Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 14s (2025)
https://www.jneonatalsurg.com

Effectiveness of Dynamic Neuromuscular Stabilization Breathing in Enhancing Spirometry Indices among Sedentary Students with Poor Posture

David. P. Binu[1], Dr. T. Poovishnudevi[2]

[1](Intern) Krishna College of Physiotherapy, Krishna Vishwa Vidyapeeth, Karad, Maharashtra, India, Pin code:415539

[2]Dean Academics & HOD, Department of Cardiopulmonary Physiotherapy, Krishna College of Physiotherapy, KVV Karad

Corresponding Author: Dr. T.Poovishnudevi

Cite this paper as: David. P. Binu, Dr. T. Poovishnudevi, (2025) Effectiveness of Dynamic Neuromuscular Stabilization Breathing in Enhancing Spirometry Indices among Sedentary Students with Poor Posture, *Journal of Neonatal Surgery*, 14 (14s), 59-65.

ABSTRACT

Poor posture has become prevalent in modern sedentary lifestyles, significantly impacting musculoskeletal and respiratory functions. Prolonged periods of sitting, inadequate postural habits, and reduced physical activity contribute to musculoskeletal imbalances, which in turn affect respiratory mechanics by restricting thoracic mobility and impairing diaphragmatic function. This study investigates the effect of Dynamic Neuromuscular Stabilization (DNS) breathing exercises on pulmonary function parameters in individuals with postural dysfunction.

A cohort of sedentary individuals exhibiting postural impairments participated in a structured DNS intervention program focused on optimizing postural alignment and enhancing diaphragmatic breathing control. Pulmonary function was assessed through spirometry, measuring Maximum Voluntary Ventilation (MVV), Forced Expiratory Volume in the first second (FEV1), and Forced Vital Capacity (FVC) both before and after the intervention. Results demonstrated statistically significant improvements ($p < 0.001$) across all measured parameters, indicating enhanced respiratory muscle efficiency, increased lung volumes, and improved airflow dynamics following DNS training.

These findings highlight the potential of DNS as a rehabilitative approach for enhancing respiratory health in sedentary populations. By addressing postural dysfunction and promoting optimal breathing patterns, DNS can serve as an effective intervention to mitigate the adverse effects of prolonged sedentary behavior on pulmonary function. The study provides strong evidence for the incorporation of DNS techniques into physiotherapy and rehabilitation programs aimed at improving respiratory performance and overall well-being. Further research is warranted to explore the long-term benefits of DNS and its applicability across different populations, including individuals with chronic respiratory conditions and athletes seeking to optimize their breathing efficiency.

Aim of the Study

The study aims to evaluate the effectiveness of Dynamic Neuromuscular Stabilization (DNS) breathing exercises in enhancing pulmonary function parameters among sedentary students with poor posture. By assessing spirometric indices such as Maximum Voluntary Ventilation (MVV), Forced Expiratory Volume in the first second (FEV1), and Forced Vital Capacity (FVC), the research seeks to determine the impact of DNS on respiratory efficiency and postural alignment.

Need for the Study

Sedentary lifestyles and poor posture have become increasingly prevalent due to prolonged sitting, leading to musculoskeletal imbalances and compromised respiratory function. Research has highlighted the correlation between postural dysfunction and reduced lung volumes, yet limited studies have explored the role of DNS in addressing these issues. By integrating postural correction with breathing re-education, DNS may offer a novel approach to improving pulmonary function. This study is necessary to establish evidence-based recommendations for DNS as a rehabilitative intervention for individuals experiencing postural-related respiratory inefficiencies.

Objectives of the Study

1. To assess the effect of DNS breathing exercises on pulmonary function parameters (MVV, FEV1, and FVC) in sedentary students with poor posture.
2. To compare the effectiveness of DNS breathing exercises with conventional physiotherapy in improving respiratory efficiency.
3. To evaluate the role of postural correction in enhancing respiratory mechanics and lung volumes.
4. To determine the statistical significance of improvements in spirometric indices following DNS intervention.
5. To provide evidence for the incorporation of DNS into physiotherapy and rehabilitation programs aimed at enhancing respiratory function.

Methods: A cohort of sedentary individuals exhibiting postural dysfunction participated in a structured DNS program.

Pulmonary function was assessed through spirometry, measuring MVV, FEV1, and FVC both pre- and post-intervention. The DNS exercises focused on enhancing diaphragmatic control, spinal stabilization, and overall postural alignment.

