International Journal of Medical and Allied Health Sciences

ISSN: 2583-1879
Available at http://www.ijmahs.org/©2021 IJMAHS All Rights Reserved

Research Article

EFFECTIVENESS OF PROPRIOCEPTIVE NEUROMUSCULAR FACILITATION ON LOW BACK PAIN AND FUNCTIONALITY AMONG TAILORS

Sona Selvaraj[1], R. K. Sharma[2], Poonam Rani[3]

1 MOT (Orthopedics) student, Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh, India,. Pin Number: 201009
2 Professor and Dean Paramedical and Principal Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh, India,'Pin Number: 201009
3 Assistant Professor Santosh College of Occupational Therapy, Ghaziabad, Uttar Pradesh, India;. Pin Number: 201009

Article Information: Received on 09-09-2026, Accepted 26 -09 - 2026, Available online 27- 09 -2026

Abstract

Background: Due to extended sitting, protracted postures, repetitive motions, and unfavorable ergonomic conditions, low back pain is a prevalent occupational musculoskeletal issue among tailors. Pain, functional restrictions, and a lower quality of life could result from these issues. A therapy strategy called proprioceptive neuromuscular facilitation (PNF) may enhance neuromuscular control, flexibility, and functional performance.

Methods: Forty tailors participated in a randomized experimental trial; they were split into two groups: the control group (n = 20) and the experimental group (n = 20). For four weeks, five days a week, the experimental group received PNF approaches in addition to conventional occupational therapy, whereas only conventional occupational therapy was given to the control group. The duration of each session was 45 minutes. The Low Back Pain Disability Questionnaire from Oswestry and the WHOQOL-BREF used to measure low back disability respectively.

Results: While the control group's score increased from 41.65 to 33.60, the experimental group's mean low back impairment score decreased from 41.25 to 26.30. The groups differed statistically significantly after the intervention ($t = 2.628$, $p = 0.012$). Additionally, the experimental group outperformed the control group in all four WHOQOL-BREF domains ($p < 0.003$).

Conclusion: When paired with traditional occupational treatment, proprioceptive neuromuscular facilitation was more successful than traditional occupational therapy alone in lowering low back impairment and enhancing tailors' functionality and quality of life**.**

Keywords: pain in the lower back, proprioceptive neuromuscular facilitation, tailors, functionality, Oswestry Disability Index, quality of life, and WHOQOL-BREF.

1. Introduction

Pain in the Lower Back is among the most widespread musculoskeletal conditions people face, and it plays a major role in causing pain, disability, and difficulty carrying out daily and work-related tasks. It touches people of all ages and occupations, usually arising from some mix of mechanical strain, poor posture, muscular weakness, and job-related demandsWhen it becomes persistent, it can seriously interfere with how well someone functions physically, how they perform at work, and their overall quality of life [1].

*__R K Sharma__, Professor and Dean Paramedical and Principal Santosh College of Occupational Therapy, Ghaziabad Uttar Pradesh
E mail: hod.occupationaltherapy@santosh.ac.in,
ORCID ID: 0000-0002-1780-4967
doi: https://doi.org/10.54618/IJMAHS.2026637
This is an open-access article, which permits the use and distribution of article provided that original author and source are credited

Jobs that require sitting for long stretches or holding the same position for extended periods are known to raise the risk of low back discomfort. Sitting for too long puts extra mechanical load on the lower spine, tires out the muscles, and reduces how freely the trunk can move. People whose work keeps them locked into static postures for hours at a time tend to be more prone to developing symptoms in the lumbar region [2].

