Original Research

Short-term Effects of Thoracic Kinesiotaping in Children with Bronchopneumonia: A Randomized Controlled Trial

Sakshi Y. Shah[1], Tejas Borkar[2]

[1]Bachelors of Physiotherapy Intern, Pravara Institute of Medical Sciences, India, [2]Associate Professor, Head of Department of Paediatric Physiotherapy Pravara Institute of Medial Sciences, India.

How to cite this article: Sakshi Y. Shah, Tejas Borkar. Short-term Effects of Thoracic Kinesiotaping in Children with Bronchopneumonia: A Randomized Controlled Trial. Indian Journal of Physiotherapy and Occupational Therapy/Volume 18 No. 3, July-September 2024.

Abstract

Background: Respiratory infections, particularly bronchopneumonia, pose a significant health challenge in paediatric populations, often leading to respiratory distress and compromised well-being. In the context of managing bronchopneumonia in children, exploring non-invasive interventions becomes beneficial. The application of thoracic kinesiotaping is hypothesized to positively impact lung volumes by assisting respiratory function and facilitating breathing pattern.

Methodology: To determine the effectiveness of thoracic kinesiotaping on the functional capacities in children with bronchopneumonia, a group of 32 children aged 5 to 12 years were selected adhering to specific inclusion criteria. These participants were then randomly assigned to two groups. Group A underwent conventional respiratory physiotherapy exclusively while Group B participants received a combination of thoracic kinesiotaping and conventional respiratory physiotherapy. Pre-intervention assessment included baseline data, pulmonary function tests (PFT), Paediatric Dyspnea Scale (PDS) and Chest expansion. The treatment protocol spanned a period of three days. Analysis of data was done through Instat software.

Conclusion: The analysis revealed a notable increase in Forced Expiratory Volume in 1 second (FEV1) and the FEV1/Forced Vital Capacity (FVC) Ratio during pulmonary function testing (PFT), accompanied by a marginal improvement in chest expansion. These findings suggest a positive impact of kinesiotaping on respiratory parameters, indicating potential benefits for children with pulmonary conditions.

Keywords: Thoracic kinesiotaping, Bronchopneumonia, Respiratory function, Children, Pulmonary Function test

Introduction

Bronchopneumonia, marked by inflammation in bronchial and bronchiolar regions resulting in lung parenchyma solidification, primarily presents acutely, often affecting lower lobes [(1)]. Globally concerning, a child succumbs to pneumonia every 43

Corresponding Author: Tejas Borkar, Associate professor, Head of Department of Paediatric Physiotherapy Pravara Institute of Medial Sciences, India.

E-mail: tejasborkar57@gmail.com

Submission date: February 24, 2024 **Revision date:** March 19, 2024 **Published date: July 24,2024**

seconds, with a prevalence of one case per 71 children annually, notably higher in South Asia [2].

Various agents contribute to pneumonia, including Streptococcus pneumoniae, Haemophilus influenzae type b (Hib), Respiratory Syncytial Virus, and in HIV-infected infants, Pneumocystis jiroveci fungi [2].

Early recognition of signs and symptoms is vital. Bacterial pneumonia may feature cough, expectoration, vomiting, diarrhea, loss of appetite, fatigue, and fever, while viral pneumonia symptoms progress slowly, potentially increasing bacterial pneumonia risk. Additional symptoms include chills, tachypnea, dyspnea, headache, and irritability [3].

Children face challenges due to physiological factors like lower lung volume and weakened respiratory muscles, contributing to the disease's rapid progression [3].

Bronchopneumonia is a restrictive lung disease that primarily affects inspiration, with the diaphragm and external intercostal muscles being the primary inspiration muscles[4]. Common conventional therapies aiding mucociliary clearance include postural drainage, vibration, percussion, puffing, coughing, and thoracic squeezing [5,6,7,8].

Recent exploration into kinesiotaping reveals potential benefits in pediatric respiratory care. Thoracic kinesiotaping, utilizing an elastic, epidermal-thickness tape, may aid in increasing blood and lymph circulation, reducing pain, stimulating proprioception, stabilizing articular surfaces, and restoring muscle tone [9,10]. Application technique influences the tape's impact on muscular strength, with taping from muscle origin to insertion facilitating function, while taping in reverse inhibits function [11]. Taping on the diaphragm, combined with breathing exercises, shows immediate improvement in respiratory muscle tone, aerobic performance, pulmonary function, and dyspnea perception [12,13,14].

