Mechanography performance tests and their association with sarcopenia, falls and impairment in the activities of daily living – a pilot cross-sectional study in 293 older adults

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Abstract

Objectives: Muscle mass and muscle power considerably decline with aging. The aim of the present study was to determine the association between muscular function using mechanography and sarcopenia, falls and impairment in the activities of daily living (ADL) in a sample of 293 community-dwelling women and men aged 60-85 years in Berlin, Germany. Methods: Muscle function was determined by muscle power per body mass in vertical countermovement jumps (2LJPrel) and the chair rising test (CRTPrel) on a force plate. Sarcopenia status was assessed by estimating appendicular muscle mass with dual-X-ray absorptiometry. Self-reported ADL impairment and falls in the last 12 months were determined. Results: ADL impairment was significantly correlated with all performance tests but not with muscle mass. The 2LJPrel (OR 0.88, 95%-CI 0.79-0.98), the Esslinger Fitness Index (EFI) (OR 0.97, 95%-CI 0.94-1.00) and the maximal velocity of the CRT (OR 0.70, 95%-CI 0.53-0.93) remained significant correlates for sarcopenia independent of age in men but not in women. The EFI could differentiate female individuals who had past fall events (OR 0.96, 95%-CI 0.93-0.98). Conclusion: The results of the present study highlight the importance of assessing muscle power in older individuals as a relevant correlate for functional decline.

Keywords: Falls, Sarcopenia, Muscle Power, Mechanography, Aged

Introduction

One of the serious consequences of aging is the gradual loss of muscle function, a phenomenon called sarcopenia. While this term was originally used solely to describe the age-associated decrease in muscle mass, it has been suggested that age-related muscle weakness should also be included in the definition. Indeed, both have been strongly linked to physical impairment and disability among the elderly. Muscle force and muscle power also decrease with advancing age, particularly in the lower body, and to a greater degree than muscle mass. Skeletal muscle power declines earlier than muscle force with advancing age and current evidence suggests that it is more strongly related to functional status than isometric muscle force or knee extensor torque. A review of muscle parameters and their relation to mobility in older individuals highlights the role of muscle power, as it explains more variance in mobility than muscle force or torque. The decrease of muscle power with aging has been linked to a decrease in the number and size of type II muscle fibres, an increase in muscle fat infiltration, changes in muscle architecture and neuromuscular activation, as well as alteration in hormonal status, protein synthesis and inflammatory mediators.

Age-associated falls frequently occur during circumstances with increased environmental demands, when older people are unable to manage these conditions. A decreased capacity for high-velocity movements - especially in the legs - has been linked to delayed responses in maintaining postural stability and thus with age-associated fall risk in older adults.

The muscle power required for a single-joint movement does
not accurately reflect the necessary muscle power for coordinated multiple-joint movements in daily life activities. In the present study, mechanography was used to assess leg extensor power. The system measures the time course of ground reaction forces, the velocity of the vertical movements of the centre of gravity and derives power as the product of force and velocity.

With this mechanical approach, the assessment of muscle function and the integration with the neural coordination of the muscle contraction in complex physiological movements such as jumping or sit-to-stand against gravity is possible, which has been shown as a robust indicator of muscle function that is relevant for daily life.

Sarcopenia

The purpose of this population-based, cross-sectional study in older men and women living in Berlin, Germany, was to test the hypothesis that in older adults muscle power output derived by mechanography performance tests is significantly associated with sarcopenia, self-reported falls and impairment in the activities of daily living (ADL) independent of sex and age in a quick and precise way.

Materials and methods

Study sample

For this population-based cross-sectional study, subjects were recruited from a random sample of all districts in Berlin, Germany, provided by the resident registration office. The sample size was calculated to be 30 subjects in each five-year band between 60 and 85 years, stratified for sex. The entry criteria for the study excluded those with: i) invalid estimates of body composition due to the presence of metal implants or artificial prostheses, edema or medications affecting water-mineral homeostasis; ii) the inability to walk without an walking aid; iii) no allowance for X-ray exposure; or iv) the inability to understand the nature of the study and follow the instructions.

