

[ORIGINAL ARTICLE]**Effects of Supervised Aerobic Exercise Program v/s Home-based Exercise Program on Stress, Sleep quality and Quality of life in Perimenopausal Women: A RCT****Murkey Samruddhi¹, Kulkarni Nupoor², Hande Deepali³, Tilekar Swanand⁴, Khot Aditi⁵**¹MPT Student, ²Associate Professor, ³Professor, ⁴Assistant Professor, ⁵Assistant Professor, Dr. A.P.J. Abdul Kalam College of Physiotherapy, PIMS, Loni.**ABSTRACT**

Background: Estrogen, a crucial hormone for women, begins to decrease throughout the perimenopause. Menopause-related symptoms, such hot flashes or irregular periods, can start to appear. Which can have an impact on quality of life and health in both short- and long-term.

Methodology: A Randomized Controlled Trial was conducted to determine effects of supervised aerobic exercise program versus home-based exercise program on stress, sleep quality and quality of life in perimenopausal women, for the age group 42 to 48 years women with a sample size of 34 Participants. Participants included were: Women in the age range 42 to 48 years, For the previous three months they did not get hormone replacement therapy or any other medication to manage their perimenopausal symptoms.

Results: Mean and Standard Deviation Values of MENQOL, DASS21, PSQI and 6MWT among perimenopausal women were calculated. All test shows significant improvement after intervention of supervised aerobic exercise group as compare to home-based exercise group. Women with Perimenopausal Age with a mean age and standard deviation (SD) 45.11 ± 1.576 years of Aerobic exercise group and 44.76 ± 1.393 years of Home-Based exercise group. The results show, MENQOL = p value - <0.05 , PSQI = p value - <0.01 , Stress = p value - <0.01 , 6MWT = p value - <0.01 .

Conclusion: The study concluded that, 8-weeks of supervised aerobic exercise training program was more effective than home-based exercise program in improving stress, sleep quality and quality of life in perimenopausal women.

Keywords: *Perimenopausal Women, Quality of Life, stress, sleep quality*

Introduction

Menopause is described as the absence of pregnancy and lactation for more than twelve months during which there is no menstruation, or amenorrhea.^[1] In another way, it is the phase before menopause that is marked by irregular menstrual cycles or prolonged amenorrhea that lasts for more than 12 months at a time.^[1]

The period leading up to menopause is known as the perimenopausal phase. Estrogen, a crucial hormone for women, begins to decrease throughout the perimenopause.

The period of irregular periods leading up to menopause is known as the perimenopause, and its duration varies.^[2] Most women who go through the menopausal transition have menopausal symptoms, which are a typical reason to seek medical assistance during this stage of life.^[3] Exercise may help enhance sleep quality and lessen daytime tiredness, according to epidemiological studies.^[4]

Nowadays, women are searching for other ways to manage menopausal symptoms, such continuing or increasing their physical activity levels.^[3] Physical discomforts, such as vasomotor symptoms including

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headaches, sleeplessness, and hot flashes, as well as vaginal atrophy, are often associated with this stage of a woman's life. Although the median ages of menopause and perimenopause (51 and 47 years, respectively) are not very different, it might take up to eight years for this shift from regular ovulatory cycles to amenorrhea.^[1] Numerous mental and physical symptoms frequently arise during this time, and they may be connected to the hormonal changes causing the change.^[1] Changes in menstrual and hormonal patterns characterize the menopausal transition, which is a sequence of stages from early perimenopause and late perimenopause to postmenopause.^[5]

Because the menopausal transition is associated with weight and fat mass gains, which may be partially driven by a decrease in physical activity, postmenopausal women are especially vulnerable to adverse health effects.^[6] Exercise has been demonstrated during the last ten years to positively alter blood lipids, body composition, muscle strength, and bone mineral density (BMD) in the aged population.^[7] Perimenopausal women frequently experience similar symptoms, such as forgetfulness, flushing, night sweats, and others, which could worsen fatigue syndrome. Fatigue has become a major health concern for perimenopausal women due to physiological malfunction and aging.^[8] The top five symptoms that women in the perimenopause experience are increased wrinkles, tiredness, back discomfort, dry eyes, and insomnia (a problem with sleeping).^[8] With longer life expectancies nowadays, women are more prone to experience protracted menopausal episodes that take up around one-third of their lives.^[9]

