Research Protocol

DOI: 10.7860/JCDR/2026/91292.24400

Physiotherapy Section

Effect of Blood Flow Restriction Training on Cardiorespiratory Endurance, Quality of Life, and Muscle Strength among Postmenopausal Women: A Research Protocol for a Randomised Clinical Trial

KASHISH MAGGU[1], MANDEEP KUMAR JANGRA[2], AKANKSHA SAXENA[3]

ABSTRACT

Introduction: Postmenopause is a physiological phase that occurs after 45-55 years of age, associated with musculoskeletal, cardiovascular, metabolic and functional changes. Blood Flow Restriction Training (BFRT) is an emerging low-intensity exercise technique that can yield gains in strength and endurance comparable to high-load Resistance Training (RT).

Need of the study: Menopause-related hormonal changes contribute to reduced muscle strength, decline in cardiorespiratory endurance, and impaired Quality of Life (QoL). BFRT has shown positive effects on muscular outcomes; however, evidence regarding its impact on cardiorespiratory endurance and QoL in postmenopausal women remains limited.

Aim: To investigate the effect of BFRT on cardiorespiratory endurance, QoL and muscle strength among postmenopausal women.

Materials and Methods: A randomised clinical trial will be conducted at Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to), Mullana-Ambala, Haryana, India, from May 2026 to March 2027. A total of 70 postmenopausal women aged 45-55 years, will be allocated to the experimental group and control group. The experimental group will receive BFRT with elastic band exercises. In contrast, the control group will receive resistance exercises through an elastic band three times a week for four weeks. Outcomes, including cardiorespiratory endurance, QoL, and muscle strength, will be assessed using the Queen's College step test, a Handheld Dynamometer (HHD), the 5-times sit-to-stand test, and the Menopause-Specific Quality of Life (MENQOL) Questionnaire at baseline and after the intervention period. Shapiro-Wilk test, Parametric tests (paired and independent t-tests) and non parametric tests (Wilcoxon Signed-Rank and Mann-Whitney) will be applied. The p-value <0.05 will be considered statistically significant.

Keywords: Exercise test, Postmenopause, Resistance training

INTRODUCTION

Menopause is a natural and irreversible physiological change characterised by the permanent cessation of the menstrual cycle, marked by a decline in ovarian function that causes a significant reduction in oestrogen and progesterone levels, typically occurring between 45 and 55 years of age [1]. World Health Organisation (WHO) defines menopause as an irreversible or permanent loss of menstrual cycles and a complete absence of ovarian follicular functions [2]. According to the Indian Menopause Society, about 65 million women in India are in the menopausal age group of around 45 years [3]. Vasomotor symptoms such as hot flashes and night sweats are the most prevalent manifestations women experience during menopause, which may persist for seven years or more [4]. The menopausal transition and the postmenopausal state are associated with several health outcomes like respiratory disorders, cardiovascular diseases and sarcopenia, which occur due to oestrogen decline and general age-related physiological changes [1,5,6].

Menopause accelerates the decline in pulmonary function. Postmenopausal women exhibit lower Forced Vital Capacity (FVC) and Forced Expiratory Volume in one second (FEV1), along with greater spirometric restriction, compared with premenopausal women [7]. Reduced lung function affects oxygen delivery during physical activity, contributing to decreased cardiorespiratory endurance and reduced exercise tolerance [5].

The decline in oestrogen levels after menopause not only reduces oestrogen's cardioprotective effects but also reduces cardiovascular fitness and impairs aerobic capacity [8]. The initial decade of postmenopause is considered a critical period for preventive measures targeting cardiovascular disease [9]. Cardiorespiratory fitness, or aerobic capacity (VO_2max), is an important measure of overall cardiovascular health and is associated with age-related changes in cardiovascular risk factors, including dyslipidaemia, insulin resistance, and chronic inflammation [8]. A decline in aerobic capacity reflects broader metabolic and cardiovascular dysregulation [10].