The present study was approved by the local ethics committee (EA4/095/05), as well as the German Radiation Protection Ordinance (Z5-22462/2-2005-063). Written informed consent was obtained from all participants before they were included in the study.

Measurements dependent variable

Anthropometry

Body weight was determined to the nearest 0.1 kg and stature was assessed to the nearest 0.1 cm using a digital weight scale and stadiometer (Seca 764). Body mass index (BMI) was calculated as weight (kg) divided by height (m²).

Sarcopenia

DXA (Lunar Prodigy Advance, GE Medical Systems, Wisconsin, USA; EnCore Software v9.3) total body scans were performed according to the standard GE LUNAR operator manual by the same operator. Appendicular skeletal muscle mass (ASM), described as the sum of arms and legs lean mass (kg)², was adjusted to the stature index (ASM/h²). Sarcopenia employing ASM/h² was defined using the cut-off values of the Rosetta Study, which are based upon two standard deviations below the mean of young adults (men: ASM/h²<7.26 kg/m², women: ASM/h²<5.5 kg/m²).

Falls

Fall history was taken retrospectively for the last 12 months. According to the recommendations of the PROFANE group, a fall was defined as “an unexpected event in which the participants come to rest on the ground, floor, or lower level”.

Syncopal falls and “high-trauma falls” (e.g. due to an external force like a car accident) were excluded from the analysis. For analysis, subjects were categorized into “no fall” versus “one or more falls” within the last 12 months.

Activities of daily living

Activities of daily living (ADL) were assessed using the sub-scale of the questionnaire used in the European Vertebral Fracture Study, where subjects are asked if they are able to perform twelve functional tasks related to dressing, washing, rising from bed, mobility, sitting on a chair for one hour, standing in line for 30 minutes, reaching an object, picking something from a floor or lifting and carrying a heavy object. A maximum sum score of 24 points was derived, where zero is equivalent to no impairment and 24 to severe impairment in the ADL.

Assessment of neuromuscular performance

To assess muscle function of the lower extremity, the Leonardo Mechanograph® Ground Reaction Force Plate (Novotec Medical, Pforzheim, Germany) with software package 4.2 was used. Three two-leg jumps (2LJ) were performed as a vertical countermovement jump with a break of one minute between each jump. Subjects were asked to jump as high as possible, whereby the jump achieving the greatest power per body mass of the valid tests was used for this study analysis. Variables of interest included the maximal total relative power per body weight during lift off (2LJP_rel), maximal jump height (2LJh), maximal velocity (2LJv) and the Esslinger Fitness Index (EFI). The EFI describes the maximal 2LJP per body mass normalized to age and gender, expressed as the percentage of the mean value of the sex matched age group. The chair-rise test (CRT) was performed on a bench of 45 cm height, anchored onto the force plate. The time was measured to stand up to full extend and sit down five times at maximum speed without break and without using the arms. For analysis, the maximal total relative power per body weight during the rise phases of five chair stands (CRTP_rel) and the maximal velocity (CRTv) were used. Sufficient reproducibility and reliability for both tests have been documented in healthy young adults as well as physically competent older subjects.

Statistical analysis

Descriptive statistics for anthropometric data, ADL, muscle mass and muscle function are reported as means ± standard deviation for quantitative variables and as percentages in cat-
egorical variables. Differences between subjects with and without sarcopenia and falls were examined in quantitative variables using a Student T-Test or Wilcoxon Test for independent samples based upon data distribution and with exact Fisher Test for categorical variables. The correlation between ADL score and muscle parameters was determined by calculating the Spearman correlation coefficient with and without adjustment for age. Correlates for sarcopenia and falls are presented in odds ratios with 95% confidence intervals using logistic regression analysis. Odds ratios were determined before and after adjusting for age. A p-value of p<0.05 was considered as the significance level. The statistical calculations were performed using the Statistical Analysis System SAS version 9.3 (SAS Institute Inc., Cary, North Carolina, USA).

