

Comparative Efficacy of Stretching and Strengthening Exercise Programs on Sleep Quality and Musculoskeletal Pain in Postmenopausal Women: A Randomized Controlled Trial

Neha Chopra¹; Sumedha Bhatia²

¹Phd. Scholar; ²Phd

^{1,2}Chandigarh University Mohali, Punjab

Publication Date: 2026/10/03

Abstract: Postmenopause is associated with a decline in estrogen levels, resulting in several musculoskeletal and psychological symptoms that adversely affect women's health. Among these, musculoskeletal pain and sleep disturbances are the most frequently reported complaints, leading to impaired functional ability and reduced quality of life. Exercise therapy is recommended as a first-line non-pharmacological intervention; however, evidence directly comparing stretching and strengthening exercise programs for improving sleep quality and musculoskeletal pain in postmenopausal women remains limited. A randomized controlled trial was conducted among 40 postmenopausal women aged 45–65 years. Participants were recruited through convenient sampling and randomly allocated into two equal groups: Group A (n = 20) received a supervised stretching exercise program, and Group B (n = 20) performed supervised strengthening exercises. Both groups underwent supervised exercise sessions three times per week for eight weeks. Outcome measures included sleep quality assessed using the Pittsburgh Sleep Quality Index (PSQI) and musculoskeletal pain evaluated using the Visual Analogue Scale (VAS). Pre- and post-intervention scores were analyzed using paired and independent *t*-tests, with the level of statistical significance set at $p < 0.05$. Both intervention groups demonstrated statistically significant improvements in sleep quality and musculoskeletal pain following the eight-week intervention ($p < 0.05$). The strengthening exercise group showed greater improvement in pain reduction, whereas the stretching exercise group exhibited superior improvement in sleep quality. Overall, both stretching and strengthening exercise programs were effective physiotherapeutic interventions for improving sleep quality and reducing musculoskeletal pain in postmenopausal women. However, stretching exercises were comparatively more beneficial for enhancing sleep quality, while strengthening exercises produced greater reductions in pain.

Keywords: Postmenopause, Stretching Exercises, Strengthening Exercises, Sleep Quality, Musculoskeletal Pain, Pittsburgh Sleep Quality Index (PSQI), Visual Analogue Scale (VAS), Physiotherapy.

How to Cite: Neha Chopra; Sumedha Bhatia (2026) Comparative Efficacy of Stretching and Strengthening Exercise Programs on Sleep Quality and Musculoskeletal Pain in Postmenopausal Women: A Randomized Controlled Trial.

International Journal of Innovative Science and Research Technology, 11(9), 2676-2680.

<https://doi.org/10.38124/ijisrt/26sep915>

I. INTRODUCTION

Menopause is a normal physiological change whereby menstruation is permanently stopped after the ovarian follicles have lost their function. It is diagnosed when 12 months of amenorrhea has occurred without any pathological or physiological reasons.¹ Due to the extended life expectancy, women currently spend almost a third of their lives in the postmenopausal stage.² Estrogen deficiency also causes bone loss, loss of muscle mass, loss of collagen production, inflammatory activity, musculoskeletal pain and

poor physical functionality.^{3–5} Sleep disorders occur in about 40–60% of postmenopausal women and are linked to fatigue, poor cognition, depression, anxiety, poor physical performance, and poor quality of life.^{6,7} Sleep disturbances and chronic pain have a bidirectional relationship, with each condition exacerbating the other.⁸ Exercise therapy is considered one of the most effective non-pharmacological interventions for menopausal symptoms and is recommended by international guidelines.^{9,10} Stretching exercises improve flexibility, reduce muscle stiffness, enhance circulation, and promote relaxation, potentially

improving sleep quality through increased parasympathetic activity.^{11,12} Strengthening exercises improve muscle strength, joint stability, bone mineral density, and physical function while reducing musculoskeletal pain.^{13,14}

II. MATERIALS AND METHODS

➤ Study Design:

Randomized controlled trial (RCT) ,Sampling technique: Simple random sampling , At Dasmesh College of Physiotherapy, Faridkot, Punjab .A total of 40 postmenopausal women aged 45-65 years participated in the study. Participants were equally allocated into two intervention groups: Group A (Stretching Exercise Program): n=20, Group B (Strengthening Exercise Program): n=20 .