Postmenopausal oestrogen reduction alters the hormonal milieu, affecting energy substrate utilisation during rest and physical activity, often increasing reliance on carbohydrate metabolism and reducing fat oxidation [10]. Reduced hormonal support and physical activity contribute to a loss of muscle mass and strength, averaging 0.4 to 0.8 kg per decade from early adulthood onward, with the rate accelerating after menopause [6]. Additional factors include inadequate protein intake, low calcium intake and vitamin D availability, and age-associated anabolic resistance [11].

Collectively, the progressive decline in pulmonary function, cardiorespiratory endurance and muscular strength contributes to a substantial deterioration in functional capacity. The decrease in functional capacity affects women's ability to perform activities of daily living and may lead to increased morbidity and reduced QoL [8]. Menopause imposes a multidimensional symptom burden affecting

QoL, vasomotor disturbances (hot flashes and night sweats), and psychological symptoms (cognitive impairment, depression and insomnia). Therefore, all these factors affect the QoL in the postmenopausal age group [12].

Regular physical activity has been recommended to counteract age-related physiological decline [11]. Traditional training approaches, such as High-Intensity Interval Training (HIIT) and aerobic training, improve cardiorespiratory fitness and metabolic health; however, they are associated with low adherence, greater perceived discomfort, and musculoskeletal injuries due to high mechanical loads [13]. RT positively influences inflammatory biomarkers and improves cardiorespiratory endurance, QoL, muscular strength, and vasomotor symptoms in postmenopausal women when performed 2-3 times weekly [11]. Therefore, there is a need for an alternative intervention that is less demanding, safer, and more feasible, yet effectively promotes physiological function.

REVIEW OF LITERATURE

The BFRT is an advanced and alternative exercise technique that involves applying external pressure (commonly via pneumatic cuffs) to the proximal limb during low-intensity RT, restricting venous flow while partially allowing arterial flow into the muscle [13]. This results in a hypoxic muscular environment, increasing metabolic stress and anabolic signalling pathways, leading to hypertrophy and strength improvements even at low training intensity [13].

Amaral et al., used a large population-based observational study involving 141,076 women from the UK Biobank to investigate the association between menopause and lung function. Women with natural menopause had significantly lower pulmonary function, with FVC reduced by 42 mL and FEV1 reduced by 34 mL compared with menstruating women. Natural menopause was also associated with significantly higher odds of spirometric restriction (adjusted OR=1.27, 95% CI: 1.18-1.37). The association was more pronounced among those who had undergone hysterectomy and/or oophorectomy, and earlier natural menopause was associated with greater reductions in lung function, while no significant association was found with airflow obstruction [7].

Ferreira L et al., conducted a systematic review of 13 studies involving approximately 700 postmenopausal women and reported that aerobic, resistance, and combined exercise programs significantly improved arterial stiffness and cardiorespiratory fitness. Combined exercise programs produced the greatest improvement in arterial stiffness, with carotid- femoral Pulse Wave Velocity (cfPWV) improving by 0.22-1.56 m/s, while one study reported an increase of 4.4mL/kg/min in maximal oxygen consumption (VO_2max). Overall, participation in exercise programs improved arterial stiffness in seven studies, and combined exercise programs improved pulse velocity by up to 2.6 m/s [14].

Similarly, Khalafi M et al., conducted a systematic review and meta-analysis of 129 randomised controlled trials involving 7,141 postmenopausal women and found that exercise training significantly enhanced cardiorespiratory fitness (SMD=1.06, 95% CI: 0.87-1.42; p-value=0.001), lower- body muscle strength (SMD=1.06, 95% CI: 0.90-1.22; p-value=0.001), upper-body muscle strength (SMD=1.11, 95% CI: 0.91-1.31; p-value=0.001), and handgrip strength (WMD=1.78 kg, 95% CI: 1.24-2.32; p-value=0.001). Aerobic and combined training were particularly effective in enhancing cardiorespiratory fitness and lower-body strength, whereas RT was more effective in enhancing upper-body strength. These findings support the role of structured exercise training in improving functional capacity and muscular strength in postmenopausal women [8].

