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Assessment of Core Strength and Stability Among Postmenopausal Women

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ABSTRACT

Objective: Core strength and stability is an important part of postmenopausal women health. The study aims to assess the strength and stability of the core in postmenopausal women concerning their age of menopause and gravid status using respective special tests.

Methods: A total of 96 healthy postmenopausal women were included in the study based upon the age criteria according to the Indian menopausal Society (IMS). The participants were screened healthy using the PARQ questionnaire. Demographic data of the subjects were collected. Following the warm-up, the core strength and stability was assessed using the Isometric Abdominal test, Isometric Extensor test, Side Bridge test. With a rest period of 5 minutes between each test, the tests outcome values were measured.

Result: The result was statistically analysed using ANOVA. In the Isometric Abdominal test, the p-value for the age of menopause was <0.0001 and for gravid status, it was <0.0001 showing an extremely significant difference. In the Isometric Extensor test, the p-value for the age of menopause was <0.0001 and for gravid status, it was <0.0001 showing an extremely significant difference. In the Side Bridge test, the p-value for the age of menopause was 0.0022 and for gravid status, it was <0.0001 showing an extremely significant difference. It shows that core strength is greatly influenced by gravid status and age of menopause.

Conclusion: The result of our study concludes that there is quite a significant difference in core strength assessed among postmenopausal women in comparison to their age of menopause and gravid status.

Key Words: Age of menopause, Core strength, Gravid status, Isometric Abdominal test, Isometric Extensor test, Postmenopause, Side Bridge test

INTRODUCTION

Menopause is defined as the cessation of menstruation for 1 year. Postmenopausal women are those who have attained menopause either naturally or by artificial means. Natural or physiological menopause is a normal ageing process due to the eventual depletion of almost all the oocytes and ovarian follicles in the ovaries. This results in decreased production of estrogen leading to appearance postmenopausal symptoms.

Age of menopause is defined as the time when a woman has experienced 12 consecutive months of amenorrhoea.[1] It is affected by various factors such as lifestyle modifications, hormonal changes, micronutrient intake, parity, a gravid status which is the total number of pregnancies, age of menarche, body mass index, addictions, etc. According to the Indian Menopausal Society, the mean age for menopause is 45.59±5.59.[2] While some attain early menopause that is between the ages 40-44 years due to genetic causes, toxins, follicle depletion, ageing, etc.

In postmenopausal women, there are changes in hormonal exposure, loss of muscle mass and strength associated with ageing, as ageing starts earlier in women than men around the time of menopause, increase in the visceral fat mass, decrease in bone mineral density, skeletal problems such as back pain, joint and muscle pain.[3] With decreased bone mass osteoporotic changes set in, leading to the risk of fractures. The symptoms also include genitourinary instability, vasomotor instability, sleep disturbances, night sweats, psychological symptoms such as mood disturbances. Previous

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studies have shown that low Bone Mineral Density may be associated with back extensor weakness, loss of leg muscle strength, slower gait, and inadequate balance in a patient with osteoporosis.[4]

The core is defined as the lumbopelvic-hip complex consisting of 29 muscles. The core is a muscular cylinder that includes the abdominals in the front, erector spinal and gluteal muscles in the back, the diaphragm as the roof and the pelvic floor, and hip girdle musculature in the bottom.[4,5] Core stability is the ability to control the position and motion of the trunk over the pelvis to allow the optimum production, transfer, and control of force and motion to the terminal segment in integrated kinetic chain activities.[6]

The core is the centre of the functional kinetic chain providing proximal stability for the distal mobility and function of the limbs. It operates as an integrated functional unit whereby the entire kinetic chain works synergistically to produce force, reduce force and dynamically stabilize against abnormal force. The core helps in the maintenance of the postural alignment and dynamic postural equilibrium during performing daily living activities. Weakness of the core leads to alteration of the normal arthro-kinematics, normal length-tension relationship, force couple, and the neuromuscular control alters leading to a significant impact on the kinematic chains.[5,6,21,23] Strength of the muscles is the ability of contractile tissue to produce tension and a resultant force based on the demands placed on it.[7] Core strength is the required muscle control around the lumbar spine to maintain functional stability.

