European Journal of Clinical Pharmacy
Print ISSN: 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Original Research Article

Impact of Pilates Program Combined with Paced Breathing on Reducing Back Pain & Pelvic Pain and Enhancing Sleep Quality & Quality of life in Perimenopausal Women

Article History:

Name of Author:
Tabassum[1] ,Niraj Kumar[2] , Anjali Chaudhary[3]

Affiliation: *[1]. Ph.D Scholar MPT Obs & Gynae Rehabilitation, Faculty of Physiotherapy, SMIH & School of Paramedical & Allied Health Sciences Shri Guru Ram Rai University, Patel Nagar, Dehradun.*
Email- tabassum@sgrrmc.com
[2]. Professor, Physiotherapy Department, School of Paramedical & Allied Health Sciences Shri Guru Ram Rai University , Patel Nagar, Dehradun.
Email- nirajkumar@sgrrmc.com
[3]. Professor, Obstetrics & Gynaecology Department Institute of Medical & Health Sciences Shri Guru Ram Rai University, Dehradun.
Email- anjalichaudhary@sgrrmc.com
Corresponding Author:
Prof.(Dr.)Niraj Kumar

Received: 11-11-2025
Revised: 21-11-2025
Accepted: 11-12-2025
Published: 31-12-2025

Abstract: ***Background***: Perimenopause is a transitional phase that ends in menopause and is characterized by a gradual decline in ovarian function along with fluctuating levels of estrogen and progesterone. These hormonal changes, particularly variations in estrogen during the menopausal transition, can significantly contribute to a wide range of physical and psychological symptoms. Common complaints include low back pain, pelvic pain, musculoskeletal discomfort, hot flashes, fatigue, mood disturbances, and sleep problems, all of which may adversely affect quality of life.
Aims of the study: The study aim was to evaluate the impact of Pilates Program: Pelvic Floor & Core Muscles Exercises combined with paced breathing on reducing back & pelvic pain and enhancing sleep quality & quality of life in Perimenopausal women. ***Methodology:*** This was an experimental pilot study involving 22 female subjects, conducted in physiotherapy department Shri Mahant Indiresh hospital, Dehradun. The study evaluated the perimenopausal symptoms, pelvic floor muscles weakness , pelvic pain & back pain, Sleep quality and quality of life in these subjects before and after physiotherapy intervention using the Menopausal Rating Scale, Modified Oxford Grading Scale, Visual Analogue Scale (VAS) for back & pelvic pain, Pittsburg Sleep Quality Index & WHOQOL-BREF. Subjects received Physiotherapy Intervention: Pilates Program for Pelvic Floor & Core Muscles Training along with Paced Breathing exercises ***Result***:This study suggests that A consistent Pilates program focused on pelvic floor and core muscle training can lead to significant improve in muscle strength & a noticeable decrease in the severity of back pain & pelvic pain & enhancement in Sleep quality & Quality of life . Conclusion The study concluded that observably increases in Modified Oxford Grading Scale scores (indicating stronger pelvic floor muscles) and decreases in VAS for back pain & pelvic pain (indicating reduced pain symptoms), PSQI Scores demonstrates a marked reduction and enhanced sleep quality,WHOQOL scores shows a steady and substantial improvement in quality of life . This inverse relationship between muscle strength and symptom severity shows the effectiveness of Pilates Program; pelvic floor & core muscles Training along with Paced Breathing, in improving pelvic floor & core muscle strength and reduced back & pelvic pain and improve sleep quality and quality of life for those experiencing these symptoms.

Keywords: Pelvic Floor Muscle, Core strengthening, Intervention, Perimenopause, Perimenopausal women, Pilates Program

INTRODUCTION

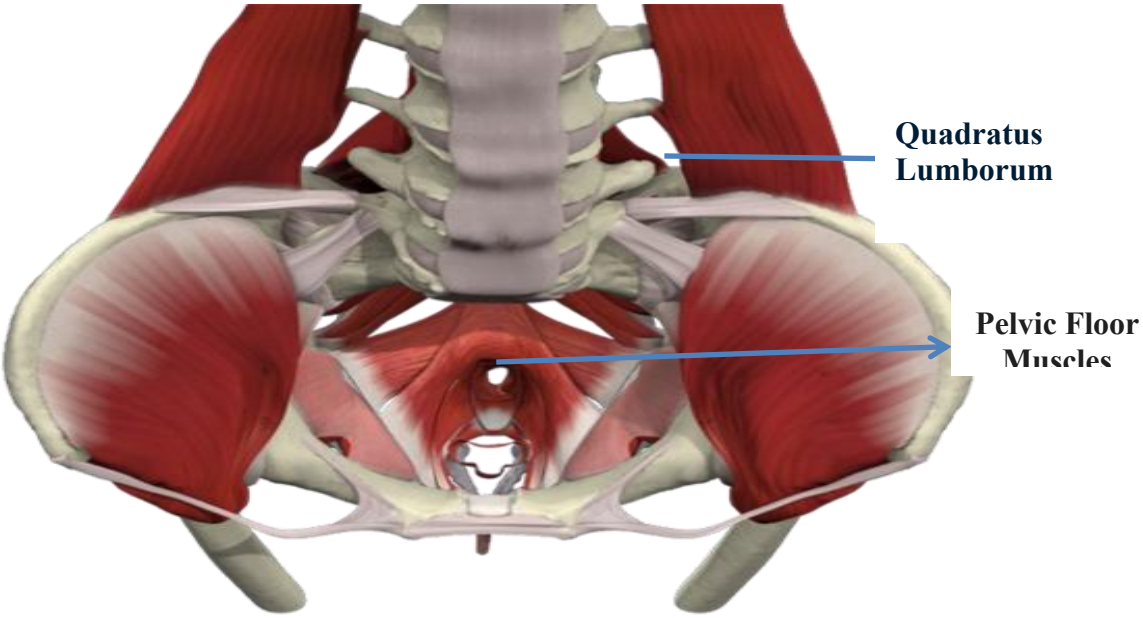


Figure No-1.1: The pelvic floor muscles form a supportive hammock at the base of pelvis,work in coordination with abdominal, back & diaphragm muscle to stabilize the trunk.