➤ Inclusion Criteria:

Women aged 45–65 years, Had experienced natural menopause for at least 12 consecutive months, Reported musculoskeletal pain involving one or more joints ,Had poor sleep quality (PSQI score > 5) ,Were willing to participate and provide informed consent ,Were able to perform the prescribed exercises independently.

➤ Exclusion Criteria:

Patients who are receiving hormone replacement therapy ,Had inflammatory arthritis or severe osteoarthritis requiring surgery ,Had recent fractures or orthopedic surgery ,Had neurological disorders affecting mobility ,Had uncontrolled hypertension or cardiovascular disease ,Had severe psychiatric illness ,Had cognitive impairment.

➤ Outcome Measures:-

Pittsburgh Sleep Quality Index (PSQI).The total score ranges from 0 to 21, with higher scores indicating poorer sleep quality ,Visual Analogue Scale (VAS).The VAS consists of a 10-cm horizontal line:0 = No pain ,10 = Worst imaginable pain .Participants marked their average pain intensity during the previous week.

➤ Intervention Protocol:

Each participant attended supervised physiotherapy sessions three times per week for eight weeks and Each session lasted approximately 40–45 minutes.

• Group A: Stretching Exercise Program:

The stretching program focused on improving flexibility, reducing muscle stiffness, and promoting relaxation.Warm-up (5–10 minutes) :-Slow walking ,Deep breathing exercises ,Gentle active range-of-motion exercises.

✓ Stretching Exercises:

Each stretch was held for 30 seconds, repeated three times with a 15-second rest between repetitions.Cervical stretching :- The participant sat comfortably with the spine erect. The head was slowly flexed, extended, and laterally flexed until a gentle stretch was felt. Each position was maintained for 30 seconds and repeated three times. (1,3),Upper trapezius stretch :-The participant sat upright

and gently tilted the head toward one shoulder while keeping the opposite shoulder relaxed. Gentle overpressure was applied using the hand to increase the stretch. (1,3),Pectoralis stretch :-The participant stood in a doorway with the forearm resting against the door frame and gently leaned forward until a stretch was felt across the chest. (1,4),Shoulder stretch:- One arm was brought across the chest while the opposite hand gently pulled the arm toward the body until a comfortable stretch was achieved. (1,4),Hamstring stretch :-The participant sat with one knee extended and leaned forward from the hips while maintaining a neutral lumbar spine until a gentle stretch was felt. (1,4),Quadriceps stretch :-Standing with support, the participant flexed the knee and grasped the ankle, bringing the heel toward the buttock. (1,4),Hip flexor stretch:- The participant assumed a half-kneeling lunge position and shifted body weight forward until a stretch was felt over the anterior hip. (1,4) ,Calf (gastrocnemius–soleus) stretch :- Standing facing a wall, the participant leaned forward while keeping the back heel on the floor. (1,4),Gluteal stretch :- In the supine position, one knee was pulled toward the opposite shoulder until a gentle stretch was perceived in the gluteal region. (1,4),Lumbar flexion stretch :-While lying supine, both knees were drawn toward the chest using both hands until a comfortable stretch was felt. (1,5),Lower back rotational stretch:- The participant lay supine with both knees flexed and slowly rotated the knees to each side while keeping both shoulders in contact with the surface. (1,5).For Cool-down Diaphragmatic breathing ,Relaxation exercises were done.

