Effect of Body Mass on Quadriceps Muscle Strength among Postmenopausal Women

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Introduction: Obesity is a major public health problem, which can lead to a reduction in functional capacity and an increase in the risk of mortality. Along with this, there are detrimental effects of menopause which can cause a decrease in functional capacity. The aim of this study was to understand the effect of obesity or increased weight on quadriceps muscle strength as age-related morphological changes are more pronounced in quadriceps.

Methods: Sixty postmenopausal women aged between 50 and 70 years were divided into two groups according to body mass index (BMI): obese (n = 35) and not obese (n = 25). To assess quadriceps muscle strength, a modified sphygmomanometer was used. The procedure was done 3 times and the mean score was recorded. The same procedure was done for both legs.

Results: The results obtained by comparing the left and right quadriceps muscle with normal and increased body mass index show extreme significance with p value < 0.0001. Mean and standard deviation were used as measurements.

Conclusion: Our results show obesity or increased weight causes a decrease in quadriceps muscle strength as observed in postmenopausal women with increased body mass index.

Keywords: Obesity, Body mass index, Postmenopausal women, Quadriceps muscle strength
Menopause is defined as the permanent cessation of menstruation and marks the end of the reproductive life of women. Menopause is followed by the peri-menopause period which begins around 40 years or mid-40s in the Indian female population. Early menopausal symptoms include hot flushes, sweating, insomnia, headache, irritability, tiredness, dyspareunia, depression, lack of concentration, loss of memory, urinary stress incontinence, vaginal dryness, palpitation, dry mouth and eyes, restless leg, reduced skin elasticity, and muscle and joint pain.

Menopause period is characterised by various hormonal changes in which first inhibin B decreases along with a rise in follicle-stimulating hormone in the early stage followed by a decrease in oestrogen and inhibin A. Obesity can be due to reduced levels of oestrogen along with poor habits. Sedentary lifestyle results in an excessive amount of fat mass contributing to loss of muscle mass and function. Women tend to lose muscle strength around the age of 50–60 years mainly due to menopause with loss of muscle mass. With ageing, there is an increased risk of limitation in function along with physical disability due to decreased muscle strength and mass. There are multiple factors contributing to this phenomenon, some of which mainly contribute to a decrease in muscle strength, which includes the following:

- Loss of oestrogen and muscle mass: The oestrogen fibres are less in postmenopausal women than in men and children which has an anabolic effect by stimulating IGF-1 receptors.
- Fibre type distribution: Type II muscle fibres have more oestrogen receptors which reduce in size as well as number in the postmenopausal period.
- Contractile properties: Adenosine monophosphate kinase is a protein whose activity gets altered in menopause. It is mainly required by muscles for glucose uptake and lipid oxidation. Along with this, the capacity of muscle to metabolise triglyceride gets reduced leading to an increase in fat mass and insulin resistance in menopause.
- Power output, isokinetic, and isometric force: Women tend to lose muscle strength around 60 years of age due to a reduction in functional motor units which can cause sarcopenia. There is evidence of reduced strength in menopause due to the reinnervation of type II fibres with type I motor units.
- Exercise: To reduce or prevent muscle strength loss due to ageing, proper dietary supplements along with resistance exercise are important as muscle strength is required in everyday life activities.
- Hormone replacement: Hormone replacement therapy plays an important role in increasing muscle strength and power.

### Method
#### Participants
This is a comparative study conducted from May 2022 to October 2022 at Krishna Institute of Medical Sciences, Karad. The inclusion criterion was women between 50 and 70 years of age with menopause while exclusion criteria for the study were women less than 50 years of age even with menopause, women with hysterectomy done before, signs and symptoms of any neurological disease, use of any hormone therapy, history of knee injury or pain, and women who did not want to participate in the study. Therefore based on inclusion and exclusion criteria, a total of 60 postmenopausal women between the ages of 50 and 70 years participated in the study (Figure 1). Their height and weight were taken and BMI was calculated. The project was approved by the Ethics Committee of Krishna Institute of Medical Sciences deemed to be University, Karad. Informed consent was taken before the assessment. According to WHO’s BMI classification, participants were divided into two groups:

- Obese (BMI ≥ 25)
- Not obese (BMI - 18.5 to 25)

25 participants were in the not obese group and 35 participants were in the obese group.
Muscle Strength Assessment

Dynamic muscle strength of knee extensor of the left and right leg was assessed by using a modified sphygmomanometer. The bag method of modified sphygmomanometer was used.20 For testing, the patient was seated with legs hanging naturally over the edge of the table at an approximately right angle and hands were kept on the thigh. Equipment placement was done distal and anterior to the leg such that it was parallel to the segment in a way to resist movement of the testing muscle group.21 The patient was asked to perform knee extension thrice against the resistance of equipment placed with the maximum effort possible and the mean score was recorded. The same procedure was done for both legs.

Statistical Analysis

Mean and standard deviation were used as measurements. Unpaired t-test was used for comparing obese and not obese postmenopausal women with normal and increased BMI. The software Instat was used for statistical analysis.

Results

As seen in Table 2, the association of right and left quadriceps strength with normal body mass index (mean 115.32 and 111.40 respectively) and increased body mass index (mean 80.286 and 76.000 respectively) is significant with p value < 0.0001.

Discussion

The main aim of this study is to evaluate and compare

Table 2.Association of Quadriceps Strength with BMI

<table>
<thead>
<tr>
<th>Variables</th>
<th>Normal BMI (Non-obese Group)</th>
<th>Increased BMI (Obese Group)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.48</td>
<td>58.88</td>
<td>NS</td>
</tr>
<tr>
<td>Right quadriceps strength</td>
<td>115.32</td>
<td>80.286</td>
<td>S</td>
</tr>
<tr>
<td>Left quadriceps strength</td>
<td>111.40</td>
<td>76.000</td>
<td>S</td>
</tr>
<tr>
<td>BMI</td>
<td>22.476</td>
<td>28.800</td>
<td>S</td>
</tr>
</tbody>
</table>

S: Significant; NS: Not significant; Values are mean
Menopause is the period after which various physiological changes occur. It leads to a decline in levels of oestrogen which reduces muscle mass and strength. We evaluated the strength of quadriceps muscle in postmenopausal women according to their body mass index and found that obese women have reduced muscle strength as compared to non-obese women. Therefore we conclude that a decrease in muscle strength occurs in postmenopausal women having increased body mass index.

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**Conflicts of Interest:** None

**References**


