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# THE ROLE OF MUSCLE STRENGTH AND GAIT SPEED IN PATIENTS WITH SARCOPENIA

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**Abstract**

Introduction: Sarcopenia is a progressive and generalized skeletal disorder that is associated with increased likelihood of adverse outcomes, including falls, fractures, physical disability, and mortality. Muscle strength is now considered more important than muscle mass in diagnosing sarcopenia.

Material and methods: This is a cross-sectional study with 75 patients in total. The patients included are from nursing homes in the Republic of North Macedonia and outpatients, aged 60 and over. The patients included were diagnosed with sarcopenia through assessment of muscle mass (bioimpedance analysis), physical performance (gait speed), muscle strength (handgrip strength), and a SARC-F score equal to or over 4. Patients diagnosed with sarcopenia fulfill the - 36 questionnaire for assessment of quality of life.

Results: In terms of Muscle Strength (MS), the patient group without sarcopenia ($Z = 3.27$) and $p = 0.001$ has statistically significantly higher Muscle Strength (handgrip strength) compared to the patient group with sarcopenia. Participants with sarcopenia have a significantly lower gait speed compared to those without sarcopenia ($Z = -5.83$, $p < 0.001$).

Conclusion: If Muscle Strength is increased by only 1kg, the quality of life in patients with sarcopenia increases on average. The test result shows a significant difference — people with sarcopenia walk more slowly. Routine handgrip and gait speed assessments in older adults can identify at-risk individuals before major functional decline occurs. Improvements in either measure indicate effective intervention and reduced sarcopenia-related risk.

***Key words:*** sarcopenia, muscle strength, gait speed, quality of life.

## Introduction

In 1989, Irwin Rosenberg proposed the term "sarcopenia," defined as the loss of skeletal muscle mass and strength that occurs with advancing age [1]. Sarcopenia literally means "loss of flesh" from the ancient Greek words 'sarx' meaning "flesh," or "meat," and penia, meaning "lack."

Definitions for sarcopenia have varied over the last 20 years, and different criteria exist regarding definitions and diagnosis.

Therefore, a European Working Group on Sarcopenia in Older People (EWGSOP) was formed in 2010 and established a consensus definition for sarcopenia [2]. Sarcopenia was primarily defined as low muscle mass plus either low muscle strength or low physical performance.

The latest international consensus, EWGSOP2, 2019 [3] and Asian Working Group for Sarcopenia [4] (AWGS, 2019/2023 updates) revised the previous definition and came to the conclusion that muscle strength is now considered more important than muscle mass in the diagnosis of sarcopenia.

Sarcopenia is now formally recognized as a muscle disease with an ICD-10-MC Diagnosis Code, which is a major step forward for clinical practice [5].

According to the population census from 1994 in the Republic of North Macedonia, 13% of the population is over 60 years old, 15% in 2002, 16,6% in 2008, and 15,01 in 2021[6].

This means that our population is aging, and this condition has a high personal, economic, and social burden if left untreated. Although sarcopenia is dominantly a geriatric condition, our community does need a concept for increased awareness regarding recognizing the symptoms, treatment, and, most importantly, actions for preventing the condition.

According to the consensus of EWGSOP2, diagnostic criteria for sarcopenia are as follows: if low muscle strength alone is present, it is classified as probable sarcopenia; If low muscle strength and low muscle mass are both present, then it is confirmed sarcopenia; If three symptoms are present (low muscle strength, muscle mass, and physical performance), then it is severe sarcopenia.

Muscle strength declines faster than muscle mass with age. Mass alone may not reflect true muscle function or quality. Strength predicts functional decline, disability, and mortality better than mass [3].

The reduction in muscle quantity contributes directly to reduced muscle strength and physical performance. It is linked with slower walking speed, difficulty performing daily tasks, higher risk of hospitalization, and mortality. Patients often report a general feeling of weakness, fatigue, and slower movements, while clinicians may observe a reduced gait speed, unstable posture, or the need for walking aids.

Slow gait speed is strongly associated with increased risk of falls and fractures, functional dependence and disability, hospitalization and longer stays, and all-cause mortality [12].

