

Sacroiliac Joint-Stability Versus Paraspinal-Stability Kinesio Taping Combined with Manual Therapy for Chronic Low Back Pain in Post-Menopausal Women: A Randomised Controlled Trial

Oeisy Dutta¹, Dr. Vaishali Chaudhary², Monika Sharma³

¹Master Scholar, Department of Physiotherapy, Institute of Applied Medicine and Research (IAMR), AtalBihari Vajpayee Medical University UP, Lucknow, Uttar Pradesh, India, Email-dtoeisy@gmail.com

²Associate Professor, Department of Physiotherapy, Institute of Applied Medicine and Research (IAMR), AtalBihari Vajpayee Medical University UP, Lucknow, Uttar Pradesh, India Email- vaishali.chaudhary@iamr.ac.in

³Professor, Department of Physiotherapy, Institute of Applied Medicine and Research (IAMR), AtalBihari Vajpayee Medical University UP, Lucknow, Uttar Pradesh, India Email-drmonikasharma05@gmail.com

Abstract

Background. Chronic low back pain is more prevalent and disabling in post-menopausal women. Oestrogen withdrawal may compromise sacroiliac joint (SIJ) force closure and lumbar extensor endurance. This study compared two clinically targeted kinesio taping applications.

Objective. To compare SIJ-stability with paraspinal-stability taping, each added to identical manual therapy, in post-menopausal women with chronic non-specific low back pain.

Methods. In this parallel-group randomised controlled trial, 76 post-menopausal women aged 50–60 years with low back pain for ≥3 months were allocated 1:1 using concealed allocation. Outcome assessor and analyst were blinded. Both groups received six weeks of identical manual therapy, motor-control retraining and home exercise, with 2–3 sessions/week. Group A received SIJ/pelvic taping; Group B received longitudinal lumbar-paraspinal taping. Primary outcome was the Oswestry Disability Index (ODI); secondary outcomes were Numerical Pain Rating Scale (NPRS), Active Straight Leg Raise (ASLR), and Biering-Sørensen trunk extensor endurance. Between-group change was analysed with independent t-tests and ANCOVA adjusted for baseline.

Results. All 76 participants completed the trial. Both groups improved in all outcomes ($p < 0.001$). Group A improved more in ODI (between-group difference in change -6.24 points, 95% CI -7.17 to -5.30), NPRS (-1.00 , -1.23 to -0.77), and ASLR (-0.50 , -0.66 to -0.34), all $p < 0.001$. Group B improved more in trunk extensor endurance (5.92 s, 4.40 to 7.44 ; $p < 0.001$). ANCOVA and non-parametric sensitivity analyses agreed. Only mild, transient skin irritation was reported.

Conclusion. Both strategies improved outcomes, but the application site was associated with a different pattern of benefit: pelvic taping produced greater gains in disability, pain and load transfer, whereas paraspinal taping produced greater gains in extensor endurance.

Keywords: chronic low back pain; postmenopause; kinesio taping; sacroiliac joint; manual therapy; randomised controlled trial

1. Introduction

Low back pain is a major contributor to disability worldwide, with prevalence in women exceeding that in age-matched men and increasing after the menopausal transition [1–3]. Menopause-related oestrogen withdrawal is associated with changes in collagen turnover, muscle mass, ligamentous stiffness, proprioception and pain modulation [4–6]. Post-menopausal women may consequently experience greater lumbar degeneration, vertebral fracture risk and persistent symptoms [7–9].

The lumbopelvic region transfers load between the trunk and lower limbs through passive restraints, active muscular compression and neural control. SIJ stability depends substantially on force closure from surrounding muscles and fascial slings, whereas lumbar segmental control relies on deep paraspinal muscles, particularly multifidus [10,11]. Reduced pelvic ligamentous stiffness and lumbar extensor atrophy may coexist after menopause [12–14].

