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Comparison of Lower Extremity Strength and Balance Among Premenopausal and Postmenopausal Women

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ABSTRACT

BACKGROUND: Menopause is the permanent end of menstruation caused by the loss of ovarian follicular function. It occurs due to a natural decline in estrogen and progesterone production, leading to various symptoms, including hot flashes, mood changes, physical discomfort and urogenital issues. Beyond these effects, menopause also impacts balance and increases the risk of falls, highlighting the need for preventive measures to maintain stability and overall well-being.
OBJECTIVE: To compare lower limb strength and balance among premenopausal and postmenopausal women.
METHOD: A cross-sectional study was conducted among 60 female participants in the age group of 40-60 years, were divided into 30 premenopausal and 30 postmenopausal group based upon the inclusion and exclusion criteria. The lower limb strength (30sec sit to stand test) and balance (static: one leg stand-eye open and close, dynamic: four square step test) were measured respectively.
RESULT: As the data was not normally distributed, intergroup comparison was done using Mann-Whitney U test. The result revealed that there was significant difference in lower limb strength (mean±SD) premenopausal:18.3±2.05 postmenopausal:11.7±2.93 and balance (static-one leg stand- eye open-premenopausal: 22.36±3.97 postmenopausal: 16.81±2.04 eye close-premenopausal: 20.57±2.67 postmenopausal: 14.14±2.67) (dynamic-four square step test-premenopausal:10.06±2.47 postmenopausal:15.98±3.09) among postmenopausal women($p<0.05$).
CONCLUSION: There is a reduction of lower limb strength and balance among postmenopausal women.

Keywords: Lower limb strength, balance, premenopausal women, postmenopausal women

INTRODUCTION

Menopause is the transition phase from the reproductive to the nonreproductive phase in a woman's life. It is a physiological event similar to menarche, pregnancy and the postpartum period. It is the span of time dating from the final menstrual period regardless of whether menopause was spontaneous or induced. At each stage of the reproductive stage, there is a change in the hormonal milieu which bring about varied changes and challenges in the woman's

physical and emotional well-being. None of the reproductive life events are considered as diseases but are probably natural biomarkers signally the need to give the additional care in these vulnerable phases of a woman's life to maintain health, prevent complications and give quality of life. [1,2]

Average age of menopause in India is 46 years. However, among Indian women, approx. 69-85% women felt that menopause adversely affected women's physical health. Menopausal symptoms include vasomotor symptoms such as hot flashes and night sweats, physical and mental fatigue, sleep problems and urogenital symptoms such as vaginal dryness and bladder and sexual dysfunctions.[3]

Falls are a major public health problem, being the second leading cause of unintentional injury deaths worldwide.[4] This greater risk of falling, as well as the presence of menopause-related decreased bone mineral density and strength, increases the number of fractures and fall-related injuries, making falls a major health concern in postmenopausal women.[5] It has been reported that the menopause transition is associated with balance deterioration,[6] and that estrogen treatment increased balance performance in postmenopausal women.[7]

In particular, a number of studies have suggested that estrogen play an important role in maintaining muscle strength, enhancing muscle repair and maintaining neurological function in older females. Menopause is associated with significant reduction in circulating estrogen levels in females. It plays an important role in the maintenance of many tissues and organs function including skeletal muscles, nerves and neural tissues in females.[8] Estrogen receptors have also been found to exist in skeletal muscle. Deficiency in hormonal level affects the skeletal muscle function and cause decline in activities of daily living (ADL).[9]

Conversely, premenopausal women, who typically maintain higher levels of estrogen, are thought to have better preservation of muscle strength and balance. Physical performance can be assessed clinically by measuring the strength and balance between premenopausal and postmenopausal females population with history of natural menopause. So the purpose of the study is to find out the relationship between physical performance amongst healthy premenopausal with regular periods and postmenopausal females with natural history of menopause.

MATERIALS & METHODS

A cross-sectional study was conducted among 60 healthy females. This study utilized purposive sampling based on below defined inclusion and exclusion criteria. Ethical clearance was obtained from the institute before conducting the research. The subjects were divided into 2 groups. Group A with 30 premenopausal females having regular monthly periods and Group B with 30 postmenopausal females having history of natural menopause. The study was conducted in Ahmedabad City, including different societies. The objectives and purpose of the study were thoroughly explained to all participants, and their written consent was obtained.