Pilots are a good example of a profession exposed to many of these risk factors. While flying, they often stay seated for long periods with little chance to shift positions. The cockpit itself demands sustained postures along with constant visual attention and manual control inputs, with very limited room to move. Together, these conditions create repeated or ongoing mechanical strain on the lumbar area and

adjacent muscles, which eventually results in lower back discomfort and diminished physical function [3].
Lower back discomfort is often linked to weaker trunk muscles, poorer proprioception (the body's sense of its own position), disrupted neuromuscular control, and a more restricted range of motion in the lower back. Being able to properly activate and coordinate the muscles of the trunk and pelvis is key to keeping the spine stable during everyday movement. Because of this, exercise approaches that build strength, improve flexibility, sharpen proprioception, and enhance coordination and neuromuscular control are considered valuable tools for treating Pain in the Lower Back [4, 5].
One such approach is Neuromuscular facilitation techniques, a form of therapeutic exercise that relies on Movement patterns that are circular and diagonal combined with methods designed to elicit neuromuscular reactions. PNF has been shown to help with muscle activation, flexibility, coordination, proprioception, core stability, and overall functional movement. These improvements may ease excessive strain on the lumbar spine and boost functional performance in people dealing with Pain in the Lower Back [6, 7].
Research backs up PNF's potential value here. One Systematic evidence of synthesis, covering 20 Clinical research and 965 participants, found that PNF training led to meaningful reductions in pain and improvements in functional disability. The combined results showed large effects on both discomfort and impairment, though the total quality of the underlying evidence was rated low, making recommendation a cautious one[8].
A separate Systematic evidence synthesis, drawing on 16 studies and 722 participants, reached similar conclusions for people with persistent pain in the Lower Back, showing that PNF training improved both pain levels and disability. It also found that PNF outperformed core strengthening exercises in these areas. That said, the authors called for more rigorous randomized experimental trials, since the quality of evidence varied from low to moderate [9].
A randomized experimental study-oriented on working-age adults who have persistent Pain in Lower Back found that just three weeks of PNF training produced significantly better results in pain reduction and disability than standard trunk exercises did. Participants in the PNF group also showed gains in static balance [5, 6].
Looking at longer-term outcomes, another randomized experimental study on persistent pain in the Lower Back patients found that four weeks of in addition to enhancing back muscle activation and other pain-related metrics, PNF training dramatically reduced pain intensity and functional impairment. According to a follow-up examination, these advantages might continue long beyond the treatment plan [5].
When evaluating effectiveness of a lower back pain treatment, functional ability is crucial. Inadequate lumbar function can make it hard to sit, stand, walk, bend, lift, or perform work duties for extended periods. This is especially relevant for pilots, since their job by nature involves long hours of sitting and limited movement. This makes treatments that both relieve pain and restore functional capacity especially valuable in an occupational context [10, 11].

2. MATERIALS AND METHODS

2.1 Study Design and Setting

Data was gathered from tailor shops in Chennai, India, and the Institutional Ethical Committee at Santosh College of Occupational Therapy reviewed, discussed, and authorized a randomized experimental pre-posttest study (Ref. No.-SCOT/JULY-25/ECOrtho-04). Before being included, each participant providedsigned, informed consent.

2.2 Participants

Participants included tailors aged between 20 and 45 years, including both males and females, with low back pain lasting for more than one month. Participants who habitually performed tailoring work involving prolonged sitting for approximately 5–7 hours per day were part of the research. Among the exclusion criteria were participants below 20 years or above 45 years of age, those with pain lasting for less than one-month, existing physical disabilities, and a history of spinal fracture, spondylolisthesis, spinal stenosis, spinal tuberculosis, acute inflammatory illness, infectious disease, or autoimmune disorders. Using a straightforward random sampling procedure, 40 eligible people were found and split into two groups: the controlled group (n = 20) and the test group (n = 20).

2.3 Intervention

Proprioceptive Neuromuscular Facilitation (PNF) procedures were administered to Group A (Experimental Group) in addition to traditional occupational therapy treatment, while Group B (Control Group) just got traditional occupational therapy approach. The intervention was administered for approximately 45 minutes in each session, five sessions per week,for a duration of four weeks. Participants underwent a total of approximately 20 intervention sessions.