Manual therapy can reduce pain and stiffness and facilitate motor-control retraining [15]. Kinesio taping is frequently used as an adjunct because elastic tape may alter cutaneous afferent input and muscle activation while permitting movement. Evidence in chronic low back pain is inconsistent: meta-analyses report small short-term effects [16,17], while several trials found no advantage over sham taping or exercise/manual therapy alone [18–20]. Other trials reported functional or mobility benefits and suggested that targeted applications may outperform generic lumbar applications [21–23].

Most previous studies compare taping with sham or usual care rather than directly comparing different taping

applications. The present trial therefore compared SIJ-stability taping, intended to augment pelvic force closure, with paraspinal-stability taping, intended to facilitate lumbar extensor control, while keeping manual therapy and exercise identical. The hypothesis was that the pelvic application would produce greater improvement in disability, pain and lumbopelvic load transfer.

2. Methods

2.1 Design and setting

This prospective, parallel-group, two-arm randomised controlled trial used a 1:1 allocation ratio and pre-test/post-test assessment. Participants were recruited from the physiotherapy outpatient department of the Institute of Applied Medicines and Research, Ghaziabad, and affiliated clinical centres, between [start date] and [end date]. Reporting followed CONSORT 2010 [25]. The trial was prospectively registered with the Clinical Trials Registry–India ([registration number]).

2.2 Ethical approval

The study was approved by the Institutional Ethics Committee of the Institute of Applied Medicines and Research ([reference number], [date]) and conducted according to the Declaration of Helsinki. Written informed consent was obtained from all participants.

2.3 Participants

Eligible participants were post-menopausal women aged 50–60 years, defined as ≥ 12 consecutive months of amenorrhoea or surgical menopause, with non-specific pain between the costal margins and gluteal folds for ≥ 3 months, mild-to-moderate pain/disability, willingness to attend supervised sessions, and informed consent. Exclusion criteria were specific spinal pathology, progressive neurological deficit, recent/planned lumbar surgery, severe osteoporosis, skin allergy or open wounds at the taping site, recent spinal injection or physiotherapy, and cognitive/communication impairment preventing participation. Eligible women were recruited consecutively until the target sample was reached.

2.4 Randomisation and blinding

After baseline assessment, a computer-generated sequence was used. Allocation was concealed in sequentially numbered, sealed, opaque envelopes prepared by an independent person. The outcome assessor and data analyst remained blinded. Participants and treating therapists could not be blinded because the applications were visibly different.

2.5 Interventions

Both groups received six weeks of 2–3 supervised sessions/week, 30–45 minutes/session. Each session included a brief pain/function/skin check, 10 minutes of moist heat to the lumbosacral region, identical manual therapy (lumbar and gluteal soft-tissue mobilisation followed by graded lumbar/SIJ mobilisation), and a common home programme of spinal mobility, deep abdominal and multifidus activation, and functional retraining. Participants were asked to avoid additional back-specific treatment and keep medication use stable unless clinically indicated.

2.6 Taping procedures

Group A (SIJ stability): elastic therapeutic tape was applied over the SIJ/pelvic girdle to augment pelvic force closure and load transfer, targeting posterior oblique and lateral sling systems. Anchors were applied without tension and working segments with light-to-moderate tension. Motor-control training emphasised pelvic stability, deep abdominal activation and coordinated multifidus engagement.

Group B (paraspinal stability): tape was applied longitudinally along the lumbar paraspinals from the sacral base toward the lower thoracic region to facilitate segmental spinal control and extensor endurance. Anchors were tension-free and the working portion used light-to-moderate tension along muscle fibres. Training emphasised neutral-spine control, controlled trunk movement and progressive extensor endurance.

Tape was renewed every 3–5 days or earlier if compromised; skin was inspected at every visit. Adherence was

monitored using attendance records and therapist checklists.

2.7 Outcome measures

Primary outcome: Oswestry Disability Index (ODI), a 10-item measure expressed as a percentage; higher scores indicate greater disability [26]. Secondary outcomes were NPRS (0–10), ASLR scored 0–5 with higher scores indicating impaired load transfer [11], and Biering-Sørensen trunk extensor endurance, recorded in seconds [27]. Outcomes were assessed at baseline and six weeks by the same blinded assessor.