The purpose of this study is to investigate the effects of thoracic kinesiotaping on the improvement of chest expansion and functional capacities in children with bronchopneumonia.The aim is determine short-term effects of thoracic kinesiotaping in children with bronchopneumonia.

Materials and Methods

This study aims to assess the effectiveness of thoracic kinesiotaping in improving functional capacities and chest expansion in children with bronchopneumonia. Additionally, it seeks to compare the outcomes of conventional physiotherapy alone versus combined with thoracic kinesiotaping.

The samples for this study were collected from the In-patient department (IPD) of Dr. VitthalraoVikhe Patil Pravara Rural Hospital, Loni. The study was conducted within the pediatric In-patient department (IPD) focusing on children admitted with bronchopneumonia. Data collection was performed through primary methods with a total of 32 children included overall. The study spanned over a duration of 1 year (2023-2024), allowing for comprehensive data collection and analysis to evaluate the outcomes of interest effectively.

SELECTION CRITERIA:

INCLUSION: Participants meeting the inclusion criteria for this study were clinically diagnosed cases of bronchopneumonia by a pediatrician, aged between 5 to 12 years. Additionally, they were required to be conscious, follow commands precisely, and able to perform exercise programs, demonstrating cooperation during the study procedures. Written informed consent from a parent or legal guardian was also mandatory for inclusion in the research.

EXCLUSION: Patients presenting with secondary complications that could potentially interfere with the study procedures, as well as those diagnosed with multiple diseases, were excluded from participation. Additionally, children with hearing impairments or cognitive impairments were not included in the study.

PROCEDURE:

Before commencing the study, approval from the Institutional Ethical Committee (IEC) was obtained through the period 7/04/2023 to 7/04/2024 with registration no. Dr.APJAKCOPT/BPT/UG/2023/62. The research study has undergone formal registration with the Clinical Trials Registry - India (CTRI), and has been assigned the unique CTRI number: CTRI/2023/08/056726.

Informed consent was acquired from parents or their legal guardians after screening them based on inclusion and exclusion criteria. Using OpenEpi version 3, 32 children diagnosed with bronchopneumonia

were enrolled, with each group initially comprising 16 individuals, later reduced to 15 due to mid-intervention discharge. Various parameters, including chest expansion, pulmonary function tests (PFT), and pediatric respiratory distress scale (PDS), were measured pre-test and after 72 hours.

The study was conducted as a single-blinded trial, with the assessor being fully aware of the interventions while ensuring that the participants remained blinded throughout the intervention process. Simple random sampling method was conducted involving the generation of random numbers in Microsoft Excel. Participants were then assigned to either Group A or Group B based on the assigned random numbers. Sealed envelopes containing the group allocations were provided to each participant accordingly. The principal assessor generated the allocation sequence, enrolled and assigned the patients using the method described above.

Group A received conventional physiotherapy, while Group B received conventional physiotherapy combined with thoracic kinesiotaping, involving the application of two "I" strips to specific areas of the thorax. The first strip was applied centrally at the xiphoid process and laterally to the costal arch with 75% tension. The ends were attached unstretched, and the strip was applied with the arm in flexion while the patient inhaled deeply. The second strip was applied from the right to the left armpit at the same level as the first strip with the base affixed centrally at T12. The second strip was attached to the posterior inferior rib cage with the same method as the first strip, and the ends were attached unstretched [15].

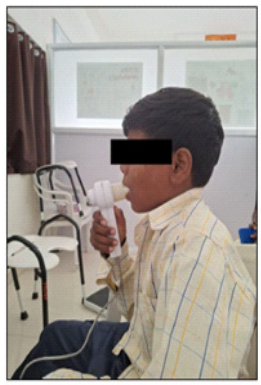
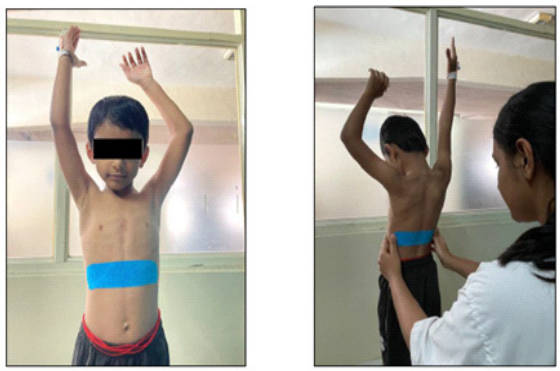


