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Research Article

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Correlation between Core Strength and Stability with Body Mass Index among Postmenopausal Women.

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Abstract: Women in postmenopausal period of their life face various physical and physiological changes causing lack of estrogen and progesterone hormones, changes in the reproductive and genitals organs, vasomotor system in the body along with mood related symptoms such as anxiety, etc. Lifestyle, body fat distribution and anthropometric changes adds on to the bone strength in postmenopausal women. It may be a risk factor for osteoporotic fracture, cardiovascular, metabolic diseases, etc. Core strength and stability is greatly influenced by body composition and adiposity. The aim of the study was to correlate the core strength assessed with the Body Mass Index (BMI) among postmenopausal women. The objective of the study is to find the correlation between the core strength assessed with the Body Mass Index using 60° flexion test, Beiring Sorenson test and Unilateral Hip Bridge Endurance test among postmenopausal women with age ranging from 46-70 years. 96 healthy postmenopausal women in Karad city with a natural history of menopause were selected for the study. Based upon BMI values, the subjects were grouped as Underweight (<18.5 kg/m^2), Normal weight (18.5-24.9 kg/m^2), Overweight (25-29.9 kg/m^2 and more). The outcome values for strength were correlated with the BMI of postmenopausal women. In the study, the Pearson correlation(r) was -0.361 and the *P* value was 0.0003 showing extremely significant correlation between the BMI and 60° Flexion test. For the Beiring Sorenson Test, the Pearson correlation value was -0.305 and the *P* value was 0.0025 showing very significant correlation between the BMI and Beiring Sorenson Test. Correlation of BMI and Unilateral Hip Bridge Endurance Test shows a Pearson Correlation value of -0.322 and the *P* value 0.0013 claiming very significant correlation between the BMI and Unilateral Hip Bridge Endurance Test. The study concludes that there is a significantly negative correlation between the core strength and stability with the Body Mass Index among postmenopausal women.

Keywords: Postmenopausal women, Core strength and stability, Body Mass Index

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1. INTRODUCTION

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. Depending upon the ratio the person is graded as per NIH and WHO criteria, which is Underweight (<18.5 kg/m^2), Normal weight (18.5-24.9 kg/m^2), Overweight (greater than or equal to 25 to 29.9 kg/m^2) and Obese (greater than or equal to 30kg/m^2).[1] The body mass index and age are the factors that influence the strength of the individual. The weaker muscle strength and high adiposity may influence the physical performance. The biomechanics of the body gets altered due to increasing weight which affects the functional abilities of the individual.[2] Similarly, in elderly age group the bony and muscular degeneration along with changes in the body composition results in osteoporosis, sarcopenic obesity and other disabling conditions.[3] 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.[4] In order to do so BMI can be used as a simple yet important diagnostic tool. Lower BMI accounts for low bone mineral density resulting in loss of bone mass and fractures. Physical activity helps in maintaining proper BMI standards throughout life. Inactivity results in lack of loading on the bone thereby reducing the muscle strength and mass promotes obesity.[5] 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. The muscles included in the complex are rectus abdominis, transversus abdominis, multifidus, external and internal oblique, paraspinal, gluteal in the back, diaphragm at the top and the pelvic floor muscles at the bottom. It is together called the Lumbo-Pelvic-Hip complex. 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. Stability as well as mobility of the body is maintained by synchronized timing of the trunk muscles for controlling the movement of the distal extremity which is moving.[6,7] Core muscles act as a pressure biofeedback for activation and control of the trunk musculature for performing activities of daily living.[8]Menopause is a natural aging process where menstrual cycle ceases. 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. Osteoporosis is an aging disorder causing decreased functioning of bone and muscles ultimately leading to fractures in later years of life.[9] Lifestyle, body fat distribution and anthropometric changes adds on to the bone strength in postmenopausal women which may be a risk factor for osteoporotic fracture, cardiovascular conditions and metabolic diseases.[10,11] Also the level of physical activity plays a major role in prevention of fractures in postmenopausal women.[12] The variation in growth of a women from her premenopausal to postmenopausal stage is drastic with changes in body composition, weight gain and increases in central adiposity which is due to rapid loss of lean mass.[13,14,15] Women face a 50% more loss of bone mass and strength as compared to men because of loss of age and menopause related estrogen deficiency.[16] There are studies showing that early exercises are beneficial in reducing the risk of postmenopausal symptoms experienced by the women. Physiotherapy exercises have shown to influence the bone mineral density, mental health, improving muscle mass, strength, balance and co-ordination.[17] the present study aims at evaluating the effect of BMI upon the core strength and stability in healthy postmenopausal women so as to prevent future risk of fractures or falls leading to disability and affecting quality of life of postmenopausal women.