• Group B: Strengthening Exercise Program:

The strengthening program emphasized progressive resistance exercises targeting major muscle groups.Warm-up (5–10 minutes):-Walking ,Dynamic mobility exercises .Strengthening Exercises:-Each exercise consisted of 3 sets of 10–15 repetitions, with resistance progressively increased according to participant tolerance.Quadriceps Strengthening: Participants performed static quadriceps contractions by tightening the anterior thigh muscles while maintaining full knee extension. (1,4), Straight Leg Raise : From the supine position, one lower limb was raised approximately 45° while maintaining knee extension and then slowly lowered. (1,4), Short Arc Quadriceps : A bolster was placed beneath the knee, and the participant actively extended the knee until full extension was achieved. (1,4) Hamstring Curl : Standing with support, the participant flexed the knee, bringing the heel toward the buttock. (1,4) Hip Abduction: In side-lying, the upper leg was lifted while maintaining knee extension and neutral hip alignment. (1,4) Hip Extension : Standing with support, one lower limb was extended posteriorly while maintaining trunk stability. (1,4) Bridging : From the supine position with knees flexed, the pelvis was elevated until the trunk and thighs formed a straight line. (1,5)Gluteal Strengthening: Participants performed voluntary gluteal contractions while maintaining normal breathing. (1,4) Core Stabilization Exercises: Abdominal bracing exercises were performed while maintaining normal breathing. (1,5) Heel Raises : Standing with support, participants rose onto their toes and slowly returned to the starting position. (1,4) Sit-to-Stand Training : Participants repeatedly stood up from a

standard chair and returned to sitting in a controlled manner. (1,4).Resistance was increased gradually using:-Body weight ,Resistance bands ,Ankle weights (where appropriate) .For Cool-down Gentle stretching ,Deep breathing exercises were done.

➤ Outcome Assessment

Participants were assessed at:

- Baseline (Week 0)
- Post-intervention (Week 8)

III. RESULT

Table 1 Paired T-test for Comparison at PRE (0th Day) and after POST (4th Weeks) Score Measurements of VAS and PSQI within Group A

Paired t-test	VAS		PSQI	
	PRE	POST	PRE	POST
Mean	7.20	4.45	14.35	11.15
S.D.	0.833	0.944	3.048	3.674
Number	20	20	20	20
Mean Diff.	2.75		3.20	
Df	19		19	
Paired t-test	12.724		14.236	
P-value	<0.001		<0.005	
Result	Significant		Significant	

Table 2 Paired T-test for Comparison at PRE (0th day) and after POST (6th Weeks) Score Measurements of VAS and PSQI within Group B

Paired t-test	VAS		PSQI	
	PRE	POST	PRE	POST
Mean	7.05	2.35	14.10	3.30
S.D.	0.887	0.489	2.845	0.923
Number	20	20	20	20
Mean Diff.	4.70		10.80	
Df	19		19	
Paired t-test	24.313		16.899	
P-value	<0.001		<0.005	
Result	Significant		Significant	

IV. DISCUSSION

The current randomized controlled trial involved the comparison of the effectiveness of the exercise programs of stretching and strengthening on the quality of sleep and musculoskeletal pain in postmenopausal women. The two interventions showed considerable improvements at the end of eight weeks of supervised exercise and this shows that exercise therapy is an effective non-pharmacological treatment of menopausal symptoms. Nevertheless, the stretching exercises led to an improvement in the quality of sleep, and strengthening exercises led to the best improvements in musculoskeletal pain. (9,10,15)

These results are in line with the increasing evidence that exercise interventions are beneficial in terms of physical and psychological health in postmenopausal women. Postmenopausal hormonal changes, especially estrogen deficiency, are some of the factors that lead to decreased muscle mass, stiffness of joints, loss of collagen synthesis, and sleep disorders. These physiological changes are alleviated through exercise as it enhances muscle performance, improves circulation, decreases inflammation, and enhances neuroendocrine adaptations. (3–5,9,10)