2.8 Sample size

For the primary outcome, assuming $\alpha=0.05$, 80% power and a standardised effect size of 0.70, 32 participants/group were required. Allowing approximately 15% attrition produced a target of 38/group (total 76).

2.9 Statistical analysis

Continuous variables were summarised as mean $\pm$ SD and categorical variables as counts/percentages. Shapiro–Wilk and residual inspection assessed distributional assumptions; Levene’s test assessed variance homogeneity. Baseline comparability used independent t-tests. Within-group change used paired t-tests with 95% CIs and standardised mean change. Between-group differences in change used independent t-tests with 95% CIs and Cohen’s d, supplemented by ANCOVA adjusting for baseline. Mann–Whitney U tests with rank-biserial correlation were used for sensitivity analyses. Where change variance was zero, Wilcoxon signed-rank testing was used. Tests were two-sided with $p<0.05$. Analysis followed intention-to-treat; because there were no losses to follow-up, this equalled the per-protocol analysis.

3. Results

3.1 Participant flow and baseline characteristics

Seventy-six post-menopausal women were randomised, 38 to each group, and all completed the six-week programme. All 76 provided complete outcome data. Mean age was 60.5 $\pm$ 6.2 years in Group A and 58.6 $\pm$ 7.3 years in Group B; mean BMI was 25.0 and 25.4 kg/m², respectively. Groups did not differ significantly on demographic, anthropometric or baseline clinical variables (all $p>0.05$).

Table 1. Baseline demographic, anthropometric and clinical characteristics. Values are mean $\pm$ SD. Group A = SIJ-stability taping; Group B = paraspinal-stability taping.

Variable	Group A (n=38)	Group B (n=38)	p
Age (years)	60.53 $\pm$ 6.22	58.55 $\pm$ 7.33	0.210
Height (cm)	157.76 $\pm$ 6.43	157.87 $\pm$ 5.72	0.940
Weight (kg)	61.89 $\pm$ 7.97	63.00 $\pm$ 7.61	0.538
BMI (kg/m ²)	24.99 $\pm$ 3.89	25.43 $\pm$ 3.97	0.629
Pain duration (months)	13.76 $\pm$ 5.53	15.08 $\pm$ 5.04	0.282
ODI (%)	49.50 $\pm$ 3.72	48.00 $\pm$ 4.33	0.109
NPRS	7.29 $\pm$ 0.87	7.05 $\pm$ 0.80	0.221
ASLR (0–5)	2.47 $\pm$ 0.51	2.45 $\pm$ 0.50	0.821
Biering-Sørensen (s)	54.47 $\pm$ 6.19	56.53 $\pm$ 6.54	0.164

3.2 Within-group change

Both groups showed statistically significant improvement in every outcome ($p<0.001$). Group A ODI decreased by 18.71 points, NPRS by 3.47 points, ASLR by 1.50 points, and endurance increased by 19.58 s. Group B ODI decreased by 12.47 points, NPRS by 2.47 points, ASLR by 1.00 point, and endurance increased by 25.50 s. All participants achieved at least a 10-point ODI improvement and ≥ 2 -point NPRS reduction. In Group B, all participants improved by exactly one ASLR point; therefore the paired t statistic was not estimable and Wilcoxon testing was used ($p<0.001$).

Table 2. Within-group changes. All reported within-group tests were $p<0.001$.

Outcome	Group A: baseline→6 wk	Change	Group B: baseline→6 wk	Change
ODI (%)	49.50→30.79	-18.71	48.00→35.53	-12.47
NPRS	7.29→3.82	-3.47	7.05→4.58	-2.47
ASLR	2.47→0.97	-1.50	2.45→1.45	-1.00
Endurance (s)	54.47→74.05	+19.58	56.53→82.03	+25.50

3.3 Between-group comparison

Group A improved more in ODI (difference in change -6.24 points; 95% CI -7.17 to -5.30), NPRS (-1.00; -1.23 to -0.77) and ASLR (-0.50; -0.66 to -0.34), all $p<0.001$. Group B improved more in trunk extensor endurance (Group A minus Group B -5.92 s; 95% CI -7.44 to -4.40; $p<0.001$).