Figure 1 - PFT Assessment



a) b)

Figure 2 -Thoracic Kinesiotaping : a)Anterior View b) Posterior View

Results

In this research, we administered a three-day treatment to clinically diagnosed children with Bronchopneumonia, with an average age of 8.4±2.03 for Group A group and 7.93±1.98 for Group B group. The participants were selected from Dr. VitthalraoVikhe Patil Pravara Rural Hospital, Pravara Institute of Medical Sciences-DU, Loni BK, based on specific inclusion and exclusion criteria. The primary outcome measure was the Pulmonary Function Test (PFT), conducted before and after the three-day treatment period.

Table 1: Gender wise distribution of children with Bronchopneumonia

	Group A	Group B	P Value	Relative Risk
Male	8	9	1	0.874
Female	7	6		

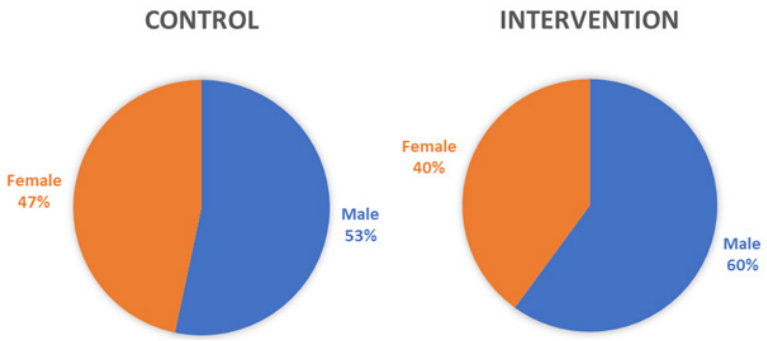


Fig 1: Gender distribution between Group A and Group B

Group A averaged 8.4±2.03 years in age, 22.27±6.62 kg in weight, and 127.27±16.5 cm in height. Group B had mean values of 7.93±1.98 years in age, 21.53±7.22 kg in weight, and 118.6±12.52 cm in height. Statistical comparison revealed no significant differences in age, height, or weight between the groups, ensuring baseline uniformity.

Table 2: Distribution of demographic data - Group A and Group B

Variables	Group A (Mean±SD)	Group B (Mean±SD)	t Value	P Value*
Age	8.4±2.03	7.93±1.98	0.6375	0.2645 (not significant)

* - Unpaired t test

Variables	Group A (Mean±SD)	Group B (Mean±SD)	U-Value	P Value*
Height	127.27±16.5	118.6±12.52	74	0.0574 (not quite significant

* - Mann-Whitney Test

Variables	Group A (Mean±SD)	Group B (Mean±SD)	t Value	P Value*
Weight	22.27±6.62	21.53±7.22	0.29	0.387 (not significant

* - Unpaired t test

PULMONARY FUNCTION TEST (PFT)

In the Pulmonary Function Test (PFT), % predicted values of FVC, FEV1, and FEV1/FVC Ratio were compared to establish baselines. In Group A, before treatment, mean FVC% was 55.07±17.04, FEV1% was 65.2±22.5, and ratio was 117.6±10.45. After treatment, FVC% increased to 65.53±17.14, FEV1 to 71.6±22.66, and the ratio decreased to 110.73±9.45. All changes were statistically significant ($p < 0.05$).

Table 3: Pre and Post Treatment PFT - Group A

	Pre (Mean±SD)	Post (Mean±SD)	t Value	P Value*
FVC%	55.07±17.04	65.53±17.14	5.495	< 0.0001 (extremely significant)
FEV1%	65.2±22.5	71.6±22.66	3.189	0.0033 (very significant)
FEV1/FVC Ratio	117.6±10.45	110.73±9.45	4.553	0.0002 (extremely significant)

*- Paired t test

For Group B, before intervention, mean FVC% was 65.53±17.14, FEV1% was 73.53±20.68, and ratio was 111.8±8.19. After intervention, FVC% increased to 77.73±15.34, FEV1 to 79.4±17.75, and the ratio decreased to 102.33±11.15. All changes were statistically significant ($p < 0.05$), indicating the effectiveness.