Numerous longitudinal studies show that each 0.1 m/s decrease in gait speed correlates with a significant rise in mortality risk among older adults [11].

**Material and methods**

This study aimed to assess the quality of life through the SF-36 questionnaire in patients (who are not in wheelchairs and 'bed-tight') aged 60 and over, diagnosed with sarcopenia, in relation to Muscle Mass and Muscle Strength.

This was a cross-sectional study (prevalence study), performed in the period of October 2023 until February 2024 in RNM, with 75 patients included. The patients included are mostly from nursing homes, who are not in wheelchairs and bed-thigh and ambulatory patients, aged 60+.

The patients included were diagnosed with sarcopenia through assessment of muscle quality (bioimpedance analysis), muscle strength (handgrip strength), physical performance (gait speed), and a SARC-F score equal to or over 4 [7].

Each patient involved in the study was assessed with the SARC-F questionnaire, which is a 5-item questionnaire (strength, walking ability, rising from a chair, stair climbing, and experiences with falls) recommended by EWGSOP2 as a screening tool with a very high specificity for predicting low muscle strength and a screening tool for sarcopenia risk [8-9].

Each patient involved was measured for muscle quality with a bioimpedance machine, handgrip strength with a dynamometer, and a gait speed test (4-meter usual walking speed test|) with speed measured manually with a stopwatch.

Sarcopenia's cut-off points recommended by EWGSOP2 regarding these parameters are:

- Grip strength for men is <27kg, for women < 16kg.
- Gait speed ≤0.8 m/s.
- ASM (appendicular skeletal muscle) <20kg for men, <15 kg for women.

Those patients diagnosed with sarcopenia fulfill the SF-36 questionnaire for assessment of quality of life. The SF-36 measures eight scales: physical functioning (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social functioning (SF), role emotional (RE), and mental health (MH) [10].

The SF-36 is a potentially valuable tool in medical research for evaluating Health-Related Quality of Life [8,10].

**Results**

A total of 74 patients were included in this study, 33 (44,0%) with diagnosed sarcopenia and 42 patients (56,0%) without sarcopenia. Only patients diagnosed with sarcopenia were included in this analysis who fulfilled the SF - 36 questionnaire.

In the distribution by gender of 33 diagnosed with sarcopenia, 30 were women and 3 men. In distribution by age, the minimum age of included patients was 60, and the maximum was 88 years old.

In terms of Muscle Strength (MS), the patient group without sarcopenia (Z = 3.27) and p = 0.001 has statistically **significantly higher Muscle Strength** (handgrip strength) compared to the patient group with sarcopenia. (Table 1.)

**Table 1.** Patient group with sarcopenia.

| Variable | Rank Sum Non - sarcopenia | Rank Sum Sacopenia | U | Z | p-level | Valid N | Valid N |
|---|---|---|---|---|---|---|---|
| Muscle Strength | 1902,00 | 948,00 | 387,00 | 3,27 | **0,001** | 42 | 33 |

The most influential parameter on the Quality of life in patients with sarcopenia is Muscle Strength (Beta = 0,86), then Gender (Beta = - 0,65), Body Fat (Beta = - 0,32), Age (Beta = - 0,29), Gait Speed (Beta = - 0,25), and Muscle Quality (Beta = 0,06).

Multiple Regression / Quality of life in patients with sarcopenia & Muscle Quality, Body Fat, Muscle Strength, Gait Speed, Age, Gender (Table 2)

**Table 2.** Quality of life in patients with sarcopenia & Muscle Quality, Body Fat, Muscle Strength, Gait Speed, Age, Gender.

| Regression Summary for Dependent Variable: Total (Sarcopenia) R= 0,69 F(6,26)=3,9930 p<0,006 | | | | | | |
|---|---|---|---|---|---|---|
| | Beta | Std.Err. of Beta | B | Std.Err. of B | t(26) | p-level |
| Intercept | | | 5353,26 | 2192,48 | 2,44 | 0,02 |
| Muscle Quality | 0,06 | 0,20 | 3,70 | 11,87 | 0,31 | 0,76 |
| Body Fat | -0,32 | 0,21 | -41,77 | 28,16 | -1,48 | 0,15 |
| Muscle Strenght | 0,86 | 0,21 | 77,31 | 18,70 | 4,14 | 0,000 |
| Gait Speed | -0,25 | 0,15 | -98,93 | 59,23 | -1,67 | 0,11 |
| Age | -0,29 | 0,16 | -37,71 | 20,69 | -1,82 | 0,08 |
| Gender (1) | -0,65 | 0,18 | -1763,78 | 497,36 | -3,55 | 0,002 |

