Relationship of Body Mass Index and Body Fat Percentage with Core Muscle Endurance Among Postmenopausal Women

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***Abstract*:** Menopause is associated with reduced muscle mass, increased body fat, and decreased bone density, leading to impaired musculoskeletal health and functional decline. Increased body mass index (BMI) and body fat percentage (BF%) may adversely affect core muscle endurance, which is essential for spinal stability, posture, and balance. This study aimed to investigate the relationship between BMI, BF%, and core endurance in postmenopausal women.

Methods: A cross-sectional correlational study was conducted among 30 postmenopausal women aged 46–65 years using convenience sampling. BMI was calculated from height and weight measurements, BF% was assessed using a Tanita Body Composition Analyzer, and core endurance was evaluated using the Abdominal Draw-In Test with a pressure biofeedback unit. Data were analyzed using the Shapiro–Wilk test for normality and Pearson's correlation coefficient, with statistical significance set at $p < 0.05$.

Results: Significant negative correlations were observed between BMI and core endurance ($r = -0.844$, $p < 0.05$) and between BF% and core endurance ($r = -0.857$, $p < 0.05$). Higher BMI and BF% were associated with lower core muscle endurance.

Conclusion: Higher BMI and body fat percentage are significantly associated with reduced core endurance in postmenopausal women. These findings suggest that BMI and BF% may serve as simple clinical indicators for identifying women at risk of poor core stability and related functional impairments. Targeted interventions focusing on weight management and core strengthening may help improve musculoskeletal health and quality of life in this population.

***Index Terms*— Menopause, Fat percentage**

I. INTRODUCTION

Menopause is a natural aging process where menstrual cycle ceases. Post menopause refers to time after menopause, when a woman hasn't experienced menstruation for over a year.

After menopause, the muscle mass is reduced by 3% per year. Between the age of 40-80 years, 30-50% of muscle mass is lost along with bone loss resulting in osteoporosis in postmenopausal women leading to fractures in later years of life. Lifestyle, body fat distribution and anthropometric changes add on to the bone strength in postmenopausal women which may be a risk factor for osteoporotic fracture, cardiovascular conditions and metabolic diseases.[1]

Preliminary studies suggest that the menopause transition is associated with deleterious changes in body composition and body fat distribution. Menopause transition is associated with an accelerated increase in total and central adiposity and a reduction in fat-free mass.[16] The menopause transition was shown to be associated with an average 10% increase in fat mass accompanied by an increase in waist circumference and an increase in total body weight despite a slight (1%) but significant decrease in muscle mass.[5] Among women, the percentage of essential body fat is greater as compared to men which has been attributed to the needs of childbearing and other hormonal functions [10] Menopause status has been associated with weight gain and increased central adiposity. Obesity and postural instability are related to an increased risk of falls.[14]

Postural instability is associated with obesity and uniform and android body fat distribution types (waist-to-hip ratio > 0.76) in Spanish postmenopausal women aged 50 to 65 years.[14] It has also been known that women with central adiposity are more prone to low back pain because of poor core strength and endurance.

The change in the growth of women from her premenopausal to postmenopausal stage is drastic with changes in body composition, weight gain and increase in central adiposity.

There are studies showing that early exercises are beneficial in reducing the risk of postmenopausal symptoms experienced by the women.[1] It has been shown that women with central obesity, as measured by the WC and WHR, have a higher prevalence of LBP further confirming the relationship between body fat distribution and LBP.[2]

Body Mass Index (BMI) is a useful anthropometric indicator used to assess the body adiposity or fat composition in individuals of any age. It is the ratio of an individual's weight in kilograms to the square of height in meters.[1] As the BMI increases the risk for various systemic diseases such as diabetes mellitus, hypertension, arthritis, etc also increase. Thus, it is necessary to keep a track on the excessive weight gain which contributes to the increasing body adiposity further leading to future complications. In order to do so BMI can be used as a simple yet important diagnostic tool.[1]

The Percentage body fat is the ratio of total fat mass in a living being to its total body mass.[2]

Core is a compartment which comprises abdominal muscles in front which helps in flexion of spine, hip musculature and the thoracolumbar, lumbar muscles helping in extension of spine. It is a central unit which provides stability for movement of the extremities. Core strength and stability is important for maintenance of good posture and a balanced gait.