All participants fulfilled the following inclusion criteria: (1) Age group within (40-60 years) (2) Premenopausal women: having regular monthly periods (3) Postmenopausal women: with natural history of menopause (4) Subjects not taking any hormonal therapy Subjects were excluded based on the following criteria: (1) Subjects with any neurological, vestibular and musculoskeletal disorders (2) Pregnant women (3) Subjects having hearing impairments and abnormal vision (4) Subjects should have not attended a structured physical activity or exercise program prior 6 months (5) Women with induced menopause, simple hysterectomy (6) Presence of medical conditions such as diabetes, cardiac disorders and thyroid disorder.

OUTCOME MEASURES

(1) 30sec Sit to Stand Test: The test is used to assess lower extremity strength.

- Participants were asked to practice once, demonstrated by therapist.
- The investigators instructed the participants to stand up and sit down fully, using both lower extremities, after an investigator said, “go” and to perform as many cycles of sit-to-stand-to-sit as possible in 30 seconds.
- Participants started this test sitting in the middle of the chair, feet positioned on the floor, and arms crossed on an armless chair with a seat height of 45-cm positioned against a wall. Participants performed two trials with a 60-second rest period between trials.
- The investigator records the number of repetitions performed by the participants in 30seconds, and the best of two was recorded.
- It is a reliable (interrater reliability ICC=0.737 and intrarater reliability ICC=0.987) method to investigate lower extremity strength. [10,11]

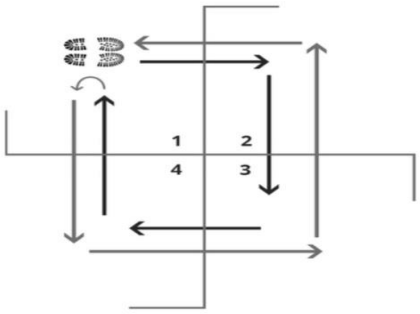
(2) One Leg Stand Test (eye open and eye close): It is the simple test used to assess static balance.

- The subject was instructed to stand without footwear on hard, even surface.
- The therapist stayed nearby to ensure the subject didn’t fall.
- The subject was instructed to perform the test by lifting one foot, first with their eyes open and then with their eyes closed.
- A stopwatch was used to record the time, which ended if the subject's raised foot began to lower, touched the ground, if they swayed, or opened their eyes.
- It is a reliable (between raters ICC=0.95-0.99, within raters ICC=0.73-0.93) and easy method for clinicians to screen the patients for fall risks. [12]

(3) Four Square Step Test: The test is used to assess dynamic balance and mobility.

- A "four-square" shape was created by arranging two bands, each about a meter long, as vertical and horizontal lines on the floor. The squares were labelled from 1 to 4 in a clockwise direction.
- During the test, the participant moved forward, sideways, and backward.
- At the start, they stood upright in square 1, facing square 2. The sequence was as follows: step forward to square 2, right to square 3, backward to square 4, left to square 1, then counter clockwise from square 4 to square 3, left to square 2, and finally backward to square 1.
- The individual looked ahead, stepped as quickly as possible while avoiding contact with the bands, making sure both feet touched the ground in every frame.
- The test began when the first leg made contact with the ground in square 2 and ended when the last leg touched the ground in square 1. The individual was instructed to learn the sequence. Then, two more tests were done, and the best time was recorded.
- It is a reliable (ICC= 0.73-0.98) method to assess dynamic balance and mobility. [13,14]

FIGURE 1: Depicts the directions for Four Square Step Test



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STATISTICAL ANALYSIS

SPSS version 20 software was used for all data analysis. Comparison of lower extremity strength and balance was done between Group A and Group B using unpaired 't' test.