Table 3. Between-group comparison of change scores. Difference = Group A minus Group B.

Outcome	Group A change	Group B change	Between-group difference (95% CI)	p
ODI (%)	-18.71±2.26	-12.47±1.80	-6.24 (-7.17 to -5.30)	<0.001
NPRS	-3.47±0.51	-2.47±0.51	-1.00 (-1.23 to -0.77)	<0.001
ASLR	-1.50±0.51	-1.00±0.00	-0.50 (-0.66 to -0.34)	<0.001
Endurance (s)	+19.58±3.28	+25.50±3.38	-5.92 (-7.44 to -4.40)	<0.001

3.4 Adjusted and sensitivity analyses

Post-intervention comparisons and ANCOVA adjusting for baseline gave the same direction and similar magnitude of between-group effects. Non-parametric sensitivity analyses also agreed with the primary analysis.

Table 4. Six-week values: unadjusted and baseline-adjusted between-group differences (Group A minus Group B).

Outcome	Unadjusted difference	p	Baseline-adjusted difference	p
ODI (%)	-4.74 (-6.90 to -2.57)	<0.001	-6.33 (-7.28 to -5.38)	<0.001
NPRS	-0.76 (-1.22 to -0.30)	0.001	-1.01 (-1.24 to -0.78)	<0.001
ASLR	-0.47 (-0.75 to -0.20)	<0.001	-0.50 (-0.66 to -0.33)	<0.001
Endurance (s)	-7.97 (-11.31 to -4.64)	<0.001	-5.88 (-7.43 to -4.33)	<0.001

Table 5. Non-parametric sensitivity analysis. IQR=interquartile range; U=Mann-Whitney statistic; r=rank-biserial correlation.

Outcome	Group A median change (IQR)	Group B median change (IQR)	U	p	r
ODI	-19.0 (-21.0 to -17.0)	-12.5 (-13.8 to -11.0)	22.0	<0.001	0.97
NPRS	-3.0 (-4.0 to -3.0)	-2.0 (-3.0 to -2.0)	180.0	<0.001	0.75
ASLR	-1.5 (-2.0 to -1.0)	-1.0 (-1.0 to -1.0)	361.0	<0.001	0.50
Endurance	20.0 (16.2 to 22.0)	25.0 (22.2 to 29.0)	171.5	<0.001	0.76

3.5 Adverse events

No serious adverse events were recorded. The source manuscript reports mild, transient skin irritation beneath the tape but leaves the number of affected participants as [Insert number]. No participant reported symptom exacerbation following manual therapy.

4. Discussion

4.1 Principal findings

Both taping applications, when added to identical manual therapy and exercise, improved disability, pain, lumbopelvic load transfer and extensor endurance over six weeks. The pattern of benefit differed: SIJ-stability taping produced greater improvement in ODI, NPRS and ASLR, whereas paraspinal-stability taping produced greater improvement in trunk extensor endurance. Thus, the interventions were not interchangeable across outcomes.

4.2 Interpretation

The findings are consistent with the proposed biomechanical rationale. Pelvic taping is intended to augment SIJ force closure through compressive input involving posterior oblique and lateral sling systems. In a population in whom pelvic passive restraint may be reduced, improved load transfer could explain the greater ASLR response [11]. Paraspinal taping is applied along the lumbar extensors and may facilitate activation through cutaneous afferent input; the larger endurance gain in the paraspinal group is consistent with that target.

Both groups nevertheless improved substantially across domains, which is expected because manual therapy, motor-control retraining and home exercise were identical. The taping application may therefore have modified the distribution of benefit rather than generated the entire improvement.

