

# Do the duration and frequency of physical activity affect the indicator of sarcopenia in older adult?

*A duração e a frequência da prática de atividade física interferem no indicativo de sarcopenia em idosos?*

*¿La duración y la frecuencia de la actividad física interfieren con la indicación de sarcopenia en los ancianos?*

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**ABSTRACT** | Sarcopenia is a syndrome characterized by progressive loss of muscle mass and associated with adverse health outcomes in older adults. Physical activity has been pointed out as an important tool for its prevention. Therefore, this study investigated the relationship of sedentary lifestyle, duration and frequency of physical activity with the indicator of sarcopenia in older adults. Five hundred and fifty-one physically active older adults enrolled in senior fitness centers of Maringá (PR) participated in this cross-sectional study. The International Physical Activity Questionnaire (IPAQ) and the SARC-F were the instruments used. Data analysis was conducted using the Kolmogorov-Smirnov tests, Spearman correlation coefficient and the Structural Equation Analysis ( $p < 0.05$ ). Results showed that older adults participated in mild to moderate physical activities weekly, but not vigorous ones, besides exhibiting low sarcopenia indicators. Structural Equations analysis revealed that the variables of mild and moderate activity presented a significant ( $p < 0.05$ ) and negative correlations with the sarcopenia indicators score, however weak ( $\beta < 0.20$ ), explaining its 7% variability. It was concluded that the practice of mild and moderate physical activity affect sarcopenia indicators in older people.

**Keywords** | Aging; Motor Activity; Musculoskeletal System.

**RESUMO** | A sarcopenia é uma síndrome caracterizada pela perda progressiva de massa muscular e está associada a desfechos adversos na saúde de idosos. A atividade física tem sido apontada como uma importante ferramenta para a prevenção da sarcopenia. Diante disso, este estudo investigou a relação da duração e frequência da prática de atividade física com os indicativos de sarcopenia de idosos. Participaram deste estudo transversal 551 idosos praticantes de atividade física nas academias da terceira idade do município de Maringá (PR). Como instrumentos foram utilizados o *international physical activity questionnaire* (IPAQ) e o SARC-F. A análise dos dados foi conduzida por meio dos testes de Kolmogorov-Smirnov, correlação de Spearman e a análise de equações estruturais ( $p < 0,05$ ). Os resultados evidenciaram que os idosos deste estudo realizam atividades físicas leves ( $Md=3$ ) e moderadas ( $Md=2$ ) semanalmente, mas não praticam atividades vigorosas.

**Descritores** | Envelhecimento; Atividade Motora; Sistema Musculoesquelético.

**RESUMEN** | La sarcopenia es un síndrome caracterizada por la pérdida progresiva de masa muscular y que está asociada a resultados adversos en la salud de los ancianos. La actividad

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física ha sido señalada como una importante herramienta para la prevención de la sarcopenia. Por lo tanto, este estudio investigó la relación de la duración y frecuencia de la práctica de actividad física con los indicadores de sarcopenia de ancianos. En este estudio transversal participaron 551 ancianos practicantes de actividad física en las Academias de la tercera edad del municipio de Maringá (PR). Como instrumentos se utilizaron el International Physical Activity Questionnaire (IPAQ) y el SARC-F. El análisis de los datos fue conducido por medio de las pruebas de Kolmogorov-Smirnov, correlación de Spearman y el análisis de ecuaciones estructurales ( $p < 0,05$ ). Los resultados evidenciaron que los ancianos realizan

actividades físicas leves ( $Md=3$ ) y moderadas ( $Md=2$ ) semanalmente, pero no actividades vigorosas ( $Md=0$ ), además de bajo indicativo de sarcopenia ( $Md=1$ ). El análisis de ecuaciones estructurales reveló que las variables de actividad leves y moderadas presentaron una asociación significativa ( $p < 0,05$ ) y negativa con la puntuación del indicativo de sarcopenia, sin embargo débil ( $\beta < 0,20$ ), explicando el 7% de su variabilidad. Se concluyó que la práctica de actividades físicas leves y moderadas parece ser un factor interviniente en el indicativo de sarcopenia en ancianos.