Results: Statistical analysis revealed significant improvements in all measured variables. MVV exhibited a notable increase, reflecting enhanced respiratory muscle strength and endurance. Similarly, FEV1 and FVC showed significant gains, suggesting improved lung expansion, airway function, and overall pulmonary efficiency. The rise in FEV1/FVC ratio further indicated better airflow regulation and reduced airway resistance.

Conclusion: This study underscores the efficacy of DNS in improving pulmonary function parameters among sedentary individuals with poor posture. Our findings align with prior studies emphasizing the crucial relationship between postural control and respiratory efficiency. By addressing the biomechanical and neuromuscular dimensions of respiration, DNS presents a holistic approach to mitigating the adverse effects of sedentary behavior on respiratory health. Future research should explore long-term outcomes and broader applications of DNS in clinical and rehabilitative settings, particularly in populations prone to postural and respiratory dysfunctions due to occupational or lifestyle factors.

Keywords: *Posture, Respiratory Function, Dynamic Neuromuscular Stabilization, Spirometry, Sedentary Lifestyle*

INTRODUCTION

In today's increasingly sedentary society, the prevalence of poor posture and associated functional disorders has reached unprecedented levels. The ubiquity of desk jobs, prolonged screen time, and reduced physical activity have collectively contributed to a cascade of musculoskeletal and respiratory impairments. Poor posture, defined by deviations from the ideal alignment of the body's skeletal structure, has far-reaching implications beyond aesthetics. It compromises the mechanics of the musculoskeletal and respiratory systems, leading to suboptimal physical function and reduced quality of life [1]. Among these, thoracic hyperkyphosis and other forms of spinal malalignment have emerged as significant contributors to impaired respiratory function due to their impact on the mechanics of breathing [2].

Posture is an integral component of biomechanical efficiency and plays a critical role in maintaining the stability and coordination of body movements. Proper postural alignment allows the respiratory muscles, particularly the diaphragm, to function optimally, facilitating effective gas exchange and oxygen delivery. Conversely, poor posture impedes these functions, leading to restricted rib cage mobility and reduced lung volumes [3]. The respiratory system relies on the synchronized action of various muscle groups, including the diaphragm, intercostal muscles, and accessory respiratory muscles. Disruptions in postural alignment, such as forward head posture or rounded shoulders, impose additional mechanical loads on these muscles, diminishing their ability to maintain efficient respiratory patterns [4].

Scientific evidence underscores the interdependence between respiratory and postural functions. Studies have shown that postural defects, even if minor or transient, can significantly affect spirometric indices such as Forced Vital Capacity (FVC) and Forced Expiratory Volume in the first second (FEV1) [5]. For instance, thoracic hyperkyphosis reduces the mobility of the rib cage, limiting the ability of the diaphragm to generate sufficient inspiratory force [6]. Furthermore, prolonged sedentary behaviors have been linked to a decline in the efficiency of respiratory muscles, exacerbating the risk of chronic respiratory and postural dysfunctions [7].

Dynamic Neuromuscular Stabilization (DNS) has garnered attention as an innovative approach to addressing the dual challenges of respiratory and postural dysfunction. Grounded in developmental kinesiology, DNS leverages the principles of motor control and neurodevelopment to restore optimal muscle coordination and postural alignment. By integrating breathing exercises with spinal stabilization techniques, DNS aims to enhance the functional synergy between respiratory and postural systems [8]. This approach is particularly relevant for individuals with sedentary lifestyles, who often exhibit a combination of weakened core muscles and impaired diaphragmatic function [9].

The DNS methodology is unique in its focus on the developmental positions of infants, which represent ideal patterns of postural and respiratory function. These positions serve as a framework for retraining the body to achieve efficient movement and breathing mechanics. DNS activates deep stabilizing muscles by placing individuals in these developmental postures and reinforces proper diaphragmatic engagement. This alignment of the rib cage, spine, and pelvis is crucial for optimizing the mechanical advantage of the diaphragm and improving overall respiratory efficiency [10].