Perimenopause is the transitional phase ends up to menopause, the stage at which menstruation permanently stops.Women in this period commonly experience low back pain, which is a significant concern and is often linked with several other perimenopausal symptoms**[Kozinoga M *et al.,*2015]**

Women in the perimenopausal period may experience a wide spectrum of clinical manifestations. These commonly include Musculoskeletsl discomfort; back pain, pelvic pain and peripheral joint pain, hot flashes, night sweats, and persistent fatigue. Psychological such as irritability, anxiety, mood fluctuations, depression, and sleep disturbances are also frequently reported. These changes are largely attributed to the gradual decline in ovarian function and the associated reduction in estrogen levels. In particular, decreasing estrogen and fluctuating progesterone levels can directly affect the brain's sleep–wake regulation and circadian rhythm, thereby contributing to sleep-related problems**[Zeng W *et al.,*2025].**

Hormonal changes during the perimenopausal period can affect pelvic floor and musculoskeletal tissues, contributing to symptoms such as pelvic and back pain, urinary incontinence, pelvic organ prolapse, and joint discomfort, all of which may reduce quality of life **[Australian Physiotherapy Association, 2024].**

back pain is highly prevalent worldwide and is influenced in women by anatomical, hormonal, and biomechanical factors. Fluctuations in estrogen and progesterone across life stages can alter bone integrity, collagen structure, and ligament stability, increasing susceptibility to lumbar instability and exacerbating musculoskeletal symptoms, particularly in women with pre-existing conditions **[Rupali Milind Salvi *et al.,* 2025].**

Low estrogen levels during the perimenopausal and postmenopausal periods can lead to pelvic floor muscle (PFM) dysfunction and ligament weakening. The PFM, including the levator ani muscles, forms a supportive "hammock" for pelvic organs, aids in continence, sexual function, core stability, and venous return, and works with abdominal and back muscles to stabilize the trunk **(Figure No-1.1)**. Declining estrogen can cause muscle and ligament atrophy, reduced blood supply, and mucosal degeneration, increasing the risk of pelvic organ prolapse and functional impairments **[Zhuo Z *et al.,* 2021 & Raizada V *et al.,*2008].**

There is a reciprocal relationship between female reproductive hormones and the circadian rhythm. The suprachiasmatic nucleus (SCN), which functions as the body's central biological clock, regulates hypothalamic activity involved in the secretion of gonadotropin-releasing hormone. Melatonin also plays an important role, as it has been shown to exert a direct influence on female reproductive and sexual function. Conversely, fluctuations in female sex hormones can modify circadian regulation, further affecting sleep and physiological rhythms**[Kyung Mee Park.,2024].**

Human sleep is regulated through the interaction between homeostatic mechanisms and the circadian rhythm, which together control the sleep–wake cycle. Many vital physiological and metabolic processes in the body follow circadian regulation and operate with an approximately 24-hour rhythm. The suprachiasmatic nucleus (SCN) acts as the primary circadian pacemaker of the brain and is organized in a hierarchical, multi-oscillator system. The SCN communicates timing signals to peripheral clocks distributed across the cerebral cortex and throughout the body, thereby influencing a wide range of physiological functions and behavioral rhythms.**[Reddy S *et al.*,2023].**

A reduction in melatonin secretion and disturbances in circadian rhythm mechanisms can adversely affect sleep regulation.The gonadotropin-releasing hormone (GnRH) system plays a central role in regulating female reproductive hormones. GnRH is released from the hypothalamus and stimulates the anterior pituitary gland to secrete follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which together govern reproductive functions through a signaling pathway that originates in the hypothalamus.This regulatory pathway is influenced by circadian rhythm mechanisms. Within the hypothalamus, specific neuronal populations are essential for integrating GnRH activity, particularly the estrogen-sensitive kisspeptin/neurokinin-B/dynorphin (KNDy) neurons. These neurons not only modulate reproductive hormonal regulation but are also involved in the homeostatic control of body temperature and other key physiological processes**[Maki, Pauline M *et al.,* 2024] .**

The sleep–wake cycle is regulated through the interaction of multiple brain nuclei and neurotransmitter systems. Wakefulness is sustained by ascending arousal networks involving noradrenaline, serotonin, dopamine, histamine, glutamate, acetylcholine, and orexin, which are suppressed by GABAergic neurons during sleep **[Haufe A *et al.,* 2022].** Sleep timing is coordinated by the suprachiasmatic nucleus, the central circadian pacemaker [**España RA *et al.,* 2011]**. Estradiol, a neuroactive estrogen **(Figure No-1.2)** ; influences sleep regulation both directly, through its actions on sleep-promoting regions and the SCN, and indirectly, by modulating neurotransmitter systems such as serotonergic and dopaminergic pathways **[Haufe A *et al.,* 2022]**.

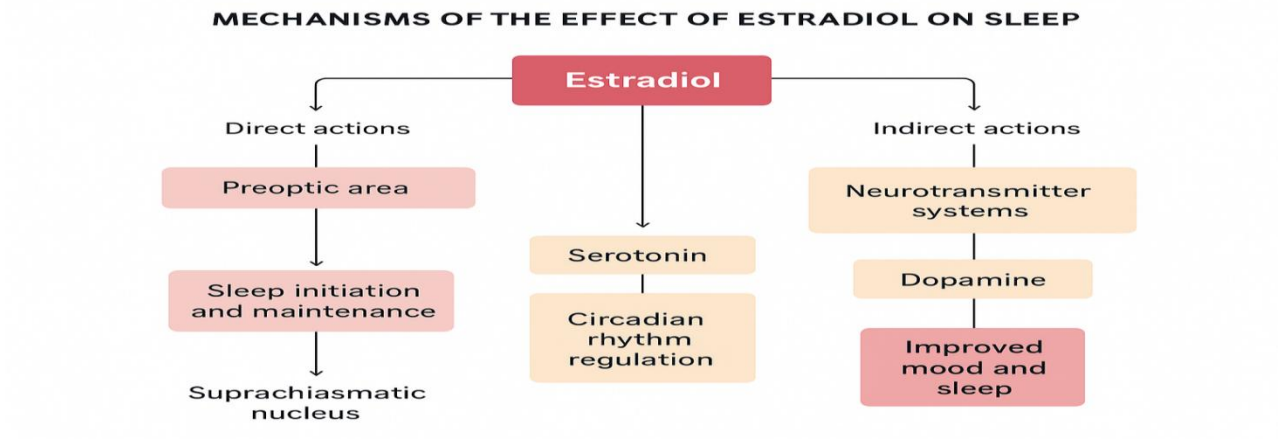


Figure No-1.2: Mechanism of the effect of estradiol on sleep

The preoptic area of the hypothalamus, rich in estrogen receptors, is a major site of estrogen-related modulation of sleep–wake activity. Fluctuations in estrogen during the menopausal transition can affect

mood and sleep, and management of sleep disturbances may also improve depressive symptoms **[Wegrzynowicz,A.K *et al.,* 2025].**

Declining ovarian hormones alter hypothalamic thermoregulation and homeostasis, leading to vasomotor symptoms [**Figure No-1.3]** such as hot flashes and night sweats reported in up to 80% of women, which frequently disrupt sleep. At the same time, reduced estrogen levels can influence circadian pacemaker activity and disturb the balance between arousal-promoting and sleep-promoting neurotransmitters, with evidence that estrogen acts at multiple thermoregulatory nodes within the hypothalamus to modulate body temperature **[Haufe A *et al.*,2022].**

Progesterone acts as a neuroactive steroid with receptors present in major sleep–wake regulatory nuclei including the basal forebrain, dorsal raphe nucleus, locus coeruleus, and the suprachiasmatic nucleus allowing it to directly modulate sleep and circadian rhythms **[Dorsey A *et al.,* 2021]** Although progesterone has sleep-promoting effects through GABAergic mechanisms [**Figure No-1.4]**, it also produces thermogenic effects that raise core body temperature, which may impair sleep quality. As a result, progesterone can show mixed or even negative associations with sleep across menstrual and reproductive transitions, depending on its influence on thermoregulation and circadian timing **[España RA *et al.*,2011].**

