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Short term effect of exercise protocol on respiratory functions in subjects with COVID

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Few studies have demonstrated that subjects with Covid have breathless at rest, fever, sore throat and other pneumonia like symptoms and are known to respond effectively towards Drug therapy which boosts their immunity. Physiotherapy is very well studied to improve immunity by imposing various exercises on the affected part, thus strengthening that part. Deep breathing and chest expansion exercises are known to be effective in treating subjects with such symptoms. Various exercises have been demonstrated for subjects with Covid. According to authors' knowledge there is very less number of studies demonstrating the effectiveness of the exercise protocol formed for Covid subjects. The objective of the study is to investigate the short term effectiveness of Structured Exercise Protocol on respiratory parameters in subjects with Covid. It is an experimental study conducted on 50 Covid positive subjects who were given regular chest physiotherapy including deep breathing exercises, segmental breathing exercises, chest expansion exercises and dedicated prone lying. The results demonstrated that: modified Borg's scale of dyspnoea, SPO_2, Respiratory rate, Xray changes, Heart rate and number of active cough extraction showed significant changes. Dedicated prone lying along with regular chest physiotherapy showed great improvement in respiratory parameters.

Keywords: Covid, Physiotherapy, Structured exercise protocol

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Covid 19, a declared global pandemic disease is a viral infection caused by the virus named Corona. The recent studies have given the name COVID-19 suggesting CORONA Virus disease 2019, resulted from an outbreak of corona patients. Several forms of Corona virus are known in origin, but the defined origin for the outbreak of 2019 is demonstrated to be of Bat. The disease primarily involves respiratory system with its main manifestations being interstitial and alveolar pneumonia and thus gradually causing severe acute respiratory syndrome (SARS). In chronic cases of COVID-19 the attack is generally on almost on all the organs including kidney, heart, digestive tract, nervous system, vascular system and mainly respiratory system[1].

Few studies have demonstrated that the subjects with Corona have demonstrated signs and symptoms similar to pneumonia. The blood analysis has shown the rise in eosinophil and leucocyte count depicting marked infection. Also, the D-dimer value, S. Ferratin and Prolactin values have shown increment, suggesting the correlation between the corona virus and pneumonia like symptoms[2].

Drug therapy is known to be very effective in treating subjects with Covid19. Drug therapy known to boost immunity is usually given to Covid positive subjects who fight the virus thus recovering the subjects health back to normal or near normal[3].

Although, few studies have also demonstrated that Chest Physiotherapy improves the respiratory parameters in subjects with Covid[1-3].

A study conducted by *Chintamani et al.*[4] demonstrated that COVID subjects showed improved status with respect to cardiac and respiratory parameters after respiratory physiotherapy along with high flow nasal canula. The reason mentioned in the study was that, subjects with COVID have weak diaphragm and abdomen due to the persistent infection in lower lobe. Once the lower lobe infection is under control by medical therapy, chest physiotherapy needs to be started so that, the maintenance of hygiene and conditioning of the cardiopulmonary system along with oxygenation led to early patient discharge[4].

Another study conducted by *Burungale et al.*[5] demonstrated that awake prone lying showed significant improvement in cardiac and respiratory

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parameters. The study was a randomised clinical trial, which divided subjects into 3 h, 6 h and 9 h of prone lying. The study concluded that 6 h of prone lying demonstrated best results in improving the deprived or abnormally elevated outcomes of lungs and heart. The reason stated was, 6 h of prone lying improved oxygenation of the lung due to direct lung expansion and alveolar dilation of the ventral collapsed alveolii seen frequently in COVID subjects[5].

According to the authors' knowledge, there is paucity of literature for effective structured exercise protocol for subjects with Covid. Hence, this study is been undertaken.

