the rate of damage to the lungs, making them more susceptible to the invasion of microorganisms, especially the Coronavirus. The result of the studies that was done by Osinibi, et al., (2021), Garcia, et al., (2021), and Athbi, and Abed-Ali, (2020) exposed a relationship between passive smoking and infection with some diseases or an increase in the severity of their complications.

Body mass index has been determined as one of the most contributing factors to many disease processes. Our study result exposed that most of the patients with COVID-19 enrolled in this study were suffering from obesity class1 and accounted for 53.3% of the experimental group and 46.7% for the control group. This finding comes along with the result of the study that was conducted by Raisi-Estabragh, et al., (2020) reported that obesity classes I to III were associated with increased risks of mortality in a hospital or mechanical ventilation.

In addition to that, the result in table (2) reveals that 36.7% of the patients did not suffer from any chronic diseases, while there was approximately one-third of them had asthma. It was known that an asthmatic patient was affected by stimuli that cause him to have an acute asthma attack as well as exacerbate his infection with other respiratory diseases, these stimuli, including allergens, exposure to viruses, or irregular use of some medications. The severity of an asthmatic attack increases with the increase of stimuli. An asthmatic patient who was infected with the Coronavirus will be more severely affected than others because the virus was one of the stimuli for the attack of asthma, which exacerbates the situation and increases the chances of hospitalization and prolongation of their stay. Regarding the infected part of the lung, this table exposed that 40.0% of the control group and 43.3% of the experimental group were effected in the bilateral-peripheral and central parts of the lungs, while 80% of the experimental group and 50% of the control group were effected more than 45 percentage of the lungs. The results of our study are consistent with a study conducted by Soldati, et al., (2020) reported that usually, the early viral pneumonia show bilateral. The researchers show that a high rate of lung damage appeared in the study sample because the study was conducted on hospitalized patients and most of them had a very high rate of lung damage. Moreover, the result in this table exposed that approximately 90% and 96.7% of the patients in the control group and experimental groups respectively were refused to take the COVID-19 vaccine. The researchers show that the lack of societal awareness about COVID-19 among Iraqi residents was the main cause for refusing to take the vaccine; this result comes along with the findings of the study conducted by Abdulah, (2021) in Iraq reported that the low level of education was the main reasons of 83.5% of the participants have not received COVID-19 vaccines.

The benefits of prostrate position and coughing exercises on the cardiopulmonary parameters was clearly exposed in table (3) it is shown that a positive effect of prostrate position and coughing exercises on the cardiopulmonary parameters (SBP, DBP, SpO2, HR, PP, RR, CO, and MAP) among patients involved in the experimental group. The improvement in the cardiopulmonary parameters occurred in the second measurement (immediately during the first hour after applying the interventional protocol), and the third measurement (two hours after completing the application of the interventional protocol). The researchers believe that the reason for the decrease in the respiratory rate and SpO2 was the reversal of the lung in a prostration position, which is one of the modes of drainage of secretions, in addition to coughing exercises that help to remove sputum and sticky mucous secretions from inside the alveoli into the respiratory tracts, which facilitates the process of eliminating them. This process is positively reflected in the process of expansion of the lungs, the opening of the alveoli, and the improvement of gas exchange. After SpO2 rises and respiratory rate decreases, the patient relaxes psychologically, stress reduces, and effort decreases during breathing, which causes a decrease in heart rate, blood pressure, cardiac output, and other cardiac parameters. McNicholas, et al., (2020) emphasized the improvement in arterial oxygenation after

implementing the prone position increasing the regional ventilation in dependent lung regions near the diaphragm and reducing pleural pressure. The prostration gives psychological comfort to Muslim patients because it is considered among the movements specific to their prayer. It is the daily method they follow for spiritual contact with the Lord, who gives them reassurance, calmness, and safety that agrees with a study conducted in Iraq by Ibraheem, et al., (2021) reported that during prostration (Sajdah), psychological satisfaction occurs due to their closeness to God, and this reflects positively on health status. Sartini, et al., (2020) reported that there was a clear statistical difference between SpO2, PaO2, and respiratory rate before, during, and after implementation of prone positioning in noninvasive ventilation patients. Mahrous, and Aboelmagd., (2022) exposed that there was a significantly decreased respiratory rate, heart rate, and increased oxygen saturation due to the knee-chest position. Rossi, et al., (2022) reported that the prone position had increased PaO2/ FiO2 for 65% of COVID‑19 pneumonia patients.

Finally, regarding the association between the effect of prostrate position and coughing exercises with demographic characteristics and clinical data of patients. The results in table (4) exposed a statistically significant relationship between SBP and chronic disease, bronchodilators, percentage of the affected area, the period since the first appearance of symptoms, hospitalization period, and take vaccine condition. The effect of prostate position and coughing exercises on DBP among COVID-19 patients that are enrolled in this study has a statistically significant association with chronic disease, the use of antitussive medications, infected part of the lung, percentage of the affected area, the period since the first appearance of symptoms, hospitalization period, and take vaccine condition. Furthermore, there was found a significant association between SpO2 and chronic disease, the infected part of the lung, percentage of the affected area, and the period since the first appearance of symptoms. In addition to that, the improvement in respiratory rate was clearly shown associated with chronic disease, the use of bronchodilators medications, the infected part of the lung, percentage of the affected area, the period since the first appearance of symptoms, hospitalization period, and method of oxygenation therapy. While the improvement in the pulse rates was noticed among patients with chronic disease, use of antitussive medications, the infected part of the lung, percentage of the affected area, the period since the first appearance of symptoms, hospitalization period, method of oxygenation therapy, and vaccination condition.

CONCLUSION

The study concludes that the prostrate position and coughing exercises were good in improving cardiopulmonary parameters among COVID-19 patients, the positive effect of the prostrate position and coughing exercises lasted for more than four hours. A significant association was found between the benefits of prostrate position and coughing exercises with demographic characteristics and clinical data of patients such as chronic disease, the use of antitussive medications, infected part of the lung, percentage of the affected area, the period since the first appearance of symptoms, hospitalization period, and vaccination condition.

Recommendations:

1. All non-intubated patients with COVID-19 should perform a prostrate position and coughing exercises for a full one hour every four hours to improve cardiopulmonary parameters.
2. Conducting another study to determine the effect of prostrate position and coughing exercises upon other cardiopulmonary parameters among non-intubated patients with COVID-19 and other respiratory diseases or cardiovascular diseases.

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Ethical clearance: The approval of the implementation of interventional protocol on patients was obtained after reviewing it by the Ethical Committee of the Nursing College/ Karbala University.

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