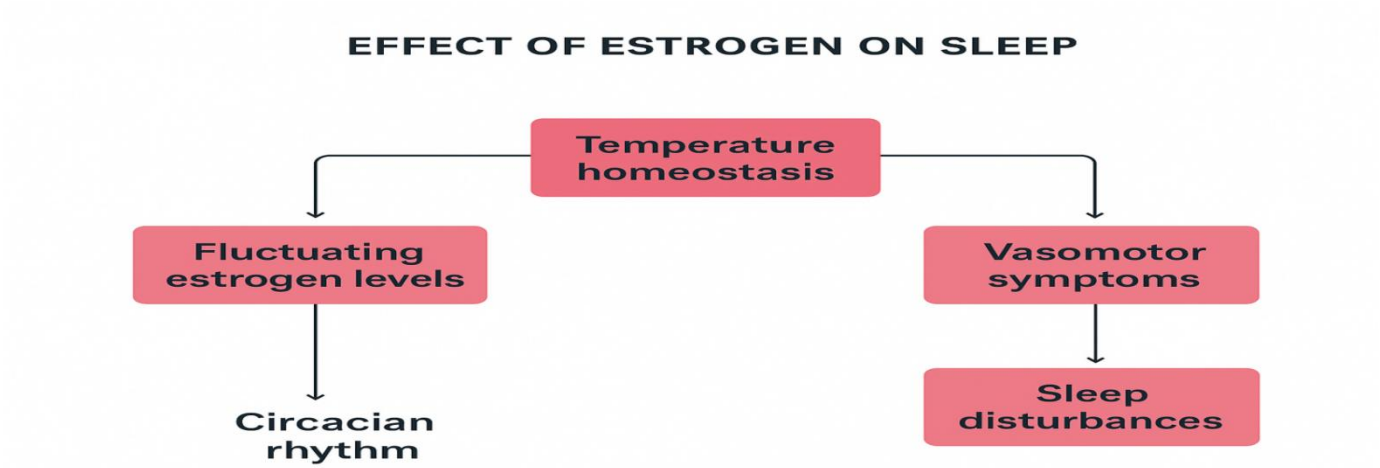


Figure No-1.3 : Fluctuation in estrogen level during perimenopause or menopause transition can profoundly influence sleep through their effect on hypothalamic temperature control or homeostasis, leading to vasomotor symptoms.

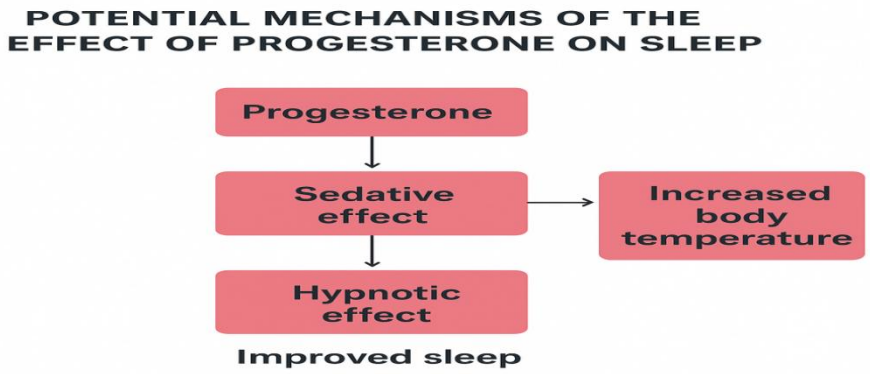


Figure No -1.4: Potential Mechanism of the effect of progesterone on

Study of Women's Health Across the Nation (SWAN), suggests that 34.3% of perimenopausal women reported sleep disturbances compared with 28.0% of premenopausal women**[Figure No-1.5]**, in their study they tracked 3,045 middle-aged women over eight years **[Kyung Mee Park, 2024].**

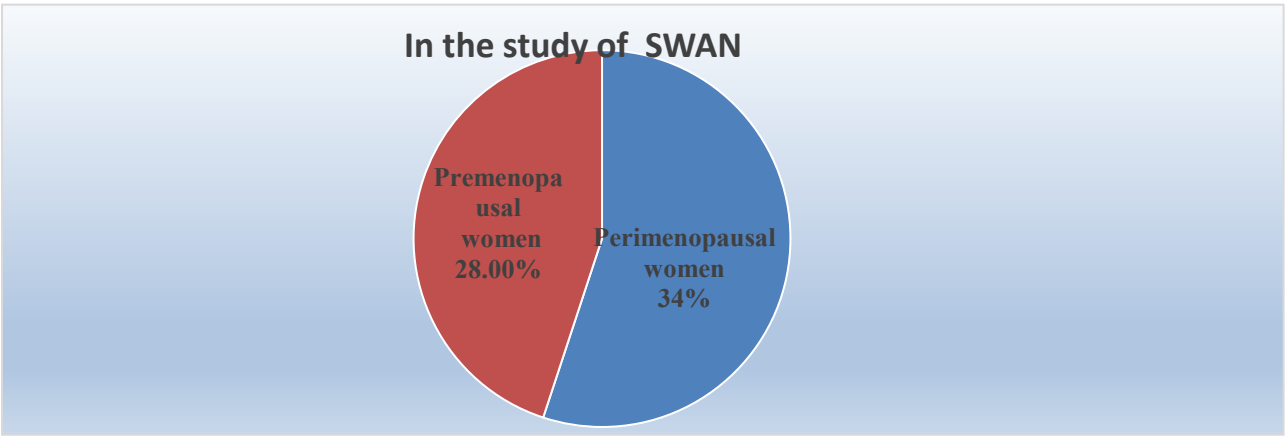


Figure No -1.5: Prevalence Rate Of Sleep Disturbances by SWAN

According to Dugan et al. 61% of 2,218 women reported lumbar spine pain. Back pain experienced at least once in the two weeks prior to the study was reported. An association was also observed between higher BMI and increased pain, Which is due to greater mechanical loading of the spine The Pilates method is increasingly used in rehabilitation and offers multiple health benefits. It emphasizes strength, concentration, stability, breath control, fluidity, and proper body alignment, targeting core muscles as well as the hips and ribcage. Overall, studies indicate that Pilates has positive effects on muscle activation and pelvic floor strengthening compared to no intervention **[Gisto L *et al.,* 2023].**

The systematic review indicates that Pilates can help individuals with low back pain improve core muscle strength in the trunk, pelvis, and abdomen. Its effectiveness is comparable to other exercise programs or physical activities of similar or different intensities**[Franks J *et al.,*2023].**

The systemic review suggests that physiotherapy interventions such as exercise, yoga, walking, reflexology, massage, and aromatherapy can improve sleep quality and reduce depression in menopausal women, though more research is needed on Pilates, footbaths, acupressure, and combined approaches **[Lialy, H.E. *et al.,* 2023].**

The conclusion of the experimental study suggests that deep breathing and aerobic exercises improve perimenopausal symptoms: deep breathing mainly enhances mood and reduces anxiety and depression, while aerobic exercise benefits sexual function **[Raabia AK *et al.,* 2022]**

Overall the meta-analysis suggests that mind-body exercise such as Pilates, yoga, or other structured exercise programs is an effective, non-pharmacological intervention to improve both physical and psychological health during the menopausal transition and leads to measurable improvements in sleep patterns, such as longer sleep duration, reduced sleep latency and improve quality of life **[Xu H *et al.,*2024].s**

1.2:1 AIMS & OBJECTIVES

This study aim was to evaluate the impact of Pilates Program: Pelvic Floor & Core Muscles Exercises (Mat Pilates Program) Combined with paced breathing on reducing back & pelvic pain and enhancing sleep quality & quality of life in Perimenopausal women

1.2:2 Objectives

- To evaluate the effectiveness of a Pilates-based pelvic floor and core muscle strengthening program in improving pelvic floor and core muscle strength and in reducing back pain and pelvic pain among perimenopausal women.
- To evaluate the effectiveness of paced breathing in enhancing sleep quality among perimenopausal women.
- To evaluate the combined effects of a Pilates-based pelvic floor and core muscle strengthening program and paced breathing on pelvic floor and core muscle strength, reduction of back pain and pelvic pain, enhancement of sleep quality, and improvement in quality of life among perimenopausal women.