Healthy postmenopausal women are those who have no recent history of back pain or spinal injury, not receiving medication that is known to affect the bone mineral content, no history of metabolic diseases, alcoholism, malabsorption, renal or hepatic diseases cardiovascular diseases, etc with a natural menopause of at least 6month-1 year.[8]

Core strength and stability are an important part of postmenopausal women's health for maintaining low back pain to preventing spinal injuries and fractures. There is a lack of baseline values which results in limitations for quantification of physical performance testing of the low back musculature.[9,10]

The purpose of this study is to assess and document the strength and stability of the core in postmenopausal women concerning the age of menopause and their gravid status using respective special tests for assessment. Also, to know the correlation of the core strength with the above-mentioned parameters.

MATERIALS AND METHOD

This cross-sectional study was conducted at Krishna Institute of medical sciences Deemed to be the university, Karad.

Procedure:

The approval for the study was obtained from the Protocol committee and the Institutional Ethical Committee of the KIMSDTU [Protocol number 0121/2019-2020]. Individuals were selected based upon the inclusion criteria of the study that is the age of menopausal age given by the Indian menopausal Society (IMS). The procedure and purpose of the study were explained to the participants. Written informed consent was taken from those who were willing to participate. Demographic information of the subjects was collected. Physical Activity Readiness Questionnaire (PAR Q for age 15-69) was given and participants with affirmative responses were selected. Following the warm-up, the core strength and stability was assessed using the required appropriate valid tests. With a rest period of 5 minutes between each test, the tests outcome values were measured. The study was concluded by statistical analysis of the outcome measures and correlation between those values.

Subject criteria:

A total of 96 healthy postmenopausal women were included in the study based upon the age criteria and the participants were screened healthy using the PARQ questionnaire.[24] The questionnaire contains demographic data of the participants followed by questions regarding the individual having any heart condition restricting physical activity, feels pain in the chest while performing any activity, loss of balance or consciousness, dizziness, any joint problem, any medications regarding blood pressure or any such reasons that contradict physical activity to be undertaken. The responses were noted as YES or NO based upon which the participants were recruited for the study.

Females with a natural history of menopause, postmenopausal women as per Indian standard criteria of age 46.2 ± 4.9 years included. Females inclusive of medical co-morbidities under control with proper management, postmenopausal women from both rural and urban sectors who were categorized as per PAR Q and fit to do strength tests were included in the study.

Subjects who had undergone hysterectomy, oophorectomy, those with a history of metabolic bone diseases, renal, hepatic cardiovascular diseases, malabsorption or neurological disorders or individuals with a recent history of spinal injury were excluded from the study.

Outcome Measures:

- Isometric Abdominal Test:
  The test is used to assess the core strength of abdominal muscles. The participant lies supine with the hip flexed to 45° and knee flexed to 90° and the hands initially at the side. The end position is assumed and held for a duration and accordingly, gradings are given ranging from normal (5) and trace (1).[10,11,13]

- Isometric Extensor Test-
  The patient lies prone on the plinth and is instructed to extend the spine. In this test, the patient starts with hands at the side, moving the hand in the small of the back, and finally behind the head for increasing difficulty. The end position is assumed and held for a duration and accordingly, gradings are given ranging from normal (5) and trace (1).[13]
- Side bridge test-
  The participants were asked to lay on their side with legs extended on a plinth, resting on their forearm with the elbow flexed to 90°. The body was maintained in a straight position and the test was terminated when the subject was unable to hold this position.[10,11,13]

STATISTICAL ANALYSIS

The outcome measures were assessed for the three tests performed. The data obtained were analysed using InStat software (version3.1). The statistics were calculated using ANOVA for all the three tests performed to determine the difference in core strength assessed about the age of menopause and gravid status of the women. Statistical analysis was done to determine the Mean, Standard deviation and significance with the Probability value *P* for each of the three tests.