2. MATERIALS AND METHODS

Participant Selection: This cross-sectional study was carried out in Krishna Institute of medical sciences Deemed to be university Karad. 96 healthy postmenopausal women ($n=4*SD^2/(M*E)^2$) with natural history of menopause were selected using Random sampling technique for the study. All females inclusive of medical co-morbidities were taken upon with proper management and control of the underlying condition. Those individuals fit for performing the special tests for assessment of core strength were included. Age of the selected participants was ranging between 46-70 years. The consent from each participant was documented in a written format. Females were recruited for the study on the basis of a natural history of menopause, their age ranging between 46-70 years fit to perform test and all females inclusive of medical co-morbidities under control with proper management. Exclusion criteria were subjects who had a history of hysterectomy or oophorectomy, recent spinal injuries and those not willing to participate. The approval for the study was obtained from the Protocol committee and the Institutional Ethical committee of the KIMSDU. Demographic data of the subjects was collected. Based upon BMI values, the subjects were grouped as Underweight (<18.5 kg/m^2), Normal weight (18.5-24.9 kg/m^2), Overweight (25-29.9 kg/m^2 and more).[1] Following warm up, the core strength was assessed using the appropriate valid tests. With a rest period of 5 minutes between each test, the tests outcome values were measured. The outcome value for strength was correlated with the BMI of postmenopausal women. Study was concluded by statistical analysis of the outcome measures and their correlation. Tests performed were:

2.1 60° flexion test

This test is used for measurement of the flexor muscle endurance. The subject is in sitting position with the upper body supported at an angle of 60°. Both hip and knee in 90° flexion and arms folded against the chest with hands placed on opposite shoulder. Then the wedge supported to the back is pulled to 10cms. The duration of hold is measured in seconds.[18]

2.2 Beiring Sorenson test

This is used for trunk extension; the subject lies prone off the edge of the plinth and all the body parts below anterior superior iliac spine are supported to the plinth with straps. Prior the participant would rest the upper body on the chair Then they were asked to cross hands across the chest with the body in horizontal plane with the ground. And the test duration is measured. [18]

2.3 Unilateral hip bridge endurance test

The UHBE test is a reliable measure of core stability. The test involves timing the subject while he is maintaining the

single leg bridge position and hand crossed at chest with a neutral hip and pelvis position as long as possible. A change in alignment is observed with alteration of more than 10° angle.[19]

3. STATISTICAL ANALYSIS

The outcome measures were assessed according to the inclusion and exclusion criteria. The data obtained was analyzed using InStat software (version3.1). The Pearson's Correlation tool was used for analysis of the correlation. The data were presented as Mean ± Standard Deviation (SD). The Pearson's Correlation is stated as 'r'. Probability value 'P' is also used for stating the significance.

4. RESULTS

The result was statistically analyzed using the Pearson's Correlation Tool._Chart_no:1 shows the distribution of postmenopausal women in 3 groups depending upon their BMI values. 56% women were in Normal category, 32% were overweight and 12% were underweight based upon the NIH and WHO criteria.

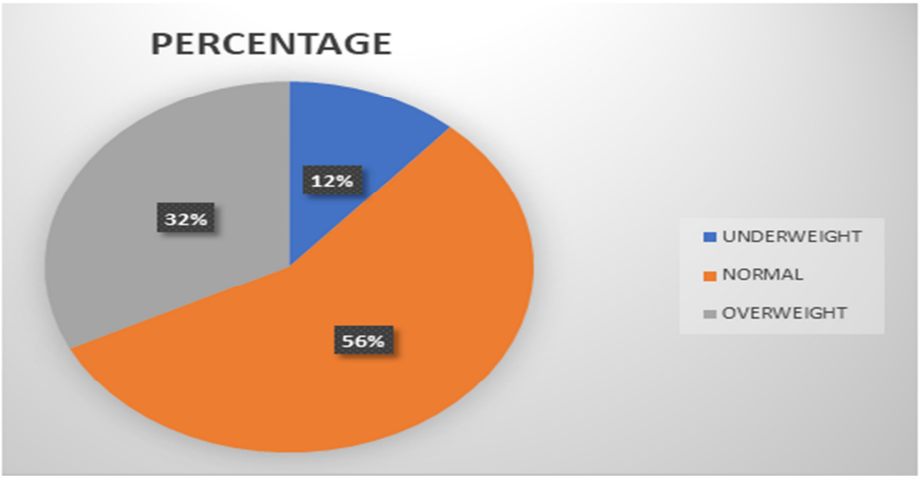

Chart no: 1- Distribution of postmenopausal women depending upon BMI grading

Table No. 1: Mean and standard deviation of special tests performed in relation to BMI

BMI	n= 96	60° Flexion test (X±SD)	Beiring Sorenson test (X±SD)	UBHE (X±SD)
Underweight	11	16.72 ± 8.25	14.57 ± 3.62	9.25 ± 5.99
Normal	54	18.06 ± 6.13	19.13 ± 7.25	13.23 ± 7.51
Overweight	31	11.39 ± 5.35	12.4 ± 5.58	6.23 ± 4.61

Mean±SD values shown N=96

The above-mentioned table shows the categorization of BMI according to the taken values and the tests performed for assessment of core strength along with the mean and standard deviation of the hold time performed. It is observed that the mean hold time for the special tests performed for core strength assessment was maximum in Normal BMI subjects followed by Underweight and significantly reduced in overweight.

