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## Influence of Lower Limb Extensor Muscle Mass and Strength in Obese Women over 45 Years of Age

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### Abstract

Leg muscle strength is important for performing daily physical activities such as walking, running, and jumping. In obesity there is an increase in fat mass which can decrease muscle mass, the effect will be a decrease in muscle strength. Increasing age will also significantly reduce muscle strength after the age of 45 years in women associated with menopause. This study aims to determine the effect of fat mass and muscle mass on leg muscle strength in obese women over 45 years of age in the Nutrition Clinic of Dustira Hospital. This study is an analytic study with a cross-sectional design. There were 52 obese women in the Nutrition Clinic of Dustira Hospital who met the research criteria. Fat mass and muscle mass were measured using the BIA tool, while the measurement of leg muscle strength was carried out using a leg dynamometer. Statistical tests used the chi-square test with a 95% confidence level. The results showed that most research subjects were in the age range of 45-55 years, and they were 52,9% in the obesity I category. Descriptive data showed that 66,7% of subjects had obese fat mass, 80,4% of subjects had very low muscle mass, and 58,8% of subjects had poor leg muscle strength. Statistical test results showed there was a significant influence between fat mass on leg muscle strength ( $p=0,003<0,05$ ) and muscle mass on leg muscle strength ( $p=0,000<0,05$ ). This shows that high fat mass, including IMCL, can reduce muscle mass, which can lead to a decrease in leg muscle strength.

**Keyword:** Fat mass, leg muscle strength, muscle mass, obesity, female >45 years old

## INTRODUCTION

Obesity reduces the ability of skeletal muscles to maintain locomotor performance (Astuti & Jatmiko, 2020; Javed, Mayhew, Shea, & Raina, 2019; Lamusu & Lamusu, 2021; Putri, Corniawati, & Imamah, 2023). The prevalence of obesity in Indonesia has continued to increase almost 3-fold since 1975. In 2018, the prevalence of obesity in Cimahi City was 24.87%. The prevalence of obesity in Cimahi City is more prevalent in women with a percentage of 33.09%, while in men it is 16.95% (Febriyanti et al., 2023).

In women the decline in muscle mass generally begins at the age of 45 years and peaks at the age of 65 years (Fitriani, 2018; Kuryłowicz, 2023). This is associated with menopause and declining estrogen levels. This condition leads to increased visceral fat and ectopic fat

deposits, particularly in muscle cells (Altajar & Baffy, 2020; Klein, Gastaldelli, Yki-Järvinen, & Scherer, 2022; Pasdar et al., 2019; Sukarno, 2021). This correlates with the incidence of obesity and increased fat in muscle cells (Intramyocellular lipid/IMCL). IMCL causes a decrease in skeletal muscle contractility and strength. Until now there has been no research on the effect of fat mass and muscle mass on leg muscle strength in obese women over 45 years of age at Dustira Hospital.

## METHODS

This study is an analytic study with a cross-sectional design. The study subjects were 51 obese women over 45 years of age at Dustira Hospital Nutrition Clinic who met the inclusion criteria. The inclusion criteria in this study were patients at the Dustira Hospital Nutrition Clinic who were diagnosed with obesity, had a nutritional status with a BMI value of  $\geq 25$  kg / m<sup>2</sup>, were female and over 45 years old, and were willing to become research respondents and fill out an informed consent sheet. The sampling technique in this study used consecutive sampling. The independent variables in this study were body fat mass and muscle mass, while the dependent variable in this study was leg muscle strength. Bivariate analysis using the chi-square test with a confidence level of 95%.

The research was conducted directly at the Dustira Hospital Nutrition Clinic by providing informed consent, and questionnaires about the respondent's identity (name, age, and gender), weight, and height. Assessment of nutritional status was carried out using the IMT formula, fat mass and muscle mass were measured by BIA, and leg muscle strength was measured using a leg dynamometer.

## RESULTS

Overview of Obese Women Over 45 Years of Age at Dustira Hospital Nutrition Clinic can be seen in Table 1.