RESULTS

In the Isometric abdominal test, there is an extremely significant difference in comparison of mean age of menopause to the core strength assessed with $p<0.0001$. Also, statistically, there is an extremely significant difference($p<0.0001$) in comparison of the mean of gravid status to the core strength assessed. (Table 1, Figure 1 and 2)

With the Isometric Extensor test statistically, there is an extremely significant difference in comparison of mean age of menopause to the core strength assessed with $p<0.0001$. Statistically, there is an extremely significant difference($p<0.0001$) in comparison of the mean of gravid status to the core strength assessed. (Table 2, Figure 3 and 4)

Side Bridge test shows that statistically, there is quite a significant difference in comparison of mean age of menopause to the core strength assessed with $p=0.0022$. Statistically, there is an extremely significant difference($p<0.0001$) in comparison of the mean of gravid status to the core strength assessed with the SBT. (Table 3, Figure 5 and 6)

DISCUSSION

The study aimed to assess the core strength and stability among postmenopausal women along with its influence on the age of menopause and gravid status. Three special tests such as isometric abdominal test, isometric extensor test, side bridge test were used as the outcome tool. The hold time was measured and accordingly, subjects were further graded as good, normal, fair, poor trace. The subjects were classified depending upon the number of individuals falling into the respective grading category. The further core strength of postmenopausal women as compared to the age of menopause and gravid status of women based on the strength assessed. The result stated that each core strength test assessed was affected by two variables i.e. age of menopause and gravid status of the women. Also, it was noted that the strength of extensor musculature was more as compared to that of abdominal or spinal flexor musculature. This result is consistent with the study performed by McGill who stated that women had longer hold duration in extension positions than flexion holds.[6]

In the Isometric abdominal test, the strength assessed had a maximum grading of 4 (good) among 37% women, grade 3 (fair) were 42% and grade 2 (poor) were 21%. The subjects with a mean age of menopause in grade 4 (good) had a mean age of 48.56 and standard deviation was 1.66, in grade 3(fair) the mean age of menopause was 46.83 and standard deviation was 2.04 and for grade 2(poor) was 46.35 and SD was 2.16. The p-value was $p<0.0001$ thus statistically there is an extremely significant difference in comparison of mean age of menopause and core strength. About the gravid status, the subject with grade 4 (good) had a mean gravid status of 2.03 and SD was 0.87. In grading 3(fair) the mean Gravida was 3.35 and SD was 0.98 and for grade 2(poor) the mean gravida was 4.2 and SD was 1.36 (Table 1). The relation of the mean of gravid status to the core strength assessed with the isometric abdominal test was calculated and the p value was $p<0.0001$ statistically there is an extremely significant difference in comparison of mean gravid status and core strength.

In the Isometric extensor test, the strength assessed had a maximum grading of 5(Normal) in 2% of women, grading of 4 (good) among 46% women, grade 3 (fair) were 32% and grade 2 (poor) were 20%. The subjects with a mean age of menopause in grading 5 was 47.5 and SD 0.71, grade 4(good) had a mean age of 48.43 and standard deviation was 1.76, in grade 3(fair) the mean age of menopause was 46.23 and standard deviation was 1.91 and for grade 2(poor) was 46.79 and SD was 2.23. The p-value was $p<0.0001$ thus statistically there is an extremely significant difference in comparison of mean age of menopause and core strength. Concerning the gravid status, the subject with grading 5 had a mean gravida of 2 and SD 0, with grade 4 (good) having a mean was 2.25 and SD of 0.97. In grading 3(fair) the mean Gravida was 3.55 and SD was 1.21 and for grade 2(poor) the mean was 4.05 and SD was 1.22. (Table 2). The relation of the mean of gravid status to the core strength assessed with the isometric extensor test was calculated and the p-value

was p<0.0001 statistically there is an extremely significant difference in comparison of mean gravid status and core strength.

In the side bridge test the strength assessed had a maximum grading of 5(Normal) in 21% of women, grading of 4 (good) among 17% women, grade 3 (fair) were 26% and grade 2 (poor) were 36%. The subjects with a mean age of menopause in grading 5 was 48.6 and SD 1.82, grade 4(good) had a mean age of 48.06 and standard deviation was 1.88, in grade 3(fair) the mean age of menopause was 47.28 and standard deviation was 1.99 and for grade 2(poor) was 46.54 and SD was 2.12. The p-value was 0.0022 thus statistically there is a significant difference in comparison of mean age of menopause and core strength. About the gravid status, the subject with grading 5 had a mean gravida of 2.1 and SD 0.91, with grade 4 (good) having a mean was 2.13 and SD 0.81. In grading 3(fair) the mean Gravida was 3.08 and SD was 1.04 and for grade 2(poor) the mean was 3.94 and SD was 1.31(Table 3). The relation of the mean of gravid status to the core strength assessed with the isometric extensor test was calculated and the p-value was p<0.0001 statistically there is an extremely significant difference in comparison of mean gravid status and core strength.