Linero C and Choi SJ conducted a randomised controlled experimental study among 26 postmenopausal women and reported that 12 weeks of low- intensity RT combined with blood flow restriction increased upper and lower strength by 40%, enhanced the bone formation marker P1NP by 7.05 ng/mL, improved balance, and prevented bone mineral density loss in postmenopausal women with osteoporosis or osteopenia. In comparison, moderate- to high-intensity RT increased muscle strength by 65%, whereas low-intensity RT alone improved only lower-limb strength (28%) and did not significantly affect bone turnover markers [15].

Similarly, Galvão Pereira PM et al., found in a randomised controlled trial of 24 postmenopausal women that low-load RT combined with blood flow restriction for 16 weeks significantly improved maximal muscle strength, quadriceps cross-sectional area, Timed Up and Go (TUG) performance, and Sit to Stand performance. These improvements were comparable to those achieved with high-load RT (p-value >0.05 between groups), whereas the rise-from-floor test improved significantly only in the blood flow restriction group (p-value <0.001), highlighting the effectiveness of low-load BFR as an alternative to conventional high-load RT [16].

These findings suggest that BFRT may serve as a safe and effective alternative to high- intensity RT for improving musculoskeletal health in postmenopausal women. Thus, this study aims to determine the effect of BFRT on cardiorespiratory endurance, QoL, and muscle strength among postmenopausal women.

Primary Objectives:

- To evaluate the effect of BFRT on cardiorespiratory endurance among postmenopausal women;
- To determine the effect of BFRT on the QoL among postmenopausal women;
- To assess the effect of BFRT on muscle strength among postmenopausal women.

Secondary Objectives: To compare the effect of BFRT combined with elastic band RT versus elastic band RT alone in improving cardiorespiratory endurance, QoL, and muscle strength among postmenopausal women.

Null hypothesis (H_0): The BFRT will have no significant difference in cardiorespiratory endurance, QoL, and muscle strength compared with elastic band RT in postmenopausal women.

Alternative hypothesis (H_1): The BFRT will result in a significant difference in cardiorespiratory endurance, QoL, and muscle strength compared with elastic band RT in postmenopausal women.

MATERIALS AND METHODS

A single-blinded, randomised clinical trial will be conducted at Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Maharishi Markandeshwar (Deemed to be University), Mullana-Ambala, Haryana, India, from May 2026 to March 2027.The Institutional Research Ethics Committee (IEC-PT26/77) approved the study, and the trial was prospectively registered under reference number CTRI/2026/04/109599. During enrolment, participants will be screened for eligibility, and those meeting the inclusion criteria will provide written informed consent.

Inclusion criteria: Postmenopausal women aged 45-55 years who are naturally menopausal for >1 year, are physically active, functionally independent, have a normal ankle-brachial index (1.00-1.40) [17], and have not engaged in any weight training for the last six months will be included in this study.

Exclusion criteria: Participants taking any medication that affects bone health, medications other than calcium and vitamin D, any osteoarticular dysfunction in the lower limbs, severe cardiovascular disease, severe osteoporosis, any neurological disorder, including, but not limited to, stroke, or Parkinson's disease will be excluded from the study.

Sample size calculation: Sample size calculated with the help of the formula:

$$n= 2(Z\alpha/2+Z\beta)^2/d^2,$$

where n is the sample size per group,

$Z\alpha/2$ is the z value at the significance level,

$Z\beta$ is the Z value corresponding to the study power,

d is the effect size.

The mean and standard deviation for the Low-Load RT with Blood Flow Restriction (LRT-BFR) group (preintervention: 47.30±6.17 kg; postintervention: 51.48±5.28 kg) were used to estimate sample size [18]. The reference study is referred to estimate the anticipated effect size for sample size calculation and not to establish clinical comparability between the study populations. Although the participants had sarcopenia, both sarcopenia and postmenopausal status are associated with age-related reductions in muscle mass, muscle strength, and physical performance. Moreover, the intervention (low-load RT with blood flow restriction) is similar to that used in the present study.