**Palabras clave** | Envejecimiento; Actividad Motora; Sistema Musculo Esquelético.

## INTRODUCTION

Sarcopenia is a disease characterized by progressive loss of skeletal muscle strength and mass<sup>1-3</sup>. The definition of this concept is based on the consensus proposed by the European Working Group on Sarcopenia in Older People (EWGSOP), according to which the diagnosis of sarcopenia includes low muscle mass, low physical performance and low muscle strength<sup>1</sup>.

Sarcopenia is common in the gerontological context, mainly because the estimate is that older adults lose, on average, 1% to 2% of skeletal muscle mass and 1.5% to 5% of muscle strength per year<sup>4</sup>. The presence of sarcopenia in older people is associated with high risks of adverse health outcomes, such as decreased functional capacity, low quality of life, increased risk of falls, and morbimortality<sup>3</sup>.

In a systematic review conducted by the global reference group in the study of the disease, EWGSOP, the prevalence of sarcopenia ranged from 1% to 29% among community residents, from 14% to 33% for those institutionalized, and 10% among those in hospital care for acute diseases<sup>5</sup>. According to the same study, there is no consensus regarding the higher or lower prevalence of sarcopenia depending on sex<sup>5</sup>.

Considering the etiological factors of sarcopenia, a recent systematic review and meta-analysis reaffirmed that regular physical activity may influence the improvement of variables involved in its diagnosis – i.e. physical strength, muscle volume and physical fitness – and that sedentary lifestyle, in turn, could anticipate sarcopenia<sup>2</sup>. However, studies on how physical activity and sedentary lifestyle<sup>6</sup> act on function, mass and

muscle strength of older adults with sarcopenia are still scarce; besides, the proposed exercise protocols are heterogeneous regarding type of exercise, intensity, and duration<sup>2</sup>.

Therefore, this study aimed to investigate the relationship of sedentary lifestyle, duration and frequency of physical activity with sarcopenia indicators in older adults of Maringá (PR).

## METHODOLOGY

### Participants

The sample, chosen intentionally and by convenience (non-probabilistic), was composed of 551 older adults (60 years or older), of both sexes, who practiced physical activity in senior fitness centers (SFC) in the municipality of Maringá. Older adults with possible cognitive deficits, assessed using the mini mental state examination (MMSE), which consists of questions grouped into seven categories (time orientation, spatial orientation, three word registration, attention and calculation, three word recall, language, and visual-constructive ability<sup>7</sup>), were excluded. The minimum score used for exclusion by the MMSE were 17 points for illiterates; 22 for older adults with schooling 1 to 4 years; 24 for those with 5 to 8 years; and 26 for those with 9 years or more. The scores correspond to the average obtained for each educational level, minus one standard deviation. Older adults below the minimum score for their educational level were excluded<sup>8</sup>.

Older adults with hearing impairment that could prevent the conduction of the study, self-reported or

perceived by the researchers, were also excluded. Those with gait accessories, hip, knee or ankle prosthesis, and/or had undergone major surgeries were also excluded.

## Instruments

A questionnaire with questions related to sex, age, ethnicity, monthly income based on the 2017 national minimum wage (R\$937.00), retirement, and schooling was used for characterizing the sample.

The International Physical Activity Questionnaire (IPAQ) short version was used to evaluate type, frequency and duration of the physical activity at leisure time, such as displacement from one place to another, household chores, and occupational activities<sup>9</sup>.

The SARC-F<sup>10,11</sup> was used to assess the sarcopenia indicators. The tool includes five components: strength (whether the individual was able to lift 2.5kg), ambulation (whether the individual was able to walk through a room or the hospital room), rise from a chair, climb stairs (whether the individual could climb a 10-flight stair) and falls (whether the individual had falls in the past year). The scores range from 0 to 2 points, being 0 = no difficulty, 1 = some difficulty and 2 = a lot of difficulty or unable to do it. The interpretation for the last component is 0 = no falls in the past year, 1 = 1-3 falls in the past year and 2 = 4 or more falls in the past year. Scores of 4 or more points in the total sum of the five components were considered an indicator of sarcopenia.