Participants and therapists were unblinded, so expectation effects cannot be excluded. In addition, without a sham-taping or no-taping arm, the study cannot isolate the specific contribution of tape from the effect of the accompanying exercise emphasis.

4.3 Comparison with existing literature

The finding that application site may influence outcome is consistent with studies suggesting benefits from targeted rather than generic applications [22,23]. The present study directly compared two mechanistically distinct applications in a post-menopausal population. The large within-group improvements are greater than effects commonly reported in meta-analyses [16,17] and should be interpreted in light of the active comparator and the intensive six-week package of manual therapy, supervised motor-control training, home exercise and taping [18–20]. Independent replication is warranted.

4.4 Clinical implications

If replicated, the results support selecting the taping application according to the dominant impairment rather than applying one technique uniformly. A pelvic application may be considered when disability and single-limb loading difficulty are prominent, whereas a paraspinal application may be considered when sustained or repetitive trunk-extension endurance is the principal deficit. The complementary pattern also raises the possibility of reassessment and changing the application as the dominant impairment changes; this requires formal evaluation.

4.5 Strengths and limitations

Strengths include random allocation with concealed sequence, blinded outcome assessment, identical co-interventions in both arms, complete follow-up, and validated outcome measures with a predefined primary endpoint.

Limitations include the absence of a sham-taping or manual-therapy-only arm, preventing isolation of the tape-specific effect; inability to blind participants and therapists; six-week follow-up only; clinical rather than instrumented outcomes; single-centre/consecutive recruitment; menopausal status established by history without hormonal assay; and no recording of bone mineral density or menopausal hormone therapy. The unusually large effect estimates and low variability also warrant independent replication in larger multicentre samples.

5. Conclusion

SIJ-stability and paraspinal-stability kinesio taping, each combined with manual therapy and exercise, were associated with improvements in pain, disability, lumbopelvic load transfer and extensor endurance in post-menopausal women with chronic low back pain over six weeks. Pelvic taping produced greater gains in

disability, pain and load transfer, while paraspinal taping produced greater gains in trunk extensor endurance. Confirmation in sham-controlled trials with longer follow-up is required.

Declarations

Ethics approval and consent to participate. Approved by the Institutional Ethics Committee of the Institute of Applied Medicines and Research, Ghaziabad ([reference number], [date]). All participants gave written informed consent.

Consent for publication. Not applicable.

Availability of data and materials. Dataset available from the corresponding author on reasonable request.

Competing interests. The authors declare no competing interests.

Funding. No specific grant from any funding agency was received.

Authors' contributions. [Initials] conceived/ designed the study, collected data and drafted the manuscript. [Initials] supervised the study, contributed to design/interpretation and critically revised the manuscript. All authors read and approved the final manuscript.

Acknowledgements. The authors thank the participants and staff of the Department of Physiotherapy, Institute of Applied Medicines and Research, Ghaziabad.