Table a. Characteristics of participants by sarcopenia status.

|                     | Females n=142 | Males n=146 |
|---------------------|---------------|-------------|
|                     | normal n=130  | sarcopenia n=12 | p-value | normal n=124  | sarcopenia n=22 | p-value |
| Age (yrs)           | 71.4 (±7.2)   | 70.3 (±8.6)   | 0.60     | 71.6 (±7.4)   | 76.9 (±6.5)   | 0.003   |
| Height (cm)         | 160.4 (±6.1)  | 163.7 (±5.7)  | 0.07     | 172.6 (±6.4)  | 171.1 (±6.0)  | 0.3     |
| Weight (kg)         | 68.0 (±9.4)   | 58.9 (±5.7)   | **0.001** | 84.0 (±11.7)  | 71.5 (±11.9)  | <0.0001 |
| BMI (kg/m²)         | 26.5 (±3.4)   | 22.0 (±2.3)   | **<0.0001** | 28.2 (±3.3)   | 24.4 (±4.0)   | <0.0001 |
| ADL score (0-24)    | 4.7 (±4.2)    | 4.3 (±3.2)    | 0.90     | 2.8 (±3.6)    | 4.5 (±4.5)    | 0.06    |
| >=1 fall (n,%)      | 27 (20.8)     | 12 (9.7)      | 1.00     | 31.4 (±6.7)   | 25.6 (±5.6)   | 0.0003  |
| 2LJP rel (W/kg)     | 25.1 (±5.4)   | 23.1 (±4.6)   | 0.25     | 93.0 (±15.3)  | 84.7 (±20.1)  | 0.03    |
| EFI (%)             | 97.8 (±17.5)  | 88.3 (±14.0)  | 0.09     | 1.9 (±0.3)    | 84.7 (±20.1)  | 0.0009  |
| 2LJ₁ (m/s)          | 1.6 (±0.3)    | 1.5 (±0.2)    | 0.50     | 0.3 (±0.1)    | 0.2 (±0.1)    | 0.002   |
| 2LJ₂ (m)            | 0.2 (±0.1)    | 0.2 (±0.0)    | 0.50     | 11.1 (±2.4)   | 9.5 (±2.5)    | 0.01    |
| Sarcopenia (n,%)    | 10 (8.9)      | 2 (6.9)       | 1.00     | 19 (14.5)     | 3 (20.0)      | 0.70    |
| 2LJP rel (W/kg)     | 9.8 (±2.1)    | 9.7 (±1.2)    | 0.30     | 8.9 (±2.1)    | 9.7 (±1.2)    | 0.0004  |
| CRT₂ (m/s)          | 0.9 (±0.2)    | 0.9 (±0.1)    | 0.60     | 1.1 (±0.2)    | 0.9 (±0.2)    | 0.45    |

Table b. Characteristics of participants by fall status.

|                     | Females n=146 | Males n=147 |
|---------------------|---------------|-------------|
|                     | no fall n=115 | >=1 fall n=31 | p-value | no fall n=131 | fall n=16 | p-value |
| Age (yrs)           | 70.7 (±7.2)   | 73.6 (±7.4)   | 0.10     | 72.1 (±7.4)   | 75.3 (±7.8)   | 0.07    |
| Height (cm)         | 160.5 (±6.3)  | 160.9 (±5.2)  | 0.77     | 172.4 (±6.4)  | 172.3 (±6.4)  | 0.85    |
| Weight (kg)         | 66.8 (±9.4)   | 70.8 (±11.3)  | **0.05** | 82.8 (±12.5)  | 78.9 (±15.0)  | 0.25    |
| BMI (kg/m²)         | 25.9 (±3.5)   | 27.4 (±4.4)   | 0.06     | 27.8 (±3.7)   | 26.4 (±3.9)   | 0.16    |
| ADL score (0-24)    | 4.5 (±4.1)    | 5.5 (±4.1)    | 0.36     | 3.0 (±3.7)    | 3.6 (±4.4)    | 0.47    |
| ASM/h² (kg/m²)      | 6.4 (±0.7)    | 6.4 (±0.7)    | 0.66     | 8.1 (±0.9)    | 7.9 (±0.8)    | 0.23    |
| Sarcopenia (n,%)    | 10 (8.9)      | 2 (6.9)       | 1.00     | 19 (14.5)     | 3 (20.0)      | 0.70    |
| 2LJPrel (W/kg)      | 25.7 (±5.1)   | 22.6 (±7.1)   | **0.03** | 30.5 (±6.9)   | 29.9 (±6.7)   | 0.75    |
| EFI (%)             | 99.2 (±16.5)  | 87.5 (±18.1)  | **0.001** | 91.1 (±16.4)  | 95.1 (±16.4)  | 0.37    |
| 2LJ₁ (m/s)          | 1.6 (±0.2)    | 1.5 (±0.4)    | **0.03** | 1.9 (±0.3)    | 1.9 (±0.3)    | 0.63    |
| 2LJ₂ (m)            | 0.2 (±0.1)    | 0.2 (±0.1)    | 0.10     | 0.3 (±0.1)    | 0.3 (±0.1)    | 0.41    |
| CRT₅rel (W/kg)      | 9.2 (±1.9)    | 8.2 (±2.6)    | 0.07     | 10.8 (±2.5)   | 11.1 (±2.6)   | 0.69    |
| CRT₅ (m/s)          | 0.9 (±0.2)    | 0.8 (±0.2)    | 0.08     | 1.1 (±0.2)    | 1.1 (±0.2)    | 0.45    |