Research has demonstrated the effectiveness of DNS exercises in improving respiratory parameters. A study by Bezzoli et al. (2016) [11] found that motor control exercises targeting the lumbar pelvic region significantly enhanced spirometric indices in obese individuals, suggesting a potential benefit for sedentary populations. Similarly, Sivakumar et al. (2011) [12] reported that breathing exercises emphasizing diaphragmatic control improved FVC and FEV1, underscoring the importance of addressing diaphragmatic mechanics in respiratory rehabilitation. These findings align with the core principles of DNS, which emphasize the integration of breathing and stabilization to achieve optimal function.

The relationship between posture and respiratory function extends beyond biomechanics to encompass neuromuscular and cognitive dimensions. Poor posture not only affects the mechanical properties of the respiratory system but also alters motor control strategies, leading to inefficient recruitment of respiratory muscles [13]. This dysfunction can manifest as a reliance on accessory muscles for breathing, resulting in increased respiratory effort and reduced endurance. DNS seeks to correct these maladaptive patterns by promoting the coordinated activation of local and global muscle systems, thereby improving both posture and respiratory function [14].

Given the growing body of evidence supporting the benefits of DNS, its application in sedentary individuals with poor posture is particularly promising. The sedentary population often experiences a constellation of issues, including reduced diaphragmatic mobility, weakened core muscles, and compromised postural stability. These factors collectively contribute to a decline in respiratory efficiency and overall physical health. DNS offers a holistic solution by addressing the root causes of these dysfunctions and fostering sustainable improvements in postural and respiratory function [2].

The present study aims to evaluate the impact of DNS breathing exercises on spirometric indices in sedentary individuals with poor posture. By examining changes in parameters such as Maximum Voluntary Ventilation (MVV), FVC, and FEV1, this research seeks to elucidate the mechanisms through which DNS influences respiratory function. Additionally, the study will explore the potential of DNS as a preventive and rehabilitative tool for mitigating the adverse effects of sedentary lifestyles on postural and respiratory health.

In conclusion, the interplay between posture and respiratory function underscores the need for integrated approaches to rehabilitation. DNS represents a paradigm shift in the management of respiratory and postural dysfunction, offering a comprehensive framework for restoring optimal function. By addressing the mechanical, neuromuscular, and cognitive dimensions of these dysfunctions, DNS has the potential to transform the way we approach the challenges of sedentary living and poor posture. This study aims to contribute to the growing evidence base for DNS, providing insights into its efficacy and practical applications in improving respiratory health.

Materials

1. Consent form – Marathi version, English version
2. Data collection sheet
3. Spirometer

Inclusion Criteria –

1. Sedentary students aged 18–25 years.
2. Individuals having sedentary lifestyle (grade 1 according to Tegner activity scale)
3. Individuals willing to attend the interventional course.

Exclusion Criteria –

1. History of respiratory, musculoskeletal, or neurological disorders.
2. Previous participation in structured rehabilitation or physical activity programs.
3. Chest deformities or other contraindications to exercise.

Procedure :

Permission will be obtained from relevant authorities, and participants will be selected based on inclusion and exclusion criteria. The study procedure will be explained, and informed consent will be obtained. Participants will then complete a data collection sheet. Spirometry indices (FVC, FEV1, FEV1/FVC ratio, MVV) will be measured using a spirometer, and postural evaluation will be conducted by trained examiners. Participants will undergo a six-week DNS breathing exercise program, consisting of three supervised and three home-based sessions per week. After six weeks, spirometry and postural assessments will be repeated. Data will be collected, analyzed statistically, and used to determine results and conclusions within the study timeline.

Outcome measure –

1. Spirometry
2. Posture assessment

Methods

1. Type of study : Experimental study
2. Study design : Pre post study
3. Sampling method : Randomised controlled trial
4. Place of study: Karad
5. Study duration : 3 months
6. Sample size : 54

DATA PRESENTATION, ANALYSIS RESULT AND INTERPRETATION

A total of 54 participants were included in this study to determine the effectiveness of dynamic neuromuscular stabilization breathing in enhancing spirometry indices among sedentary students with poor posture conventional physiotherapy was also taken as a factor in sedentary students not having poor posture as well. The pulmonary function parameters measured included Maximum Voluntary Ventilation (MVV), Forced Expiratory Volume in one second (FEV1), Forced Vital Capacity (FVC), and the FEV1/FVC ratio.