Sleep difficulties are prevalent among women going through menopause; Sixteen to forty two percent of premenopausal, 39 to 47 percent of perimenopausal, and 35 to 60 percent of postmenopausal women have reported experiencing them.^[10] Women are one to two times more likely than males to have incontinence during the perimenopause. There are fluctuations during the perimenopause, with average estrogen levels in the numerous studies also find that good mood increases and tiredness reductions associated with exercise can help people successfully translate their intentions into action and boost their adherence to exercise.^[11]

Adults should perform at least one hundred and fifty minutes of moderate-to-vigorous aerobic physical

activity every week, according to the Canadian Society for Exercise physiology, in order to get the health advantages.^[6]

The main factors in menopause are levels of progesterone and estrogen. Urban women tend to complain more about mood swings, sexual issues, hot flashes, and psychological issues. Menopause marks the beginning of a period of reduced estrogen exposure, which can have an impact on quality of life and health in both short- and long-term.^[12]

Menopause can be made more tolerable by exercise, a healthy diet, quitting smoking, and reducing stress. These strategies can also help to prevent the chronic illnesses that can develop in the postmenopausal years.^[12] According to Conde et al., hot flashes and sweating (51 percent), as well as anxiousness (61 percent), were the most common menopausal symptoms.

For women in their midlife, aerobic exercise may enhance the quality of their sleep and lessen hot flashes brought on by sleep disruption.^[10] Few studies have examined the impact of aerobic exercise on stress, sleep quality, and quality of life in perimenopausal women in the literature. Therefore, the current study aimed to find the influence of an eight-week effects of supervised aerobic exercise program versus home-based exercise program on stress, sleep quality and quality of life in perimenopausal women. There aren't many researches in the literature that assess how aerobic exercise affects perimenopausal women's stress levels, sleep patterns, and overall quality of life.^[10] Another study revealed that postmenopausal osteoporotic women's static and dynamic balances significantly improved after a 4-week submaximal aerobic exercise program.^[13] Also, there are studies which have reported that the supervised exercise programme was effective for menopausal women but the adherence to attend the exercise programme at clinical set up is limited. Research revealed that while fatigue is common or prevalent in perimenopausal women, its intensity may not always be obvious.^[14] It is crucial for them to improve their ability to adjust to the perimenopausal phase through medical care, food, exercise, and medical therapy in order to get through this phase without any problems.^[15] Therefore, it was anticipated that a home-based exercise program may have higher adherence because participants can work out whenever it is

convenient for them. But there is hardly any study which determined the effects of aerobic training as a home-based programme in perimenopausal women. Therefore, the current study is needed to determine whether Aerobic exercises versus home-based aerobic exercises has an effect on stress, sleep quality and quality of life in perimenopausal women. It will help physiotherapists intervene early and reverse the condition before excessive harm is done. Hence, physical activity or, even better, exercise may be one strategy to offset some of these negative consequences. The aim of the study was to compare the effect of supervised aerobic exercises versus home-based exercises on stress, sleep quality, and quality of life in perimenopausal women by using the DASS-21, MENQOL, and PSQI scales after eight weeks of intervention. The objective of the study is to assess the effect of an aerobic exercise program in stress, sleep quality and quality of life in perimenopausal women and to assess the effect of home-based exercise program in stress, sleep quality and quality of life in perimenopausal women.

Methodology :

This randomized controlled trial, approved by the Institutional Ethical Committee (COPT/MPT/2023/20) and registered under CTRI/2023/04/051410, was conducted on perimenopausal women aged 42–48 years at a community physiotherapy OPD and their homes. Participants were screened using inclusion and exclusion criteria, briefed in their preferred language, and written informed consent was obtained. Eligible participants had not taken hormone replacement therapy or other medications for perimenopausal symptoms in the past three months, did not follow a specific diet, and were not engaged in regular fitness regimens. Women with conditions like diabetes, thyroid, cardiovascular, psychiatric, or kidney disorders, recent bereavement, or who were on medication for perimenopausal symptoms were excluded. A total of 34 participants were randomized into two groups: group one was 17 participants using an aerobic exercise program, and the second group was 17 participants using a home-based exercise program for a period of 8 Weeks, with sessions lasting 30–45 minutes, three times per week. Exercise intensity was monitored using the Ratings of Perceived Exertion (RPE) scale (13–16). Blinded participants were assessed using demographic data, DASS-21, MENQOL, PSQI, and the 6-minute walk test at baseline, 4 weeks, and 8 weeks. The home-based

group maintained a follow-up chart and visited the OPD at the 4th and 8th weeks.