In the study conducted by Dawn et al 2010, it was stated that estradiol is beneficial for muscle strength among postmenopausal women. Estradiol showed an influence over the binding of myosin and actin filaments during the contraction of the skeletal muscle.[12,14] Estrogen has improved muscle mass and strength by increasing the collagen content of the muscles. It also affects the tendons and ligaments by decreasing the stiffness and thereby affecting the performance and injury rates.[14] However, in postmenopausal women there is loss of the essential hormones, thus early the age of menopause is the hormonal depletion. Therefore, there is a rapid decline in muscle mass after menopause due to depletion in protein synthesis and other bodily mechanisms.[15,16] Thus, in our study the age of menopause has shown a significant influence over the core strength of postmenopausal women i.e. earlier the age of menopause moreover is the decline in core strength.

Gravid status in this study affects the core strength. The women with a higher gravid status had a decrease in core strength in comparison to those with a lower gravida. Our result is consistent with the study performed by Carla et al.,2014 which stated that the pelvic floor muscle function and strength was greatly reduced in multiparous women as compared to that of nulliparous.[17]Many studies have concluded that age and core strength has some negative correlation stating the relation of bone loss along with ageing. Along with ageing, many other factors are involved in the loss of core strength one of which, according to cohort studies is pregnancies in a female's life affecting her abdominal strength.[18] A study conducted by Derbyshire et al. 2008, stated that all the parameters of exercises training and physical activity levels were altered in a woman during and after her pregnancy. Thus, the age of menopause and gravid status had a significant effect on the core muscle strength. Core strengthening and stability would be beneficial for the prevention of future injuries. As the various study has been proven core strengthening to be effective in the reduction of pain, disability and improving Quality of life.[19-22]

The study was limited to a single geographical area also the strength assessment can be done using a standardized tool to nullify the errors of testing. Musculoskeletal health is a major indicator of functional decline among postmenopausal women. Barriers include age, physical status, nutritional status, lifestyle, health issues, etc which interferes with exercise performance of core strength. So, it is necessary to research upon core strength that adds to the safety and health promotion for performing functional activities. The leading cause of disability of person in the working years as well as of those in other age groups is the musculoskeletal conditions. Impairment of the back and spine are particularly disabling so, it is important to screen and evaluate the core which is the centre for all the functional activity to prevent disabilities. For understanding how is the pattern of weakness and instability of the core and thus preventing future injuries. As the core strength decreases, the dynamic stability is affected and there is an increased tendency of falls and loss of balance control, increased risk for fractures, impaired mobility, impairment in performing activities of daily living.

The result of our study concludes that there is quite a significant difference in core strength assessed among postmenopausal women in comparison to their age of menopause. The values obtained for that of gravid status showed an extremely significant difference suggesting that the gravid status of the women grossly affects the core strength in postmenopausal years of life. Therefore, certain modifiable factors must be looked upon which may influence the strength of women in their postmenopausal phase of life where a variety of physiological and physical changes happen to occur. Hence it is necessary to focus on the improvement of core stability and endurance with the help of physical activity which will reduce the future risk of injuries.

CONCLUSION

Our study concludes that there is quite a significant difference in core strength assessed among postmenopausal women when compared to their age of menopause and gravid status. Thus, stating that the core strength of postmenopausal women is significantly influenced by various factors such as the age of menopause and the gravid status of the women.

Clinical Significance: Core strengthening and stability training can be started earlier as a preventive measure for women to avoid any musculoskeletal conditions, fractures, injuries, etc. in later postmenopausal phases of their lives.

Conflict of Interest: No known conflict of interest.

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Authors Contribution: Bhosale Siddhi conducted the literature review for the study, developed the manuscript requirements. Bhosale Komal conducted the discussion and findings of the study. Both collected the samples included and analyzed the data. Dr. S Anandh provided the background information while manuscript preparation. All authors read and finalized the manuscript.