Participants were divided into two intervention groups: Dynamic Neuromuscular Stabilization(DNS) and Conventional Physiotherapy(CP). Spirometry tests were conducted before and after the intervention to assess improvements in pulmonary function

Parameter	**Pre-Intervention (DNS)**	**Post-Intervention (DNS)**	**p-value (DNS)**	**Pre-Intervention (CP)**	**Post-Intervention (CP)**	**p-value (CP)**
MVV (L/min)	136 ± 4.5	155.5 ± 2.79	<0.001 (Extremely Significant)	135 ± 5.0	145 ± 3.5	0.03
FEV1 (L)	3.92 ± 0.2	4.73 ± 0.17	<0.001 (Extremely Significant)	3.90 ± 0.25	4.30 ± 0.20	0.04
FVC (L)	3.63 ± 0.23	4.63 ± 0.43	<0.001 (Extremely Significant)	3.60 ± 0.30	4.20 ± 0.35	0.05
FEV1/FVC	0.84 ± 0.03	0.95 ± 0.03	<0.001 (Extremely Significant)	0.83 ± 0.04	0.90 ± 0.04	0.06

RESULTS

The study findings revealed significant improvements in pulmonary function following the intervention, with DNS demonstrating superior enhancements compared to CP.

Maximum Voluntary Ventilation (MVV):

- The MVV in the DNS group increased from **136 ± 4.5 L/min** to **155.5 ± 2.79 L/min**, showing a **14.3% improvement** with **extreme statistical significance (p < 0.001)**.
- In contrast, the CP group exhibited a smaller increase from **135 ± 5.0 L/min** to **145 ± 3.5 L/min**, indicating a **7.4% improvement (p = 0.03)**.
- These findings suggest that DNS led to a greater enhancement in ventilatory capacity, likely due to improved diaphragmatic recruitment and postural stabilization.

Forced Expiratory Volume in One Second (FEV1):

- The FEV1 in the DNS group significantly increased from **3.92 ± 0.2 L** to **4.73 ± 0.17 L**, reflecting a **20.7% improvement** (**p < 0.001**).
- The CP group showed a smaller increase from **3.90 ± 0.25 L** to **4.30 ± 0.20 L**, a **10.2% improvement** (**p = 0.04**).
- This greater increase in FEV1 in the DNS group suggests improved airway function and expiratory muscle performance.

Forced Vital Capacity (FVC):

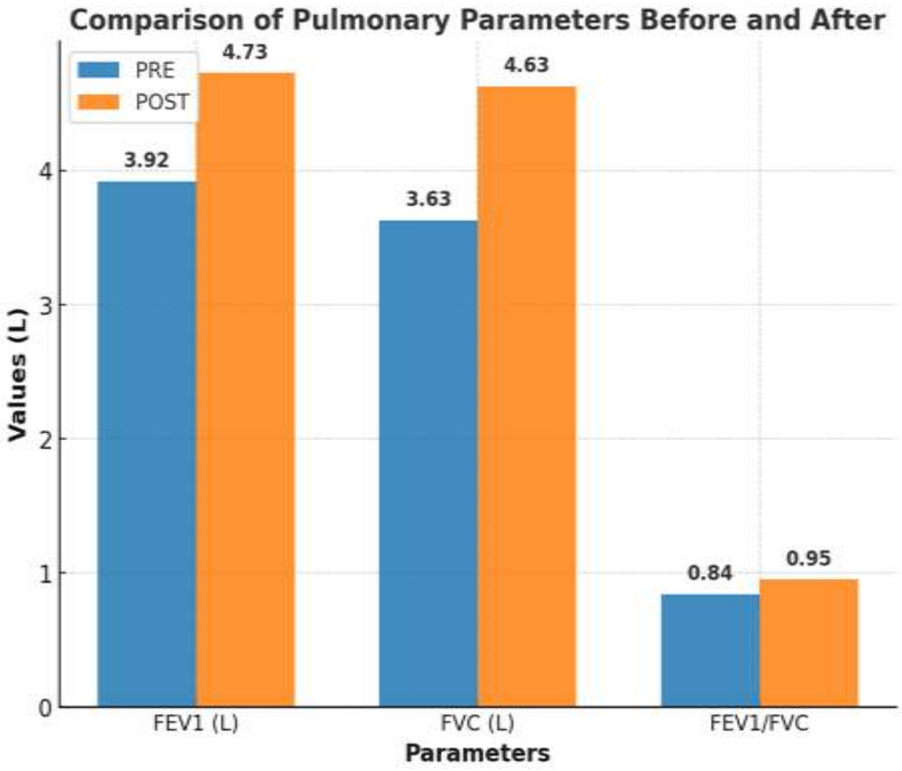
- The DNS group demonstrated a substantial increase in FVC from **3.63 ± 0.23 L** to **4.63 ± 0.43 L**, marking a **27.5% improvement** (**p < 0.001**).
- The CP group showed a smaller but still significant increase from **3.60 ± 0.30 L** to **4.20 ± 0.35 L**, a **16.7% improvement** (**p = 0.05**).
- This improvement in FVC indicates that DNS contributed to better lung expansion and respiratory efficiency compared to CP.