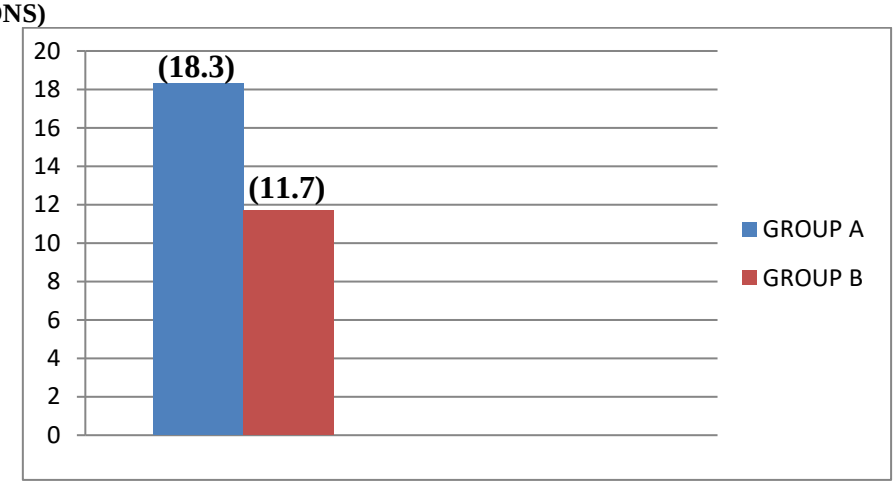
RESULT

As the data was not normally distributed, the Mann-Whitney U test was used for intergroup comparison. The results demonstrated a significant difference in lower limb strength and balance between premenopausal and postmenopausal women ($p<0.05$)

TABLE 1: THE DIFFERENCE BETWEEN GROUPS

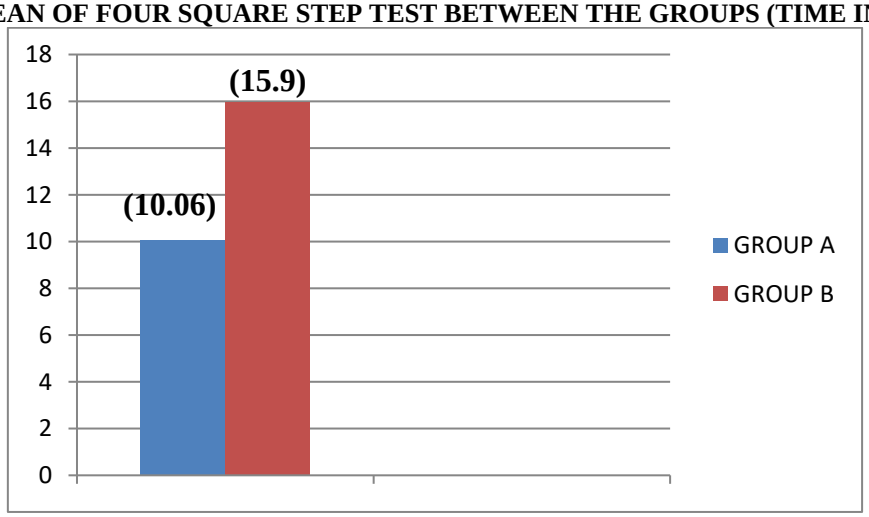
TEST	PREMENOPAUSAL GROUP (GROUP A) MEAN±SD	POSTMENOPAUSAL GROUP (GROUP B) MEAN±SD	p VALUE	RESULT
30 SEC SIT TO STAND TEST (No. of repetitions)	18.3±2.05	11.7±2.93	<0.05	SIGNIFICANT
FOUR SQUARE STEP TEST (Time in secs)	10.6±2.47	15.9±3.09	<0.05	SIGNIFICANT
ONE LEG STAND (Eye open) (Time in secs)	22.3±3.97	16.8±2.04	<0.05	SIGNIFICANT
ONE LEG STAND (Eye close) (Time in secs)	20.1±2.67	14.1±2.67	<0.05	SIGNIFICANT

GRAPH 1: MEAN OF 30SEC SIT TO STAND TEST BETWEEN THE GROUPS (NO. OF REPETITIONS)



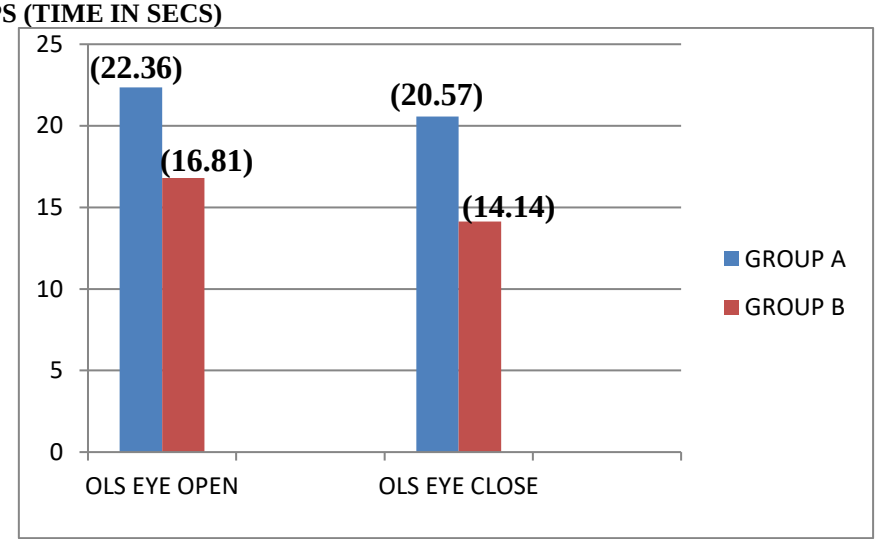
Interpretation: A significant difference was found between Group A and Group B, indicating reduced lower extremity strength in postmenopausal women compared to premenopausal women. ($p<0.05$)