Table 4: Pre and Post Treatment PFT - Group B

	Pre	Post	t Value/ r Value	P Value
FVC%	65.53±17.14	77.73±15.34	5.859 (t)	< 0.0001 (extremely significant)*
FEV1%	73.53±20.68	79.4±17.75	2.282 (t)	0.0193 (significant)*
FEV1/FVC Ratio	111.8±8.19	102.33±11.15	0.6844 (r)	0.0001 (extremely significant)^

*- Paired t test

^- Wilcoxon matched-pairs signed-ranks test

Variations in lung volumes (FVC, FEV1, and FEV1/FVC ratio) were assessed by comparing pre and post-intervention measurements in Group A and Group B. Group A showed FVC difference of 8.93±6.3, FEV1 difference of 6.4±7.77, and ratio difference of 6.87±5.84. In Group B, FVC difference was 12.2±8.06, FEV1 difference was 5.87±9.96, and ratio difference was 9.47±6.45. These findings highlight distinct changes in lung volumes following interventions.

Table 5: Comparison of lung volumes between Group A and Group B

Difference	Group A	Group B	t Value/U value	P Value
FVC	8.93±6.3	12.2±8.06	1.237 (t)	0.1132 (not significant) *
FEV1	6.4±7.77	5.87±9.96	3.987 (t)	0.0002 (extremely significant) *
FEV1/FVC Ratio	6.87±5.84	9.47±6.45	33.5 (u)	0.0006 (extremely significant) ^

*- Unpaired t test

^- Mann-Whitney Test

PEDIATRIC DYSPNEA SCALE (PDS)

The study evaluated dyspnea severity before and after intervention in both groups, ensuring uniformity in comparison. No significant difference in dyspnea severity was noted between pre- and post-intervention assessments in both groups.