Outcome measures:

Depression Anxiety Stress Scales (DASS21) ($r = 78-87$): - This questionnaire is a shortened (21 items) form of a self-report instrument with 42 items.

This scale's rating was:

0 Never applied to me in the slightest

1 Sort of applied to me, or sometimes – occasionally

2 Applied to me extensively, or for a significant portion of the time – OFTEN

3 applied to me extensively, or nearly always – that is, most of the time.^[16]

Menopause Specific Quality of Life (MENQOL):

-The Likert-scaled MENQOL is a self-administered questionnaire with a total of twenty-nine items. The impact of one of four areas of menopausal symptoms – vasomotor (items one to three), psychosocial (items four to ten), physical (items eleven to twenty-six), and sexual (items twenty-seven to twenty-nine) – as experienced during the past month is evaluated by each item. Items related to a particular symptom are graded on a scale of zero (not bothersome) to six (very unpleasant) depending on whether they are present or not. Each subscale's means are calculated by dividing the total number of items in the domain by the total number of items in that domain.^[17]

Pittsburgh Sleep Quality Index (PSQI) ($r = 0-21$):-

The nineteen self-reported items fall into one of seven subcategories: daytime dysfunction, habitual sleep efficiency, subjective sleep quality, sleep latency, length, and interruptions. For clinical purposes, five further questions, which are not scored, are added. Each question has a score between zero and three, where higher scores correspond to more severe sleep problems.^[18]

Six-minute walk test :- This sub-maximal exercise test evaluates endurance and aerobic capacity. The result utilized to compare changes in performance capacity is the distance traveled over a six-minute period. Standard Range: 400 to 700 meters.

Intervention

This intervention program was of eight weeks duration i.e., three sessions per week for twenty to sixty minutes each session. Group A were receiving supervised aerobic exercise program. Group B were receiving homebased exercise program.



Fig: 1 Sternocleidomastoid stretch



Fig:2 Tibialis anterior stretch



Fig 3: Hamstring stretch



Fig 5: Stepping exercise

The method involved meditation, where in women were instructed to repeat "OM" for five minutes during their meditation.



Fig 6: Omkar meditation

Data Analysis And Results: -

The present study included thirty-four women participants with perimenopausal age with a mean age standard deviation (SD) 45.11 ± 1.576 years of aerobic exercise group and 44.76 ± 1.393 years of home-based exercise group. The baseline characteristics of the participants in both the groups are shown in Table 1 and revealed that both the groups were comparable.

Data analysis was done by using R-software, RM – ANOVA Tests.

Table no. 1: Demographic data of Participants

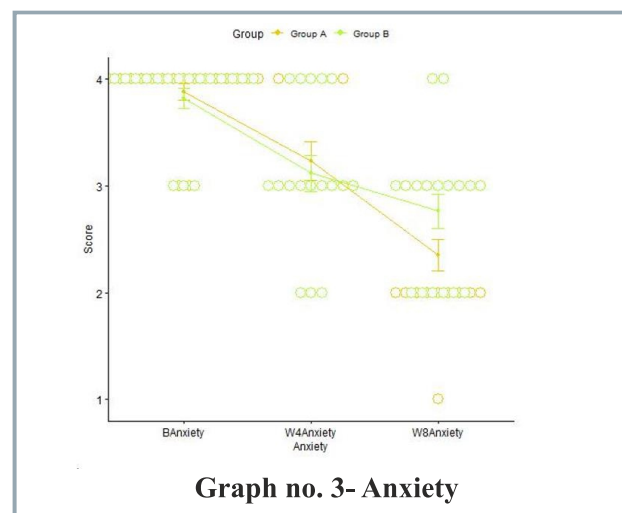
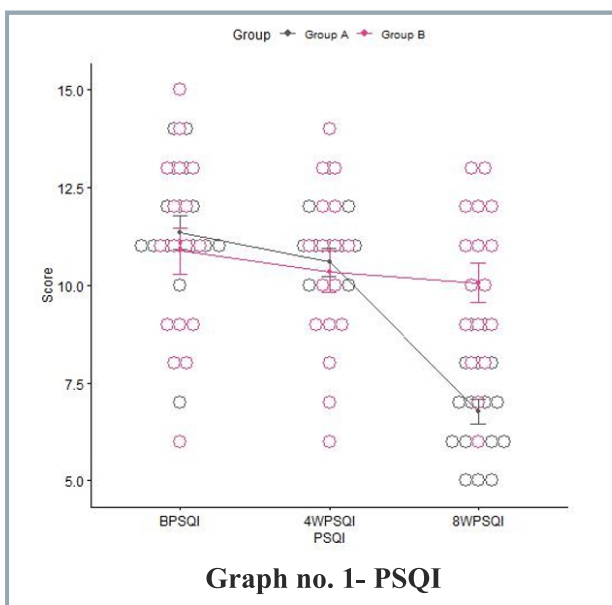
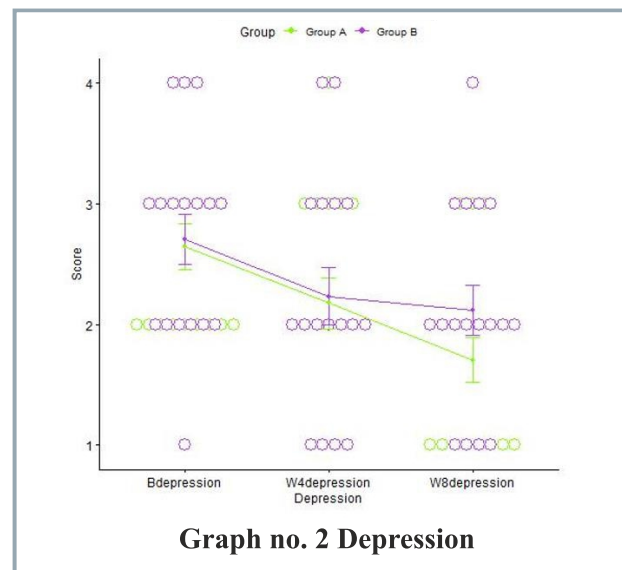
Variables	Group		P – Value
	Experimental (Aerobic) (n = 17)	Control (Home) (n = 17)	
	Mean ± SD	Mean ± SD	
Age	45.11 ± 1.576	44.76 ± 1.393	0.6600
BMI	24.25 ± 1.772	23.04 ± 2.229	0.9901