GRAPH 2: MEAN OF FOUR SQUARE STEP TEST BETWEEN THE GROUPS (TIME IN SECS)



Interpretation: A significant difference was found between Group A and Group B, indicating reduced dynamic balance in postmenopausal women compared to premenopausal women. ($p<0.05$)

GRAPH 3: MEAN OF ONE LEG STAND TEST (OLS) EYE OPEN AND EYE CLOSE BETWEEN THE GROUPS (TIME IN SECS)



Interpretation: A significant difference was found between Group A and Group B, indicating reduced static balance in postmenopausal women compared to premenopausal women. ($p<0.05$)

DISCUSSION

Several studies have shown that postmenopausal women are more prone to sedentary habits and loss of fitness,[15] which is clearly associated with deterioration in health and lower quality of life.[16] Therefore, it is important for postmenopausal women to change their sedentary lifestyles by performing physical activities.

Signs and symptoms of menopause includes irregular menses vasomotor instability (hot flashes and night sweats), atrophy of genitourinary tissue, increased stress, breast tenderness, vaginal dryness, forgetfulness, mood changes, and in certain cases osteoporosis and heart disease. These effects are due to the hormonal changes which affect each woman to a different extent.[17]

It has been proposed that sit-to-stand is better tolerated and produces less hemodynamic stress compared to the 6MWT and has been proposed as a reliable and practical test that could be used for to assess functional status quickly without much equipment and space. [18,19] During the menopause transition, women are predisposed to experience musculoskeletal pain,[20] which is associated with decreased physical activity and mobility.

A decline in estrogen levels after menopause has been associated with decreased muscle function and sarcopenia, which may contribute to reduced lower limb strength.[21] Estrogen plays a critical role in maintaining muscle protein synthesis and neuromuscular function; therefore, its decline can lead to muscle atrophy and diminished force production.[22] Our findings corroborate those of,[23] who reported a significant reduction in quadriceps strength and functional mobility in postmenopausal women compared to premenopausal women.

Additionally, the observed impairments in balance among postmenopausal women may be attributed to both muscular weakening and reduced proprioception. Studies have shown that estrogen deficiency affects neuromuscular coordination and balance control, increasing the risk of falls.[24] A systematic review by Howe et al. (2011) concluded that postmenopausal women exhibit increased postural sway, delayed reaction times, and greater susceptibility to balance disturbances, supporting the present study's findings. [25]

Physical activity and resistance training have been suggested as effective interventions to mitigate menopause-related declines in muscle strength and balance (Marsh et al., 2013). [26] Exercise programs focusing on strength training and proprioceptive exercises can enhance

muscle function and stability, potentially reducing fall risk in postmenopausal women (Liu-Ambrose et al., 2004).[27] Future research should explore the long-term effects of such interventions on lower extremity strength and balance in this population.

In conclusion, our study highlights significant differences in lower extremity strength and balance between premenopausal and postmenopausal women, emphasizing the need for targeted strategies to preserve musculoskeletal health post-menopause.

Limitations

- Subjects' physical activity levels, socioeconomic status or dietary intake was not taken into consideration.
- BMI was not taken into consideration.

Future Research

- Larger sample size for more accurate results.
- Upper extremity strength, endurance, flexibility and grip strength among premenopausal and postmenopausal women can also be taken for more comprehensive understanding of overall musculoskeletal health and functional capacity across different menopausal stages.

CONCLUSION

The present study concludes that lower extremity strength, static balance and dynamic balance was reduced in postmenopausal women in comparison with premenopausal women.

Declaration by Authors

Ethical Approval: Approved

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Conflict of Interest: None

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