Core muscles act as a pressure biofeedback for activation and control of the trunk musculature for performing activities of daily living.[1]

Core strength is the ability of a muscle to exert or withstand force. Regulation of these forces in surrounding muscles results in active control of spinal stability.[8] Maintenance of these forces refers to core endurance. Endurance of TrA signifies the core endurance of the lumbar region as TrA is one of the local muscles of lumbar spine.[8]

The core abdominal muscles, including the transverse abdominis (TrA), the internal and external obliques, and the multifidus, provide support to the low back, and poor functioning of this muscle group is linked to low back pain. The TrA in particular has a multifunctional role because it potentially functions as a stabilizer muscle, as well as having a minor role in trunk rotation and respiration. The ability to stabilize the lumbar spine requires initiation of contraction by the TrA prior to the application of any force.[9]

The weaker muscle strength, endurance and high adiposity may influence physical performance. The biomechanics of the body gets altered due to increasing weight which affects the functional abilities of the individual.[1]

The present study aims at evaluating the effect of body mass index and body fat percentage with core endurance among post-menopausal women and thus contribute to advancing tailored healthcare strategies that promote physical wellbeing and independence by preventing future risk of falls or fractures and improve quality of life. The outcome of this study shall shed more light on the work of core muscles among post-menopausal women with different body mass index and body fat percentage and help to decrease the associated risk. In addition, it will further help in understanding the impact of body mass index and body fat percentage on reduction in muscle endurance. Menopause is a natural ageing process associated with decrease in muscle mass by 3% per year along with bone loss resulting in osteoporosis in postmenopausal women.Core endurance is greatly influenced by body composition and adiposity.

Individuals with a high percentage of body fat tend to have higher fat distribution over the abdominal region and decreased core endurance which is associated with poor posture and low back pain.

This study aims to provide valuable insight into the relationship between anthropometric measures and core endurance, which is essential for stability, by highlighting the impact of adiposity on musculoskeletal health and demographics to guide targeted interventions for improving health and quality of life.

II. METHODOLOGY

This study was conducted in a community setting among postmenopausal women aged 46–65 years. A total of 30 participants were recruited using a convenience sampling technique. Women who were postmenopausal, not engaged in regular exercise, and willing to participate in the study were included. Participants with a history of recent spinal or abdominal surgeries were excluded to ensure safety and minimize potential confounding factors. The study followed a cross-sectional correlational design, aiming to examine the relationship between the variables of interest at a single point in time. Data collection involved the use of a weighing scale and height scale for anthropometric measurements, a Tanita Body Composition Analyzer to assess body composition, and a pressure biofeedback unit to evaluate muscle function and stability-related parameters. All measurements were obtained following standardized procedures to ensure consistency and reliability.

Prior to the commencement of the study, approval was obtained from the Institutional Research Board (IRB). Participants were recruited from the community based on the predefined inclusion and exclusion criteria. All eligible participants were informed about the purpose and procedures of the study, and written informed consent was obtained before data collection began. Anthropometric measurements, including height and weight, were recorded, and Body Mass Index (BMI) was subsequently calculated. Body fat percentage was assessed using a Tanita Body Composition Analyzer, while core endurance was evaluated using a pressure biofeedback unit. All measurements were performed following standardized procedures to ensure accuracy and consistency. After the completion of data collection, the data were analyzed using appropriate statistical methods, and correlation analysis was conducted to determine the relationship between the study variables.

III. ASSESSMENT METHODS

Assessment of BMI:

Body weight was measured using a weighing scale, and height was measured using a height scale. Body Mass Index (BMI) was then calculated using the formula: weight in kilograms divided by the square of height in meters (kg/m^2).

Assessment of Body Fat Percentage:

Body fat percentage was assessed using a Tanita Body Composition Analyzer. Participants were instructed to avoid exercise and alcohol for 24 hours, and food and caffeine for 4 hours before testing, while consuming 2–4 glasses of water approximately 2 hours prior to assessment. They removed shoes, socks, jewellery, and other personal items, and their feet were cleaned with alcohol wipes before standing barefoot on the analyzer's footpads. A low-level electrical current (50 kHz, 800 μA) was passed through the body to measure segmental resistance and estimate body fat percentage. Participants remained still with relaxed arms throughout the assessment.

Assessment of Core Endurance:

Core endurance was assessed using the Abdominal Draw-In Test. Core muscle endurance was determined by the number of successful 10-second holds completed.

IV. STATISTICAL ANALYSES

Data was subjected to normal distribution using normality test Shapiro Wilk test. This test was used to determine the normality. Data passed the normality test. Hence further data was analyzed using Pearson's correlation coefficient formula.

Pearsons's correlation coefficient was used to determine the relationship between the two variables which are body mass index and body fat percentage with core endurance.

Statistical significance was assessed by determining p value.