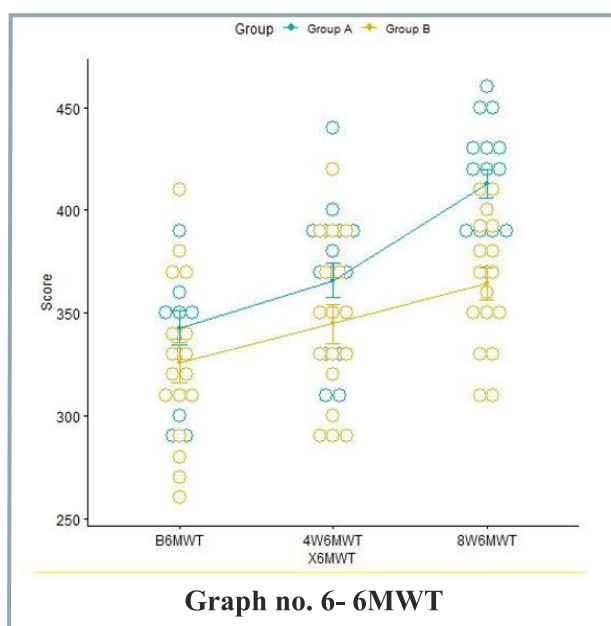
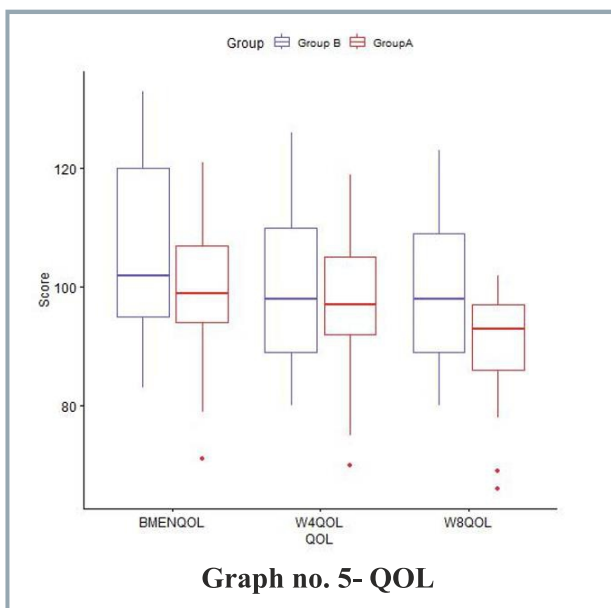
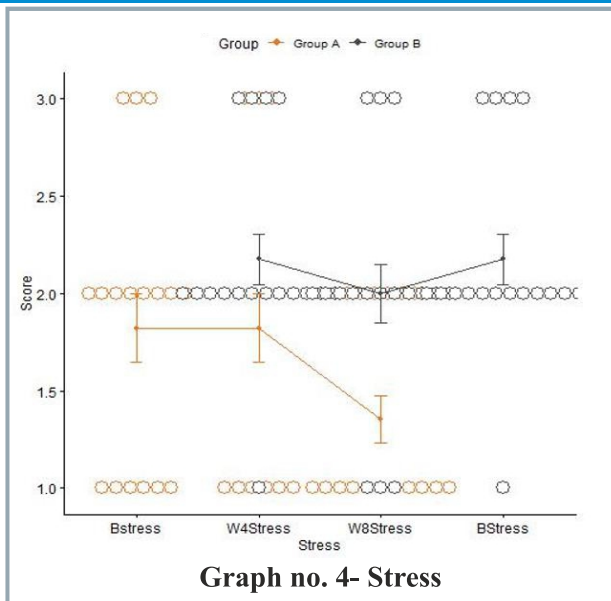
Table no. 2: RM-ANOVA Tests

