IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

EFFECTS OF PRANAYAMA ON RESPIRATORY FUNCTIONS AND QUALITY OF LIFE IN PATIENTS WITH INCOMPLETE SPINAL CORD INJURY.

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Abstract: Background: Spinal cord injury (SCI) is usually accompanied by weakness or paralysis of respiratory muscles, decreased vital capacity (VC), and decreased lung and chest wall compliance. Pranayama optimizes the use of abdominal and diaphragmatic muscles to improve respiration. Strengthens the respiratory system, facilitates extensions of muscle, enhances lung capacity, and also includes a meditative and mindfulness component. This study aims to find out the effect of pranayama on respiratory functions and quality of life in patients with Incomplete Spinal Cord Injury. Methodology: 15 participants between the age group 18–60 years with incomplete spinal cord injury were selected with convenient sampling. Participants were given Pranayama in a single group for a 4-week duration. Respiratory functions were assessed before and after 4 weeks of intervention protocol by Pulmonary Function Test (PFT) and Chest Expansion Test and quality of life by SCIM scale. Results: Results of this study showed that there were significant differences in post values of FVC ($p = 0.0006$), FEV1($p = 0.0001$), Chest expansion at sternal ($p = 0.0281$), xiphoid ($p = 0.0035$) and T8 level ($p = 0.0001$) and SCIM ($p = 0.0033$) respectively after a 4-weeks pranayama program. Significant improvement in Respiratory Functions and Quality of life was seen. Conclusion: This study concluded that the 4-week Pranayama program improves Respiratory functions and Quality of Life in patients with incomplete Spinal Cord injuries. Implication: Pranayama can also be considered as an addition to the routine Chest physiotherapy protocol for spinal cord injury patients.

Keywords **-** Pranayama, respiratory functions, spinal cord injury, PFT, SCIM

INTRODUCTION

A spinal cord injury refers to any damage or trauma to the spinal cord that contains both white matter (ascending and descending tracts) and grey matter (sensory and motor neurons). Such an injury can result in paralysis of the muscles and affect sensory abilities and other body functions below the level of injury. The spinal cord is a bundle of cells and nerves that connects the bottom part of the brain to the lower back, sending and receiving signals to and from the rest of the body.[1] Spinal cord injury (SCI) often results in weakened or paralyzed respiratory muscles, decreased vital capacity (VC), increased respiratory secretions, and an ineffective cough. This can cause respiratory dysfunction and lead to complications such as dyspnea, respiratory failure, pulmonary thromboembolism, pulmonary edema, bronchitis, atelectasis, pneumonia, sleep disturbance, and dysphonia. While respiratory complications are most common during the first year after the injury, patients may continue to experience them for the rest of their lives. In tetraplegic patients with spinal cord injuries, pneumonia significantly increases mortality, especially when compared to the general population. Although the risk of death decreases after the first year, respiratory dysfunction remains the leading cause of morbidity and mortality in patients with SCI. [2] Normal breathing requires coordination between the control of the respiratory muscles and the autonomic control of the bronchopulmonary tree. When the inspiratory muscles are impaired, it becomes difficult to breathe deeply, which can lead to atelectasis, gas exchange abnormalities, and lung compliance issues. On the other hand, dysfunction of the expiratory muscles can cause difficulty in coughing and secretion, increased airway resistance, and the persistence of infections. When there is a loss of sympathetic autonomic signaling to the bronchopulmonary tree, it can lead to changes in mucus production and airway tone. The extent and completeness of the spinal cord injury (SCI) determine the severity of respiratory dysfunction. Injury-associated respiratory reduction can result in a decrease in forced expiratory reserve (FEV1), forced vital capacity (FVC), inspiratory capacity, total lung capacity (TLC), and an increase in residual capacity (RV). Patients with a complete cervical spine injury may not be able to maintain spontaneous breathing. People with minor or incomplete injuries usually show impaired restraint and reduced coughing.[2,3]