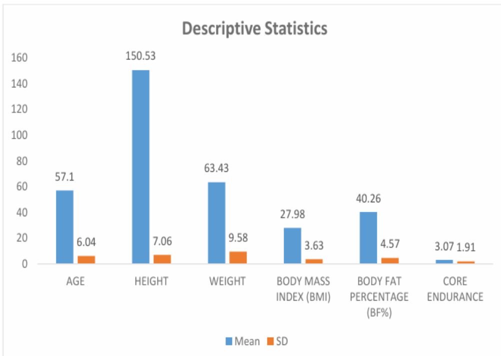
The result was interpreted by comparing the p value to the chosen significance level.

If p value is less than 0.05, the null hypothesis will be rejected to conclude significant correlation and if p value is greater than 0.05, then null hypothesis will be accepted suggesting no significant correlation.

The mean and standard deviation (SD) for demographic variables of all strata are shown below.

Descriptive Statistics

Variable	Minimum	Maximum	Mean	SD
AGE	45.00	65.00	57.10	6.04
HEIGHT	140.00	168.00	150.53	7.06
WEIGHT	46.20	90.30	63.43	9.58
BODY MASS INDEX (BMI)	21.90	36.60	27.98	3.63
BODY FAT PERCENTAGE (BF%)	30.70	49.90	40.26	4.57
CORE ENDURANCE	.00	7.00	3.07	1.91

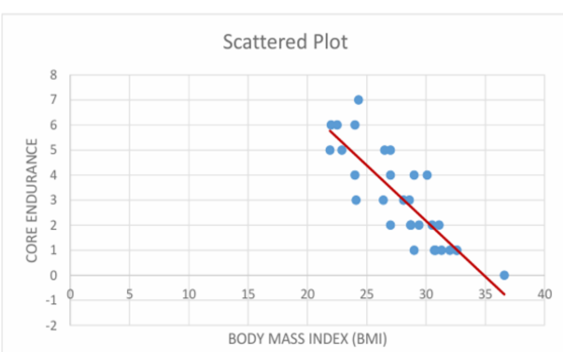


V. PEARSONS CORRELATION ANALYSIS

Correlation coefficient r-value for body mass index (BMI) and core endurance has been recorded as -0.844 which is statistically significant at 5% level with non-linear association. It means both the variables are moving in opposite directions at the same time of association with each other. It is also called an indirect relationship between the variables.

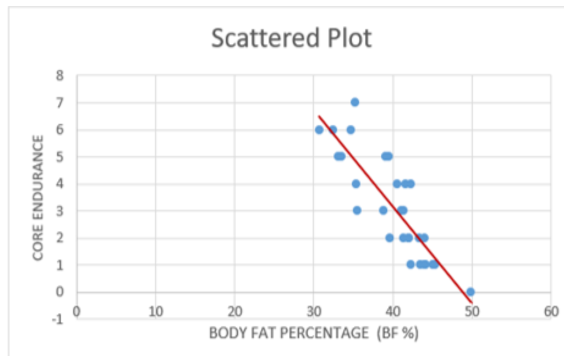
Variable X	Variable Y	r-value	p-value	Results
BODY MASS INDEX (BMI)	CORE ENDURANCE	-0.844	0.001	Significant at 5% Non-Linear association

VI. PEARSONS CORRELATION ANALYSIS



Variable X	Variable Y	r-value	p-value	Results
BODY FAT PERCENTAGE (BF %)	CORE ENDURANCE	-0.857	0.001	Significant at 5% Non-Linear association

Correlation coefficient r-value for body fat percentage (BF%) and core endurance has been recorded as -0.857 which is statistically significant at 5% level with non-linear association. It means both the variables are moving in opposite directions at the same time of association with each other. It is also called as indirect relationship between the variables.



VII. CONCLUSION

The present study demonstrated a significant negative correlation between body mass index (BMI), body fat percentage, and core endurance. Higher BMI and body fat percentage were associated with lower core endurance, indicating an inverse relationship between body composition and core muscle performance. The findings support the alternative hypothesis and suggest that increases in adiposity may adversely affect the capacity to sustain core muscle activity.

These results highlight the influence of body composition on functional fitness and core stability. Maintaining an optimal BMI and body fat percentage may contribute to improved core endurance and overall musculoskeletal health. The findings may have implications for the development of targeted exercise and weight-management interventions aimed at enhancing core performance. Further studies involving larger and more diverse populations are recommended to validate these findings and explore the underlying mechanisms governing the relationship between body composition and core endurance.

VIII. CLINICAL IMPLICATIONS

Body mass index and body fat percentage could serve as simple indicators for identifying women at risk of poor core endurance and related complications (falls, back pain, mobility issues).

Designing personalized exercise interventions based on body mass index, body fat percentage could enhance outcomes for postmenopausal women. Integrating weight management, endurance training, and lifestyle modification could improve musculoskeletal health, functional independence, and quality of life. Can inform community health programs to encourage physical activity in postmenopausal women, reducing long term healthcare burden.

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