TABLE: REPEATED MEASURES ANOVA														
Variable	N	Group A (Mean ± SD)			N	Group B (Mean ± SD)			F-value <small>(df)</small>			Effect Size (η^2)		
		Baseline	4 th Week	8 th Week		Baseline	4 th Week	8 th Week	Group <small>(1, 16)</small>	Time <small>(2, 32)</small>	Group * Time <small>(2, 32)</small>	Group	Time	Group*Time
PSQI	17	11.35 ± 1.73	10.59 ± 1.54	6.77 ± 1.30	17	10.88 ± 2.42	10.35 ±2.18	10.06 ± 2.08	3.84 *	121.34 ***	78.59 ***	0.05	0.28	0.18
Depression	17	2.65 ± 0.79	2.17 ± 0.88	1.716 ± 0.77	17	2.71 ± 0.85	2.24 ± 0.97	2.12 ± 0.86	0.35	29.17 ***	2.01	0.01	0.13	0.01
Anxiety	17	3.88 ± 0.33	3.24 ± 0.75	3.35 ± 0.61	17	3.82 ± 0.39	3.12 ± 0.70	2.77 ± 0.66	0.21	63.52 ***	4.11 *	0.01	0.46	0.04
Stress	17	1.82 ± 0.73	1.82 ± 0.73	1.35 ± 0.49	17	2.18 ± 0.53	2.18 ± 0.53	2.00 ± 0.61	8.60 **	9.58 ***	2.47	0.08	0.08	0.27
MENQOL	17	99.71 ± 13.49	97.53 ± 13.49	89.24 ± 10.29	17	104.88 ± 14.29	100.06 ± 12.94	98.88 ± 11.72	4.81 *	8307 ***	22.67 ***	0.05	0.07	0.01
6MWT	17	342.94 ± 35.14	365.88 ± 34.29	412.94 ± 28.23	17	325.88 ± 40.32	344.71 ± 39.86	364.41 ± 32.11	9.86 **	267.51 ***	40.79 ***	0.15	0.3	0.04
p value: * $p < 0.01$; ** $p < 0.05$; *** $p < 0.01$; **** $p < 0.001$														

p value: * < 0.01; ** < 0.05; *** < 0.01; **** < 0.001

In the above table (Table 2) showing between groups difference of Mean ± SD, F-value, P- value and effect Size of Sleep quality, Depression, Anxiety, Stress, Menopausal quality of life and 6 Minute Walk Test. The P-value of between groups of PSQI is <0.01 and F-value is 3.84, Stress p-value is <0.01 and F-value is 8.60, MENQOL P-value is <0.05 and F-value is 4.81, 6-Minute Walk Test P-value is <0.01 and F-value is 9.86. The Mean ± SD of Group A (Supervised Aerobic exercise group) showing the most significant changes from baseline to 4th week and from baseline to 8th week compared to group B (Home-Based exercise group).