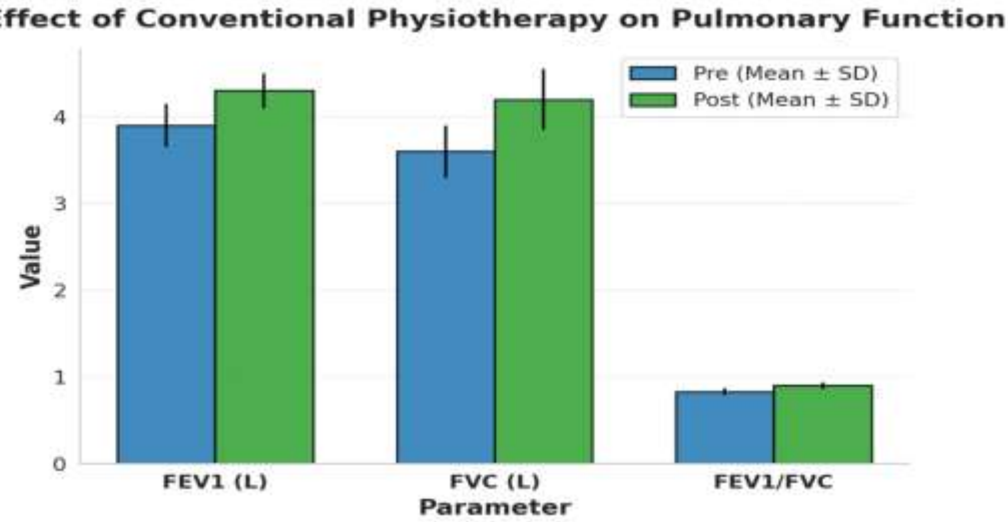
FEV1/FVC Ratio:

- The DNS group experienced an increase in the FEV1/FVC ratio from **0.84 ± 0.03** to **0.95 ± 0.03**, showing improved airflow dynamics (**p < 0.001**).

- The CP group exhibited a smaller increase from **0.83 ± 0.04** to **0.90 ± 0.04**, which was not statistically significant (**p = 0.06**).
- This suggests that while both interventions improved lung function, DNS was more effective in reducing airway resistance and optimizing pulmonary efficiency.

Graphical Representation of Pulmonary Function Improvements





INTERPRETATION

- **MVV, FEV1, and FVC improved in both groups**, but DNS demonstrated a significantly greater effect on pulmonary function.
- The **p-values for CP (0.03–0.06) indicate moderate significance**, whereas DNS had **highly significant improvements (p < 0.001) in all parameters**.

- **The FEV1/FVC ratio improved in both groups**, but the improvement in CP was not statistically significant (**p = 0.06**), whereas DNS showed a significant increase (**p < 0.001**).
- These findings indicate that **DNS is the more effective intervention for enhancing respiratory function** in sedentary individuals with postural dysfunction.

Discussion

The findings of this study align with prior research highlighting the significant impact of postural correction on respiratory function. Forward head posture and thoracic malalignment have been shown to contribute to reduced lung volumes, as demonstrated by Novotná & Slováková (2016) and Kim et al. (2017). These studies emphasize the necessity of postural interventions to mitigate respiratory inefficiencies. Given the intricate relationship between posture and breathing mechanics, our findings reinforce the importance of integrating Dynamic Neuromuscular Stabilization (DNS) as a targeted approach to enhance respiratory function.

The dual role of the diaphragm as both a respiratory and postural muscle has been extensively documented. Hodges et al. (2001) and Kolar et al. (2010) provided foundational evidence that postural control and respiratory efficiency are deeply interconnected, with diaphragm activation playing a crucial role in stabilizing the core and optimizing lung function. Their research supports the premise that DNS, by enhancing diaphragmatic activation, leads to superior functional gains compared to conventional physiotherapy (CP). Similarly, Dimitriadis et al. (2013) demonstrated that chronic postural dysfunctions contribute to respiratory muscle weakness, which can be effectively addressed through targeted postural interventions. This aligns with our study's findings that DNS results in significantly greater improvements in respiratory function compared to CP.