Based on these values, the calculated effect size was: Cohen's d=0.72.

For an effect size of d=0.72, α=0.05 ($Z\alpha/2$=1.96), and statistical power (1-β)=0.80 ($Z\beta$=0.84), so, putting these values into the formula:

$n = 2(1.96+0.84)^2/\ 0.72^2$

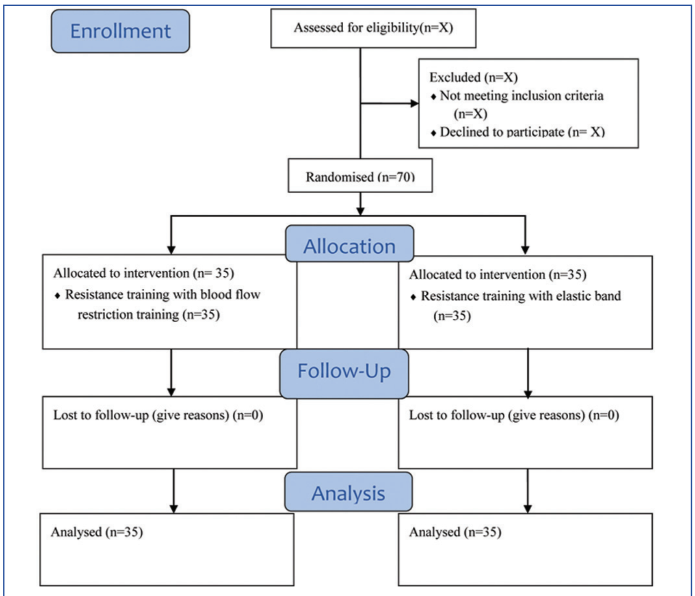
$= 2(2.80)^2/\ 0.5184$

= 15.68/0.5184

= 30.2

The required sample size was 62 (n≃ 31 per group) participants. After accounting for a 10% dropout rate, the required sample size increased to 69 participants; however, it was subsequently rounded up to 70 participants for equal group allocation and to demonstrate the randomisation process (i.e., 35 in each group).

The study methodology is summarised in the Consolidated Standards of Reporting Trials (CONSORT) flow diagram [Table/Fig-1]. Participants will be recruited using criterion-based purposive sampling and allocated to two groups via a computer-generated block-randomisation sequence: the Control group and the Experimental group. The therapist will conduct all intervention procedures. Sequential, numbered, sealed, opaque envelopes will be used for allocation concealment. The outcome assessor will be blinded to group allocation. In case unblinding is required, it will be documented with justification.



[Table/Fig-1]: CONSORT flow diagram of the study.

The control group will receive elastic-band resistance exercises for both upper and lower extremities as explained in [Table/Fig-2] [19,20]. In contrast, the participants in the experimental group will perform the same exercises with blood flow occlusion and modified intensity as given in [Table/Fig-3] [19,20]. The occlusion cuff will be applied at mid-arm during upper-extremity exercises and below the gluteal fold during lower-extremity exercises.

Exercise	Intensity	Frequency
Upper extremity exercises:		
• Shoulder abduction [19] • Shoulder flexion [19] • Seated row [19] • Arm curls (biceps curls) [20] • Arm extensions (overhead triceps extension) [20]	• 70% of 1RM • 4 sets of 10 repetitions for each exercise, performed at 30-second intervals	3 times a week for 4 weeks
Lower extremity exercises:		
• Leg curls (prone knee flexion/ hamstring curls) [20] • Hip abduction [19] • Leg extensions (knee extension) [20] • Straight leg raises (hip flexion) [20]	• 70% of 1RM • 4 sets of 10 repetitions for each exercise, performed at 30-second intervals	3 times a week for 4 weeks
1 RM = Submaximal load (kg)/ (102.78- 2.78 x maximum number of repetitions)/100		

[Table/Fig-2]: Exercise protocol for elastic band RT [19,20].