2.METHODS & MATERIALS

2.1 :Ethical consideration Ethical approval for the study was obtained from the Institutional Ethical Committee (SGRR/IEC/03/24). The study was registered with the Clinical Trial Registry of India (CTRI/2025/06/089873) and the Copyright Office, Government of India (Registration No. LD-27299/2015). Written informed consent was obtained from all participants prior to enrollment. The study was conducted at Shri Mahant Indiresh Hospital,

Patel Nagar, Dehradun, with approval from **2.2: Research Design and settings**
This was an experimental pilot study involving 22 female subjects. Study conducted in the Out Patient Door (OPD) Department of Physiotherapy and simultaneously referred from Obs & Gynaecology Units at the Shri Mahant Indiresh Hospital (SMIH) Patel Nsagar, Dehradun

2.3: Eligibility Criteria: Inclusion Criteria:[Table No-2.3.1]

Inclusion Criteria	Clinical Features / Symptoms
Perimenopausal Status	Clear perimenopausal diagnosis/Menopausal Rating Scale
Vasomotor Symptoms (VMS)	Hot flashes, heart palpitations
Musculoskeletal Symptoms	Back pain
Pelvic Symptoms	Pelvic pain, perineal laxity
Sleep Problems	Sleep disturbances / insomnia
Menstrual Criteria	Amenorrhea for **3–11 months** prior to consent

Table No - 2.3.1: Inclusion Criteria (symptoms / conditions suitable for exercise intervention)

Exclusion Criteria :[Table No-2.3.2]

Exclusion Category	Condition / Reason for Exclusion
Medical Contraindications	Musculoskeletal, neurological, pulmonary, or cardiac disorders limiting safe exercise participation
Hormonal Therapy	Use of **HRT within the last 6 months**
Post-Surgical Status	Recent abdominal surgery or acute abdominal operative procedures
Exercise Safety Concern	Any condition that may restrict activity or alter outcome measures

Table No - 2.3.2: Exclusion Criteria (Not Suitable for Exercise / Needs Medical Referral)

2.4: Materials Used : A measuring tape , pen and paper for recording assessment findings and outcome scores, and Mat for Pilates Program to facilitate the performance of the intervention exercises in a safe and comfortable environment.
2.5: Treatment duration: 24 weeks (6 month), 45min-1 hr ,3 days alternatively in a week.
2.6: Outcome Measures : The study evaluated the perimenopausal symptoms, pelvic floor muscles weakness , pelvic pain & back pain, Sleep quality and quality of life in these subjects before and after physiotherapy intervention using: **[Table No-2.6.1]**

Table No - 2.6.1: Outcome Measures

OUTCOME MEASURES	
Primary Outcme Measures	Menopause Rating Scale Modified Oxford Grading Scale Visual Analogue Scale(VAS) : For Back Pain & Pelvic Pain
Secondary Outcme Measure	Pittsburgh Sleep Quality Index (PSQI) World Health Organization Quality Of Life Assessments (WHOQOL)

2.7:Intervention: Pilates Program: The intervention consisted of Pilates based (Mat Pilates) exercises program for Pelvic Floor & Core Muscles Strengthening along with Paced Breathing intervention.The program was implemented over 24 weeks with gradual progression in exercise intensity to improve muscle strength, endurance, and coordination, as outlined in **[Table No-2.7.1],[Table No-2.7.2] & [Table No-2.7.3]**

PILATES PROGRAM: EXERCISES FOR PELVIC FLOOR MUSCLES Principles like Breath:Inhale & Exhale Concentration, Precision		
Exercise	**Procedure**	**Muscle Focus**
MARCH	Lie on your back, knees bent, feet flat. Inhale deeply, press lower back into the floor, keep neutral pelvis. Exhale, lift one knee toward chest ("march") while bracing core. Alternate legs.	Pelvic floor, deep core, hip flexors
FROGGER	Lie on back, knees bent, heels together. Inhale, press lower back into floor. Exhale, extend legs toward ceiling, then open knees outward and return to start.	Pelvic floor, adductors, lower abdominals
FLAT BACK HINGE	Lie on back, knees bent, feet flat. Hinge at hips to lift pelvis slightly while maintaining neutral spine. Lower back down slowly.	Core, glutes, pelvic floor
SHOULDER BRIDGE	Lie on back, knees bent, feet hip-width apart. Inhale, press into heels, lift hips to create a straight line from shoulders to knees. Exhale, lower slowly.	Glutes, hamstrings, pelvic floor, lower back
SIDE LYING KNEE TO HEEL	Lie on side, knees bent. Inhale, draw top knee toward chest; exhale, extend to bring heel in line with hip. Repeat slowly.	Obliques, pelvic floor, hip abductors
BIRD DOG	Start on all fours. Inhale, engage core; exhale, extend opposite arm and leg parallel to floor. Hold briefly, return.	Core stabilizers, pelvic floor, glutes, back extensors
QUADRUPED PLANK	On hands and knees or forearms, extend knees back to form plank. Engage core and pelvic floor. Hold.	Core, pelvic floor, shoulders
DEEP SQUAT	Stand with feet shoulder-width apart, inhale. Exhale, lower into deep squat while keeping heels down and core engaged. Return to standing.	Glutes, quadriceps, pelvic floor

Table No - 2.7.1: Pilates Based Exercise Program For Pelvic Floor Muscles Strengthening

