



Effects of Aerobic Training on Physical Fitness, Balance, Fatigue, and Quality of Life in Postmenopausal Women: A Randomized Controlled Trial

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Abstract:

Introduction: Menopause is associated with physiological changes that lead to reduced fitness, impaired balance, increased fatigue, and diminished quality of life. Aerobic exercise represents a safe, non-pharmacological intervention to counteract these effects.

Objective: To evaluate the effect of a six-week aerobic exercise on fitness, balance, fatigue, and quality of life in postmenopausal women.

Methods: A randomized controlled trial was conducted with 100 postmenopausal women aged 45–60 years randomly to experimental (n=50) and control (n=50) groups. The experimental group received structured aerobic exercise (Progressive Step Marching Exercise) three times weekly for six weeks. Outcome measures included the 30-second chair stand test, seated medicine ball throw test, sit and reach test, berg balance scale (BBS), Fatigue severity scale (FSS), and Menopause-specific quality of life questionnaire (MENQOL). Assessments were conducted at baseline, 3 weeks, and 6 weeks.

Results: At 6 weeks, the experimental group demonstrated statistically significant improvements compared to the control group in all fitness parameters ($p < 0.05$) and fatigue reduction ($p = 0.026$). The physical domain of MENQOL also improved significantly ($p = 0.003$), while total quality of life scores showed no significant difference between groups ($p = 0.248$).

Conclusion: Aerobic exercise effectively enhances physical fitness, balance, and reduces fatigue in postmenopausal women. While domain-specific quality of life improvements was observed, overall quality of life may require longer intervention duration.

Keywords: Menopause, aerobic exercise, physical fitness, balance, fatigue, quality of life.

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Introduction

Menopause, defined as the permanent cessation of menstruation for 12 consecutive months, marks a significant biological transition affecting nearly half of the global female population, typically between the ages 45–55 years.¹ In India, the average age of natural menopause is approximately 46.2 years, earlier than the global average of 51 years.² This earlier onset, influenced by factors such as nutrition, healthcare access, body mass index, and physical activity levels, highlights regional variations in the menopausal experience. The menopausal transition is characterised by dramatic hormonal changes, particularly oestrogen and progesterone decline, leading to elevated follicle-stimulating hormone (FSH) and luteinizing hormone (LH) levels.³ Estrogen deficiency triggers systemic disruptions manifesting as vasomotor symptoms (hot flashes, night sweats), musculoskeletal complaints, mood disturbances, cognitive changes, and accelerated physical decline.⁴

Postmenopausal women experience accelerated functional decline beyond normal aging. Estrogen plays critical roles in maintaining skeletal muscle mass, neuromuscular function, bone density, cardiovascular health, and metabolic efficiency.⁵ Its deficiency leads to sarcopenia, reduced muscle strength, altered coordination, increased visceral adiposity, and compromised balance—collectively increasing the risk of falls and reducing functional independence.^{6,7}

Fatigue, reported by up to 47.4% of postmenopausal women, results from poor sleep due to vasomotor symptoms, hormonal imbalance, mitochondrial dysfunction, and psychological stress.⁸ Balance impairment, often overlooked, occurs due to estrogen's influence on neuromuscular coordination and vestibular function.⁹ Combined with osteoporosis risk, balance deficits significantly increase fracture risk.

While hormone replacement therapy (HRT) remains a standard approach, it carries risks including cardiovascular disease, breast cancer, and thromboembolic events, making it unsuitable for many women.¹⁰ Regular physical activity, particularly aerobic exercise, has emerged as an effective, holistic alternative. The American College of Sports Medicine recommends at least 150 minutes of moderate aerobic activity weekly for postmenopausal women.¹¹

Aerobic exercise improves cardiovascular fitness, reduces abdominal fat, enhances insulin sensitivity, preserves lean body mass, reduces anxiety and depression, improves cognitive function and sleep, and maintains bone density.^{12,13} Despite strong evidence, many postmenopausal women remain inactive due to fatigue, joint pain, fear of injury, poor motivation, and cultural barriers, particularly in rural settings.¹⁴