2.4 Outcome Measures

A standardized measure for assessing functional disability related to low back pain is the Oswestry Low Back Pain Disability Questionnaire (ODI). It evaluates how much a person's capacity to carry out everyday

activities and functional duties is impacted by low back pain

The World Health Organization created the WHOQOL-BREF, a standardized tool for evaluating a person's quality of life. It assesses quality of life in four basic areas: environmental, social relationships, both physical and mental well-being. Better quality of life in the corresponding domains is indicated by higher scores.

A master chart was used to compile and record theResults of the standard. IBM SPSS Statistics was used to analyze the data. For both within-group and between-group comparisons, the proper statistical tests were employed, such as paired samples and independent samples t-tests. Non-parametric statistical tests were also used where necessary. The statistical significance level was set at $p < 0.05$.

2.5 Statistical Analysis

3. RESULTS

3.1 Demographic Characteristics

Chart 1 offers specific demographic detailsregarding the people involved. The comprised 40 participants in total, 20 of whom were divided into 20 groups: the Standard Team and the Test Team. The individuals involved average age was 33.52 ± 6.46 years. Participants in the Control Group were 33.80 ± 6.49 years old, while those in the Experimental Group were 33.25 ± 6.58 years old.

3.1 Table 1: Participants' Demographic Features

Characteristics	Group of Experiments (n = 20)	Group of Control (n=20)	Total (n=40)
No. of Participants	20	20	40
Mean Age ± SD	33.25 ± 6.58	33.80 ± 6.49	33.52 ± 6.46

3.2 Baseline Comparisons

The pre-test results of the Low Back Pain Disability Questionnaire from Oswestry and the WHOQOL-BREF domains showed no statistically significant change ($p > 0.05$) between the two groups, suggesting that both groups were similar at baseline (Table 2).

Table 2: Baseline Assessment (Pre-Test Data Analysis)

Scale	Group of control	Group of experimental	t Value	p Value	Interpretation
OLBP	Pre-test	Pre-test	0.209	0.836	No statistically significant distinction
WHOQOL-BREF Domain 1	Pre-test	Pre-test	0.629	0.533	No statistically significant distinction
WHOQOL-BREF Domain 2	Pre-test	Pre-test	-0.067	0.947	No statistically significant distinction
WHOQOL-BREF Domain 3	Pre-test	Pre-test	0.462	0.647	No statistically significant distinction
WHOQOL-BREF Domain 4	Pre-test	Pre-test	0.424	0.674	No statistically significant distinction

3.3 Post-Intervention Analysis of Experimental and Control Groups

All four WHOQOL-BREF domains and after the intervention, there were statistically significant differences between the Treatment Group Control group on the Oswestry in Low Back Pain Disability Questionnaire. The treatment Group outperformed the Control Group following the intervention. Following the test, OLBP scores showed a statistically significant difference ($t = 2.628$, $p = 0.012$). Furthermore, there were significant differences in WHOQOL-BREF Domains 1 ($p = 0.001$), 2 ($p < 0.001$), 3 ($p < 0.001$), and 4 ($p = 0.003$). (Table 3).

Table 3: Post-Intervention Analysis of Outcome Measures

Scale	Group of Control	Group of Experimental	t Value	p Value	Interpretation
OLBP	Post-test	Post-test	2.628	0.012*	A statistically significant difference
WHOQOL-BREF	Post-test	Post-test	-3.553	0.001*	A statistically significant

Scale	Group of Control	Group of Experimental	t Value	p Value	Interpretation
Domain 1					difference
WHOQOL-BREF Domain 2	Post-test	Post-test	-3.806	<0.001*	A statistically significant difference
WHOQOL-BREF Domain 3	Post-test	Post-test	-4.359	<0.001*	A statistically significant difference
WHOQOL-BREF Domain 4	Post-test	Post-test	-3.126	0.003*	A statistically significant difference

3.4 Pre- and Post-Test Data Analysis of both Groups

Both groups demonstrated progress following the procedure, according to a comparison of outcome measures taken before and after the test. However, the Experimental Group made greater progress than the Control Group.