## Procedures

This is an analytical, observational and cross-sectional study.

First, a map showing the SFCs of the city was acquired with the Health Department. These SFCs were divided into regions (north, south, east and west) and then three centers were drawn per region, totaling 12 SFCs evaluated.

The researchers talked to the older adults at different times, before or after the physical activity in the SFC. Those who agreed to participate in the study signed the informed consent form. Data was collected via interview as to avoid reading mistakes by the older adults. Each interview lasted on average 15 minutes per subject.

## Data analysis

Preliminary data analysis was performed using the Kolmogorov-Smirnov normality test. As non-normal data was found, descriptive statistics were presented by the median (Md) and interquartile range (Q1-Q3). Spearman's correlation coefficient was used to verify the relationship between the variables. The significance adopted was  $p < 0.05$ .

To verify the magnitude of the relationships between sedentary lifestyle and physical activity practice in the sarcopenia indicators, path analysis models were conducted through the analysis of structural equations with the variables showing significant correlation ( $p < 0.05$ ). The existence of outliers was evaluated using Mahalanobis ( $MD^2$ ), and the univariate normality of the variables was evaluated using the asymmetry coefficients ( $ISkI < 3$ ) and uni and multivariate kurtosis ( $IKuI < 10$ ). Since the data showed atypical distribution, the Bollen-Stine bootstrap technique was used to correct the value of the coefficients estimated by the maximum likelihood method<sup>12</sup>, implemented in the software AMOS, version 22.0. To check whether the sample fits the analysis proposed, we applied the bootstrapping technique<sup>13</sup>. No  $MD^2$  values indicating the existence of outliers were observed, nor strong enough correlations between the variables indicating multicollinearity (variance inflation factors  $< 5$ ). Based on Kline's recommendations<sup>14</sup>, the interpretation of the regression coefficients was little effect on coefficients  $< 0.20$ , moderate effect on coefficients up to 0.49, and strong effect on coefficients  $> 0.50$  ( $p < 0.05$ ).

## RESULTS

Of the 551 older adults, a prevalence of females (62.6%), aged 60 to 69 years (55%), white (62.1%), with a partner (59%), whose monthly income ranged from one to two MW (55.5%), were retired (70.9%) and did not complete elementary education (42.5%) was observed.

Table 1 shows the descriptive values of the study variables. The older adults showed a Md of 30 minutes of walking per day (when this activity was practiced) and no frequency of vigorous activities. They had low indicators of sarcopenia, and a Md of 1 point in the SARC-F.

Table 1. Descriptive analysis of the variables physical activity practice and indicator of sarcopenia in older adults – Maringá, PR, Brazil, 2018

Variables	Md (Q1-Q3)
Physical activity practice	
Days of mild activity (walking)	3 (3-5)
Walking minutes per day	30 (30-60)
Walking minutes per week	125 (80-225)
Days of moderate activity	2 (0-3)
Minutes of moderate activity per day	30 (0-60)
Minutes of moderate activity per week	60 (0-150)
Days of vigorous activity	0 (0-1)
Minutes of vigorous activity per day	0 (0-30)
Minutes of vigorous activity per week	0 (0-60)
Indicators of sarcopenia	1 (0-2)

Md: median; Q1-Q3: interquartile range.

Table 2 shows the values of the correlations between the variables. The following significant correlations ( $p < 0.05$ ) were observed for sarcopenia with the practice of physical activity: days of mild activity ( $r = -0.21$ ), minutes of walking per day ( $r = -0.15$ ) and per week ( $r = -0.23$ ), minutes of moderate activity per day ( $r = -0.16$ ) and per week ( $r = -0.11$ ), days of vigorous activity ( $r = -0.10$ ), and minutes of vigorous activity per day ( $r = -0.10$ ) and per week ( $r = -0.11$ ).