Materials and Methods

This randomised controlled trial was conducted at the College of Physiotherapy, Pt. B.D. Sharma University of Health Sciences, Rohtak, Haryana, India, from July 2024 to June 2025. Ethical approval was obtained from the Institutional Biomedical Research Ethics Committee (BREC/24/713, dated 8/06/2024). Women younger than 60 years who were postmenopausal, defined as absence of menstruation for more than 12 months, or surgically menopausal following total hysterectomy with bilateral salpingo-oophorectomy performed at least 12 months prior were included in the study. Women were excluded if they were currently using

hormone replacement therapy; had cardiovascular, respiratory, or neurological disorders or any clinically diagnosed psychiatric condition; had musculoskeletal injuries affecting the upper or lower extremities; had undergone any surgery within the previous year except total hysterectomy with bilateral salpingo-oophorectomy; or required the use of walking aids¹⁵. A total of 100 postmenopausal women were recruited from the Obstetrics and Gynaecology Outpatient Department and were randomly allocated to either the experimental group (n = 50) or the control group (n = 50) using the lottery method. During the intervention period, 11 participants from the experimental group initially withdrew but were replaced to maintain the sample size, and all 100 participants completed the study and were included in the final analysis. Participants in the experimental group received a structured aerobic exercise program three times per week for six weeks, with each session lasting 35–45 minutes.¹⁶ Each session consisted of a 5-minute warm-up and a 5-minute cool-down that included general stretching exercises for the upper extremities (neck, shoulder, trunk, elbow, and wrist) and lower extremities (hip, knee, and ankle), with each stretch held for 5 seconds. The main exercise component lasted 20–30 minutes and comprised Progressive Step Marching Exercise (PSME) performed to a metronome rhythm with gradually increasing intensity. During weeks 1–2, exercises were performed at 70–80 beats per minute (bpm) for 10 minutes followed by 80–90 bpm for 10 minutes; during weeks 3–4, intensity progressed to 80–90 bpm for 15 minutes and 90–100 bpm for 15 minutes; and during weeks 5–6, exercises were performed at 90–100 bpm for 15 minutes followed by 100–110 bpm for 15 minutes. Movement patterns included marching in place, forward and backward marching, lateral marching, step-touch movements, and walking variations. Participants in the control group continued their usual daily activities without engaging in any structured exercise program. Outcome measures were assessed at baseline, at 3 weeks, and at 6 weeks

Outcome measures

Physical fitness, fatigue, and quality of life were assessed using standardized measures: strength and endurance with the 30-Second Chair Stand Test¹⁷, upper body power with the Seated Medicine Ball Throw Test¹⁸, flexibility with the Sit and Reach Test¹⁹, balance with the Berg Balance Scale²⁰, fatigue with the Fatigue Severity Scale²¹, and quality of life with the MENQOL questionnaire²²

Statistical Analysis

The data was compiled in MS Excel worksheet, and the collected data was analyzed using SPSS (STATISTICAL PACKAGE OF SOCIAL SCIENCES) version 16.0. Mean $\pm$ SD was calculated for demographic data. Categorical variables were expressed as frequencies and percentages. Pre- and post-assessment data were analyzed using paired t-test. Comparison was done between the groups for all the variables (strength and endurance, power, flexibility, balance, fatigue, and quality of life) using an independent t-test. For all statistical tests, p-value < 0.05 was taken to indicate a significant.

Results

Of the 100 randomly selected women, all 100 continued until the end of the study (100% compliance rate at endpoint). During the intervention, 11 experimental group participants initially withdrew but were replaced to maintain sample size. The final analysis

included all 100 participants (50 in the experimental and 50 in the control group). The participating women were, on average, 51 years old, with an average BMI of 25.9 kg/m² (SD, 4.15 kg/m²; Table 1).

Demographic data

Table 1.1 showed demographic representation of all participants. Groups were compared by using independent t test.