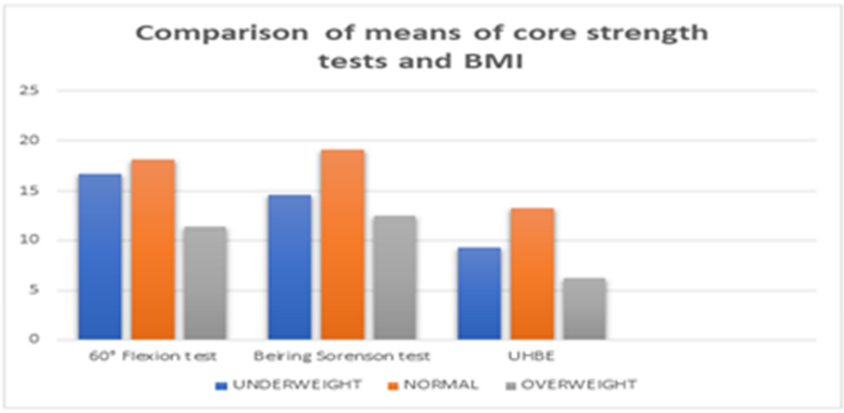

Chart no:2-Comparison of means of core strength tests and BMI

The graph depicts the alteration in the mean values of BMI when compared to the core strength tests performed. The core strength for overweight or obese postmenopausal women was reduced significantly as compared to normal BMI women. Also, considerable strength decline was observed in underweight postmenopausal women while comparing the mean duration of hold to that of women with a normal BMI range.

Table No. 2 Correlation between BMI and 60° Flexion Test			
		BMI	60° Flexion Test Duration
BMI	Pearson Correlation	1	-.361*
	Sig. (2 tailed)		.0003**
	N	96	96***
60° Flexion Test Duration	Pearson Correlation	-.361	1
	Sig. (2 tailed)	.0003	
	N	96	96

Pearson's correlation **Probability value P total number of samplesTable 2 depicts correlation of BMI and 60° Flexion test; the Pearson correlation was -0.361 and the P value was 0.0003 showing extremely significant correlation between the Body Mass Index and 60° Flexion test.***

Table No. 3 Correlation between BMI and Beiring Sorenson Test			
		BMI	Beiring Sorenson Test Duration
BMI	Pearson Correlation	1	-.305*
	Sig. (2 tailed)		.0025**
	N	96	96***
Beiring Sorenson Test Duration	Pearson Correlation	-.305	1
	Sig. (2 tailed)	.0025	
	N	96	96

Pearson's correlation **Probability value P total number of samples Table 3 depicts correlation of BMI and Beiring Sorenson Test, the Pearson correlation was -0.305 and the P value was 0.0025 showing very significant correlation between the Body Mass Index and Beiring Sorenson Test.***

Table No. 4 Correlation between BMI and UHBE Test			
		BMI	UHBE Test Duration
BMI	Pearson Correlation	1	-.322*
	Sig. (2 tailed)		.0013**
	N	96	96***
UHBE Test Duration	Pearson Correlation	-.322	1
	Sig. (2 tailed)	.0013	
	N	96	96

Pearson's correlation **Probability value P total number of samplesTable 4 depicts correlation of BMI and Unilateral Hip Bridge Endurance Test; the Pearson correlation was -0.322 and the P value was 0.0013 showing very significant correlation between the Body Mass Index and Unilateral Hip Bridge Endurance Test.***