People with spinal cord injuries may experience breathing difficulties and the lung issues mentioned above for a variety of reasons, including difficulties with productive cough and clearance of secretions; excessive mucus production; spontaneous contraction of the abdominal muscles; restricted positions; and mobility limitations.[3]

Research has shown that individuals with spinal cord injuries typically have lower levels of health-related and overall QOL compared to those without such injuries.[4]

Pranayama is a precise science and the fourth limb of Ashtanga yoga. "Tasmin Sati Svasa Prasvasayorgativicchedah Pranayamah" means the regulation of breath or control of Prana. It involves stopping inhalation and exhalation after achieving a steady posture or seat, also known as asana.[5]

The term Pranayama is derived from the Sanskrit words 'Pran' meaning life force and 'Ayama' meaning extension or elongation. [6]. Pranayama is a breathing technique that can aid in improving your mental health. It's a method that frees your mind of negative thoughts and helps to alleviate stress. By practicing pranayama, you can prepare your mind for meditation, which can help you gain control over your thoughts. This will lead to a greater sense of inner peace and can also promote a restful sleep. Many people confuse the practice of pranayama with deep breathing. However, there is a significant difference between the two. When we breathe deeply, the movement of the breath is fast and forceful. This means that there is not enough time for the cells to absorb the inhaled oxygen. On the other hand, in pranayama, the breathing movements are very slow, allowing enough time for every alveolus (tiny air sacs in the lungs) to absorb oxygen properly.

NEED FOR THE STUDY:

About 75% of the Patients with Spinal Cord Injury suffer from Respiratory Dysfunction. Spinal cord injury is usually accompanied by weakness or paralysis of respiratory muscles, decreased Vital Capacity (VC), increased respiratory secretions, an ineffective cough, and decreased lung and chest wall compliance, which cause respiratory dysfunction. Not only does pranayama have the potential to steady the mind, but the practice has far-reaching physiological benefits such as increased heart rate variability, improved oxygen saturation, and overall re-balancing of the nervous system. Respiratory rate, rhythm of respiration, Lung volume and capacities, breath breath-holding time are significantly and positively influenced by the practice of pranayama. Very few studies have reported the effects of Pranayama on respiratory dysfunction in Neurological disorders like Guillain-Barre syndrome, Multiple Sclerosis, etc. To improve Respiratory Functions in SCI many studies have been done but there is less evidence on the use of Pranayama to improve Respiratory functions in SCI. Therefore, this study attempts to find out the effects of Pranayama on improving Respiratory Functions and Quality of Life and also to ensure that Pranayama can be used as an Add-on therapy to Conventional Physiotherapy in SCI.

RESEARCH METHODOLOGY:

Study design and Study setting: A Pre and post Experimental study was conducted in the Spinal Cord Injury Rehabilitation Centre, Dr. APJ Abdul Kalam College of Physiotherapy, Loni.

Sample size and method: A total of 15 participants were selected by Conventional Sampling method.

Participants: Patients with Incomplete Spinal Cord Injury between the age group of 18 to 60 years.

Study Duration: 1 year.

SELECTION CRITERIA:

The Inclusion Criteria of the study included participants of Age between 18 to 60 years, Both Male and Female patients, Patients with Incomplete Spinal Cord Injury. (ASIA- B, C, D), Patients with Cervical, Thoracic, and Lumbar levels of Spinal Cord Injury, subacute and chronic stage of Spinal Cord Injury and willing to participate.

The Exclusion Criteria of the study included Patients with complete Spinal Cord Injury. (ASIA- A), Patients with any orthopedic impairment, hemodynamically unstable, acute injury, Patients who require a ventilator or oxygen therapy and Patients with any underlying Cardiac or Respiratory condition.

PROCEDURE:

A protocol was prepared, and ethical approval was obtained from the institutional ethical committee. 15 participants were included according to the inclusion criteria. All the subjects were explained about the study, and a written informed consent form was signed by each one of them. A pre-assessment was taken, which included a pulmonary function test (PFT) and a chest expansion test. A four-week intervention protocol was planned. This included pranayama exercises. This was given with the conventional neuro-physiotherapy treatment. Participants were trained in a wheelchair sitting. A post-assessment was taken after four weeks. For assessing quality of life (QoL), the spinal cord independence measure (SCIM) scale was used. Post-data on all outcome measures was collected after four weeks of duration, and analysis was done.