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Table 1: Mean and standard deviation of AOM and Gravid status with the isometric abdominal test

Isometric abdominal test	n= 96	Age of menopause	Gravid status
Normal 5	0	0	0
Good 4	36	48.56 ± 1.66	2.03 ± 0.87
Fair 3	40	46.83 ± 2.04	3.35 ± 0.98
Poor 2	20	46.35 ± 2.16	4.2 ± 1.36
Trace 1	0	0	0
p-value		<0.0001	<0.0001
F ratio		11.169	31.66
Interference		Extremely Significant	Extremely significant

ANOVA results for significance.

Table 2: Mean and standard deviation of AOM and Gravid status with isometric the extensor test

Isometric extensor test	n=96	Age of menopause	Gravid status
Normal 5	2	47.5 ± 0.71	2 ± 0
Good 4	44	48.43 ± 1.76	2.25 ± 0.97
Fair 3	31	46.23 ± 1.91	3.55 ± 1.21
Poor 2	19	46.79 ± 2.23	4.05 ± 1.22
Trace 1	0	0	0
p-value		<0.0001	<0.0001
F ratio		8.864	15.732
Interference		Extremely Significant	Extremely Significant

ANOVA results for significance.

Table 3: Mean and standard deviation of AOM and Gravid status with side bridge test

Side bridge test	n = 96	Age of menopause	Gravid status
Normal 5	20	48.6 ± 1.82	2.1 ± 0.91
Good 4	16	48.06 ± 1.88	2.13 ± 0.81
Fair 3	25	47.28 ± 1.99	3.08 ± 1.04
Poor 2	35	46.54 ± 2.12	3.94 ± 1.31
Trace 1	0	0	0
p-value		0.0022	<0.0001
F ratio		5.22	16.55
Interference		Significant	Extremely Significant

ANOVA results for significance.

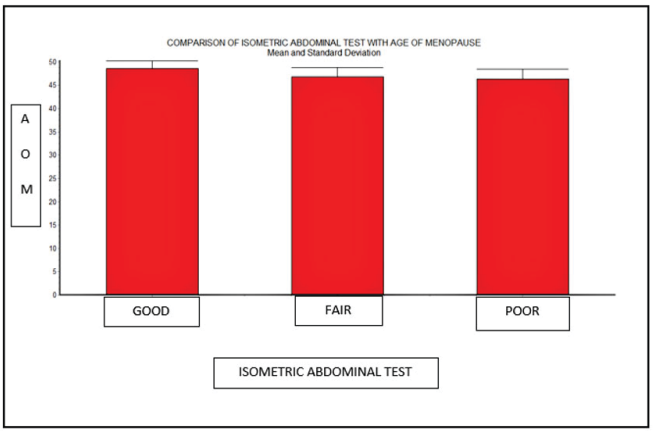

Figure 1: Shows variation in Mean and standard deviation of Age of menopause of postmenopausal women with the isometric abdominal test.

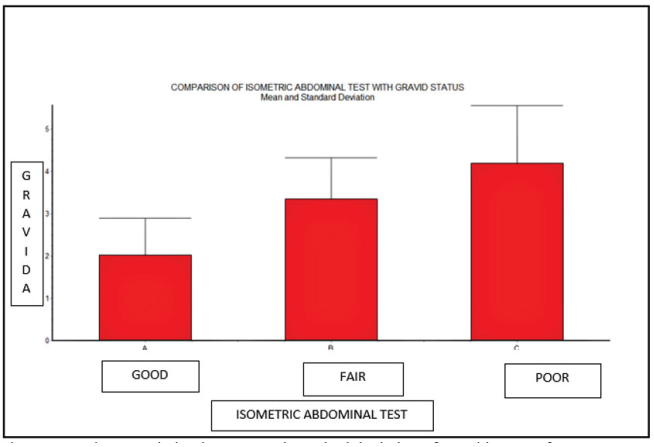

Figure 2: Shows variation in Mean and standard deviation of Gravid Statusof postmenopausal women with the Isometric abdominal test.