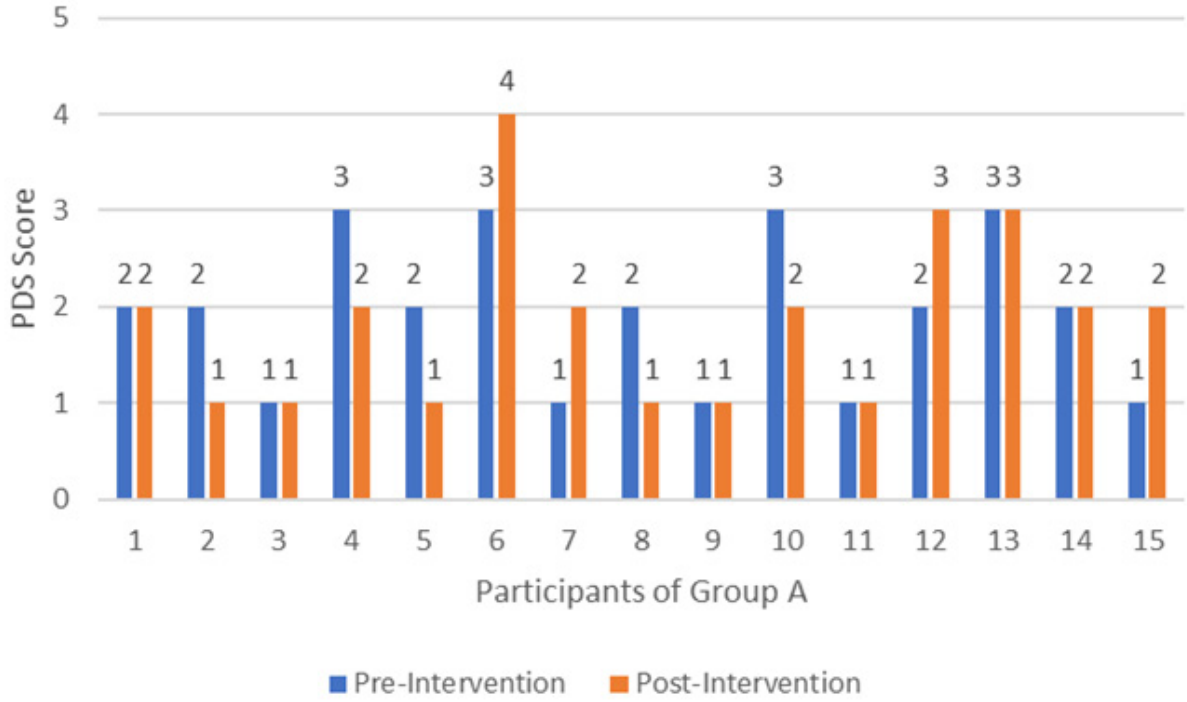


Fig 6- PDS Score- Group A

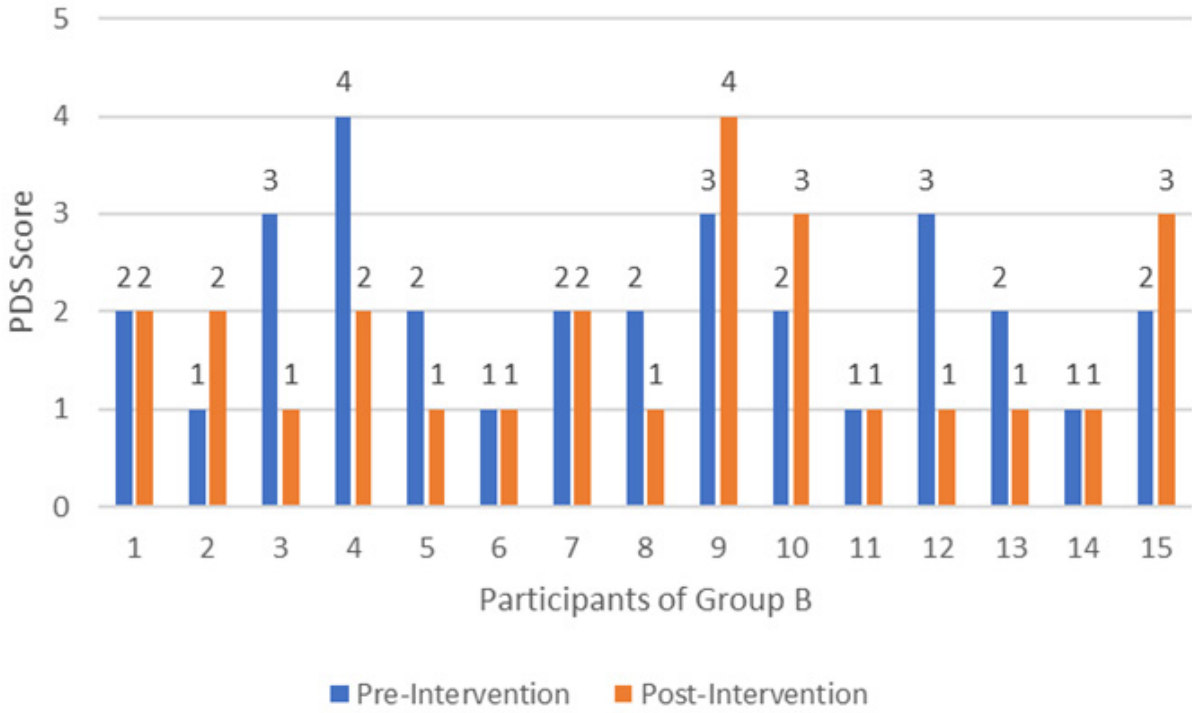


Fig 7- PDS Score- Group B

CHEST EXPANSION

Chest expansion was assessed through circumferential measurements using a tape, capturing the variance between deep inspiration and deep expiration by recording chest circumferences at the fourth intercostal space level. The comparison revealed no statistically significant difference in chest expansion between the children in Group A and those in Group B.

Table 6: Comparison of Chest Expansion between Group A and Group B

Variable	Group A (Mean±SD)	Group B (Mean±SD)	t Value	P Value*
Chest Expansion	0.4±0.34	0.37±0.3	t = 0.92	0.1817 (not significant)

*- Mann-Whitney Test

Discussion

The current study aimed to explore the impact of conventional physiotherapy and thoracic kinesiotaping on pulmonary function tests in children diagnosed with bronchopneumonia. Thoracic kinesiotaping involved the application of two strips anteriorly and posteriorly on the diaphragm, combined with conventional physiotherapy, to assess its influence on lung volumes.

The intervention resulted in a significant improvement in lung volumes, with all 3 PFT values showing statistically significant improvement. This highlights the positive impact of combined conventional physiotherapy and thoracic kinesiotaping on pulmonary function in bronchopneumonia children within a short treatment duration.

By specifically targeting the primary inspiratory muscle i.e. the diaphragm, with proprioceptive stimulation, we aimed to explore the potential multifaceted benefits of kinesiotape [16]. Proprioceptive feedback is provided by assisting individuals with restrictive lung diseases to become more aware of their breathing patterns and make adjustments as needed which can lead to more efficient breathing techniques, reducing respiratory effort and improving oxygenation[17].