The mean OLBP scores for the treatment group significantly decreased from 41.25 ± 6.70 in the pre-test to 26.30 ± 8.72 at the after test. By contrast, the Control Group's score decreased from 41.65 ± 5.32 in the pre-test to 33.60 ± 8.84 at the post-test. Following the intervention, there was a significant difference between the groups ($p = 0.012$).

Similarly, the Experimental Group demonstrated greater improvement across all four WHOQOL-BREF domains compared with the Group of Control (Table 4).

Table 4: Descriptive Statistics of Outcome Measures

Outcome Measure	Group	Mean Pre-test	Mean Post-test	SD Pre-test	SD Post-test
OLBP	Group of Control	41.65	33.60	5.32	8.84
OLBP	Experimental Group	41.25	26.30	6.70	8.72
WHOQOL-BREF Domain 1	Control Group	20.25	22.30	1.77	1.78
WHOQOL-BREF Domain 1	Experimental Group	19.90	24.30	1.74	1.78
WHOQOL-BREF Domain 2	Control Group	18.70	21.10	2.34	2.31
WHOQOL-BREF Domain 2	Experimental Group	18.75	23.85	2.40	2.25
WHOQOL-BREF Domain 3	Control Group	9.20	11.00	1.28	1.45
WHOQOL-BREF Domain 3	Experimental Group	9.00	13.00	1.45	1.45
WHOQOL-BREF Domain 4	Control Group	24.95	26.55	2.93	3.03
WHOQOL-BREF Domain 4	Experimental Group	24.55	29.55	3.03	3.03

3.5 Within-Group Pre- and Post-Test Data Analysis

Both the Groups showed statistically significant improvements after the intervention, according to within-group analysis. The Experimental Group outperformed the Control Group in low back disability and all four WHOQOL-BREF areas.

OLBP scores decreased by an average of 14.95 points for the treatment Group and 8.05 points for the Control Group. Improvements were statistically substantial for both groups ($p < 0.001$). Additionally, the Experimental Group showed noticeably better improvement in all four WHOQOL-BREF domains.

Overall, the results show that Proprioceptive Neuromuscular Facilitation in conjunction with traditional occupational treatment was more successful than traditional occupational therapy alone in lowering low back handicap and enhancing tailors' quality of life.

4.DISCUSSION

This study set out to determine how effective neuromuscular facilitation techniques is in reducing Pain in the Lower Back and improving functionality and quality of life among tailors. The findings showed that participants who received PNF combined with conventional occupational therapy (Group A) experienced significantly greater improvements in low back disability and across all four quality-of-life domains compared with the control group (Group B), which received conventional occupational therapy alone. Even though both groups improved significantly following therapy, extent of improvement was consistently greater in the experimental group, suggesting that adding PNF techniques offers additional clinical benefit for managing Pain in the Lower Back linked to prolonged occupational sitting.

The demographic analysis confirmed that the two groups were well matched before treatment began. Mean age was similar between Group A (33.25 ± 6.58 years) and Group B (33.80 ± 6.49 years), and there were No significant variations were found in baseline ODI or WHOQOL-BREF scores.The study's internal validity is strengthened by this baseline similarity, which shows that the benefits observed following treatment can be linked to the intervention itself as opposed to pre-existing group disparities. Random allocation helped minimize selection bias and ensured both groups started from a comparable level of disability and quality of life.

Tailors are especially vulnerable to Pain in the Lower Back due to prolonged static sitting, sustained forward-bent postures, repetitive trunk movements, and continuous use of foot-operated sewing machines. These repetitive, static postures increase fatigue in the lumbar extensor muscles, tighten the hamstrings and hip flexors, and reduce neuromuscular control of the trunk. Over time, these changes in lumbopelvic mechanics lead to abnormal loading of the lumbar spine, resulting in pain, reduced mobility, and functional limitations. The present findings support this biomechanical explanation, showing that interventions targeting neuromuscular facilitation of the trunk and lower limbs can meaningfully reduce low back disability while also improving quality of life.