Table 2. Correlation matrix between the practice of physical activity and score of indicators of sarcopenia – Maringá, PR, Brazil, 2018

Physical activity practice	Indicators of sarcopenia
Days of mild activity (walking)	-0.21*
Walking minutes per day	-0.15*
Walking minutes per week	-0.23*
Days of moderate activity	-0.04
Minutes of moderate activity per day	-0.16*
Minutes of moderate activity per week	-0.11*
Days of vigorous activity	-0.10*
Minutes of vigorous activity per day	-0.10*
Minutes of vigorous activity per week	-0.11*

\*Significant correlation:  $p < 0.05$ .

To verify the magnitude of the associations between the variables duration and frequency of physical activity and the sarcopenia indicators in older adults, path analysis models were conducted through the analysis of structural equations among the variables showing significant correlation ( $p < 0.05$ ). Path analysis model 1 (Figure 1) showed that the variables duration and frequency of physical activity explained the 6% variability of the sarcopenia score in older adults. However, only the trajectories of the variables walking days per week, walking minutes per week and minutes of moderate activity per day and per week showed a significant association ( $p < 0.05$ ) with sarcopenia. Thus, the other variables were excluded, and the model was tested again.

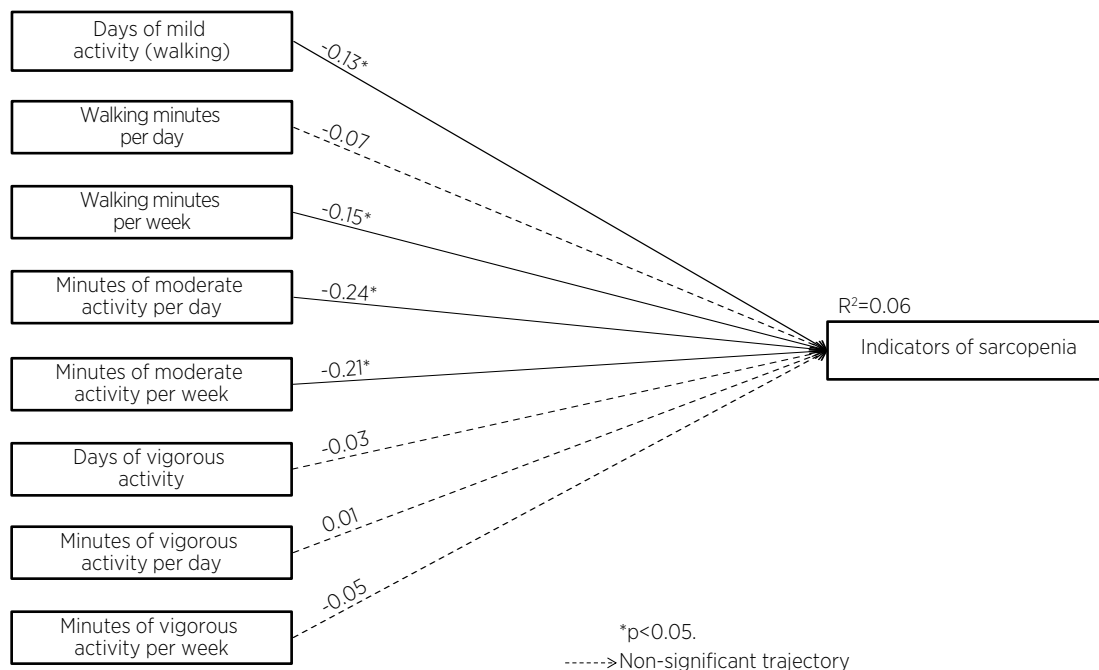


Figure 1. Path analysis model 1 of the relationships between physical activity practice and indicators of sarcopenia in the older adults – Maringá, PR, Brazil, 2018

\*Significant correlation:  $p < 0.05$ ; R: coefficient of determination.