Table 1. Baseline Demographic Characteristics

Variable	Experimental Group (n=50)	Control Group (n=50)	p-value
Age (years)	50.70±5.35	51.96±5.00	0.227 ^{NS}
BMI (kg/m ²)	25.23±3.63	26.64±4.51	0.088 ^{NS}
The mean difference was significant when value of p was ≤ 0.05. NS- Non- significant (p > 0.05)			

Table 1.2. showed between group analysis of all variable by using independent t-test.

Variable		Experimental Group (n=50) Mean ± SD	Control Group (n=50) Mean ± SD	t-value	p-value
30s chair sit stand test	Baseline	11.82±2.30	12.62±2.62	1.620	0.108 ^{NS}
	3 weeks	12.80 ±2.48	13.28±3.301	.822	0.413 ^{NS}
	6 weeks	14.66 ± 2.07	12.10 ± 3.05	-4.91	0.000**
Seated medicine ball throw test	Baseline	1.80 ± 0.31	1.89 ± .34	1.347	.181 ^{NS}
	3 weeks	1.94 ± 0.31	1.79 ± .30	-2.610	.010*
	6 weeks	2.13 ± .30	1.68 ± .032	-7.225	.000*
Sit and reach test	Baseline	-8.10±3.07	-7.58±3.69	0.766	0.445 ^{NS}
	3 weeks	-7.40±3.28	-7.82±3.94	-0.579	0.564 ^{NS}
	6 weeks	-5.92±3.29	-8.84±3.66	-4.196	.0001**
Berg balance scale	Baseline	49.78±4.23	49.10±4.66	-0.764	0.447 ^{NS}
	3 weeks	51.42±2.94	48.32±4.95	-3.809	.0001*
	6 weeks	52.28±2.84	47.94±4.96	-5.376	.0001*
Fatigue Severity Scale score	Baseline	4.58±1.15	4.20±1.31	-1.562	0.121 ^{NS}
	3 weeks	3.94±0.92	4.27±1.34	1.449	0.151 ^{NS}
	6 weeks	3.80±0.91	4.32±1.36	2.259	0.026*
Vasomotor score of MENQOL	Baseline	4.21±1.30	3.87±1.46	-1.213	0.228 ^{NS}
	3 weeks	3.98±1.20	4.06±1.61	0.273	0.785 ^{NS}
	6 weeks	3.93±1.19	4.14±1.59	0.774	0.441 ^{NS}
Psychological domain score of MENQOL	Baseline	4.72±1.92	4.99±1.76	0.734	0.465 ^{NS}
	3 weeks	4.59±1.88	5.10±1.78	1.383	0.170 ^{NS}
	6 weeks	4.57±1.88	5.13±1.79	1.541	0.126 ^{NS}
Physical domain score of MENQOL	Baseline	5.04±1.03	4.76±1.21	-1.272	0.2064 ^{NS}
	3 weeks	4.48±0.89	4.96±1.20	2.256	0.026*
	6 weeks	4.36±0.90	5.01±1.21	3.032	0.003**
Sexual Domain score of MENQOL	Baseline	5.39±2.34	4.42±2.53	-1.978	0.051 ^{NS}

	3 weeks	5.39±2.34	4.40±2.54	-2.016	0.047*
	6 weeks	5.38±2.34	4.41±2.53	-1.995	0.049*
Total Score of MENQOL	Baseline	5.00±1.00	4.77±1.47	-1.118	0.266 ^{NS}
	3 weeks	4.77±1.47	4.90±1.55	0.680	0.498 ^{NS}
	6 weeks	4.71±0.93	4.95±1.58	1.163	0.248 ^{NS}
The mean difference was significant when value of p was ≤ 0.05. NS- Non- significant (p > 0.05)					