INTERVENTION:

After the approval was obtained by the Ethical Committee, Pre-assessment of all the participants was taken and then a four-week treatment plan was planned. All the participants were trained in a single group. The participants were trained in a well-ventilated

room and by sitting in a wheelchair. The pranayama primarily focused on 1) Improving Respiratory functions, 2) Improving Lung and Chest Compliance, and 3) Quality of Life.

Pranayama intervention included:

Udgeetha Pranayama ('OM' Chanting): Udgeetha Pranayama involves deep and rhythmic breathing while chanting 'OM' during an exhale. This practice enhances lung capacity and respiratory health.

Bhramari Pranayama (Humming Bee Sound): Bhramari Pranayama involves creating a humming sound while exhaling. It promotes deep breathing, expands lung capacity, and enhances respiratory efficiency.

Sheetali Pranayama (Cooling Breaths): Sheetali Pranayama is a breathing technique that involves curling the tongue lengthwise to form a tube-like shape. The tip of the curled tongue is then extended out of the lips to produce a hissing sound while inhaling. Exhale completely with both nostrils. This technique helps to enhance lung capacity, improves the efficiency of breathing, and may lead to better oxygen exchange in the lungs.

Nadi Shuddhi Pranayama (Anulom-Vilom/Alternate Nostril Breathing): Nadi Shuddhi Pranayama is a breathing technique in which three cycles of exhalation through the left nostril are followed by three cycles of exhalation through the right nostril and inhalation through the left, both should be of equal duration. Deliberate and controlled breathing improves lung capacity and respiratory efficiency.

Bhastrika Pranayama (Rapid Ventilation Breathing): Bhastrika Pranayama is a breathing technique in which abdominal muscles lie below. Here, both inhalation and exhalation are vigorous and forceful. This forceful inhalation and exhalation stimulate the respiratory muscles and enhance lung capacity.

Dirgha Pranayama (Deep and Slow Breathing): Dirgha Pranayama also known as Three-part breath or complete breath, is a foundational yogic breathing technique that involves deep and conscious breathing, focusing on 3 parts of the respiratory system: a) the lower abdomen (diaphragmatic or belly breathing), b) the chest (thoracic breathing), c) the upper chest or collar bone area (clavicular breathing). This holistic approach to breathing helps maximize lung capacity and encourages a more relaxed and efficient breath.

These Pranayama techniques were given for four weeks (7 Days per week) and after that post-assessment was taken to determine the changes after practicing pranayama on Respiratory Functions and Lung and Chest wall compliance.

PROTOCOL: Before starting with the intervention, a Pre-assessment was taken of all the participants included. After that, a four-week treatment plan was planned. It was given as 1 set per day (with regular conventional physiotherapy) for 7 days per week. A 2-3 min break was given after each pranayama exercise. This was continued for four weeks and after that post-assessment was taken.

OUTCOME MEASURES:

1) Pulmonary Function Test.
2) Chest Expansion Test.
3) Spinal Cord Independence Measure (SCIM).

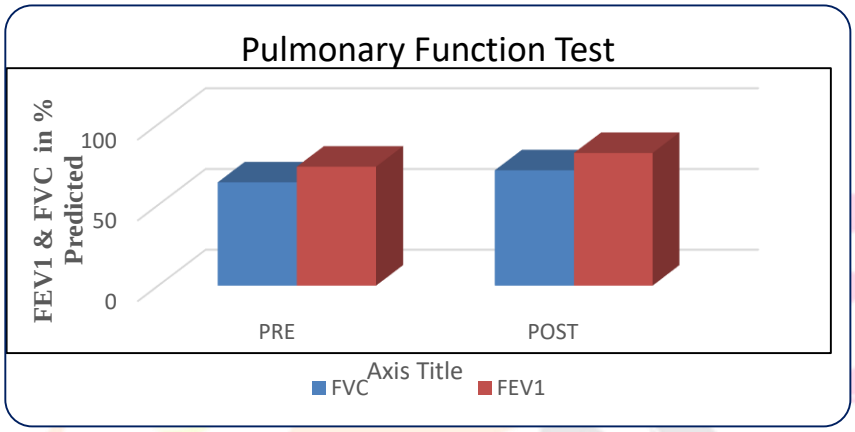
RESULTS:

Results were analyzed based on data obtained pre- and post-intervention using the Graph Pad Instat application. Descriptive statistics for all outcome measures were expressed as mean, standard deviations, and tests of significance such as paired t-tests. The study was conducted in Spinal cord injury patients with an age Mean±SD value of 36.4 ± 14.40 years which were selected from the Smt. Sindhutai Eknathrao Vikhe Patil Spinal Cord Injury Rehabilitation Center, PIMS-DU, Loni BK based on inclusion and exclusion criteria. There were a total of 15 participants out of which 13 were males and 2 were females. Out of the total sample, the number of patients with a cervical level of injury was 3, thoracic level injury was 7, and lumbar level was 5.

1. Pulmonary Function Test (PFT):

Pulmonary Functions	Pre-Intervention Mean±SD	Post-Intervention Mean±SD	T value	P value (p<0.001)
FVC	63.93±18.83	71.4±17.17	4.382	0.0006 Significant
FEV1	73.66±20.56	82.13±18.45	8.166	0.0001 Significant

Table no: 1



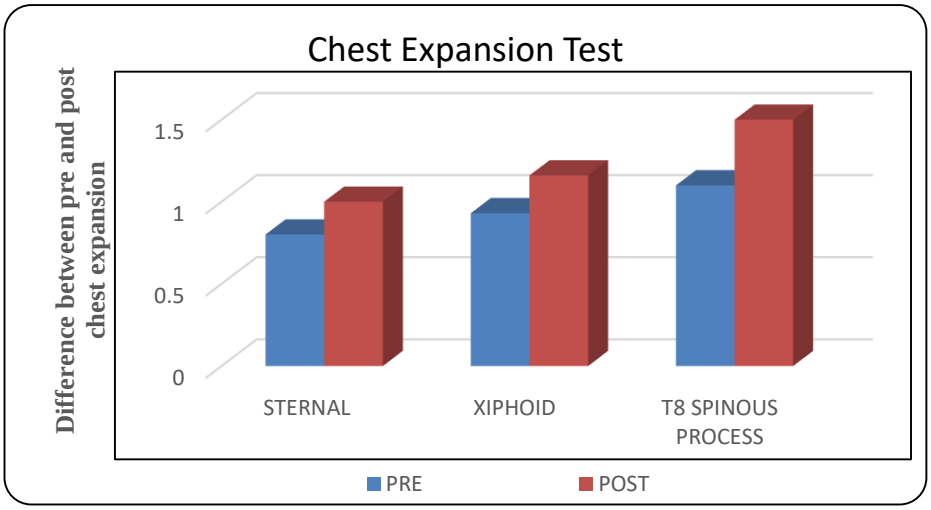
Graph no: 1

The pre-intervention (Mean ± SD) value of FVC is 63.93 ± 18.83 post-intervention (Mean ± SD) value of FVC is 71.4 ± 17.17. The pre-intervention (Mean ± SD) value of FEV1 is 73.66 ± 20.05 post-intervention (Mean ± SD) value of FEV1 is 82.13 ± 18.45. Pre-intervention PFT and post-intervention PFT were compared and analyzed with a Paired t-test. The mean difference of Pre and Post FVC was -7.467 with a t-value of 4.382 and p-value of 0.0006 i.e. ($p<0.001$) which shows an extremely significant difference in pre- and post-intervention FVC. The mean difference of Pre and Post FEV1 was -8.467 with a t-value of 8.166 and p-value of 0.0001 i.e.($p<0.001$) which shows an extremely significant difference in pre- and post-intervention FEV1.