Model 2 (M2) showed that the variables mild and moderate activities showed a significant association ( $p < 0.05$ ) and a negative correlation with the indicator of sarcopenia score, explaining its 7% variability (Figure 2). Specifically, the variable “minutes of moderate activities” showed moderate association ( $\beta = -0.22$ ) with the sarcopenia

indicator score, while “walking days per week” ( $\beta = -0.14$ ), “walking minutes per week” ( $\beta = -0.12$ ), and “minutes of moderate activity per week” ( $\beta = -0.15$ ) showed a weak association. These results seem to indicate that the more the older adults practice mild and moderate physical activities, the less the tendency of showing indicators of sarcopenia.

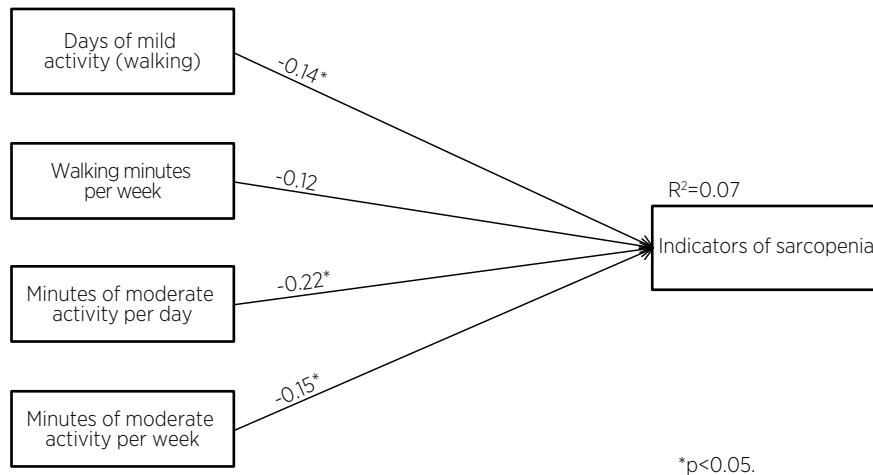


Figure 2. Path analysis model 2 of the relationships between physical activity practice and indicators of sarcopenia in older adults - Maringá, PR, Brazil, 2018

\*Significant correlation:  $p < 0.05$ ; R: coefficient of determination.

## DISCUSSION

The main results of this study show that the more older adults practice mild (walking) and moderate-intensity physical activities, the lower the tendency of showing indicators of sarcopenia. Mainly, daily and weekly moderate activities seem to interfere with the indicators of sarcopenia in older adults. The older adults in this study practiced physical activity in general, and not systematic physical exercise.

Although older adults tend to practice lower intensity activities (walking and gardening)<sup>15</sup>, when we considered intensity, we observed that moderate activities are the most noticeable and concur with the National Center for Health Statistics<sup>16</sup>. On the other hand, high-intensity/vigorous activities showed the lowest scores. However, Osuka et al.<sup>17</sup> observed stronger effects of high-intensity training on outcomes related to cardiovascular, physiological, and motivational functions compared with moderate-intensity training.

According to Raso, Greve, and Polito<sup>18</sup>, the results of the studies indicate that when older adults are subjected to adequate intensities, they respond with improvements comparable or better than those observed in young adults. Cruz-Jentoft et al.<sup>19</sup>, in their turn, analyzed the effect of training on muscle mass in older adults of both sexes.

The results show that older adults enrolled in a training program have better results when compared with those who practice low-intensity exercise (domestic activities). Danni et al.<sup>20</sup> observed the effect of training for treating sarcopenia in older adults in their review; the authors conclude that the most appropriate training model are high-intensity strength exercises (60%-95% of a maximum repetition - 1RMM), from two to three times a week. Although, in a recent systematic review, Vlietstra, Hendrickx, and Waters<sup>2</sup> state that the 12-week protocol used in most of the studies assessed was not enough for a significant improvement. These improvements are only possible when observed after 24 weeks of intervention.

The older adults in the present study were evaluated regarding the diagnosis of sarcopenia using SARC-F and, according to the score obtained, they adults showed a Md of 1 point, that is, a score that indicates its absence. This prevalence differs from data obtained by EWGSOP, in which the collective prevalence of sarcopenia in older adults was 15.4%, being 16.1% among women and 14.4% among men.