Discussion

The results of the present study demonstrate that a six-week, well-planned aerobic exercise regimen produces prompt and clinically significant enhancements in several functional capacities among postmenopausal women. Notable improvements were documented across all assessed outcomes: lower-extremity endurance increased by 23.98%, upper-body power rose by 18.33%, flexibility improved by 26.92%, and balance showed a 5.02% enhancement. In addition, participants experienced a 17.03% decrease in perceived fatigue levels. These findings suggest that structured aerobic exercise programs effectively enhance cardiovascular performance, muscular endurance, and overall physical function in postmenopausal women through physiological adaptations such as increased stroke volume, improved peripheral oxygen utilization, and enhanced oxidative metabolic capacity²³. The observed enhancements in upper-body power, even though the exercise program primarily targeted the lower limbs, are consistent with previous evidence indicating that aerobic training promotes overall improvements in cardiorespiratory fitness, neuromuscular activation, and fatigue resistance across diverse muscle groups.^{24,25} Flexibility improvements exceeding 25% observed in the present study suggest that aerobic exercise programs incorporating consistent warm-up and cool-down phases can effectively enhance connective tissue extensibility and reduce menopausal-related stiffness²⁶. Similarly, the observed gains in balance indicate that short-term aerobic and rhythmic movement activities can positively influence postural control, dynamic stability, and functional balance performance in postmenopausal women. These improvements support the role of aerobic and functional exercise in maintaining neuromuscular efficiency, lowering fall risk, and preserving independence in daily activities within this population²⁷. The reduction in fatigue demonstrated in this study reflects the beneficial effects of aerobic exercise on physiological regulation, including improved sleep quality, autonomic balance, and reduced systemic stress, all of which contribute to lower perceived fatigue levels. These mechanisms are particularly relevant to menopausal fatigue, which is often associated with sleep disruption, reduced cellular energy efficiency, and decreased physical activity¹⁷. The improvement observed in the physical domain of the MENQOL indicates that symptoms such as musculoskeletal discomfort, joint stiffness, sleep disturbance, and activity limitation are responsive to short-duration aerobic exercise interventions²⁶. In contrast, the lack of significant changes in vasomotor and psychological domains suggests that these aspects of menopausal health may require longer intervention periods or more comprehensive exercise strategies to elicit measurable adaptations. Psychological well-being and emotional symptoms often respond more gradually and may benefit from additional modalities such as resistance

training or mind-body approaches. Conversely, the significant improvement noted in the sexual domain highlights the positive influence of aerobic exercise on sexual quality of life, likely mediated through enhanced physical comfort, reduced fatigue, and improved self-perception rather than direct hormonal effects¹³.

Overall, the rapid improvements in strength, endurance, flexibility, balance, and fatigue observed in this study emphasize the effectiveness of short-term aerobic exercise as an early intervention for functional enhancement in postmenopausal women. These adaptations reflect physiological systems that are highly responsive to rhythmic, moderate-intensity movement. At the same time, the limited changes in vasomotor and psychological outcomes underscore the need for longer-duration or multi-component exercise programs to address the broader spectrum of menopausal symptoms. Therefore, aerobic exercise should be considered a foundational component of clinical and community-based programs aimed at improving physical function, reducing fatigue, and enhancing early quality-of-life outcomes in postmenopausal women.

Limitations

The present study has certain limitations that should be acknowledged. The six-week duration of the aerobic exercise intervention may not have been sufficient to produce significant improvements in vasomotor symptoms or broader quality-of-life outcomes, which often require longer intervention periods. Additionally, the exclusive use of aerobic exercise as the training modality may have limited the overall benefits observed, as combining aerobic exercise with resistance or multimodal training could potentially yield more comprehensive improvements across physical and psychosocial domains. Furthermore, participants were recruited from a single centre in Haryana, North India, which may limit the generalizability of the findings to postmenopausal women from other regions and diverse sociocultural settings..

Conclusion

This randomized controlled trial shows that a six-week aerobic exercise program significantly improves physical fitness, balance, and fatigue in postmenopausal women, enhancing functional capacity and reducing fall risk. While improvements were seen in physical aspects of quality of life, overall quality of life did not differ significantly between groups, suggesting the need for longer or multi-component interventions. Nevertheless, the findings support aerobic exercise as a safe, accessible, and clinically effective non-pharmacological strategy to promote functional independence and manage menopausal symptoms.

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