PILATES PROGRAM: EXERCISES FOR CORE MUSCLES Principles likeBreath:Inhale & ExhaleConcentration, Precision		
Exercise	**Procedure**	**Muscle Focus**
Hundred I	Lie on back, lift head, neck, and shoulders off mat. Legs lifted to tabletop or extended (modify by keeping knees bent). Pump arms up and down while breathing in 5 counts, out 5 counts.	Rectus abdominis, transverse abdominis, obliques, pelvic floor
Hundred II	Similar to Hundred I, but legs lowered closer to floor while maintaining abdominal engagement. Arms pump as before.	Rectus abdominis, deep core, pelvic floor
Roll-Up	Lie on back, arms overhead. Inhale, lift arms, head, and spine sequentially off mat. Exhale to reach toward toes. Inhale to roll back down slowly.	Rectus abdominis, obliques, spinal flexors, pelvic floor
Single Leg Stretch	Lie on back, head and shoulders lifted. Pull one knee toward chest while extending opposite leg, switch legs in a controlled manner.	Rectus abdominis, obliques, hip flexors, pelvic floor
The Scissors	Lie on back, head and shoulders lifted. Alternate legs straight toward ceiling and lower toward floor while holding other leg.	Rectus abdominis, hip flexors, pelvic floor
Teaser	Lie on back, arms extended overhead. Inhale, lift head, shoulders, and legs to form a V-shape. Exhale, lower down slowly.	Rectus abdominis, obliques, hip flexors, pelvic floor
Push-Up	From plank position, lower body toward floor while keeping core engaged; exhale to push up.	Core stabilizers, rectus abdominis, shoulders, pelvic floor
Leg Pull Front	From plank position, lift one leg toward ceiling while maintaining spinal alignment. Alternate legs.	Glutes, core stabilizers, spinal erectors, pelvic floor

PILATES PROGRAM: EXERCISES FOR CORE MUSCLES Principles likeBreath:Inhale & ExhaleConcentration, Precision		
Exercise	**Procedure**	**Muscle Focus**
Rollover	Lie on back, lift legs overhead to touch floor behind head, then roll back down slowly.	Rectus abdominis, obliques, hip flexors, pelvic floor
Imprinting the Spine	Lie on back, knees bent, feet flat. Inhale, feel natural curve in spine; exhale, gently press lower back into mat, engaging core and pelvic floor.	Transverse abdominis, pelvic floor, multifidus

Table No - 2.7.2: Pilates Based Exercise Program For Core Muscles Strengthening

Table No-2.7.3: Gradual progression in exercise intensity

Training Phase (Weeks)	Repetitions per Set
1st – 4th week	**15 repetitions**
5th – 8th week	**15 repetitions**
9th – 12th week	**20 repetitions**
13th – 16th week	**20 repetitions**
17th – 20th week	**25 repetitions**
21st – 24th week	**25 repetitions**

Paced Breathing : The patient was instructed to sit or lie comfortably and relax the body. They were guided to inhale gently through the nose for 3–5 seconds, allowing the abdomen to rise, and then exhale slowly for 6–7 seconds in a smooth, controlled manner **[Table No-2.7.1]:**

PACED BREATHING PROTOCOL		
Training Phase (Weeks)	**Inhale / Exhale Duration**	**Repetitions per Set**
1–4 weeks	Inhale 3 sec / Exhale 3 sec	15
5–8 weeks	Inhale 4 sec / Exhale 4 sec	15
9–12 weeks	Inhale 4 sec / Exhale 5 sec	20
13–16 weeks	Inhale 4 sec / Exhale 6 sec	20
17–20 weeks	Inhale 4–5 sec / Exhale 6–7 sec	25
21–24 weeks	Inhale 5 sec / Exhale 7–8 sec	25

Table No-2.7.4: Gradual progression in intensity

3.STATISTICAL ANALYSIS & RESULTS

3.1: The statistical analysis was performed both manually and using software tools. SPSS version 23 was utilized to analyze the data, while Microsoft Excel and Word were employed to generate tables, graphs, and charts. To examine the differences within groups over time, a one-way repeated measures ANOVA was applied **[Table No-3.1.1]**.

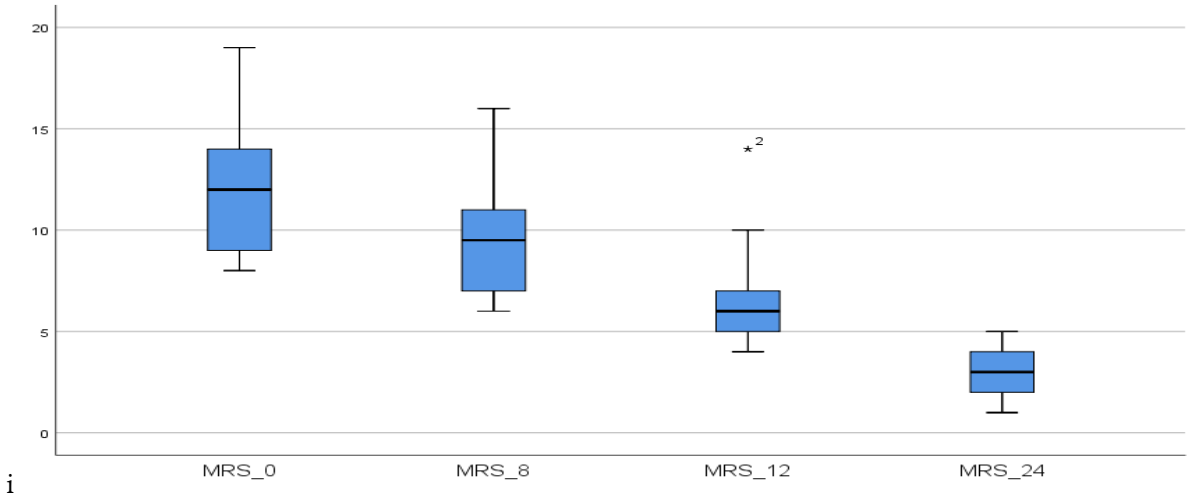
Table No-3.1.1: Statistical analysis :the differences within groups over time, a one-way repeated measures ANOVA was applied

Sr. No.	Variable	Timeline	Median (IQR)	Min.-Max.	p-value
Primary Outcome Measures					
1.	**MRS**	0 Week	12.0 (9.0–14.25)	8–19	0.001
		8 Week	9.5 (7.0–11.0)	6–16	
		12 Week	6.0 (5.0–7.0)	4–14	
		24 Week	3.0 (2.0–4.0)	1–5	
2.	**Modified Oxford Grading Scal**	0 Week	2.0 (1.5–2.0)	1–3	0.001
		8 Week	3.0 (2.0–3.0)	2–3	
		12 Week	3.0 (3.0–4.0)	3–4	
		24 Week	5.0 (4.0–5.0)	4–5	
3.	**VAS (Low Back Pain)**	0 Weeks	6.0 (1.0)	5–8	**0.000***
		8 Weeks	4.0 (1.0)	4–7	
		12 Weeks	3.0 (0.25)	2–5	
		24 Weeks	1.0 (1.0)	0–2	
	VAS (Pelvic Pain)	0 Weeks	4.0 (2.75)	0–6	**0.000***
		8 Weeks	3.0 (2.50)	0–5	
		12 Weeks	2.0 (1.25)	0–3	
		24 Weeks	0.5 (1.0)	0–2	
Secondary Outcome Measures					
4.	**PSQI**	0 Week	14.0 (11.0–20.0)	9–25	0.001
		8 Week	10.0 (8.75–16.0)	7–18	
		12 Week	7.0 (6.0–12.25)	5–15	
		24 Week	4.0 (4.0–7.0)	2–9	
5.	**WHOQOL**	0 Week	17.75 (17.25–19.56)	15.75–26.50	0.001
		8 Week	25.25 (24.25–25.94)	22.25–35.50	
		12 Week	31.5 (29.88–36.31)	28.25–45.00	
		24 Week	48.25 (46.19–49.94)	42.25–52.00	