2) Chest Expansion Test:

Table no: 2

CHEST EXPANSION	Pre-Intervention Mean±SD	Post-Intervention Mean±SD	T value	P value
Sternal	0.8 ± 0.2535	1 ± 0.1890	2.449	0.0281 Significant
Xiphoid	0.93 ± 0.3200	1.166 ± 0.3086	3.50	0.0035 Significant
T8 Spinous process	1.1 ± 0.4309	1.5 ± 0.4226	7.483	0.0001 Significant



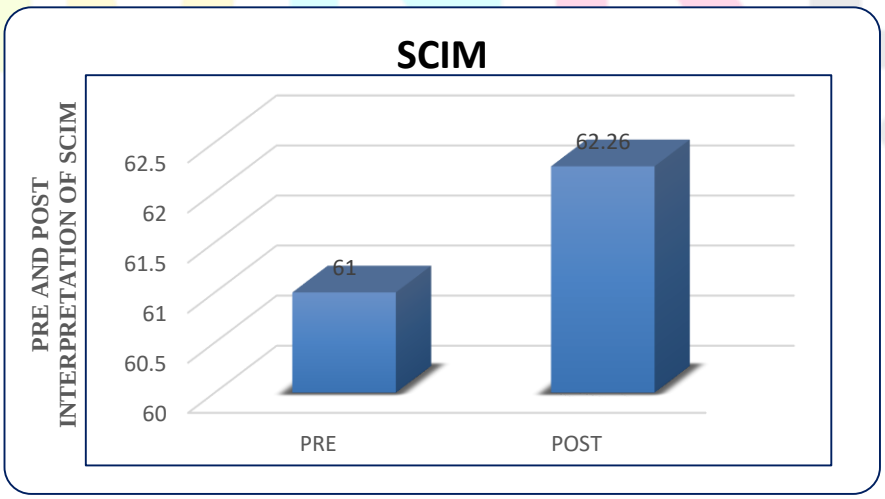
Graph no: 2

Pre- and post-intervention Chest Expansion Tests were compared and analyzed with a Paired t-test.
The pre-intervention (Mean ± SD) value of the Chest Expansion Test at the Sternal level is 0.8 ± 0.2535 and the post-intervention (Mean ± SD) is 1 ± 0.1890. The mean difference of the Pre- and Post-Chest Expansion Test at the Sternal level was -0.2000 with a t-value of 2.449 and a p-value of 0.0281 ($p<0.001$) which shows a significant difference in pre-and post-intervention.
The pre-Intervention (Mean ± SD) value of the Chest Expansion Test at the Xiphoid level is 0.93 ± 0.3200 and post-Intervention (Mean ± SD) is 1.166 ± 0.3086. The mean difference of the pre-and Post Chest Expansion Test at the Xiphoid level was -0.2333 with a t-value of 3.50 and p-value of 0.0035 ($p<0.001$) which shows a significant difference in pre-and post-intervention.
The pre-intervention (Mean ± SD) value of the Chest Expansion Test at the T8 spinous process level is 1.1 ± 0.4309 and the post-intervention (Mean ± SD) is 1.5 ± 0.4226. The mean difference of the pre-and Post Chest Expansion Test at the T8 spinous process level was -0.4000 with a t-value of 7.483 and p-value of 0.0001

3) Spinal Cord Independence Measure (SCIM):

SCIM	Pre-Intervention Mean±SD	Post-Intervention Mean±SD	T value	P value (p<0.001)
SCORE	61 ± 24.495	62.26 ± 25.198	3.537	0.0033 Significant

Table no: 3



Graph no: 3

The pre-Intervention (Mean ± SD) value of SCIM is 61 ± 24.495 and post-Intervention (Mean ± SD) is 62.26 ± 25.198.
Pre- and post-intervention SCIM was compared and analyzed with a Paired t-test.
The mean difference between Pre and Post SCIM was -1.267 with a t-value of 3.537 and p-value of 0.0033 ($p<0.001$) which shows a significant difference in pre- and post-intervention.