Pulmonary function test (PFT) patterns in restrictive conditions such as bronchopneumonia typically manifest as a normal or increased FEV1/FVC ratio (>0.70) alongside a reduced Forced Vital Capacity (FVC) (less than 80%) [18].

Post-intervention, both Group A and Group B showed increased FVC% and FEV1%, indicating improved lung volumes. Group B demonstrated a more substantial increase compared to Group A. Additionally, both groups exhibited an elevated FEV1/FVC ratio initially, reflecting a restrictive pattern, but post-intervention, this ratio reduced, indicating improvement. Importantly, Group B showed a greater reduction in the ratio compared to Group A, suggesting a decrease in the restrictive pattern with thoracic kinesiotaping and conventional physiotherapy.

Restrictive lung diseases often involve stiffness or reduced flexibility of the chest wall, making it difficult to expand the lungs fully during inhalation. kinesiotape can be applied to promote greater mobility of the chest wall, facilitating deeper breathing and improved lung expansion [19]. Many individuals with restrictive lung diseases experience discomfort associated with breathing due to the increased effort required to expand the lungs against stiffness or resistance. kinesiotape can help alleviate this pain by providing support to the chest wall and reducing muscle tension, allowing for more comfortable and efficient breathing.

The Pediatric Dyspnea Scale was chosen due to dyspnea's prevalence as a symptom in pediatric bronchopneumonia. Most children experienced mild dyspnea, primarily falling within Grades 1 and 2. In Group A, 5 out of 15 children showed improvement, while in Group B, 8 out of 15 children improved. Kase et al. proposed that kinesiotaping stimulates mechanoreceptors proportionally to tape tension, triggering positional stimuli in the skin, which are transformed into sensory stimuli, enhancing or reducing movement[20]. Burcu Metin Ökmen et al. observed improvement in mMRC Dyspnea Scale scores pre- and post-treatment in adult participants [21].

The diaphragrm aids chest expansion contracting and descending during inhalation, allowing for lung expansion. In this study, circumferential chest expansion at the 4th intercostal space was measured using an inch tape, with a normal value of 2.5cm for children aged 5-12 years[22]. While various studies have explored the correlation between kinesiotaping

and chest expansion, our study found only marginal increases: 0.4 cm in Group A and 0.37 cm in Group B compared to baseline measures. However, there was no statistically significant difference in chest expansion between Group B and Group A.

Conclusion

The present study has concluded that kinesiotaping elicits short-term effects on pulmonary function test (PFT) parameters, particularly enhancing Forced Expiratory Volume in 1 second (FEV1) and the FEV1/Forced Vital Capacity (FVC) ratio. These improvements signify an enhancement in lung function following kinesiotape application, highlighting its potential as a therapeutic intervention for respiratory conditions.

LIMITATIONS AND FUTURE SCOPE

The study's limitations include its small sample size, the need for comparing multiple kinesiotape placements to determine the most effective method, and the lack of isolation of the impact of medications and physiotherapy treatment. However, it presents an opportunity for future exploration in a larger population to assess the effects of kinesiotape application on the duration of hospital stays. Conducting such a study on a broader scale could elucidate whether the use of kinesiotape contributes to shorter hospital stays, potentially facilitating faster patient discharge and improving overall healthcare efficiency.

DECLARATION OF CONFLICTS AND FUNDINGS

There were no potential conflicts of interest observed in the study. This research study received no external funding.