**Table 1. Overview of obese women over 45 years old at Dustira Hospital Nutrition Clinic based on age and nutritional status**

| Age               | Nutritional Status |             |            |             |           |              |
|-------------------|--------------------|-------------|------------|-------------|-----------|--------------|
|                   | Obesity I          |             | Obesity II |             | Total     |              |
|                   | n                  | %           | n          | %           | n         | %            |
| 45 - 55 years old | 21                 | 47,7        | 23         | 52,3        | 44        | 100,0        |
| 56 - 65 years old | 4                  | 80,4        | 1          | 20,0        | 5         | 100,0        |
| >65 years old     | 2                  | 100,0       | 0          | 0,0         | 2         | 100,0        |
| <b>Total</b>      | <b>27</b>          | <b>52,9</b> | <b>24</b>  | <b>47,1</b> | <b>51</b> | <b>100,0</b> |

Table 1 shows that the majority of research subjects were in the age range between 45-55 years, totaling 44 people, 27 people (52.9%) had obesity I nutritional status, and 24 people (47.1%) had obesity II nutritional status. While obese women in the age range of 56-65 years were 5 people and more than 65 years of age were 2 people.

According to Riskesdas 2018, the prevalence of obesity in adult women aged more than 18 years was 44.4%. Obesity is associated with menopause in women which causes a decrease in estrogen levels resulting in changes in body fat composition from subcutaneous fat deposition to visceral fat and ectopic fat (Altajar & Baffy, 2020; Dinas Kesehatan Kota Bandung, 2021; Pasdars et al., 2019).

The description of fat mass in obese women aged over 45 years in the Nutrition Clinic of Dustira Cimahi Hospital is described in Table 2.

**Table 2. Fat mass overview of the study subjects**

| Age               | Underfat |            | Healthy  |            | Fat Mass Overfat |             | Obesitas  |             | Total     |              |
|-------------------|----------|------------|----------|------------|------------------|-------------|-----------|-------------|-----------|--------------|
|                   | n        | %          | n        | %          | n                | %           | n         | %           | n         | %            |
| 45 - 55 years old | 0        | 0,0        | 0        | 0,0        | 12               | 27,3        | 32        | 72,7        | 44        | 100,0        |
| 55 - 65 years old | 0        | 0,0        | 0        | 0,0        | 4                | 80,0        | 1         | 20,0        | 5         | 100,0        |
| >65 years old     | 0        | 0,0        | 0        | 0,0        | 1                | 50,0        | 1         | 50,0        | 2         | 100,0        |
| <b>Total</b>      | <b>0</b> | <b>0,0</b> | <b>0</b> | <b>0,0</b> | <b>17</b>        | <b>33,3</b> | <b>34</b> | <b>66,7</b> | <b>51</b> | <b>100,0</b> |

In Table 2, it can be seen that of the 51 obese women over 45 years of age at the Dustira Hospital Nutrition Clinic, 17 people (33.3%) were included in the overfat fat mass category and as many as 34 people (66.7%) were included in the obese fat mass category. In women, a decrease in estrogen levels during menopause results in an increase in body weight and accumulation of visceral fat. Obesity is characterized by ectopic fat accumulation in skeletal muscle leading to increased intramuscular fat deposition and IMCL (Moore, Bembem, Lein, Bembem, & Singh, 2020; Roh & Choi, 2020; Straight, Toth, & Miller, 2021; Wiranata & Inayah, 2020).

The description of muscle mass in obese women over 45 years of age at the Nutrition Clinic of Dustira Cimahi Hospital is described in Table 3.