One of the most notable findings was the significant drop in Oswestry Disability Index scores among participants who performed PNF exercises. Group A showed a considerably larger reduction in disability (17.30 percentage points) compared with Group B (9.50 percentage points). This suggests that PNF techniques — which combine muscle contraction and relaxation through diagonal movement patterns — help improve flexibility in tight lumbar and hip muscles, reduce muscle spasm, correct muscle imbalances, and enhance proprioceptive input and neuromuscular control. As a result, participants experienced less pain during functional activities and better performance of everyday occupational tasks such as prolonged sitting, forward bending, and rising from a seated position.

This improvement in low back disability aligns with earlier research. Kim and Lee found that PNF-based abdominal strengthening significantly decreased discomfort and practical limitation scores in a individual with prolonged pain, with results notably better than those achieved through traditional physical therapy. In a similar vein, Hosseini Far and colleagues discovered that PNF exercise regimens improved considerably decreased pain and impairment in individuals with non-specific persistent pain in lumbar. GAO and colleagues, in a Systematic evidence synthesis of twelve randomized experimental trials, concluded that PNF was beneficial for relieving pain and improving waist-related functional disability compared with control interventions. These underlying mechanisms may help explain the greater reduction in ODI scores observed in this study.

The experimental group's members' WHOQOL-BREF quality-of-life scores significantly improved, which was another important discovery. Since persistent Pain in the Lower Back negatively affects physical function, psychological well-being, social participation, and satisfaction with one's environment, improvements in pain and mobility would be expected to enhance overall quality of life. The marked gains across all four domains in Group A suggest that participants experienced better physical capacity, improved psychological health, greater social engagement, and increased satisfaction with their daily environment following the PNF intervention.

This improvement in quality of life is in line with research by Areeudomwong and colleagues, who demonstrated that among individuals who have persistent lower a four-week PNF training course for back discomfort resulted in significant, long-lasting improvements inPain severity, functional impairment, patient contentment, and in relation to well being . These effects persisted at a twelve-week follow-up. Likewise, Mavromoustakos and colleagues found that a six-week PNF program achieved greater reductions in pain and disability, along with increased positive emotions, compared with a general exercise program. Together, these findings support the idea that PNF contributes not just to pain reduction, but to significant gains in overall health-related quality of life.

The domain-wise analysis further reinforces PNF's effectiveness. Participants in Group A showed greater improvementin each of the four WHOQOL-BREF domains, with the social relationships domain

(D3) showing the largest between-group difference ($t = 4.359$, $p < 0.001$). This shows that PNF influences multiple aspects of quality of life rather than producing isolated benefits. Improved trunk muscle activation and reduced pain likely enhanced postural endurance, working capacity, and participation in daily life, contributing to better performance across various life domains.

The consistency of domain score changes within each group is worth noting. Every participant in Group A improved by exactly 4-5 points across the domains, while every participant in Group B improved by exactly 2 points. Because of this uniformity, the paired t-statistic could not be computed for these variables, so the non-parametric Wilcoxon signed-rank test was applied instead, confirming highly significant within-group improvement ($p < 0.001$). This pattern reflects a very consistent treatment response across participants; however, future studies with larger, more diverse samples would likely show greater variation in individual responses to treatment.

This study's utilization of several validated outcome measures is one of its main advantages. The Oswestry Pain in the Lower Back Disability Questionnaire, one of the most popular and widely used instruments for assessing functional limitations associated with lower back pain and renowned for its strong was used to measure low back functional limitation. The WHOQOL-BREF, a trustworthy and cross-culturally validated tool, was used to gage quality of life. A more thorough assessment of health-related gains and a more complete picture of the intervention's efficacy were made possible by included all four quality-of-life domains (D1–D4). The use of both within-group and between-group analyses, applying both parametric and non-parametric methods, further strengthened the reliability of the conclusions by producing consistent results across different analytical approaches.