Materials and Methods

Ethical clearance

Ethical clearance was obtained from institutional ethical committee of Krishna Institute of Medical Sciences, Deemed to Be University, Faculty of Physiotherapy Karad-Maharashtra with Ref No: KIMS/IEC/03/2020

Participants

It is an experimental study including 50 subjects who were diagnosed as Covid19 positive. Inclusion criteria for recruitment were; Covid 19 positive, Borg's scale of dyspnoea grade: 3 and above, respiratory rate not below 20, both the genders, subjects willing to participate in study and age: above 18 years.

Exclusion criteria were: fever, unconscious subjects, subjects with neurological or cardio-respiratory instability, subjects with surgical history, neoplasia, and known case of sever balance issues. Subjects were recruited by convenience sampling. Study population was selected from the Intensive Care Unit of KRISHNA HOSPITAL- Karad India, diagnosed with Covid. This study was approved by the Institutional Ethics Committee KIMSDU Karad. All participants were informed about the procedures and the written informed consent form was taken to participate in the study. Subjects were recruited on the basis of inclusion and exclusion criteria.

Experimental procedure

Demographic details and outcome measures like: age, gender, height, weight, BMI, modified Borg's scale of dyspnoea, SPO_2, Respiratory rate, Heart rate, number of active cough extraction, X-ray reading were recorded pre-therapy. Structured exercise protocol was imposed every day for seven days with frequency twice daily.

Duration and sessions of exercises

Session 1: Deep breathing exercises, chest expansion exercises and prine lying for 30 min.

Session 2: Ankle toe movements, hand pumps and heel sides along with prone lying for 45 min.

Session 3: Shoulder abduction movements, hip abduction movements and diaphragmatic breathing along with prone lying for 45 min again.

Total duration of exercises: 135 min each time, so twice daily= 270 min/day

Session 1: 30 + 5 min= 35 min

Session 2: 45 min + 5 min= 50 min

Session 3: 45 + 5 min= 50 min

7^{th} day the outcome measures were noted again and tallied statistically using 16.0 version for the results.

Outcome Measures

1. *Modified Borg's scale of dyspnoea*: scale to measure rate of exertion, ranges from 0 to 10 where we have to ask patients to mark the reading of how breathless are they feeling[6].
2. *SPO_2*: It is a measure of the amount of oxygen-carrying hemoglobin in the blood relative to the amount of hemoglobin not carrying oxygen. It gives the value of oxygen saturation in the blood. Usually measured by Pulse oxymetry[7].
3. *Respiratory rate*: respiratory rate was counted for a minute using the stopwatch and observation technique and noted down[7].
4. *Heart rate* was recorded from the pulse oxymetry[7].
5. *Number of active cough extraction*: number of active cough extraction by coughing technique was noted throughout 24 h until next exercise session was intervened.
6. *X-ray changes*: ground glass opacification, Bilateral alveolar consolidation, air space consolidation and crazy paving appearnace[8].

The outcome measure readings were taken on pre-therapy and immediately post-therapy.

Results

Statistical analysis was done using 16.0 version and Student unpaired test was used for analysis

I ***Demographic characteristics of participants:*** Age, Gender and weight showed no significant difference between pre therapy and post therapy.

II ***SPO2, respiratory rate and number of active cough extraction:*** *the parameters were assessed using students t-test.* The analysis was conducted

between parameter against time. Post therapy definite improvement was seen in all the parameters with p value <0.05* for SPO2, Respiratory rate, heart rate respectively and <0.001* for modified Borg's scale grade, number of active cough extraction/24 h respectively suggesting effective improvement (Table 1).

III ***X-ray changes:*** Chi square analysis showed X-ray demonstrating significant changes with respect to Lungs. The X-ray changes difference was statistically significant with p value <0.05 with respect to air space consolidation, ground glass appearance, crazy paving appearance (Table 2).

IV X-ray of a single patient day wise is mentioned at the end of the study.

Discussion

In the present study, all the outcome measures enlisted above were significantly improved post-therapy. It is already demonstrated in various studies that subjects with COVID positive have tachycardia, tachypnea and deprivation of oxygen saturation in blood hence lower SPO2 levels[9]. It already been studied that Physiotherapy exercises have improved with symptoms leading to achievement of normal respiratory and heart rate along with SPO_2 and active cough extraction with basic chest exercises like deep breathing exercises and chest expansion technique[10].