DISCUSSION:

This study is an attempt to examine the effects of pranayama on respiratory functions and quality of life in 15 patients with incomplete spinal cord injury with a mean age of 36.4 ± 14.40. This study was conducted in Smt. Sindhutai Eknathrao Vikhe Patil, SCI Rehabilitation Centre, Dr. APJ AK College of Physiotherapy, Pravara Institute of Medical Sciences, Loni.
The pre- and post-intervention data was collected and analyzed and results were obtained.
No specific study has been done in the Spinal Cord Injury population to find out the effect of pranayama on Respiratory function and quality of life. Therefore, this study can be considered to be novel.
In this study, we described the effectiveness of Pranayama on pulmonary functions, chest mobility, and quality of life in patients with incomplete spinal cord injury.
We found that pre-intervention Mean±SD FVC was 63.93 ± 18.83 and after 4 weeks of intervention (post-intervention) FVC was 71.4 ± 17.17 with a t-value of 4.382 and p-value of 0.0006. Also, pre-intervention Mean±SD FEV1 was 73.66 ± 20.05 and after 4 weeks of intervention, FEV1 was 82.13 ± 18.45 with a t-value of 8.166 and p-value of 0.0001.
This indicates there is significant improvement in pulmonary functions i.e. FVC and FEV1 following 4 weeks of pranayama program.
Also, we found that the Mean±SD of pre-intervention chest expansion at sternal level 0.8 ± 0.2535 and after 4 weeks is 1 ± 0.1890 with a t-value of 2.449 and p-value of 0.0281. Mean±SD of pre-intervention chest expansion at xiphoid level 0.93 ± 0.3200 and after 4 weeks is 1.166 ± 0.3086 with a t-value of 3.50 and p-value of 0.0035. The Mean±SD of pre-intervention chest expansion at T8 spinous process level is 1.1 ± 0.4309 and after 4 weeks is 1.5 ± 0.4226 with a t-value of 7.483 and p-value 0.0001. This shows significant improvement in chest wall compliance.
Mean±SD of pre-intervention values of SCIM is 61 ± 24.495 and after 4 weeks is 62.26 ± 25.198 with a t-value of 3.537 and p-value 0.0033. This shows significant improvement in Quality of life.
Study shows that 4 weeks of Pranayama has improved Respiratory functions, chest mobility, and quality of life in Spinal Cord Injury patients.

Respiratory dysfunction is a well-known cause of morbidity and mortality in individuals with spinal cord injury (SCI). It impairs respiratory muscles, reduces vital capacity, weakens the ability to cough effectively, lowers lung and chest wall compliance, and increases the oxygen cost of breathing due to the distortion of the respiratory system. This leads to an increase in the work of breathing, which can cause respiratory muscle fatigue. Chest wall, lung, and abdominal compliance changes in paraplegia and tetraplegia can contribute to respiratory muscle fatigue.[7]

Pranayama is a breathing technique that utilizes abdominal and diaphragmatic muscles to improve respiration. It strengthens the respiratory system and facilitates muscle extensions. Pranayama can also be helpful for people with breathing difficulties due to a lack of lung capacity or minor surgical interventions. It has a relaxing effect on the body, which can regulate normal breathing and heart functioning. Additionally, it increases the exchange volume of the lungs, allowing for the inflow of fresh air and the outflow of carbon dioxide. This enhanced flow of air into the lungs helps improve overall pulmonary functions. [8]

Pranayama is a technique that can improve your respiratory system. It works by increasing the elasticity and strength of collagen fibers, which helps with the contraction and power of your breathing. It can also stimulate the secretion of pulmonary surfactant, which increases the exchange volume of your lungs. Maintaining the level of prostaglandins can reduce bronchiolar smooth muscle tonicity, leading to an enhanced flow of air into your lungs. It is believed that Pranayama can also stimulate stretch receptors, which affect smooth muscles and improve lung capacity. By relaxing your skeletal muscles and the thoracic cage, as well as the smooth muscles of the bronchi, Pranayama can help boost your pulmonary functions. Furthermore, extended expiratory periods and voluntary breath-holding periods can improve lung capacity when these Pranayama techniques are performed regularly. [8]