References

1. Xu J, Lei M, Xu D. Global, regional, and national burden of low back pain in postmenopausal women from 1990 to 2021: a comprehensive analysis using data from the Global Burden of Disease Study 2021. *Front Endocrinol (Lausanne)*. 2025;16.
2. Wáng YXJ, Wáng JQ, Káplár Z. Increased low back pain prevalence in females than in males after menopause age: evidences based on synthetic literature review. *Quant Imaging Med Surg*. 2016;6(2):199-206.
3. Wang YXJ. Menopause as a potential cause for higher prevalence of low back pain in women than in age-matched men. *J Orthop Translat*. 2017;8:1-4.
4. Shuster LT, Rhodes DJ, Gostout BS, Grossardt BR, Rocca WA. Premature menopause or early menopause: long-term health consequences. *Maturitas*. 2010;65(2):161-6.
5. Khadilkar SS. Musculoskeletal disorders and menopause. *J Obstet Gynaecol India*. 2019;69(2):99-103.
6. Juppí H, Sipilä S, Fachada V, Hyvärinen M, Cronin N, Aukee P, et al. Total and regional body adiposity increases during menopause: evidence from a follow-up study. *Aging Cell*. 2022;21(1):e13621.
7. Heuch I, Heuch I, Hagen K, Storheim K, Zwart JA. Menopausal hormone therapy, oral contraceptives and risk of chronic low back pain: the HUNT Study. *BMC Musculoskelet Disord*. 2023;24(1).
8. Xu HW, Yi YY, Zhang SB, Hu T, Wang SJ, Zhao WD, et al. Does vitamin D status influence lumbar disc degeneration and low back pain in postmenopausal women? A retrospective single-center study. *Menopause*. 2020;27(5):586-92.
9. Sawicki P, Tałalaj M, Życińska K, Zgliczyński WS, Wierzbą W. Comparison of the characteristics of back pain in women with postmenopausal osteoporosis with and without vertebral compression fracture. *Med Sci Monit*. 2021;27:e930052.
10. Vleeming A, Schuenke MD, Masi AT, Carreiro JE, Danneels L, Willard FH. The sacroiliac joint: an overview of its anatomy, function and potential clinical implications. *J Anat*. 2012;221(6):537-67.
11. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. *Spine (Phila Pa 1976)*. 2001;26(10):1167-71.
12. Spencer L, McKenna L, Fary R, Jacques A, Briffa K. Upper back pain in postmenopausal women and associated physical characteristics. *PLoS One*. 2019;14(7):e0220452.
13. Kanwal S, Yaqoob I, Shakil-Ur-Rehman S, Ghous M, Ghazal J, Namroz N. Effects of core muscle stability on low back pain and quality of life in postmenopausal women: a comparative study. *J Pak Med Assoc*. 2021;71(1-A):37-40.
14. Midhuna MK. Effect of paraspinal strengthening exercise on the level of low back pain among post menopausal women. *Glob J Res Anal*. 2022;11(9).