A study demonstrated that structured exercise therapy along with high flow nasal cannula showed significant improvement in subjects with COVID in both cardiac and respiratory parameters. The reason by the author was, the structured exercise not only was targeted to the cardio-pulmonary aspect but was given to the entire body in order to improve the immunity of the body system. Also, the high flow nasal cannula maintained the oxygenation of the lung. So the research study documented that, Physiotherapy plays a very important role in improving the immunity, lung-cardiac strength and conditioning along with the rest body. The set of exercise given was not only directed to the lung and heart but also to the entire body system. The study concluded that, the exercise program given along with High flow nasal cannula worked effectively in treating COVID subjects[4]. The present study follows the same principle and all the outcome measures were improved quiet effectively. All the exercises clubbed in this study have been individually demonstrated in the effectiveness in treating subjects' symptoms like breathless, tachycardia, cough with sputum, etc. Also, few studies and systematic reviews have demonstrated that lying prone for 7-8 h to be effective for such subjects[10].

A study conducted on awake prone lying showed prone lying was effective in treating subjects with COVID. The study divided the subjects into 3 groups. Group one had 3 hours of prone lying, group 2 had 6 h of prone lying and group 3 had 9 h of prone lying. The study concluded that 6 hours of awake prone lying demonstrated to be effective in treating the COVID subjects with reason being, awake prone lying improved ventilation of collapsed ventral alveoli[5]. Results of the present study shows the improvement in all the parameters by the same principle explained in other studies as well.

In the present study, Pre therapy, the X-ray showed alveolar consolidation, ground glass appearance of the lung, crazy paving appearance and definite air space consolidation. Post therapy with chest expansion techniques demonstrated clear lung fields and opacification. X-ray of a subject throughout the therapy is listed date wise at the end of the article. As the chest expansion exercises and deep breathing exercises induced the alveolar expansion and improved the ventilation of the lungs within, helping in oxygenation of blood thus improving SPO_2; decreased the rate of exertion and breathlessness at rest[6].

Table 1 — Parameters x time analysis by student's t test (Mean ±SD)

Parameters	Pre therapy	Post therapy	*p* value
$SP0_2$	90 ±5	98 ±2	<0.05*
Respiratory rate	45±3	20±2	<0.05*
Heart rate	100±5	69±5	<0.05*
Modified Borg's scale grade (rate of exertion)	7±3	0±1	<0.001*
Number of active cough extraction/24 hours	0±1	5±2	<0.001*

Table 2 — X-ray parameters x time analysis by Wilcoxon Matched pair test

Parameters	Pre therapy	Post therapy
Alveolar Consolidation	0.148	<0.05*
Ground glass Opacification	0.217	<0.05*
Crazy paving appearance	0.189	<0.05*

p value was considered significant if it was less than or equal to <0.05*

Conclusion

The Structured Physiotherapy Protocol delivered for subjects with sub-acute Covid showed, definite improvement in respiratory parameters like SPO_2,

Respiratory rate, Heart rate, number of active cough extraction, X-ray changes and Borg's scale. This shows significant improvement in immunity and health and conditioning of the lunge suggesting effective towards its use in future for Covid subjects in sub-acute stage. The reduction of rate of Borg's scale of dyspnoea showed greater improvement in strength and capacity of lung, thus making the subjects less dependent on ventillatory support. Prone lying position was inculcated in the structured exercise protocol which was demonstrated as useful for subjects with Covid which helped in quicker improvement of the respiratory parameters. Future scope of the study would be that, it can be used to inculcate the protocol for subjects diagnosed with COVID and check its efficacy by performing Randomized controlled trials.

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Author Contribution Statement

Chintamani R developed a theory and performed the computations along with Burunagle M. Chintamani R verified the data by analytical methods and supervised the findings of the work. Both the authors discussed and contributed to the final manuscript.

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