All continuous variables are presented as mean±SD, categorical variables as number and percentage.
ADL= activities of daily living, ASM= appendicular skeletal lean mass arms and legs (kg).
Sarcopenia: females ASM/h²≤5.5, males ASM/h²≤7.26;
2LJPrel= maximum two leg jump power per kg body mass; EFI=Esslinger Fitness Index.
2LJ₁=maximum two leg jump velocity; 2LJ₂=maximum two leg jump height.
CRT₅rel= maximum chair rise test power per kg body mass; CRT₅=maximum chair rise test velocity.
Results

146 women and 147 men between 60-85 years participated in the study. Based upon the sarcopenia definition by Baumgartner et al. 3, 11.8% of the participants were classified as sarcopenic. Men were affected almost twice as much as women (15.1% versus 8.5%) (Table 1a). In both sexes, subjects with sarcopenia presented with significantly lower body mass and BMI than participants without sarcopenia (Table 1a). Only in men were sarcopenic subjects significantly older and presented with significant lower values in all neuromuscular performance tests than normal subjects (Table 1a). No differences in retrospective falls were observed between sarcopenic and non-sarcopenic subjects (Table 1a). 16% of the participants had experienced one or more falls in the last 12 months. Self-reported falls occurred twice as often in women compared to men (21.2% versus 11%) (Table 1b). In both sexes, subjects with sarcopenia presented with significantly lower body mass and BMI than participants without sarcopenia (Table 1a). Only in men were sarcopenic subjects significantly older and presented with significant lower values in all neuromuscular performance tests than normal subjects (Table 1a). No differences in retrospective falls were observed between sarcopenic and non-sarcopenic subjects (Table 1a). 16% of the participants had experienced one or more falls in the last 12 months. Self-reported falls occurred twice as often in women compared to men (21.2% versus 11%) (Table 1b). In bivariate analysis, fallers presented with significant lower values in the 2LJP rel (p=0.03), EFI (p=0.001) and 2LJ v (p=0.03) in women, but not in men (Table 1b). No difference in muscle mass was observed between fallers and non-fallers (Table 1b).

A negative correlation between ADL score and muscle parameters were found for all muscle performance tests but not for muscle mass (Table 2). The correlation was stronger in men than in women and became weaker after adjustment for age. In men the partial correlation was strongest for CRT v (r=0.434, p=0.0001) and in women for the EFI (r=0.266, p=0.002).

After logistic regression analysis, the 2LJP rel (OR 0.88, 95%-CI 0.79-0.98), the EFI (OR 0.97, 95%-CI 0.94-1.00) and the CRT v (OR 0.70, 95%-CI 0.53-0.93) remained significant correlates for sarcopenia independent from age in men, but not in women (Table 3a). Although the crude ORs of 2LJ h, 2LJ v and CRTP rel were significantly associated with sarcopenia status in men, the observed association diminished after adjustment for age. In females, all mechanography performance tests were associated with falls in the last 12 months in the unadjusted model (Table 3b). After adjustment for age, only the EFI remained a significant correlate for falls in women (OR 0.96, 95%-CI 0.93-0.98) (Table 3b). No association between falls and muscle mass was observed.