The difference in the quality of sleep in the stretching group was greater, which can be attributed to the relaxation response that is triggered during the long stretching. Stretching boosts the activity of the parasympathetic nervous system, lowers sympathetic arousal, lowers muscle tension, and increases flexibility, which all help to initiate and maintain sleep. Diaphragmatic breathing, slow and controlled stretching can also help decrease psychological stress and anxiety which are significant causes of insomnia in postmenopausal women. Better circulation and reduction in musculoskeletal discomfort are additional factors that lead to quality sleep. (6,8,11,12)

On the other hand, strengthening exercises were found to be more effective in alleviating musculoskeletal pain. Progressive resistance exercises enhance muscle strength, better joint stability, neuromuscular control and reduction of mechanical load on weight-bearing joints. Enhanced muscular support in the knees, hips, and lumbar spine enhances normal functional movement patterns and reduces pain in the day-to-day activities. Exercises can also be strengthened, which can activate endogenous analgesic substances and enhance metabolic efficiency and help to reduce pain. (13,14,16)

The results of the current study are in line with the previous studies that have shown that routine exercise can alleviate menopausal symptoms. Aibar-Almazan et al. studies have indicated that postmenopausal women who were subjected to structured physical exercise had a significant improvement in sleep quality and health-related quality of life. On the same note, Kovács et al. noted that exercise interventions decreased the severity of insomnia and increased physical functioning and psychological well-being. (15,16)

A number of researchers have also pointed out the advantages of resistance training in alleviating musculoskeletal pain. Howe et al. have shown that progressive strengthening exercises enhance muscle strength, physical performance, and functional capacity and decrease pain and disability in middle-aged and older women. These physiological changes probably underlie the higher decrease in musculoskeletal pain in the strengthening group in the current study. (14,16)

The observed enhancement in both intervention groups highlights the fact that exercise, irrespective of the modality is a viable conservative management approach to postmenopausal symptoms. Flexibility, muscular strength, cardiovascular fitness, balance and overall functional independence are promoted by regular involvement in supervised exercise programs. Moreover, exercise also leads to better mood, less anxiety and self-efficacy, which positively affect the quality of sleep and the perception of pain. (9,10,13,15)

Clinically, physiotherapists are advised to think of exercise prescriptions based on the chief complaints of postmenopausal women. Structured stretching programs can be more effective in women who mainly have sleep disturbances, but progressive strengthening exercises can be more effective in women with chronic musculoskeletal pain. Stretching and strengthening together can be the most beneficial overall and should be investigated in future studies as a safe, cost-effective, and available intervention to manage menopausal symptoms. (9,10,15,16)

V. CONCLUSION

The current randomized controlled trial showed that stretching and strengthening exercise programs were equally effective in enhancing the quality of sleep and minimizing musculoskeletal pain in postmenopausal women, after eight weeks of supervised exercise. Although both forms of exercises were effective, the stretching exercises had more positive effects on sleep quality, and strengthening exercises had more positive effects on musculoskeletal pain.

The results indicate that physiotherapy-based exercise interventions are important and safe, cost-effective, and non-pharmacological treatment methods of managing menopausal symptoms. The exercise programs are to be personalized based on the main clinical complaints of patients. Stretching exercises can be considered as a choice of women whose sleep disturbances are predominant, and

strengthening exercises can be more suitable to women with chronic musculoskeletal pain.

Further research using bigger samples, multicenter recruitment, longer intervention, and long-term follow-up is appropriate to validate such results and identify the most effective combination of exercise modalities as a comprehensive approach to managing postmenopausal health.