Discussion

The Result of the present study shows that a supervised aerobic exercise program showed an extremely significant effect on stress, sleep quality, and quality of life in perimenopausal women compared with a home-based exercise program. The impact of stress in perimenopausal women shows extremely significant results in the supervised aerobic exercise group and very significant results in the home-based exercise group. This is in accordance with the study of Blumenthal, J.A., et. al. reported that a program of aerobic exercise may serve to reduce levels of cardiovascular response to behavioral stressors among middle-aged women.^{[19][20]} Changes in sleep have been linked to clinical and metabolic changes that may raise the risk of cardiovascular disease, particularly once menopause hormone medication has been discontinued.^[9] When compared to hormone therapy or yoga, a meta-analysis of five RCTs revealed insufficient evidence to support the claim that exercise reduces vasomotor menopausal symptoms, such as hot flashes and night sweats.^[9] The following are some possible effects of exercise on sleep quality: deep physical and mental relaxation is achieved during practice; stress can be soothed and emotions can be stabilized through breath regulation; this makes patients easily drowsy and accelerates them into deep sleep. Additionally, exercise can raise the body's energy expenditure, encourage the production of endorphins in the brain, and reduce or even eliminate a patient's exhaustion.^[21] The sleep quality shows extremely significant results in the supervised aerobic exercise group and significant results in the home-based exercise group. According to Mansikkamäki, K., et. al., symptomatic menopausal women who engage in aerobic training for six months may experience fewer hot flashes and better sleep.^[10]

The main factors influencing menopause are estrogen and progesterone levels. At this point, the ovaries produce less progesterone and estrogen. The body will react when these hormones are produced less, which frequently causes discomfort for women whose body parts depend on estrogen to stay healthy.^[12] In our study, the impact of menopausal quality of life in perimenopausal women shows extremely significant results in the supervised aerobic exercise group and significant results in the

home-based exercise group. This would be in accordance with a study by Ağıl, A., et. al. reported that resistance exercise and aerobic exercise were found to have a positive impact on menopausal symptoms, psychological health, depression, and quality of life.^[22]

Omkar meditation is believed to contain cosmic energy that alleviates human suffering, enhances memory, promotes better interpersonal connections, allows for more peaceful sleep, and dramatically lowers stress.^[12]

At 44.69 ± 3.79 years old, Indian women start experiencing irregular periods, which are indicative of the perimenopausal stage.^[2] Previous research demonstrated the benefits of physical exercise for perimenopausal women, since it may alleviate vasomotor, psychological, somatic, and sexual issues.^[14] A recent 12-week exercise therapy study with Chinese middle-aged women experiencing perimenopausal syndrome revealed that the symptoms of menopause (fatigue, headache, irritability, arthralgia/myalgia, paresthesia, and sleeplessness) are effectively improved. The study was randomized and controlled with a placebo.^[14] Participants in our aerobic training intervention showed a relief of depression, anxiety, stress, sleep quality, and menopausal quality of life, this also supports the positive view of the impact of exercise on perimenopausal symptoms. Based on the baseline data from both groups, it was shown that over fifty percent of perimenopausal women did not exercise regularly and that many of them consumed harmful amounts of fats and oils, which is against recommended dietary guidelines.^[14] Since new habits are naturally invoked and likely to be maintained, one of the anticipated consequences of this intervention was the development of new habits.^[14] Reetta Heinonen et al. discovered a correlation between the frequency and intensity of hot flashes and objective signs of sleep disturbance in postmenopausal women in their cross-sectional multicenter study.^{[23][24]} Eighty percent of participants showed increased flexibility in the sleep quality results, and five people reported greater quality of life and a decrease in menopausal symptoms after the eight-week program.^[12]

Our study showed that the relatively short duration aerobic exercise (8 weeks, thrice a week) program significantly improved effects of supervised aerobic

exercise program on stress, sleep quality and quality of life in perimenopausal women when compared to home-based exercise program.

Perimenopausal women were significantly more likely to experience early morning awakenings and difficulty falling asleep, also known as sleep problems. The inability to fall asleep was found to be the most significant and reliable predictor of the development of moderate to severe sleep problems later in life in perimenopausal women.^[24] All of them indicated that perimenopausal women could be better equipped to deal with the next, far more serious sleep issues if they had identified and intervened early on regarding their poor sleep quality.^[25]

A study by Hsiao-Hui Chiu found a favorable correlation between exhaustion and "irregular exercise".^[25] While the exact mechanism underlying regular exercise's ability to reduce fatigue syndrome remains unclear, one theory is that it could boost physical stamina, elevate mood (euphoria), and encourage sleep by drawing attention away from uncomfortable feelings.^[19] The most important and major precipitating factor for fatigue syndrome is poor sleep, which can be significantly improved by regular exercise combined with a regular lifestyle. One study that used high- and moderate-intensity interval training programs was able to improve both sleep quality (a better Pittsburgh sleep quality index) and decrease the fatigue scale (low fatigue severity scale).^[19] Mengnan Zhao's findings demonstrated that exercise had a substantial impact on both the quality of sleep and the symptoms of insomnia in perimenopausal women, with the benefits of exercise being somewhat greater for sleep quality than for insomnia symptoms.^[21] Combining the findings of the meta-analysis with the body of available research, this study proposes that exercise can help perimenopausal women with their sleep disturbances, enhance the quality of their sleep.^[21]