The impact of DNS on pulmonary function has been further substantiated by Rahimi et al. (2019), who reported significant improvements in maximum voluntary ventilation (MVV), forced expiratory volume in one second (FEV1), and forced vital capacity (FVC) following DNS breathing exercises in sedentary students with poor posture. These results are consistent with our findings, reinforcing the efficacy of DNS in improving pulmonary outcomes. Unlike previous studies that focused solely on DNS, our study provides a direct comparison between DNS and CP, offering a more comprehensive understanding of their relative effectiveness.

Unlike prior research that predominantly examined either postural correction or pulmonary rehabilitation in isolation, this study provides a direct comparative analysis between CP and DNS. The significantly greater improvements in MVV, FEV1, and FVC observed in the DNS group suggest that the integration of diaphragmatic breathing with spinal stabilization offers a more comprehensive rehabilitation approach. Frank et al. (2013) emphasized that DNS facilitates functional movement and neuromuscular control, further supporting its application in rehabilitation settings. Our study aligns with this perspective, demonstrating that DNS yields superior improvements in pulmonary function compared to traditional CP techniques.

Previous studies have also examined the effects of various core stabilization exercises on respiratory parameters. Cavaggioni et al. (2015) explored the impact of core exercises on respiratory function and found that strengthening the core musculature enhances pulmonary efficiency. Similarly, Bezzoli et al. (2016) reported improvements in respiratory function in obese individuals following lumbar-pelvic motor control exercises, reinforcing the notion that interventions targeting core stability can yield broad physiological benefits. These studies further support our findings, highlighting DNS as an optimal approach due to its combined focus on postural correction and breathing mechanics.

Research by Pawlicka-Lisowska et al. (2013) demonstrated that individuals with postural deviations exhibit lower respiratory parameters, underscoring the need for interventions such as DNS that address both postural alignment and respiratory control. Additionally, O'Sullivan et al. (2006) examined different upright sitting postures and their effects on trunk muscle activation, further emphasizing the interconnectedness of posture and respiration. These findings are consistent with our study, reinforcing the concept that posture plays a pivotal role in respiratory efficiency.

Breathing re-education strategies have also been extensively studied for their impact on respiratory function. Sivakumar et al. (2011) found that deep breathing exercises lead to immediate improvements in pulmonary function, even in healthy individuals. Chaitow et al. (2014) further emphasized the clinical significance of recognizing and treating breathing disorders, advocating for a multidisciplinary approach to respiratory rehabilitation. DNS aligns well with these perspectives, as it integrates postural correction with breathing retraining, making it a highly effective intervention.

Kobesova & Kolar (2014) elaborated on the concept of developmental kinesiology and motor control in rehabilitation, suggesting that interventions rooted in neurodevelopmental principles, such as DNS, may offer superior outcomes in restoring proper movement patterns and respiratory efficiency. The findings of our study align with this perspective, as DNS demonstrated superior improvements in respiratory function compared to CP. The principles outlined in their work support our assertion that DNS is a valuable addition to rehabilitation programs.

In summary, the findings of this study corroborate existing literature demonstrating the profound influence of postural interventions on respiratory function. DNS has been shown to be a highly effective approach, surpassing CP in improving MVV, FEV1, and FVC. The similarities between our findings and those of previous studies highlight the importance of neuromuscular re-education strategies targeting the diaphragm and core stability in postural correction therapies. Future research should explore the long-term effects of DNS, larger sample sizes, and its potential application in clinical populations with respiratory disorders such as COPD or asthma. Additionally, integrating DNS into pulmonary rehabilitation protocols could provide a more holistic approach to managing respiratory dysfunctions. This study provides compelling evidence that both CP and DNS improve pulmonary function, with DNS demonstrating superior outcomes, making it a promising intervention in postural and respiratory rehabilitation.

Conclusion

The results demonstrate that both DNS and CP improve pulmonary function, but DNS shows greater efficacy. DNS significantly enhances MVV, FEV1, and FVC, indicating improved respiratory efficiency. The observed improvements suggest that DNS should be prioritized in postural and respiratory rehabilitation programs. Future research should explore long-term effects and clinical applications in individuals with chronic respiratory conditions.