Pranayama strengthens respiratory muscles, enhances the level of surfactant, stimulates stretch receptors, and relieves tension, thus enhancing lung volumes and capacities. It reduces physiological dead space ventilation and reduces the work of breathing. [8] The mechanisms of action of pranayama on pulmonary functions involve a combination of physiological, neurological, and psychological factors. Here are some key aspects:

Pranayama is a breathing technique that emphasizes conscious control of breathing, including diaphragmatic breathing. This technique strengthens the diaphragm, which is the primary muscle involved in respiration. This leads to improved control and efficiency in breathing. Pranayama techniques facilitate controlled breathing through the deliberate contraction of the diaphragm, establishing a link between the conscious and unconscious minds. When the diaphragm contracts, the chest expands, which lowers the thoracic inspiratory pressure and allows air to enter the lungs through the trachea. Deep and controlled breathing techniques used in pranayama can help enhance lung capacity. This, in turn, leads to more effective inhalation and exhalation, facilitating optimal oxygen exchange in the lungs. A study conducted by **Prem Balaguru et al.** aimed to determine the effect of pranayama training on the vital capacity, respiratory pressures, and respiratory endurance of young, healthy volunteers. The study has provided valuable insights into the patterns of change and improvement observed in yoga-practicing subjects. The study found that respiratory efficiency, including dynamic lung functions (FVC, FEV1) and static respiratory muscle strength (PImax, PEmax, and 40 mm Hg endurance), can be improved by a 12-week practice of pranayama.[9] **Ambareesha Kondam, et.al** conducted a study to assess the impact of practicing pranayama on respiratory health. The study focused on measuring the effect of vital capacity (VC), forced vital

capacity (FVC), and peak expiratory flow rate (PEFR) in subjects who practiced pranayama regularly. The findings of the study indicate that consistent yoga practice for six weeks improved respiratory function, decreased sympathetic activity, and increased parasympathetic tone. The improvement in pulmonary function was due to better ventilation throughout the lungs during slow and deep breathing. This suggests that pranayama can be beneficial for healthy individuals as well as those with respiratory diseases. It can be used as an adjunctive therapy in the management of respiratory disorders. [10]

Pranayama is a breathing technique that involves various respiratory muscles, such as intercostal muscles and accessory muscles of respiration. Regular practice of this technique can enhance the strength and endurance of these muscles, thereby promoting the overall function of the respiratory system. A study conducted by **Sabina Kupershmidt et al.** revealed that performing a basic set of three pranayama breathing exercises for only 6 weeks (three 10-minute sessions per week) improved lung function (PEF and FEV1) significantly.[11] In a study conducted by **F. Magia, A. Bhise, et al.,** the effects of pranayama, or yoga breathing, on lung function measures were examined in patients who had suffered thoracic spinal cord injuries while in the hospital which showed that including pranayama in the rehabilitation of spinal cord injury patients can improve lung function measures and reduce the need for external lung support devices in patients with traumatic thoracic spinal cord injuries. [12]

Pranayama, a breathing technique, can improve the lungs' ability to expand and contract easily. This leads to smoother and more efficient respiratory movements. A study conducted by **Ankad Roopa B. et al. (2011)** evaluated the effects of pranayama and meditation on respiratory parameters in healthy individuals. The study found that regular practice of pranayama and meditation resulted in a significant increase in chest expansion, breath-holding time, and PEFR (peak expiratory flow rate) after yoga practice. [13] In a study conducted by **Akhila Nai et al**, six-week yoga and pranayama protocols were provided to chefs who were exposed to cooking fumes.The study found that the practice of yoga and pranayama had a significant positive effect on the chest expansion and breath-holding time of the chefs. [14]