A 4-month randomized controlled trial with middle-aged women who were symptomatic found no significant difference in sleep quality between walking and low-intensity yoga routines.^[26] Menopausal symptoms were the only ones linked to total sleep quality after adjusting for the effects of physical exercise.^[26] Results from a different experiment corroborate the findings regarding better sleep among symptomatic midlife women not receiving hormone medication, but not with relation

to hot flashes or night sweats following a twenty-four-week exercise intervention.^[23] Likely as a consequence of the aerobic training in the middle of the intervention, sleep quality was better in the supervised aerobic exercise group than in the home-based aerobic exercise group.

The strengths of our study included the randomized controlled trial design and fairly large sample size. Furthermore, participants' adherence was good since there was no drop-out in both groups. Feasibility and convenience were a positive point of home exercise programme. A good response rates, and good results among the perimenopausal women with no experience of the aerobic exercises before the study. In the present study the women in the supervised aerobic exercise group reported better sleep quality, depression, anxiety, stress and quality of life and a reduction in perimenopausal symptoms compared to home-based exercise group at the end of the intervention. This study includes a good response rates, and good results among the perimenopausal women with no experience of the aerobic exercises before the study.

Conclusion

The study concluded that, eight-weeks of supervised aerobic exercise training program was more effective than home-based exercise program in improving stress, sleep quality and quality of life in perimenopausal women.

Limitations

1. We acknowledge that the mobile phone was not used due to a lack of internet facilities.
2. Actual supervision was not possible for the home-based exercise Group to monitor the accuracy of the exercise protocol.

Data Availability Statement

Data available – Yes

Data types – De-identified participants data.

After publication, trial data will be made available on reasonable request to the corresponding author. The Corresponding author have all the data. On request, all data will be made available.

The process data is available with the corresponding author, samruddhimurkey@gmail.com .

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Conflict of Interest : There is no Conflict of Interest.

References

1. Rasgon N, Shelton S, Halbreich U. Perimenopausal mental disorders: epidemiology and phenomenology. *CNS spectrums*. 2005 Jun;10(6):471-8.
2. Ahuja M. Age of menopause and determinants of menopause age: A PAN India survey by IMS. *Journal of mid-life health*. 2016 Jul 1;7(3):126-31.
3. Nelson DB, Sammel MD, Freeman EW, Lin H, Gracia CR, Schmitz KH. Effect of physical activity on menopausal symptoms among urban women. *Medicine and science in sports and exercise*. 2008 Jan 1;40(1):50.
4. MY C. Efficacy of a 24-week aerobic exercise program for osteopenic postmenopausal women. *Calcif Tissue Int*. 2000;67:443-8.
5. Vyas R, Hande D, Nishad P, Barot H. Effects of pelvic floor muscle training vs an assisted pelvic floor muscle training among rural perimenopausal women with urinary incontinence: A comparative study. *International Journal of Yoga, Physiotherapy and Physical Education*. 2018;3(1):121-4.
6. Carter ND, Khan KM, Petit MA, Heinonen A, Waterman C, Donaldson MG, Janssen PA, Mallinson A, Riddell L, Kruse K, Prior JC. Results of a 10 week community based strength and balance training programme to reduce fall risk factors: a randomised controlled trial in 65–75 year old women with osteoporosis. *British journal of sports medicine*. 2001 Oct 1;35(5):348-51.
7. Kemmler W, Von Stengel S, Weineck J, Lauber D, Kalender W, Engelke K. Exercise effects on menopausal risk factors of early postmenopausal women: 3-yr Erlangen fitness osteoporosis prevention study results. *Medicine & Science in Sports & Exercise*. 2005 Feb 1;37(2):194-203.
8. Campbell KL, Westerlind KC, Harber VJ, Bell GJ, Mackey JR, Courneya KS. Effects of aerobic exercise training on estrogen