3.2: Interpretation:

Primary Outcome Measures:

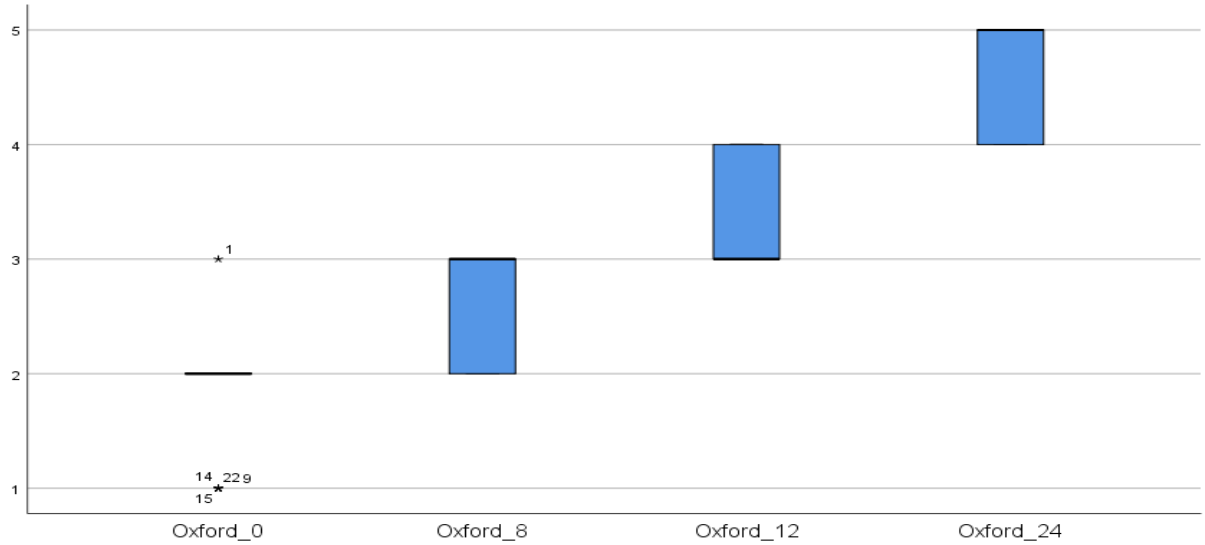
1. **Menopause Rating Scale (MRS):** Median MRS scores decreased steadily from 12.0 at baseline to 3.0 at 24 weeks, indicating a substantial reduction in menopausal symptom severity **[Boxplot Graph No-3.2.1]**.



Boxplot Graph No-3.2.1: Steady decline in Menopause Rating Scale (MRS)

The boxplot shows a steady decline in **Menopause Rating Scale (MRS)** scores from a median of 12 at baseline to 3 at 24 weeks, indicating a significant reduction in menopausal symptom severity. The narrowing interquartile range over time reflects more consistent improvements among perimenopausal women, with most scores clustering between 1 and 5 by 24 weeks, demonstrating uniform and meaningful reductions in disability.

2. **Modified Oxford Grading Scale:** Pelvic floor muscle strength, as measured by Oxford scores, improved from a median of 2.0 at baseline to 5.0 at 24 weeks, reflecting a marked enhancement in muscle function**[Boxplot Graph No-3.2.2]**.



Boxplot Graph No-3.2.: Steady increase in Modified Oxford Grading Scale

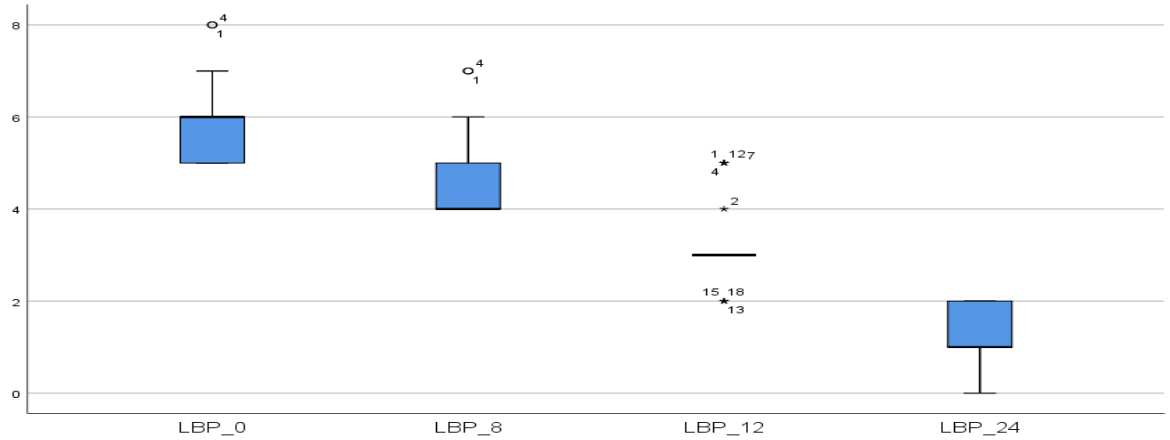
The boxplot demonstrates a steady increase in pelvic floor muscle strength over 24 weeks. Median scores improved from around 2 at baseline to 4–5 by 24 weeks, with values becoming more tightly clustered, indicating consistent and significant functional gains and reduced variability among participants.

3.Visual Analogue Scale (VAS) for Low Back Pain (LBP) and Pelvic Pain (PP):[Boxplot Graph No-3.2.3 A & B].

LBP: Median scores decreased from 6.0 at baseline to 1.0 at 24 weeks.

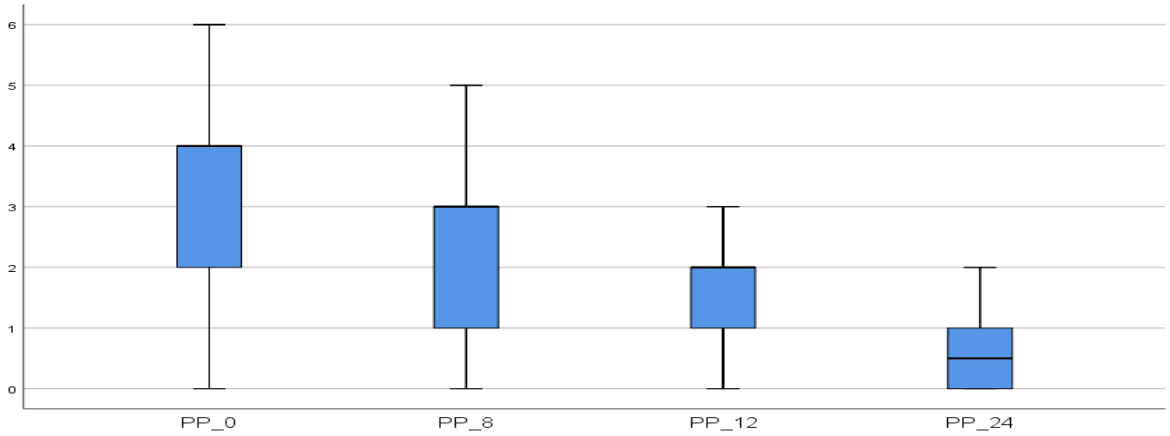
PP: Median scores declined from 4.0 to 0.5 over the same period.