**Table 3. Muscle mass overview of the study subjects**

| Age               | Very Low  |             | Low       |             | Good     |            | Increased |            | Total     |              |
|-------------------|-----------|-------------|-----------|-------------|----------|------------|-----------|------------|-----------|--------------|
|                   | n         | %           | n         | %           | n        | %          | n         | %          | n         | %            |
| 45 - 55 years old | 35        | 79,5        | 9         | 20,5        | 0        | 0,0        | 0         | 0,0        | 44        | 100,0        |
| 56 - 65 years old | 5         | 100,0       | 0         | 0,0         | 0        | 0,0        | 0         | 0,0        | 5         | 100,0        |
| >65 years old     | 1         | 50,0        | 1         | 50,0        | 0        | 0,0        | 0         | 0,0        | 2         | 100,0        |
| <b>Total</b>      | <b>41</b> | <b>80,4</b> | <b>10</b> | <b>19,6</b> | <b>0</b> | <b>0,0</b> | <b>0</b>  | <b>0,0</b> | <b>51</b> | <b>100,0</b> |

Based on the results of the study in Table 3, it can be seen that of the 51 women with obesity aged over 45 years at the Dustira Hospital Nutrition Clinic, there were 41 people (80.4%) who were in the very low muscle mass category. Women who experience menopause have higher muscle protein synthesis and breakdown. The imbalance of protein synthesis and protein degradation will cause fiber atrophy which can reduce muscle mass and cause a decrease in muscle strength (Chidi-Ogbolu & Baar, 2019).

Based on Table 4, it can be seen that leg muscle strength in obese women over 45 years of age at Dustira Hospital Nutrition Clinic is more in the category of less muscle strength with a total of 30 people (58.8%).

**Table 4. Overview of leg muscle strength of research subjects**

| Age           | Limb Muscle Strength |     |      |     |        |      |      |       |           |      | Total |       |
|---------------|----------------------|-----|------|-----|--------|------|------|-------|-----------|------|-------|-------|
|               | Very Good            |     | Good |     | Medium |      | Less |       | Very Less |      |       |       |
|               | n                    | %   | n    | %   | n      | %    | n    | %     | n         | %    | n     | %     |
| 45 - 55 Tahun | 0                    | 0,0 | 0    | 0,0 | 9      | 20,5 | 25   | 56,8  | 10        | 22,7 | 44    | 100,0 |
| 56 - 65 Tahun | 0                    | 0,0 | 0    | 0,0 | 1      | 20,0 | 3    | 60,0  | 1         | 20,0 | 5     | 100,0 |
| >65 Tahun     | 0                    | 0,0 | 0    | 0,0 | 0      | 0,0  | 2    | 100,0 | 0         | 0,0  | 2     | 100,0 |
| Total         | 0                    | 0,0 | 0    | 0,0 | 10     | 19,6 | 30   | 58,8  | 11        | 21,6 | 51    | 100,0 |

A decrease in the number and size of muscle fibers, atrophy in some muscle fibers, and an increase in fatty tissue result in decreased muscle strength, flexibility, slowed reaction time and decreased functional ability. In women, decreased muscle strength occurs with age and is exacerbated due to a decrease in the hormone estrogen during menopause (Collins, Laakkonen, & Lowe, 2019; Fitriani, 2018).

Based on the results of the chi-square statistical test, the probability value (p-value) is smaller than 0.05, which is 0.003 (Table 5). This shows that there is a significant influence between fat mass on leg muscle strength.

**Table 5. Effect of fat mass on leg muscle strength**

| Fat Mass     | Limb Muscle Strength |            |          |            |           |             |           |             |           |             | Total     | p- value |
|--------------|----------------------|------------|----------|------------|-----------|-------------|-----------|-------------|-----------|-------------|-----------|----------|
|              | Very Good            |            | Good     |            | Medium    |             | Less      |             | Very Less |             |           |          |
|              | n                    | %          | n        | %          | n         | %           | n         | %           | n         | %           | N         |          |
| Underfat     | 0                    | 0,0        | 0        | 0,0        | 0         | 0,0         | 0         | 0,0         | 0         | 0,0         | 0         | 0,003    |
| Healthy      | 0                    | 0,0        | 0        | 0,0        | 0         | 0,0         | 0         | 0,0         | 0         | 0,0         | 0         |          |
| Overfat      | 0                    | 0,0        | 0        | 0,0        | 7         | 41,2        | 10        | 58,8        | 0         | 0,0         | 17        |          |
| Obesitas     | 0                    | 0,0        | 0        | 0,0        | 3         | 8,8         | 20        | 58,8        | 11        | 32,4        | 34        |          |
| <b>Total</b> | <b>0</b>             | <b>0,0</b> | <b>0</b> | <b>0,0</b> | <b>10</b> | <b>19.6</b> | <b>30</b> | <b>58.8</b> | <b>11</b> | <b>21.6</b> | <b>51</b> |          |