- metabolism in premenopausal women: a randomized controlled trial. *Cancer Epidemiology Biomarkers & Prevention*. 2007 Apr 1;16(4):731-9.
9. Pal A, Hande D, Khatri S. Essment of menopausal and perimenopausal symptoms in women above 40 years in rural area. *Int J Healthc Biomed Res*. 2013;1:166-74.
 10. Mansikkamäki K, Raitanen J, Nygård CH, Heinonen R, Mikkola T, Luoto R. Sleep quality and aerobic training among menopausal women—a randomized controlled trial. *Maturitas*. 2012 Aug 1;72(4):339-45.
 11. Mehta CC, Hande D, Kale PA. Effect of music on perceived exertion, enjoyment, mood and affect during high intensity interval training. *IOSR J Sports Phys Educ*. 2018;5:13-21.
 12. Jayabharathi B, Judie A. Complementary health approach to quality of life in menopausal women: a community-based interventional study. *Clinical interventions in aging*. 2014 Nov 7:1913-21.
 13. Gunendi Z, Ozyemisci-Taskiran O, Demirsoy N. The effect of 4-week aerobic exercise program on postural balance in postmenopausal women with osteoporosis. *Rheumatology international*. 2008 Oct;28:1217-22.
 14. Xi S, Mao L, Chen X, Bai W. Effect of health education combining diet and exercise supervision in Chinese women with perimenopausal symptoms: a randomized controlled trial. *Climacteric*. 2017 Mar 4;20(2):151-6.
 15. Asghari M, Mirghafourvand M, Mohammad-Alizadeh-Charandabi S, Malakouti J, Nedjat S. Effect of aerobic exercise and nutrition education on quality of life and early menopause symptoms: A randomized controlled trial. *Women & health*. 2017 Feb 7;57(2):173-88.
 16. Lovibond PF, Lovibond SH. Depression anxiety and stress scales. *Behaviour Research and Therapy*. 1995 Jan 1.
 17. Radtke JV, Terhorst L, Cohen SM. The Menopause-Specific Quality of Life Questionnaire: psychometric evaluation among breast cancer survivors. *Menopause*. 2011 Mar 1;18(3):289-95.
 18. Shahid A, Wilkinson K, Marcu S, Shapiro CM. Pittsburgh sleep quality index (PSQI). STOP, THAT and one hundred other sleep scales. 2012:279-83.
 19. Blumenthal JA, Fredrikson M, Matthews KA, Kuhn CM, Schniebolck S, German D, Rifai N, Steege J, Rodin J. Stress reactivity and exercise training in premenopausal and postmenopausal women. *Health Psychology*. 1991;10(6):384.
 20. Ağıl A, Abıke F, Daşkan A, Alaca R, Tüzün H. Short-Term exercise approaches on menopausal symptoms, psychological health, and quality of life in postmenopausal women. *Obstetrics and gynecology international*. 2010;2010(1):274261.
 21. Zhao M, Sun M, Zhao R, Chen P, Li S. Effects of exercise on sleep in perimenopausal women: A meta-analysis of randomized controlled trials. *Explore (New York, NY)*. 2023 Feb 8;19(5):636-45.
 22. Rubio-Arias JÁ, Marín-Cascales E, Ramos-Campo DJ, Hernandez AV, Pérez-López FR. Effect of exercise on sleep quality and insomnia in middle-aged women: A systematic review and meta-analysis of randomized controlled trials. *Maturitas*. 2017 Jun 1;100:49-56.
 23. Heinonen R, Luoto R, Lindfors P, Nygård CH. Usability and feasibility of mobile phone diaries in an experimental physical exercise study. *Telemedicine and e-Health*. 2012 Mar 1;18(2):115-9.
 24. Jiménez-García JD, Hita-Contreras F, de la Torre-Cruz MJ, Aibar-Almazán A, Achalandabaso-Ochoa A, Fábrega-Cuadros R, Martínez-Amat A. Effects of HIIT and MIIT suspension training programs on sleep quality and fatigue in older adults: randomized controlled clinical trial. *International journal of environmental research and public health*. 2021 Feb;18(3):1211.
 25. Chiu HH, Tsao LI, Liu CY, Lu YY, Shih WM, Wang PH. Using a short questionnaire of the perimenopausal fatigue scale to evaluate perimenopausal women prone to fatigue syndrome. *Taiwanese Journal of Obstetrics and Gynecology*. 2021 Jul 1;60(4):734-8.
 26. King AC, Oman RF, Brassington GS, Bliwise DL, Haskell WL. Moderate-intensity exercise and self-rated quality of sleep in older adults: a randomized controlled trial. *Jama*. 1997 Jan 1;277(1):32-7.