REFERENCES

- [1]. World Health Organization. *Research on the menopause in the 1990s: report of a WHO scientific group*. Geneva: World Health Organization; 1996.
- [2]. The North American Menopause Society. The 2022 hormone therapy position statement of The North American Menopause Society. *Menopause*. 2022;29(7):767-794.
- [3]. Cauley JA. Estrogen and bone health in men and women. *Steroids*. 2015;99(Pt A):11-15.
- [4]. Greising SM, Baltgalvis KA, Lowe DA, Warren GL. Hormone therapy and skeletal muscle strength: a meta-analysis. *J Gerontol A Biol Sci Med Sci*. 2009;64(10):1071-1081.
- [5]. Szoek CEI, Cicuttini FM, Guthrie JR, Dennerstein L. The relationship of reports of aches and joint pains to the menopausal transition: a longitudinal study. *Climacteric*. 2008;11(1):55-62.
- [6]. Baker FC, de Zambotti M, Colrain IM, Bei B. Sleep problems during the menopausal transition: prevalence, impact, and management. *Nat Sci Sleep*. 2018;10:73-95.
- [7]. Kravitz HM, Joffe H. Sleep during the perimenopause: a SWAN story. *ObstetGynecol Clin North Am*. 2011;38(3):567-586.
- [8]. Finan PH, Goodin BR, Smith MT. The association of sleep and pain: an update and a path forward. *J Pain*. 2013;14(12):1539-1552.
- [9]. American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 11th ed. Philadelphia: Wolters Kluwer; 2021.
- [10]. The North American Menopause Society. The 2023 nonhormone therapy position statement of The North American Menopause Society. *Menopause*. 2023;30(6):573-590.
- [11]. Behm DG, Wilke J. Do self-myofascial release and stretching improve performance, recovery, and sleep? A systematic review. *Sports Med*. 2019;49(10):1443-1468.
- [12]. Afonso J, Clemente FM, Nakamura FY, Morouço P, Sarmiento H, Inman RA, et al. The effectiveness of stretching in improving sleep quality, stress, and flexibility: a systematic review. *J Sports Med Phys Fitness*. 2021;61(6):906-917.
- [13]. Fragala MS, Cadore EL, Dorgo S, Izquierdo M, Kraemer WJ, Peterson MD, et al. Resistance training for older adults: position statement from the National Strength and Conditioning Association. *J Strength Cond Res*. 2019;33(8):2019-2052.

- [14]. Howe TE, Shea B, Dawson LJ, Downie F, Murray A, Ross C, et al. Exercise for preventing and treating osteoporosis in postmenopausal women. *Cochrane Database Syst Rev*. 2011;(7):CD000333.
- [15]. Aibar-Almazán A, Martínez-Amat A, Cruz-Díaz D, Jiménez-García JD, Achalandabaso A, Sánchez-Montesinos I, et al. Effects of a multimodal exercise program on sleep quality, quality of life, and physical fitness in postmenopausal women: a randomized controlled trial. *Int J Environ Res Public Health*. 2019;16(14):2582.
- [16]. Kovács C, Fekete N, Tóth K, Szabó Z. Effects of exercise training on sleep quality, physical function, and psychological well-being in postmenopausal women. *Menopause*. 2020;27(5):555-562.
- [17]. Kisner C, Colby LA, Borstad J. *Therapeutic Exercise: Foundations and Techniques*. 8th ed. Philadelphia: F.A. Davis; 2023.
- [18]. American College of Sports Medicine. *ACSM's Guidelines for Exercise Testing and Prescription*. 12th ed. Philadelphia: Wolters Kluwer; 2025
- [19]. Magee DJ. *Orthopedic Physical Assessment*. 7th ed. St. Louis: Elsevier; 2021.
- [20]. Hall CM, Brody LT. *Therapeutic Exercise: Moving Toward Function*. 4th ed. Philadelphia: Wolters Kluwer; 2018.
- [21]. McGill SM. *Low Back Disorders: Evidence-Based Prevention and Rehabilitation*. 3rd ed. Champaign, IL: Human Kinetics; 2016.
- [22]. Sharman MJ, Cresswell AG, Riek S. Proprioceptive neuromuscular facilitation stretching: mechanisms and clinical implications. *Sports Medicine*. 2006;36(11):929–939.
- [23]. Garber CE, Blissmer B, Deschenes MR, et al. Quantity and quality of exercise for developing and maintaining cardiorespiratory, musculoskeletal, and neuromotor fitness in apparently healthy adults: guidance for prescribing exercise. *Medicine & Science in Sports & Exercise*. 2011;43 (7):1334–1359.