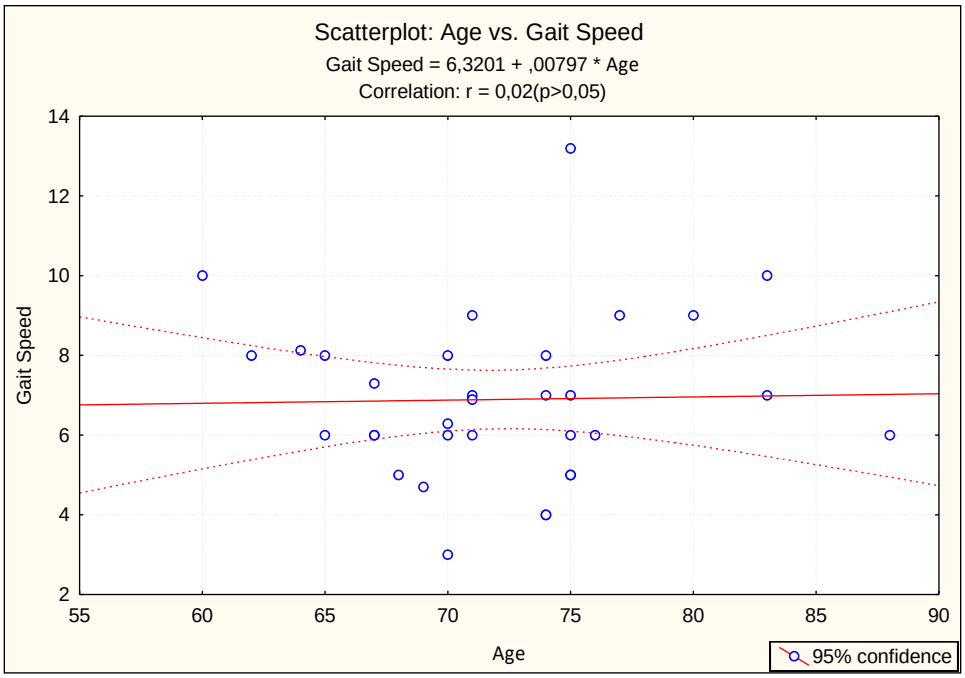
Gait Speed descriptive analysis

The value of Gait Speed varies within the range of 6.89 ± 2.04 seconds, with a 95% confidence interval of 6.17–7.63 seconds. The median is 6.89 seconds, the minimum value is 3.00 seconds, and the maximum value is 13.20 seconds (Table 3).

**Table 3.** Statistical analysis.

| Variable | Valid N | Mean | Confidence -95,00% | Confidence +95,00% | Median | Minimum | Maximum | Range | Std.Dev. |
|---|---|---|---|---|---|---|---|---|---|
| Gait Speed | 33 | 6,89 | 6,17 | 7,62 | 6,89 | 3,00 | 13,20 | 10,20 | 2,04 |

In the graph below (3.1), the correlation is shown between Gait Speed as the dependent variable and the age of participants in the sarcopenia group as the independent variable. For r = 0.02 (p > 0.05), a very weak positive and non-significant correlation was found. With each one-year increase in age, Gait Speed (the time required to walk 4 meters) increases by 0.008 seconds, which is not statistically significant (p > 0.05), but the time required to walk 4 meters increases with age, or the patient is walking slower.




**Graph 3.1.**

Participants with sarcopenia have a **significantly lower gait speed** compared to those without sarcopenia (Z = -5.83, p < 0.001).

The negative Z value (-5.83**)** also supports this: it indicates that the sarcopenia group's average gait speed is lower than that of the non-sarcopenia group (Table 4).