According to another systematic review<sup>21</sup>, sarcopenia is quite prevalent in this population, especially among women. The authors of this review found, in a study conducted in the USA with 4,504 individuals aged 60 years or more, that the total prevalence of sarcopenia was 7% among

men and 10% among women; in the United Kingdom, in a study conducted with 1,787 individuals of the same age group, the prevalence of sarcopenia was 4.6% among men and 7.9% among women, corresponding to the model proposed by EWGSOP; in turn, in a study conducted in Japan with 1,882 older adults aged between 65 and 89 years, the prevalence of sarcopenia was 21.8% among men and 22.1% among women.

Légrand et al.<sup>22</sup> estimated the prevalence of sarcopenia, according to the minimum score set by EWGSOP, in 567 older adults aged 80 years or older, and 12.5% of them had a positive diagnosis. These studies suggest that sarcopenia is present in this population and that its prevalence may increase with age. The older adults in this study<sup>21</sup> were aged 60 to 69 years (55%), with monthly income ranging from one to two MW (55.5%), were retired (70.9%), and did not complete elementary school (42.5%). Although low income represents a factor that can predispose to sarcopenia<sup>1</sup>, the age group of 60-69 years can contribute to understand the non-diagnosis of the disease.

The results of this study show that the subjects had a Md of 30 minutes of walking per day (when this activity was practiced), no frequency of vigorous activities and, even so, had a low indicator of sarcopenia, in which the Md in SARC-F was 1 point. According to the literature, the recommendation of physical exercises to prevent future sarcopenia encompasses mainly resistance exercises; therefore, the walking activity is not enough to justify the Md of 1 point in the SARC-F. Also, not all subjects in this study walk regularly. These data reminds us the etiology of sarcopenia, which does not depend solely on the absence of physical exercises, but also on genetic, endocrine, physiological, nutritional, and environmental factors<sup>2,5,23</sup>, which this study did not address.

The path analysis model revealed that the trajectories of the variables days of mild activity (walking) per week, minutes of walking per week and minutes of moderate activity per day and per week showed a significant association ( $p < 0.05$ ) with the absence of indicator of sarcopenia. According to Woo<sup>23</sup>, resistance training is the basis for increasing muscle mass and improving physical performance. According to the guidelines of the American College of Sports Medicine, resistance training two to three times a week is recommended for gaining strength and hypertrophy<sup>24</sup>. In a recent literature review conducted by Rego et al.<sup>25</sup> to establish the most recent evidences on the benefits of resistance exercise related to sarcopenia in older adults, the researchers showed that the benefits

of regular physical activity is not limited to sarcopenia, improving other syndromes associated with aging, such as osteoporosis and arthrosis. The authors also show that, regardless of the age at which the practice of physical activity begins, its long-term benefits are valid<sup>25</sup>.

As limitations of this study, the following elements can be evidenced: the study did not divide the score obtained in the SARC-F between men and women and did not evaluate in which sex the practice of physical activity predominated; the cross-sectional design of this study prevents from inferring causality (cause/effect); the evaluation of physical activity was carried out through self-reporting. Thus, further studies are suggested to monitor the older adults practice of physical activity and its impact on the indicators of sarcopenia, as well as studies using other forms of evaluation of physical activity, such as accelerometer and pedometer.

## CONCLUSION

Although EWGSOP reports a significant prevalence of indicators and diagnosis of sarcopenia in older adults worldwide<sup>1</sup>, the data of this study show a low prevalence of indicative of this disease among the sample studied. It was concluded that the practice of mild and moderate physical activities seems to be an intervener factor in the indicator of sarcopenia in older adults. From a practical viewpoint, guidance is needed for the practice of activities such as walking, jogging, and resistance exercises, which can be important tools to avoid loss of mass and muscle strength during the aging process. Thus, practicing regular physical activity is essential so that this population can preserve their independence in the performance of daily life activities and quality of life.

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