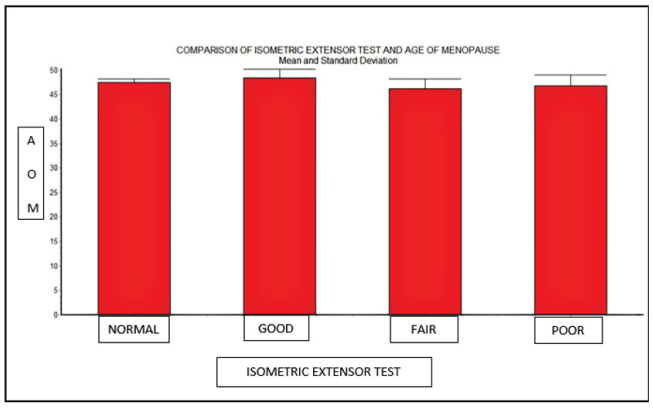

Figure 3: Shows variation in Mean and standard deviation of Age of menopause of postmenopausal women with the Isometric extensor test.

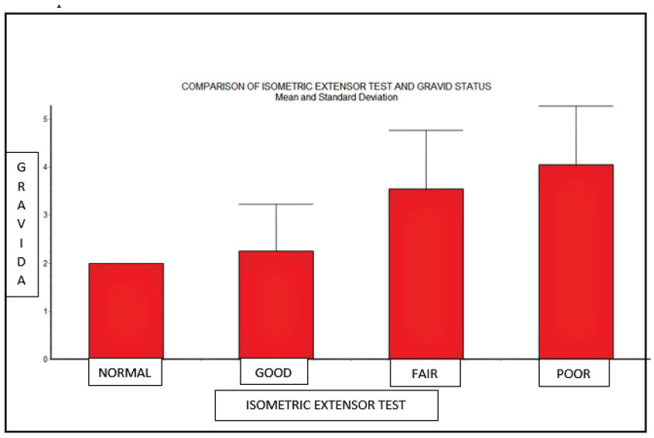

Figure 4: Shows variation in Mean and standard deviation of Gravid status of postmenopausal women with the Isometric extensor test.

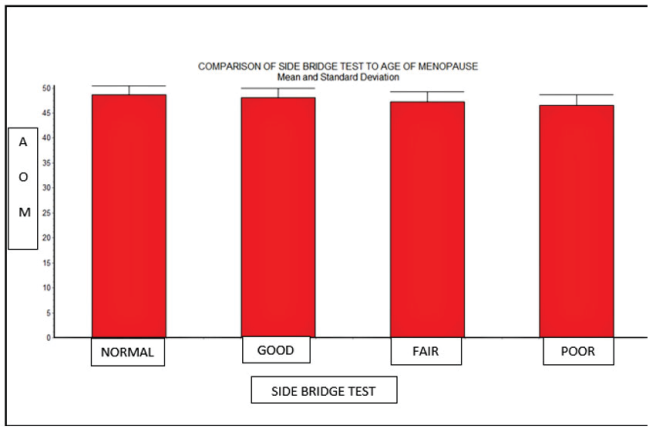

Figure 5: Showing variation in Mean and standard deviation of Age of menopauseof postmenopausal women with the side bridge test.

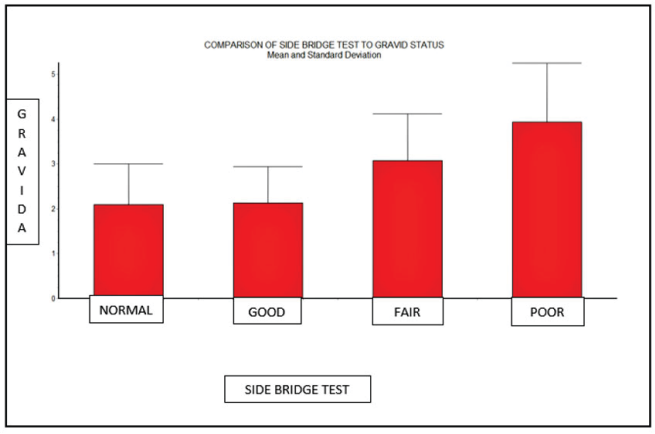

Figure 6: Showing variation in Mean and standard deviation of Gravid status of postmenopausal women with the side bridge test.