Exercise	Intensity	Frequency
Upper extremity exercises:		
• Shoulder abduction [19] • Shoulder flexion [19] • Seated row [19] • Arm curls (biceps curls) [20] • Arm extensions (overhead triceps extension) [20]	• 20-30% 1 RM in a progressive manner (week 1- 20%, week 2- 20%, week 3-4 – 30% • 4 sets of 10 repetitions for each exercise, performed at 30-second intervals	3 times a week for 4 weeks
Lower extremity exercises:		
• Leg curls (prone knee flexion/ hamstring curls) [20] • Hip abduction [19] • Leg extensions (knee extension) [20] • Straight leg raises (hip flexion) [20]	• 20-30% 1 RM in a progressive manner (week 1- 20%, week 2- 20%, week 3-4 – 30% • 4 sets of 10 repetitions for each exercise, performed at 30-second intervals	3 times a week for 4 weeks
Limb Occlusion pressure (LOP): 50% for the upper limb and 80% for the lower limb of arterial occlusion pressure (AOP) [20].		

[Table/Fig-3]: Exercise protocol for elastic band Resistance Training (RT) with BFRT.

Primary Outcome Measure

1. **Cardiorespiratory endurance:** The Queen College Step Test (QCST) will be used to measure cardiorespiratory endurance, with good interrater reliability (ICC=0.941-0.971) and intrarater reliability (ICC=0.914- 0.995) for estimation of VO_2max. This involved stepping on a 16.25-inch platform at gender-specific cadences (Females: 88 bpm) for three minutes. Participants stepped for three minutes at a pace of 22 steps per minute for females. The stepping pattern followed a four-step cadence: 'up-up-down-down'. After the 3-minute test, participants stopped immediately, and their heartbeats were recorded for 15 seconds following a 5- to 20-second rest period. Then, recovery heart rate will be measured for 15 seconds (x4) to estimate VO_2max using a formula.

   Women: VO_2max(mL/kg/min)=65.81-(0.1847×heart rate (bpm) [21].

2. **Muscle strength:**

- Upper limb muscle strength- The HHD will be used; showing excellent intrarater and good-to-excellent interrater reliability (ICC 0.84-0.96). Participants will be sitting/standing with the arms parallel to the trunk, elbows at 90°, and wrists in slight flexion (5-10). The participant will be instructed to perform a maximum isometric contraction for approximately 3-5 seconds by exerting maximal force against the device during dynamometric measurements. For each muscle group, the following three trials will be performed with appropriate rest intervals between trials, and the best will be used for analysis. Measurements will be recorded in kilograms (kg) of force [22].
- Lower limb muscle strength: Muscle strength will be assessed with the Sit-to-Stand test. Sit-to-Stand (STS) test, also known as the 5-time sit-to-stand test, with high Intraclass Correlation Coefficients (ICCs) generally above 0.90 for test-retest (intraclass) and strong interrater (inter-class/examiner) reliability, often

exceeding 0.90. It assesses lower-limb strength by having a person stand up and sit down repeatedly from a chair without using the armrest, counting the repetitions. It measures the time required for a participant to stand up and sit down from a chair five consecutive times as quickly as possible. The participant sits on a chair with their back straight and feet flat on the floor. Arms will be crossed over the chest to avoid upper-limb assistance. During the test, the participant stands up fully and sits down again five times as quickly as possible. Time begins when the examiner says "go" and stops when the participant stands up completely for the fifth time. The total time (in seconds) required to complete five repetitions will be recorded. Shorter time indicates better lower limb strength and functional performance [23].

Secondary Outcome Measure

1. **Menopause-Specific Quality of Life (MENQOL) Questionnaire:** It shows strong internal consistency (Cronbach's 0.81-0.89) and, while widely used for natural menopause, is also effective in identifying symptoms in clinical populations. This questionnaire is a self-administered instrument used to measure the impact of menopausal symptoms on QoL across four domains (29 items): vasomotor, psychosocial, physical, and sexual. Each item is scored on a Likert scale ranging from one to eight, where higher scores indicate greater symptom severity and poorer QoL, and lower MENQOL scores indicate better QoL [24].