The narrowing interquartile ranges (IQRs) suggest that pain reduction was consistent among participants. Friedman test results confirmed that these reductions were statistically significant for both LBP and PP ($p < 0.001$).



Boxplot Graph No-3.2.3:A) Consistent reduction in Visual Analogue Scale (VAS) – Low Back Pain

The boxplot shows a consistent reduction in low back pain over 24 hours. Median scores decreased from around 6 at baseline to 1 at 24 hours, with a narrowing spread of values, indicating that most participants experienced substantial and uniform pain relief over time, despite a few outliers.

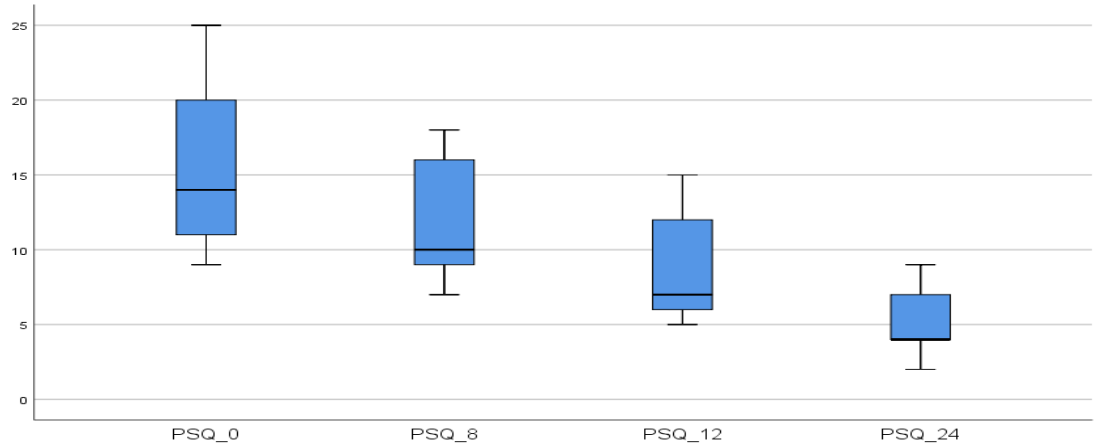


Boxplot Graph No-3.2.3:B) Consistent reduction in Visual Analogue Scale (VAS) – Pelvic Pain

The boxplot shows a progressive and consistent reduction in pelvic pain over 24 hours. Median scores decreased from 4 at baseline to 0.5 at 24 hours, with the spread of values narrowing over time, indicating that most participants experienced substantial and uniform pain relief.

Secondary Outcome Measures:

3. **Pittsburgh Sleep Quality Index (PSQI):** Median PSQI scores reduced from 14.0 to 4.0, indicating improved sleep quality and reduced sleep disturbances**[Boxplot Graph No-3.2.4]**.

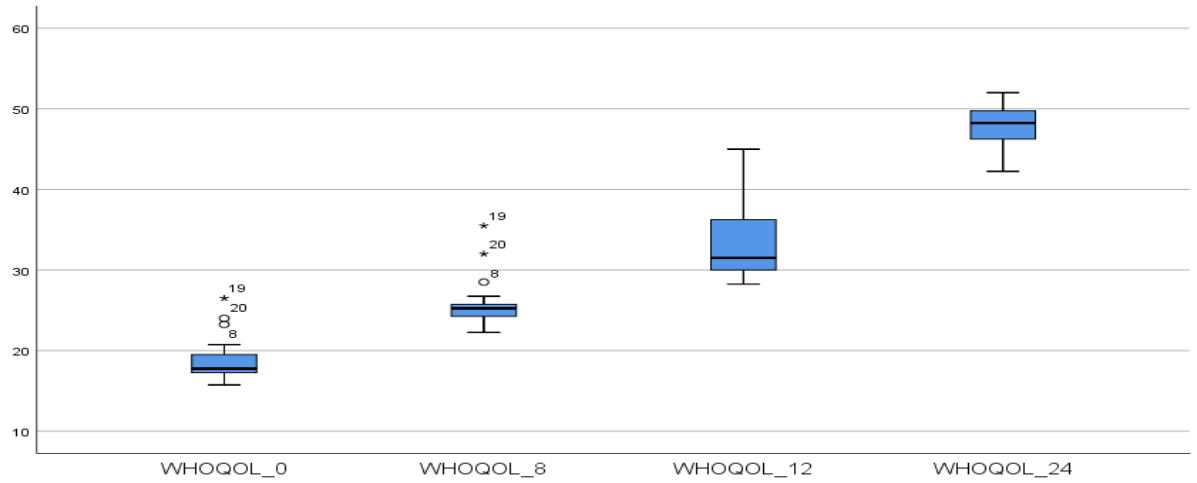


Boxplot Graph No-3.2.4: Progressive reduction in Pittsburgh Sleep Quality Index (PSQI)

The boxplot shows a progressive reduction in PSQI scores over 24 weeks. Median scores declined from ~14 at

baseline to ~4 at 24 weeks, with a narrowing spread, indicating consistent and significant improvements in sleep quality.

4. **World Health Organization Quality of Life (WHOQOL):** Median WHOQOL scores increased from 17.75 at baseline to 48.25 at 24 weeks, reflecting enhanced overall quality of life and well-beng**[Boxplot Graph No-3.2.5]**.



Boxplot Graph No-3.2.5 : Steady and substantial improvement in WHO Quality of Life (WHOQOL)

The boxplot demonstrates a steady and substantial improvement in quality of life over 24 weeks. Median scores increased from ~18 at baseline to ~48–50 at 24 weeks, with a narrowing spread, indicating consistent and significant gains in overall well-being among participants.

DISCUSSION

The present study demonstrates that a 24-week Pilates based (Mat Pilates) exercises program for Pelvic Floor & Core Muscles Strengthening combined with Paced Breathing intervention significantly improved multiple health outcomes among perimenopausal women, including perimenopausal symptoms, pelvic floor muscle function, pain reduction, sleep quality, and overall quality of life.

Primary Outcome Measures:

The Menopause Rating Scale (MRS) showed a marked reduction in symptom severity, with median scores decreasing from 12.0 at baseline to 3.0 at 24 weeks. This aligns with evidence from meta-analyses indicating that mind-body exercises, including Pilates and yoga, effectively reduce vasomotor, psychological, and somatic menopausal complaints while improving overall well-being [Xu H et al., 2024; Raabia AK et al., 2022].

Pelvic floor muscle strength, as assessed by the Modified Oxford Grading Scale, improved from a median of 2.0 to 5.0. Strengthened pelvic floor musculature contributes not only to continence and pelvic support but may also alleviate musculoskeletal discomfort. This finding is consistent with previous studies reporting that Pilates enhances core and pelvic floor muscle activation, comparable to other structured exercise programs [Gisto L et al., 2023; Franks J et al., 2023].

Pain reduction, measured by the Visual Analogue Scale (VAS) for low back pain (LBP) and pelvic pain (PP), was significant. Median LBP scores decreased from 6.0 to 1.0, and PP scores declined from 4.0 to 0.5, with narrowing interquartile ranges indicating consistent improvement among participants. These results reflect the known benefits of Pilates and core strengthening in reducing lumbar spine and pelvic discomfort, which is especially relevant given the high prevalence of low back pain in midlife women and its association with factors such as increased BMI [Dugan SA et al., 2006].