There are a few things to be mindful of despite these positive outcomes. First, because of the relatively small sample size of 40 participants, larger populations may not benefit as much from the findings. Second, the intervention period may not have been long enough to capture long-term changes in quality of life. Third, the study focused solely on tailors, limiting how applicable the findings are to other occupational groups. In addition, no long-term follow-up was conducted, so it remains unclear whether the improvements observed will be sustained over time. Future research should involve larger, multicentre samples, longer intervention periods, objective assessments of posture and flexibility, electromyographic evaluation of trunk muscles, andlong-term monitoring to ascertain whether these advantages endure.

From a clinical standpoint, these findings carry meaningful implications for occupational therapy practice. Identifying low back dysfunction early among tailors may help prevent the progression to persistent Pain in the Lower Back and disability. Incorporating PNF techniques into standard rehabilitation programs may improve flexibility, reduce pain, strengthen trunk control, and support participation in occupational tasks. Workplaces might also consider pairing exercise-based interventions with ergonomic training, regular rest breaks, and workstation adjustments to help reduce the high rate of Pain in the Lower Back among workers who spend long hours seated at tailoring tasks.

Overall, the results of this investigation firmly support the alternative hypothesis — that neuromuscular facilitation techniques is effective in reducing Pain in the Lower Back and improving functionality among tailors. The statistically significant improvements seen in Oswestry Disability Index scores and WHOQOL-BREF quality-of-life domains demonstrate that PNF combined with conventional occupational therapy offers greater therapeutic benefit than conventional occupational therapy alone. These results align with current neurophysiological theory and existing clinical evidence supporting PNF's role in managing persistent mechanical Pain in the Lower Back. As such, PNF should be considered a valuable component of occupational therapy for tailors and other groups exposed to prolonged static sitting and repetitive trunk movements.

5. CONCLUSION

This study's outcome that neuromuscular facilitation Methods work well in reducing Pain in the Lower Back and improving both functionality and quality of life among tailors. While both groups showed significant improvement after treatment, participants who received PNF combined with conventional occupational therapy showed notably greater reductions in Oswestry Disability Index (ODI) scores, along with greater gains across all four WHOQOL-BREF quality-of-life domains. These results suggest that adding PNF to conventional occupational therapy offers extra therapeutic value by improving flexibility, strengthening neuromuscular control of the trunk, and reducing disability linked to prolonged static sitting. Based on these findings, neuromuscular facilitation techniques can be recommended as an effective, clinically meaningful intervention for both preventing and managing mechanical Pain in the Lower Back among tailors and others whose work involves long periods of sitting and repetitive tasks.

6 DECLARATIONS

- **Acknowledgements:** The authors thank everyone who offered assistance and helpful criticism during this study.

- **Authors' Contributions:** SSconceptualized the study, drafted the protocol, carried out data collection, and wrote the initial manuscript draft. RKS supervised the project and critically revised the manuscript. PR edited the manuscript and organized its submission. All authors evaluated and approved the final text.
- **Ethical Approval and Consent:** Accepted by Santosh College of Occupational Therapy's Institutional Ethical Committee (Ref. No. - SCOT/JULY-25/ECOrtho-04). Every individual participant in the study gave their informed consent to take part in the intervention and have their information made public.
- **Financial Support Statement:**For this study, no specific grant from a public, commercial, or nonprofit funding agency was obtained.
- **Conflict of Interest Statement:** The writers affirm that they have no conflicting interests.

- **Data Availability Statement:** The datasets created and analyzed for this investigation are available upon reasonable request from the corresponding author.