   All outcome measures will be assessed at baseline and after the 4-week intervention.

STATISTICAL ANALYSIS

Data will be analysed using the Statistical Package for the Social Sciences (SPSS) version 27.0. Data normality will be assessed using the Shapiro- Wilk test. For variables following a normal distribution, descriptive statistics will be presented as mean±Standard Deviation (SD); for non-normally distributed variables, the median and Interquartile Range (IQR) will be reported. Between-group comparisons will be performed using the independent-samples t-test for normally distributed data and the Mann-Whitney U test for non-normally distributed data. Intragroup (within-group) comparisons will be conducted to assess pre-post changes within each intervention arm. For normally distributed data, the paired-samples t-test will be applied; for non-normally distributed data, the Wilcoxon signed-rank test will be applied. All statistical tests will be two-tailed, with value of p-value <0.05 is considered statistically significant.

REFERENCES

[1] Raj A, Chakole S, Agrawal S, Gupta A, Khekade H, Prasad R, et al. The impact of menopause on cardiovascular aging: A comprehensive review of androgen influences. Cureus. 2023;15(8):e43569.

[2] World Health Organization. Menopause [Internet]. 2024 [cited 2026 Jul 4]. Available from: https://www.who.int/news-room/fact-sheets/detail/menopause.

[3] Paulose B, Kamath N. Quality of life of postmenopausal women in urban and rural communities. J Menopausal Med. 2018;24(2):87-91.

[4] Gatenby C, Simpson P. Menopause: Physiology, definitions, and symptoms. Best Pract Res Clin Endocrinol Metab. 2024;38(1):101855.

[5] Real FG, Svanes C, Omenaas ER, Antò JM, Plana E, Jarvis D, et al. Lung function, respiratory symptoms, and the menopausal transition. J Allergy Clin Immunol. 2008;121(1):72-80.e3.

[6] Maltais ML, Desroches J, Dionne IJ. Changes in muscle mass and strength after menopause. J Musculoskelet Neuronal Interact. 2009;9(4):186-97.

[7] Amaral AF, Strachan DP, Gómez Real F, Burney PG, Jarvis DL. Lower lung function associates with cessation of menstruation: UK Biobank data. Eur Respir J. 2016;48(5):1288-97.

[8] Khalafi M, Sakhaei MH, Habibi Maleki A, Rosenkranz SK, Pourvaghar MJ, Fang Y, et al. Influence of exercise type and duration on cardiorespiratory fitness and muscular strength in post-menopausal women: A systematic review and meta-analysis. Front Cardiovasc Med. 2023;10:1190187.

[9] Le Bourvellec M, Delpech N, Bosquet L, Enea C, Gellen B. Impact of cardiorespiratory fitness on vascular health in early postmenopausal women: A cross-sectional study. Arch Cardiovasc Dis. 2026;119(1):S137-S138.

[10] Zarins ZA, Wallis GA, Faghihnia N, Johnson ML, Fattor JA, Horning MA, et al. Effects of endurance training on cardiorespiratory fitness and substrate partitioning in postmenopausal women. Metabolism. 2009;58(9):1338-46.

[11] Rizzoli R, Stevenson JC, Bauer JM, van Loon LJ, Walrand S, Kanis JA, et al. The role of dietary protein and vitamin D in maintaining musculoskeletal health in postmenopausal women: A consensus statement from the European Society for Clinical and Economic Aspects of Osteoporosis and Osteoarthritis (ESCEO). Maturitas. 2014;79(1):122-32.

[12] Shepherd-Banigan M, Goldstein KM, Coeytaux RR, McDuffie JR, Goode AP, Kosinski AS, et al. Improving vasomotor symptoms; psychological symptoms; and health-related quality of life in peri- or post-menopausal women through yoga: An umbrella systematic review and meta-analysis. Complement Ther Med. 2017;34:156-64.