5. DISCUSSION

The aim of the study was to evaluate the correlation of core strength and stability to the Body Mass Index in healthy postmenopausal women. A total of 96 postmenopausal women were selected for the study using random sampling method. The participants were grouped according to their calculated BMI using height and weight respectively. Out of which 12% of postmenopausal women were in Underweight category, 56% were under Normal BMI category and 32% were Overweight. Valid and appropriate special tests were selected for the assessment of core strength including the 60° Flexion test, Beiring Sorenson Test and Unilateral Hip Bridge Endurance test. The individual's ability to hold the test position was calculated in seconds. Further the respective means and standard deviations were analyzed and Pearson correlation was calculated. The mean hold time for 60° Flexion test in underweight category was 16.72 sec. For normal weight it was 18.06 sec and for overweight it was 11.39 secs. For Beiring Sorenson Test, the mean duration for underweight postmenopausal women was 14.57 secs. For normal weight women it was 19.13 secs and for overweight the mean was 12.4 secs. Also, for UHBE the mean duration of hold was 9.25 secs for underweight, 13.23 secs for normal weight and 6.23 secs for overweight. In the present study it was seen that, the Pearson correlation was -0.361 and the P value was 0.0003. And showing extremely significant correlation between the Body Mass Index and 60° Flexion test. For the Beiring Sorenson Test, the Pearson correlation was -0.305 and the P value was 0.0025. It showed very significant correlation between the Body Mass Index and Beiring Sorenson Test. Correlation of BMI and Unilateral Hip Bridge Endurance Test shows a Pearson correlation value of -0.322 and the P value 0.0013 claiming very significant correlation between them. A study conducted by Hue O et al suggested that a possible risk factor for fall is lower Body Mass index. The changes in balance and stability is greatly influenced by the alteration in body weight of a person [2]. There is a more positive correlation upon the Bone mineral density and the leaner BMI women. As the loading upon the bone is affected the muscular strength and muscle mass gets reduced along with loss of bone and osteoporosis [3]. This study states that decrease in the BMI levels i.e BMI<18.5 kg/m^2, decreases the core strength of the postmenopausal women when compared to the normal BMI counterparts. Martina AT et al stated in a study that there exists a negative relation between the core strength and BMI among children between the age of 11-14 years. Adiposity may influence the postural stability [6]. A considerable reduction in the functioning in daily living activities is observed within obese or overweight individuals. A BMI of 25kg/m^2 or more is a major risk factor for postural and balance instability among postmenopausal women between the age of 50-65 years [13]. Thus, the result of present study is consistent with the

above-mentioned studies stating that there is a negative correlation between the Body Mass Index and the core muscular strength. As the BMI value increases the core strength decreases. Central or abdominal obesity is influenced by menopause related hormonal loss rather than aging alone. In order to maintain the balance in standing position, more torque gets generated at ankle joint due to variation in center of mass. The center of mass is thus influenced by increase in the abdominal obesity. Thus, changing the biomechanics while standing ultimately altering the balance of an individual. Where as in case of Lower BMI the rate of bone loss in more along with risk of osteoporosis in postmenopausal age.[15,20,21] Core strength and stability is greatly influenced by the body composition of an individual. As the core strength is affected the movement pattern and recruitment of the extremities gets affected. It happens because core is the functional link of the body. A study by Amin WM. Mohamed Bin et al stated that there was an increase in the various parameters of static balance in subjects with a higher BMI. It was observed as a result of a compensation for reduced strength, endurance of core musculature along with altered recruitment of these muscles. Increased fat distribution is linked to diminished functional performance of a person.[22] Elevated fat mass increases the load stress acting on the core muscles affecting balance. Where poor body composition leads to poor core muscle function which is similarly to the results of the present study.[23] Some studies have proved gender to be the reason of decreased core strength along with the BMI. The body fat composition of females differ that of the males. Thus, obesity is linked to decreased functional performance, reduced fitness levels, associated co-morbidities, biomechanical disadvantages, etc affecting the strength of a person.[23,24] Hence physical activity should be included in order to maintain a proper BMI appropriate for the specific age and sex group. Physical activity is beneficial for improving the muscle strength, balance, proprioception, fitness, Quality of life also prevention of lifestyle related disorders. Focusing on high intensity exercises is of utter importance for controlling the BMI standards.

6. CONCLUSION

The study concludes that there is a significant negative correlation between the core strength and stability with the Body Mass Index among postmenopausal women i.e. as the body mass index increases the core strength and stability declines. As obesity or adiposity increases the core strength declines. Also, as the BMI decreases the core strength reduces as compared to that of Normal BMI women. Thus, to conclude maintaining a normal BMI is necessary to prevent future risk of injuries and fractures in postmenopausal age of women. Core strength and stability training should be focused and the importance of physical activity should be noted throughout the life of an individual.

7. AUTHOR CONTRIBUTION STATEMENT

Bhosale Siddhi and Bhosale Komal designed the project and was directed under the guidance of Dr. S Anandh. Bhosale Siddhi and Bhosale Komal performed the experiment and data was analyzed. The theoretical framework was developed by Bhosale Siddhi and Bhosale Komal. All authors discussed the result and commented on the manuscript. . All authors approved the final version of manuscript. All Authors have equally contributed for this study.

8. ETHICS AND PERMISSION

The Institutional Ethics Committee of Krishna Institute of medical sciences has hereby given permission to initiate the research project titled "Corelation Between Core Strength And Stabilty With Body Mass Index Among Postmenopausal Women" by author A and B under the guidance of author C. Ref. No. KIMSDU/IEC/06/2019

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11. CONFLICT OF INTEREST

Conflict of interest declared none.

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