References

1. Davidson's Principles and Practice of Medicine. United Kingdom: Elsevier Health Sciences; 2018.
2. Pneumonia in children. [Internet]. Pneumonia in Children. 2022 Nov 11 [cited 2024 Feb 9]. Available from: https://www.who.int/news-room/fact-sheets/detail/pneumonia
3. Stanford Medicine Children's Health. [Internet]. Pneumonia in Children. n.d. [cited 2024 Feb 9]. Available from: https://www.stanfordchildrens.org/en/topic/default?id=pneumonia-in-children-90-P02958
4. Hall JE. Guyton and Hall Textbook of Medical Physiology. Saunders; 2015 May 20.
5. Flude LJ, Agent P, Bilton D. Chest physiotherapy techniques in bronchiectasis. Clinics in Chest Medicine. 2012;33(2):351-61.
6. Main E, Prasad A, Schans CP. Conventional chest physiotherapy compared to other airway clearance techniques for cystic fibrosis. Cochrane Database of Systematic Reviews. 2005;(1):CD002011. doi:10.1002/14651858.CD002011.pub2
7. Yang M, Yan Y, Yin X, Wang BY, Wu T, Liu GJ, et al. Chest physiotherapy for pneumonia in adults. Cochrane Database of Systematic Reviews. 2013;(2):CD006338. doi:10.1002/14651858.CD006338.pub3
8. Yousefnia-Darzi F, Hasavari F, Khaleghdoost T, Kazemnezhad-Leyli E, Khalili M. Effects of thoracic squeezing on airway secretion removal in mechanically ventilated patients. Iranian Journal of Nursing and Midwifery Research. 2016;21(3):337-42.
9. Lee M, Kim M, Ahn C. Impact of Concurrent Inspiratory Muscle Training and Tape on Inspiratory Muscle Strength, Endurance and Pulmonary Function. Journal of The Korean Society of Integrative Medicine. 2014;2:65-73. doi:10.15268/ksim.2014.2.3.065
10. Halseth T, McChesney JW, Debeliso M, Vaughn R, Lien J. The effect of kinesio taping on propioception at the ankle. J Sport Sci Med. 2004;3:1-7.
11. Liu YH, Chen SM, Lin CY, et al. Motion Tracking on Elbow Tissue from Ultrasonic Image Sequence for Patients with Lateral Epiconylitis. 29th Annual International Conference of the IEEE EMBS Cite. Internationale, Lyon, France, August 23-6, 2007.
12. Kase K, Hashimoto T, Okane T. Kinesio Taping Perfect Manual. Japan: Kinesio Taping Association; 1996.
13. Williams S, Whatman C, Hume PA, Sheerin K. Kinesio taping in treatment and prevention of sports injuries. Sports medicine. 2012 Feb 1;42(2):153-64.
14. Ganesh BR, Praneetha N, Naik V. Comparison of Two Thoracic Kinesio-Taping Techniques on Pulmonary Function, Oxygen Saturation, and Exercise Capacity in COPD Patients: A Randomized Clinical Trial. Indian Journal of Physical Therapy and Research. 2023;5(1):32-36. doi:10.4103/ijptr.ijptr_168_22
15. Kumbrink B. K-Taping in Pediatrics: Basics Techniques Indications. 2015 Nov 23. doi:10.1007/978-3-662-46585-1

16. Williams S, Whatman C, Hume PA, Sheerin K. Kinesio taping in treatment and prevention of sports injuries. Sports medicine. 2012 Feb 1;42(2):153-64.

17. Ganesh BR, Praneetha N, Naik V. Comparison of Two Thoracic Kinesio-Taping Techniques on Pulmonary Function, Oxygen Saturation, and Exercise Capacity in COPD Patients: A Randomized Clinical Trial. Indian Journal of Physical Therapy and Research. 2023;5(1):32-36. doi:10.4103/ijptr.ijptr_168_22

18. Ponce MC, Sankari A, Sharma S. Pulmonary Function Tests. [Updated 2023 Aug 28]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2024 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK482339/

19. Thongchote K, Sangchuchuenjit C, Vichaichotikul W, Choosaranon N, Kulsiri N, Lopansri P, et al . The Functional Correction of Forward Shoulder Posture with Kinesiotape Improves Chest Mobility and Inspiratory Muscle Strength: A Randomized Controlled Trial. Ann Appl Sport Sci. 2023;11(2). doi:10.52547/aassjournal.1138

20. Kase K, Wallis J, Kase T. Clinical therapeutic application of the kinesio taping method. Tokyo, Japan: Ken Ikai Co Ltd; 2003.

21. Burcu Metin Ökmen, Özlem ŞengörenDikiş, KorgünÖkmen, Lale Altan & Tekin Yildiz. Investigation of the effect of kinesiotaping on the respiratory function and depression in male patients with chronic obstructive pulmonary disease: a prospective, randomized, controlled, and single-blind study. The Aging Male. 2020;23(5):648-654. doi:10.1080/13685538.2019.1567703

22. Aditi Soman, Dhanashree Kirtikar, Taruna Gambhir. Normative Value of Chest Expansion in Healthy Children Between 5 to 12 Years of Age Group. Int J Physiother Res. 2022;10(5):4395-4400. doi:10.16965/ijpr.2022.162.