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**Table 4.** The sarcopenia group's average gait speed is lower than that of the non-sarcopenia group

| Variable | Rank Sum Non - sarcopenia | Rank Sum Sarcopenia | U | Z | p-level | Valid N | Valid N |
|---|---|---|---|---|---|---|---|
| Gait Speed | 1054,50 | 1795,50 | 151,50 | -5,83 | **0,000** | 42 | 33 |

When assessing the significance of predictors for sarcopenia, it was determined that **Gait Speed** has the strongest influence (Wald = 15.071 / p < 0.001 (p = 0.000)), followed by **Age** (Wald = 1.744 / p > 0.05 (p = 0.187)), **Fat Body** (Wald = 1.054 / p > 0.05 (p = 0.305)), **Muscle Quality** (Wald = 0.235 / p > 0.05 (p = 0.628)), and **Muscle Strength** (Wald = 0.178 / p > 0.05 (p = 0.673)), while **Gender (1)** has the weakest influence (Wald = 0.025 / p > 0.05 (p = 0.873)). (Table 5)

**Table 5.** Statistical analysis.

| | | B | S.E. | Wald | df | Sig. | Exp(B) | 95% C.I.for EXP(B) | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Lower | Upper |
| Step 1[a] | Gender (1) | (,209) | 1,309 | ,025 | 1 | ,873 | ,812 | ,062 | 10,556 |
| | Age | (,084) | ,064 | 1,744 | 1 | ,187 | ,919 | ,812 | 1,041 |
| | MQ | (,020) | ,041 | ,235 | 1 | ,628 | ,980 | ,905 | 1,062 |
| | Fat Body | ,087 | ,085 | 1,054 | 1 | ,305 | 1,091 | ,924 | 1,289 |
| | Muscle Strength | (,018) | ,043 | ,178 | 1 | ,673 | ,982 | ,902 | 1,069 |
| | Gait Speed | 1,449 | ,373 | 15,071 | 1 | **,000** | 4,258 | 2,049 | 8,848 |
| | Constant | (2,971) | 5,834 | ,259 | 1 | ,611 | ,051 | | |

a. Variable(s) entered on step 1: Gender, Age, MQ, Fat Body, Muscle Strength, Gait Speed.

With an increase in the time required to walk 4 meters (Gait Speed) by one unit, the risk of sarcopenia increases by 325.8% (Exp(B) = 4.258). The effect of Gait Speed is statistically significant (95% CI: 2.049–8.848; $p < 0.001$)

**Conclusion**

The literature presents that the process of aging increases the risk for sarcopenia and its consequences (like falls, injuries, increased morbidity and mortality), therefore influencing the quality of life. Hence, this study reports that the quality of life in patients with sarcopenia is decreased on average if the age increases by 1 year only.

If Muscle Strength is increased by only 1kg, the quality of life in patients with sarcopenia increases by 77,31(B = 77,31) / p<0,001(p=**0,000**) on average (if the rest of the parameters are constant).

The gait speed is one of the most powerful and practical indicators of functional status, frailty, and risk outcomes in patients with sarcopenia.

The test result shows a significant difference — people with sarcopenia walk more slowly, and this finding is highly statistically significant. Slow gait speed reflects reduced muscle strength and coordination, which are key features of sarcopenia. It directly correlates with difficulty performing daily activities such as walking, climbing stairs, and self-care.

Therefore, gait speed serves as a functional marker of independence — slower speeds indicate a higher risk of disability and loss of autonomy.

Early detection, diagnosis, and monitoring of sarcopenia is possible through routine assessment of muscle strength in older adults.

Improving muscle strength is the cornerstone of sarcopenia management. Strength training and nutrition therapy can significantly improve functional outcomes. Routine handgrip and gait speed assessments in older adults can identify at-risk individuals before major functional decline occurs. Improvements in either measure indicate effective intervention and reduced sarcopenia-related risk.

This research represents an important challenge in the field, as the Republic of North Macedonia currently lacks any published studies or clinical trials on sarcopenia among the elderly, as well as data on its social and economic burden.

Therefore, this study will serve as a first step toward raising awareness of the need for a public health approach to sarcopenia.

Such an approach will help patients and healthcare professionals better understand the disease, ultimately leading to improved care and quality of life for the elderly population.

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