15. Espírito Santo J, Moita J, Nunes A. The efficacy of manual therapy on musculoskeletal pain in menopause: a systematic review. *Healthcare (Basel)*. 2024;12.
16. Sheng Y, Duan Z, Qu Q, Chen W, Yu B. Kinesio taping in treatment of chronic non-specific low back pain: a systematic review and meta-analysis. *J Rehabil Med*. 2019;51(10):734-40.
17. Luz Júnior MA, Almeida MO, Santos RS, Civile VT, Costa LOP. Effectiveness of kinesio taping in patients with chronic nonspecific low back pain: a systematic review with meta-analysis. *Spine (Phila Pa 1976)*. 2019;44(1):68-78.
18. da Luz MA, Sousa MV, Neves LAFS, Cezar AAC, Costa LOP. Kinesio Taping is not better than placebo in reducing pain and disability in patients with chronic non-specific low back pain: a randomized controlled trial. *Braz J Phys Ther*. 2015;19(6):482-90.
19. Castro-Sánchez AM, Lara-Palomo IC, Matarán-Peñarrocha GA, Fernández-Sánchez M, Sánchez-Labraca N, Arroyo-Morales M. Kinesio Taping reduces disability and pain slightly in chronic non-specific low back pain: a randomised trial. *J Physiother*. 2012;58(2):89-95.
20. Added MAN, Costa LOP, de Freitas DG, Fukuda TY, Monteiro RL, Salomão EC, et al. Kinesio taping does not provide additional benefits in patients with chronic low back pain who receive exercise and manual therapy: a randomized controlled trial. *J Orthop Sports Phys Ther*. 2016;46(7):506-13.
21. Uzunkulaoğlu A, Aytekin MG, Ay S, Ergin S. The effectiveness of Kinesio taping on pain and clinical features in chronic non-specific low back pain: a randomized controlled clinical trial. *Turk J Phys Med Rehabil*. 2018;64(2):126-32.
22. Peñalver-Barrios ML, Lison JF, Ballester-Salvador J, Schmitt J, Ezzedinne-Angulo A, Arguisuelas MD, et al. A novel (targeted) kinesio taping application on chronic low back pain: randomized clinical trial. *PLoS One*. 2021;16(5):e0250686.
23. Sonel Tur B, Karacif D, Ay S, Gökmen D, Can Ozdemir E, Evcik D. Exercise and two different kinesio taping techniques in patients with sacroiliac joint dysfunction: a randomized controlled trial. *Turk J Phys Med Rehabil*. 2025;71(3):274-83.
24. Elbasti MS, Akcan K. The effect of kinesio tape application on clinical parameters in postmenopausal women with chronic low back pain: a randomized controlled study. *Cureus*. 2024;16(11).
25. Schulz KF, Altman DG, Moher D; CONSORT Group. CONSORT 2010 statement: updated guidelines for reporting parallel group randomised trials. *BMJ*. 2010;340:c332.
26. Fairbank JC, Pynsent PB. The Oswestry Disability Index. *Spine (Phila Pa 1976)*. 2000;25(22):2940-52.
27. Biering-Sørensen F. Physical measurements as risk indicators for low-back trouble over a one-year period. *Spine (Phila Pa 1976)*. 1984;9(2):106-19.
28. Ostelo RW, Deyo RA, Stratford P, Waddell G, Croft P, Von Korf M, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)*. 2008;33(1):90-4.
29. Alahmari KA, Rengaramanujam K, Reddy RS, Samuel PS, Tedla JS, Kakaraparthi VN, et al. The immediate and short-term effects of dynamic taping on pain, endurance, disability, mobility and kinesiophobia in individuals with chronic non-specific low back pain: a randomized controlled trial. *PLoS One*. 2020;15(9):e0239505.
30. Blanco-Giménez P, Vicente-Mampel J, Gargallo P, Maroto-Izquierdo S, Martín-Ruiz J, Jaenada-Carrilero E, et al. Effect of exercise and manual therapy or kinesiotaping on sEMG and pain perception in chronic low back pain: a randomized trial. *BMC Musculoskelet Disord*. 2024;25(1).
31. Trobec K, Peršolja M. Efficacy of kinesio taping in reducing low back pain: a comprehensive review. *J Health Sci*. 2019;7(1):1-8.
32. Opara JA, Fiałkowski T. The effect of kinesiology taping on posture, balance, and gait in patients suffering from low back pain. *Diagnostics (Basel)*. 2024;14(22).
33. Grase MO, Elhafez HM, Abdellatif MM, Genedi AF, Mahmoud MA. Effect of instrument assisted soft tissue mobilization versus kinesiotape for chronic mechanical low back pain: a randomized controlled trial. *Physiother Q*. 2023;31(2):27-33.
34. Alrwaily M, Schneider M, Sowa G, Timko M, Whitney SL, Delitto A. Stabilization exercises combined with neuromuscular electrical stimulation for patients with chronic low back pain: a randomized controlled trial.

Braz J Phys Ther. 2019;23(6):506-15.

35. Nageswari C. The effectiveness of Pilates exercise training on selected post-menopausal women with non-specific low back pain in improving pain, flexibility and endurance: a pilot study. Int J Biosci. 2024.

36. Yerra A, Bala S, Yalamanchili R, Bandaru R, Mavoori A. Menopause-related quality of life among urban women of Hyderabad, India. J Midlife Health. 2021;12(2):161.

37. Madhavudu MV, Janani, Divya N, Ranganathan P, Mahesh PG, Subramanyan HHPV, et al. Determining the predominant risk factor of low back pain among pre-menopausal and post-menopausal women. Int J Exp Res Rev. 2023;34:36-43.

38. Ahmed MA, Awad MA, Botla AM, Abo-Elenien MF, Mansour AA. Effect of kinesiotape versus myofascial release on postnatal low back pain: a randomized controlled trial. Phys Rehabil Recreat Health Technol. 2025;10(6):389-96.