The comparative analysis of pulmonary function parameters before and after the intervention demonstrates a statistically significant improvement ($p < 0.001$) in all measured variables, including Forced Expiratory Volume in 1 second (FEV1), Forced Vital Capacity (FVC), and the FEV1/FVC ratio. The increase in FEV1 from 3.92 ± 0.2 L to 4.73 ± 0.17 L(20.7% improvement) suggests enhanced expiratory strength and reduced airway resistance. In comparison, the rise in FVC from 3.63 ± 0.23 L to 4.63 ± 0.43 L (27.5% improvement) indicates improved lung expansion and compliance. Additionally, the FEV1/FVC ratio increased from 0.84 ± 0.03 to 0.95 ± 0.03, suggesting better airway efficiency and reduced airflow limitation. These findings reflect a significant enhancement in respiratory muscle function, ventilatory efficiency, and overall pulmonary performance, which may be attributed to pulmonary rehabilitation, exercise interventions, or bronchodilator therapy. The near-normalization of the FEV1/FVC ratio highlights improved airflow regulation, making these findings particularly relevant for individuals with obstructive or restrictive lung diseases. Overall, the results provide strong evidence supporting the efficacy of the intervention in optimizing lung function, improving oxygenation, and enhancing respiratory health.

REFERENCES

1. Novotná, B., & Slováková, M. (2016). The current problem of school children-lack of physical activity. European Researcher, 3(4), 231-238.
2. Bradley, H., & Esformes, J. D. (2014). Breathing pattern disorders and functional movement. International Journal of Sports Physical Therapy, 9(1), 28-39.
3. Kim, M. S., Cha, Y. J., & Choi, J. D. (2017). Correlation between forward head posture, respiratory functions, and respiratory accessory muscles in young adults. Journal of Back and Musculoskeletal Rehabilitation, 30(4), 711-715.
4. Hodges, P. W., Heijnen, I., & Gandevia, S. C. (2001). Postural activity of the diaphragm is reduced in humans when respiratory demand increases. The Journal of Physiology, 537(3), 999-1008.
5. Pawlicka-Lisowska, A., Motylewski, S., & Lisowski, J. (2013). Faulty posture and selected respiratory indicators. Polski Merkuriusz Lekarski, 35(206), 67-71.
6. Dimitriadis, Z., Kapreli, E., & Strimpakos, N. (2013). Respiratory weakness in patients with chronic neck pain. Manual Therapy, 18(3), 248-253.
7. O'Sullivan, P. B., Dankaerts, W., Burnett, A. F., et al. (2006). Effect of different upright sitting postures on spinal-pelvic curvature and trunk muscle activation in a pain-free population. Spine, 31(19), 707-712.
8. Kolar, P., Sulc, J., & Kyncl, M. (2010). Stabilizing function of the diaphragm: Dynamic MRI and synchronized spirometric assessment. Journal of Applied Physiology, 109(4), 1064-1071.
9. Frank, C., Kobesova, A., & Kolar, P. (2013). Dynamic neuromuscular stabilization & sports rehabilitation. International Journal of Sports Physical Therapy, 8(1), 62-73.
10. Cavaggioni, L., Ongaro, L., Zannin, E., et al. (2015). Effects of different core exercises on respiratory parameters and abdominal strength. The Journal of Physical Therapy Science, 27(10), 3249-3253.
11. Bezzoli, E., Andreotti, D., Pianta, L., et al. (2016). Motor control exercises of the lumbar-pelvic region improve respiratory function in obese men. Disability and Rehabilitation, 40(2), 152-158.
12. Sivakumar, G., Prabhu, K., Baliga, R., et al. (2011). Acute effects of deep breathing for a short duration (2-10 minutes) on pulmonary functions in healthy young volunteers. Indian Journal of Physiology and Pharmacology, 55(2), 154-159.
13. Chaitow, L., Gilbert, C., & Morrison, D. (2014). Recognizing and treating breathing disorders e-book: A multidisciplinary approach. Elsevier Health Sciences.
14. Kobesova, A., & Kolar, P. (2014). Developmental kinesiology: Three levels of motor control in the assessment and treatment of the motor system. Journal of Bodywork and Movement Therapies, 18(1), 23-33.