Secondary Outcome Measures:

Sleep quality improved substantially, as indicated by a reduction in PSQI scores from 14.0 to 4.0. This supports findings from systematic reviews suggesting that physiotherapy interventions, exercise, and mind-body practices can enhance sleep and reduce depressive symptoms in menopausal women [Lialy H.E. et al., 2023].

Overall quality of life, assessed using WHOQOL, increased markedly from 17.75 to 48.25. This indicates that the intervention not only addressed physical symptoms but also positively influenced psychological and social well-being, consistent with

prior evidence that structured mind-body exercises improve both physical and mental health outcomes during the menopausal transition [Xu H et al., 2024; Raabia AK et al., 2022].

5.LIMITATIONS

Age-related Constraints: Women over 50 years of age may face difficulty performing some Pilates-based exercises due to reduced flexibility, joint mobility, or pre-existing musculoskeletal conditions, which may limit the generalizability of the findings to older perimenopausal or postmenopausal populations.

Exercise Intensity and Compliance: Some participants may have found certain Pilates movements or paced breathing exercises challenging to perform correctly, potentially affecting adherence and the uniformity of intervention delivery.

Short-term Follow-up: The study assessed outcomes up to 24 weeks. Long-term sustainability of improvements in pelvic floor strength, pain reduction, and quality of life was not evaluated

CONCLUSION

The 24-week Pilates-based pelvic floor and core muscles strengthening program, combined with paced breathing, resulted in significant improvements in perimenopausal symptoms, pelvic floor muscle strength, back pain & pelvic pain reduction, sleep quality, and overall quality of life among perimenopausal women. The intervention demonstrated consistent and meaningful benefits across both physical and psychological domains, highlighting its potential as a safe, non-pharmacological strategy for managing perimenopausal challenges. These findings support the incorporation of structured mind-body exercise programs into routine care for perimenopausal women to enhance functional well-being and overall quality of life.

REFERENCES

1. Australian Physiotherapy Association. Physiotherapy and women's pain: An overview of evidence-based physiotherapy care. July 2024. Available from: https://australian.physio/sites/default/files/submission-2024-07/APA_Appendix_A_Inquiry_into_Womens_Pain_July_2024.pdf
2. Choudhary A, Bansal K. Menopause and movement: exercise for better sleep and psychological well-being—a systematic review. Menopause. 2025 Nov 1;32(11):1063–71. doi:10.1097/GME.0000000000002610. PMID:40694785
3. Dorsey A, de Lecea L, Jennings KJ. Neurobiological and hormonal mechanisms regulating women's sleep. Front Neurosci. 2021;14:625397. doi:10.3389/fnins.2020.625397
4. Dugan SA, Powell LH, Kravitz HM, Everson-Rose SA, Karavolos K, Luborsky J. Musculoskeletal pain and menopausal status. Clin J Pain. 2006;22(4):325–31. doi:10.1097/01.ajp.0000208249.07949.d5
5. España RA, Scammell TE. Sleep neurobiology from a clinical perspective. Sleep. 2011 Jul 1;34(7):845–58. doi:10.5665/SLEEP.1112. PMID:21731134; PMCID:PMC3119826
6. Franks J, Thwaites C, Morris ME. Pilates to improve core muscle activation in chronic low back pain: a systematic review. Healthcare. 2023;11:1404. doi:10.3390/healthcare11101404
7. Gisto L, Ribeiro D, Avelino P, Costa H, Kiefer K. Effects of the Pilates method on the pelvic floor muscles: a systematic review. Manual Therapy, Posturology & Rehabilitation J. 2023;21. doi:10.17784/mtprehabjournal.2023.21.729
8. Haufe A, Baker FC, Leeners B. The role of ovarian hormones in the pathophysiology of perimenopausal sleep disturbances: A systematic review. Sleep Med Rev. 2022 Dec;66:101710. doi:10.1016/j.smrv.2022.101710. PMID:36356400
9. Kyung Mee Park. Sleep disturbance in perimenopausal women. Chronobiol Med. 2024;6(3):109–15. doi:10.33069/cim.2024.0027
10. Kozinoga M, Majchrzycki M, Piotrowska S. Low back pain in women before and after menopause. Prz Menopauzalny. 2015 Sep;14(3):203–7. doi:10.5114/pm.2015.54347. PMID:26528111; PMCID:PMC4612559
11. Lialy HE, Mohamed MA, AbdAllatif LA, et al. Effects of different physiotherapy modalities on insomnia and depression in perimenopausal, menopausal, and post-menopausal women: a systematic review. BMC Womens Health. 2023;23:363. doi:10.1186/s12905-023-02515-9
12. Maki PM, Panay N, Simon JA, et al. Sleep disturbance associated with the menopause. J Menopausal Soc. 2024;31(8):724–33. doi:10.1097/GME.0000000000002386
13. Raabia AK, Augustina J. Efficacy of deep breathing exercise and aerobic exercise on perimenopausal women. Int J Physiother Res. 2022;10(2):4177–81. doi:10.16965/ijpr.2022.113
14. Raizada V, Mittal RK, et al. Pelvic floor anatomy and applied physiology. Gastroenterol Clin North Am. 2008;37(3):493–509, vii. doi:10.1016/j.gtc.2008.06.003. PMID:18793993; PMCID:PMC2617789
15. Reddy S, Reddy V, Sharma S. Physiology, Circadian Rhythm. [Updated 2023 May 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK519

507/
16. Rupali Milind Salvi, Shubhada Kale, et al. Lower back pain in women across life stages: Insights from adolescence to menopause. Adesh Univ J Med Sci Res. 2025;7(1):1–9. doi:10.25259/AUJMSR_7_2025
17. Sumaira Kanwal, Irum Yaqoob, Syed Shakil-Ur-Rehman, et al. Effects of core muscle stability on low back pain and quality of life in postmenopausal women: A comparative study. J Pak Med Assoc. 2021;71(1-A). doi:10.47391/JPMA.151
18. Wegrzynowicz AK, Walls AC, Godfrey M, Beckley A. Insights into perimenopause: A survey of perceptions, opinions on treatment, and potential approaches. Women. 2025;5(1). doi:10.3390/women5010004
19. Wright VJ, Schwartzman JD, Itinoche R, Wittstein J, et al. The musculoskeletal syndrome of menopause. Climacteric. 2024 Oct;27(5):466–72. doi:10.1080/13697137.2024.2380363. PMID:39077777
20. Xu H, Liu J, Li P, Liang Y. Effects of mind-body exercise on perimenopausal and postmenopausal women: a systematic review and meta-analysis. Menopause. 2024 May 1;31(5):457–67. doi:10.1097/GME.0000000000002336. PMID:38669625; PMCID:PMC11465887
21. Zeng W, Xu J, Yang Y, Lv M, Chu X, et al. Factors influencing sleep disorders in perimenopausal women: a systematic review and meta-analysis. Front Neurol. 2025 Feb;16:1460613. doi:10.3389/fneur.2025.1460613