Certain pranayama practices involve slowing down the breathing rate. This not only helps conserve energy but also allows for more profound and mindful breaths, which positively impact pulmonary functions. A study conducted by **P. Waghmare et al**. on the effect of pranayama on cardio-respiratory efficiency found that the practice of pranayama significantly decreased the respiratory rate while significantly increasing FVC, FEV1, PEFR, and MVV in subjects. [15] Pranayama includes a meditative and mindfulness component. In the research done by **Heera Jayasheela** (2018) on the impact of Pranayama on the quality of life of chronic obstructive pulmonary disease patients admitted to Pravara Rural Hospital, Loni (Bk), Thirty COPD patients in the age group of 30 years and older were studied. The study findings have shown improvement in lung function parameters and have an overall positive effect on the quality of life of COPD patients. Pranayama (yogic breathing) has an overall positive effect on patients with COPD. [16] The study conducted by **S. K. Katiyar et al**. (2006) aimed to determine the role of Pranayama in the rehabilitation of COPD patients. There was a small but insignificant increase in FVC and FEV1 in the study group. They conclude that pranayama (yogic breathing) has an overall positive effect on patients with moderate-to-severe COPD. [17] In the study conducted by **Shankarappa V. et al.,** the PFT values were recorded in young, healthy subjects before and after 6 weeks of pranayama. The study concluded that pulmonary function parameters (FVC, FEV1, PEFR, FEF25-75%, and breath holding time (BHT)) were significantly increased. An evaluation of a non-controlled study with 50 adult subjects was undertaken to study the effect of 6 weeks of pranayama on the lung parameters in this study. [18]

To determine the additional benefits of pranayama and meditation in the rehabilitation of patients with Guillain-Barré syndrome (GBS), **Ragupathy Sendhilkumar et al**. undertook a study. In GBS patients, the quality of their sleep significantly improved with yogic relaxation, pranayama, and meditation. Anxiety, despair, and pain levels decreased in both groups (conventional and control), although there was no statistically significant difference between them. Similar improvements in general functional status were seen in both groups, with no discernible differences between them. [19]

Mooventhan A. et al. conducted a study to assess the impact of Bhramari pranayama and OM chanting on the pulmonary function of healthy individuals. The study found significant improvement in slow vital capacity (SVC), and forced expired volume in 1 s (FEV1), along with PEF, FEF25%, and MVV. As a result, the study concluded that Bhramari pranayama and OM chanting are effective in enhancing pulmonary function in healthy individuals.[20]

Rana Bal Budhi et al. (2019) conducted a study to observe the impact of bhastrika pranayama (bellows breath) and exercise on the lung function of healthy individuals. The study concluded that practicing bhastrika pranayama can help recruit normally unventilated lung spaces, strengthen respiratory muscles, and increase the elastic properties of the lungs and chest, which in turn improves ventilatory functions. The results show that after 1 month of practicing bhastrika pranayama, FVC, FEV1, PEFR, and MVV increased significantly compared to physical exercise.[21] **Baljinder Singh Bal** conducted a study to investigate the impact of Anulom Vilom and Bhastrika Pranayama on vital capacity and maximal ventilatory volume. The study concluded that the pranayama training program had a significant positive effect on both vital capacity and maximal ventilatory volume. Specifically, the Bhastrika Pranayama and Anulom Vilom Pranayama showed significant improvement in both vital capacity and maximal ventilatory volume.[22]

CONCLUSION:

According to this study, 4 weeks of the Pranayama program improved the respiratory functions and quality of life in patients with incomplete spinal cord injuries.

Consequently, Pranayama can be considered as an additional treatment option to the routine physiotherapy protocol for spinal cord injury patients.

LIMITATIONS AND STRENGTH:

Limitation:

1. There was a small sample size.
2. The study duration was shorter.
3. No follow-up with the subjects was done to determine whether the effects were still present.
4. Only incomplete SCI patients were included in the study.

Strength: The findings of this study show that Pranayama is an effective and practical tool in clinical practice that helps in improving Respiratory Functions, Chest wall compliance, and quality of life in patients with spinal cord injury.

FUNDING: None.

CONFLICT OF INTEREST: Author has no conflict of interest.

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