Progressive accumulation of IMCL leads to increased oxidative stress, insulin resistance, and inflammation resulting in decreased muscle mass and strength (Cleasby, Jamieson, & Atherton, 2016; Li et al., 2022). Skeletal muscle oxidative stress impairs insulin

signaling and inhibits insulin signaling pathways thereby increasing the occurrence of insulin resistance. In the state of insulin resistance, glucose absorption is greatly reduced so that muscle strength will decrease. In addition, the accumulation of IMCL can also cause inflammation in skeletal muscle which limits the regeneration potential of muscle tissue. As a result, muscle fibers are damaged resulting in a decrease in muscle mass and muscle strength (Shou, Chen, & Xiao, 2020; Sukarno, 2021).

Based on the results of the chi-square statistical test, the probability value (p-value) is smaller than 0.05, namely 0.000 (Table 6). This shows that there is a significant influence between muscle mass on leg muscle strength.

**Table 6. Effect of muscle mass on leg muscle strength**

| Muscle Mass | Limb Muscle Strength |     |      |     |        |      |      |      |           |      | Total | p- value |
|-------------|----------------------|-----|------|-----|--------|------|------|------|-----------|------|-------|----------|
|             | Very Good            |     | Good |     | Medium |      | Less |      | Very Less |      |       |          |
|             | n                    | %   | n    | %   | n      | %    | n    | %    | n         | %    | n     |          |
| Very Low    | 0                    | 0,0 | 0    | 0,0 | 3      | 7,3  | 27   | 65,9 | 11        | 26,8 | 41    | 0,000    |
| Low         | 0                    | 0,0 | 0    | 0,0 | 7      | 70,0 | 3    | 30,0 | 0         | 0,0  | 10    |          |
| Good        | 0                    | 0,0 | 0    | 0,0 | 0      | 0,0  | 0    | 0,0  | 0         | 0,0  | 0     |          |
| Increased   | 0                    | 0,0 | 0    | 0,0 | 0      | 0,0  | 0    | 0,0  | 0         | 0,0  | 0     |          |
| Total       | 0                    | 0,0 | 0    | 0,0 | 10     | 19,6 | 30   | 58,8 | 11        | 21,6 | 51    |          |

Decreased muscle mass and strength can be a major cause of decreased functional ability. Limb muscles are essential for daily activities such as walking, running and jumping. According to Mustafa's research in 2022, there is a significant relationship between leg muscle strength and the risk of falls in the elderly. This condition will have an impact on reducing the ability to maintain static or dynamic body balance (Astuti & Jatmiko, 2020; Moore et al., 2020; Mustafa, Thanaya, Adiputra, & Saraswati, 2022).

## CONCLUSIONS

The majority of obese women over 45 years old in the Dustira Hospital Nutrition Clinic are in the age range between 45-55 years and are in the first obesity category. The majority of obese women over 45 years old in the Dustira Hospital Nutrition Clinic have fat mass in the obese category (66.7%). The majority of obese women over 45 years old at Dustira Hospital Nutrition Clinic have very low muscle mass (80.4%). Leg muscle strength in obese women over 45 years of age at Dustira Hospital Nutrition Clinic is more in the less category (58.8%). Fat mass and muscle mass have a significant effect on leg muscle strength in obese women over 45 years of age at the Dustira Hospital Nutrition Clinic.

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**CONFLICT OF INTEREST**

The researcher declares that there is no conflict of interest in the making and writing of this scientific work that the researcher wrote.