7. Conflict of Interest: Nil

8. References:

1. **Wu A, March L, Zheng X, Huang J, Wang X, Zhao J, Blyth FM, Smith E, Buchbinder R, Hoy D.**Global low back pain prevalence and years lived with disability from 1990 to 2017: Estimates from the Global Burden of Disease Study 2017. Annals of Translational Medicine. 2020;8(6):299.https://pmc.ncbi.nlm.nih.gov/articles/7186678/https://atm.amegroups.org/article/view/38037/html
2. **Zanola RL, Donin CB, Bertolini GRF, Buzanello Azevedo MR.**Biomechanical repercussion of sitting posture on lumbar intervertebral discs: A systematic review. Journal of Bodywork and Movement Therapies. 2024;38:384–390. https://pubmed.ncbi.nlm.nih.gov/38763583/https://www.sciencedirect.com/science/article/pii/S1360859224000330
3. **Yang Y, Liu S, Ling M, Ye C.**Prevalence and potential risk factors for occupational low back pain among male military pilots: A study based on questionnaire and physical function assessment. Frontiers in Public Health. 2022;9:744601.https://pmc.ncbi.nlm.nih.gov/articles/PMC8764305/
4. **Hosseinifar M, Akbari A, Ghiasi F, Shamsoaldini N, Shahraki R.** The effects of proprioceptive neuromuscular facilitation exercises on pain, function, lumbar mobility, and lumbar lordosis in patients with non-specific chronic low back pain. Global Journal of Health Science. 2016;9(2):271–279.
5. **Kim BR, Lee HJ.**Effects of proprioceptive neuromuscular facilitation-based abdominal muscle strengthening training on pulmonary function, pain, and functional disability index in chronic low back pain patients. Journal of Exercise Rehabilitation. 2017;13(4):486–490.https://pubmed.ncbi.nlm.nih.gov/29114517/
6. **Areeudom wong P, Wongrat W, Neammesri N, Thongsakul T.**A randomized controlled trial on the long-term effects of proprioceptive neuromuscular facilitation training on pain-related outcomes and back muscle activity in patients with chronic low back pain. Musculoskeletal Care. 2017;15(3):218–229.https://pubmed.ncbi.nlm.nih.gov/27791345/
7. **Park K, Seo K.**The effects on the pain index and lumbar flexibility of obese patients with low back pain after PNF scapular and PNF pelvic patterns. Journal of Physical Therapy Science. 2014;26(10):1571–1574.https://pmc.ncbi.nlm.nih.gov/articles/PMC4210400/https://www.jstage.jst.go.jp/article/jpts/26/10/26_jpts-2014-094/_article
8. **Gao P, Tang F, Liu W, Mo Y.**The effects of proprioceptive neuromuscular facilitation in treating chronic low back pain: A systematic review and meta-analysis. Journal of Back and Musculoskeletal Rehabilitation. 2022;35(1):21–33.
9. **Mavromoustakos S, Beneka A, Malliou V, Adamidis A, Kellis E, Kagiaoglou A.**Effects of a 6-week proprioceptive neuromuscular facilitation intervention on pain and disability in individuals with chronic low back pain. Journal of Physical Activity, Nutrition and Rehabilitation. 2015;1:1–10.
10. **Andersen K, Baardsen R, Dalen I, Larsen JP.** Impact of exercise programs among helicopter pilots with transient low back pain. BMC Musculoskeletal Disorders. 2017;18:269.https://pubmed.ncbi.nlm.nih.gov/28633669/https://link.springer.com/article/10.1186/s12891-017-1631-0
11. **Fritz JM, Irrgang JJ.**A comparison of a modified Oswestry Low Back Pain Disability Questionnaire and the Quebec Back Pain Disability Scale. Physical Therapy. 2001;81(2):776–788.https://pubmed.ncbi.nlm.nih.gov/11175676/https://academic.oup.com/ptj/article-abstract/81/2/776/2829542