[13] Pearson SJ, Hussain SR. A review on the mechanisms of blood-flow restriction resistance training-induced muscle hypertrophy. Sports Med. 2015;45(2):187-200.

[14] Ferreira L, Abrantes C, Alves ME, Moreira C, Moreira H. Effects of exercise programs on cardiorespiratory fitness and arterial stiffness on postmenopausal women: A systematic review study. Maturitas. 2024;181:107917.

[15] Linero C, Choi SJ. Effect of blood flow restriction during low-intensity resistance training on bone markers and physical functions in postmenopausal women. J Exerc Sci Fit. 2021;19(1):57-65.

[16] Galvão Pereira PM, Rihan Geraldes AA, David Silva Costa MG, de Araújo JP, Aniceto RR, Cunha Costa M, et al. Low-load resistance training and blood flow restriction improves strength, muscle mass and functional performance in postmenopausal women: A controlled randomized trial. Int Phys Med Rehabil J. 2019;4(2):63-68.

[17] American Heart Association, American College of Cardiology. 2024 AHA/ACC guideline for the management of lower extremity peripheral artery disease. Circulation. 2024;149:e1313-e1410.

[18] Zhang M, Song Y, Zhu J, Ding P, Chen N. Effectiveness of low-load resistance training with blood flow restriction vs. conventional high-intensity resistance training in older people diagnosed with sarcopenia: A randomized controlled trial. Sci Rep. 2024;14(1):28427.

[19] Son WM, Park JJ. Resistance band exercise training prevents the progression of metabolic syndrome in obese postmenopausal women. J Sports Sci Med. 2021;20(2):291-99.

[20] Mondal A, Jangra MK, Saxena A. Effects of blood flow restriction training on quadriceps muscle strength and biochemical parameters among individuals with type 2 diabetes mellitus: A protocol for a randomised controlled trial. J Clin Diagn Res. 2025;19(10):YK05-YK08.

[21] McArdle WD, Katch FI, Pechar GS, Jacobson L, Ruck S. Reliability and interrelationships between maximal oxygen intake, physical work capacity and step-test scores in college women. Med Sci Sports. 1972;4(4):182-86.

[22] Bonhof-Jansen EDJ, van Ham A, Kroon GJ, Winter RW, Brink SM. Validity and reliability of a portable handheld dynamometer compared to a fixed isokinetic dynamometer to assess forearm torque strength. Hand Surg Rehabil. 2023;42(2):147-53.

[23] Muñoz-Bermejo L, Adsuar JC, Mendoza-Muñoz M, Barrios-Fernández S, Garcia-Gordillo MA, Pérez-Gómez J, et al. Test-retest reliability of Five Times Sit to Stand Test (FTSST) in adults: A systematic review and meta-analysis. Biology (Basel). 2021;10(6):510.

[24] Hilditch JR, Lewis J, Peter A, van Maris B, Ross A, Franssen E, et al. A menopause-specific quality of life questionnaire: Development and psychometric properties. Maturitas. 1996;24(3):161-75.

PARTICULARS OF CONTRIBUTORS:
1. Postgraduate Student, Department of Cardiopulmonary Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Ambala, Haryana, India.
2. Associate Professor, Department of Cardiopulmonary Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Ambala, Haryana, India.
3. Associate Professor, Department of Neurological Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Ambala, Haryana, India.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Dr. Mandeep Kumar Jangra,
Associate Professor, Department of Cardiopulmonary Physiotherapy, Maharishi Markandeshwar Institute of Physiotherapy and Rehabilitation, Mullana, Ambala-133207, Haryana, India.
E-mail: mjangra708@gmail.com

PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Jun 22, 2026
- Manual Googling: Aug 08, 2026
- iThenticate Software: Aug 10, 2026 (3%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. NA

Date of Submission: **Jun 16, 2026**
Date of Peer Review: **Jun 27, 2026**
Date of Acceptance: **Aug 12, 2026**
Date of Publishing: **Sep 01, 2026**