No adverse events were observed in the neuromuscular tests on the Leonardo platform.

Discussion

In the present study, we examined neuromuscular performance applying mechanography and their association with sarcopenia, fall status and ADL impairment in 293 older adults. Through bivariate analysis, we found significant differences in jumping and chair rising power between sarcopenic and non-sarcopenic subjects (Table 1a). 16% of the participants had experienced one or more falls in the last 12 months. Self-reported falls occurred twice as often in women compared to men (21.2% versus 11%) (Table 1b). In bivariate analysis, fallers presented with significant lower values in the 2LJP rel (p=0.03), EFI (p=0.001) and 2LJ v (p=0.03) in women, but not in men (Table 1b). No difference in muscle mass was observed between fallers and non-fallers (Table 1b).

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No adverse events were observed in the neuromuscular tests on the Leonardo platform.
ASM/height\(^2\) in contrast to 8.5% in women, whereas Singh et al. report sarcopenia in 15% males and 24% females, applying the same operational definition for sarcopenia. The prevalence of sarcopenia based upon the ASM/height\(^2\) definition in our female study population is less than in the large American epidemiological studies, although it is comparable to other European populations. Muscle function and muscle size considerably decrease with age. While the prevalence of sarcopenia increases with aging, the decline of muscle power adjusted for body mass in the 2LJ test and CRT from the third to the ninth decade varied between 40-50% in both sexes. Hence, the analysis of the neuromuscular performance tests should be age-adjusted. For men, our results showed a significant association of the performance tests with sarcopenia status in bivariate analysis. After controlling for potential confounders, the 2LJP\(_{rel}\), the EFI and chair rise velocity remained strongly associated with sarcopenia.

Consistent with previous research, in our investigation females were more affected by age-associated falls in the last 12 months compared to males. However, self-reported falls only occurred in 16% of our study population, which is less than the commonly reported 25-30% in subjects 60 years and older. Through bivariate analysis, we could show that muscle power performance tests were significantly associated with falls in women. Further multiple logistic regression analysis results indicated that only the EFI could differentiate female individuals who had past fall events. Similar to our results, Cheng et al. displayed an inverse association of maximum power normalized for body mass during sit-to-stand movement with previous falls using force plate technology (OR 0.5, 95% CI 0.4-0.8), indicating that the larger the muscle power, the lower the possibility of previous falling events. However, the effects of age and sex were not included in the analysis, which means that confounding might have biased the results.

### Table 3a. Association between sarcopenia and mechanography performance tests.

|                      | Females Model 1 | Females Model 2 | Males Model 1 | Males Model 2 |
|----------------------|-----------------|----------------|--------------|--------------|
|                      | OR (95%-CI)      | OR (95%-CI)    | OR (95%-CI)  | OR (95%-CI)  |
| 2LJP\(_{rel}\) (W/kg)| 0.93 (0.83-1.05)| 0.87 (0.74-1.01)| 0.86 (0.78-0.94)***| 0.88 (0.79-0.98)*|
| EFI (%)              | na              | 0.97 (0.93-1.00)| 0.97 (0.94-1.00)***| 0.97 (0.94-1.00)***|
| 2LJ\(_v\) (m/s) (unit 0.1)| 0.92 (0.72-1.16)| 0.80 (0.59-1.10)| 0.76 (0.64-0.90)**| 0.82 (0.66-1.01)|
| 2LJ\(_h\) (m) (unit 0.1)| 0.65 (0.21-2.10)| 0.3% (0.08-1.54)| 0.35 (0.17-0.71)**| 0.49 (0.20-1.20)|
| CRT\(_rel\) (W/kg)| 1.24 (0.88-1.75)| 1.24 (0.82-1.87)| 0.77 (0.62-0.95)*| 0.86 (0.68-1.08)|
| CRT\(_v\) (m/s) (unit 0.1)| 1.10 (0.76-1.56)| 1.02 (0.67-1.57)| 0.65 (0.50-0.84)**| 0.70 (0.53-0.93)**|

The risk was modeled for one or more falls versus no falls in the last 12 months.

*p<0.05, **p<0.01, ***p<0.001;

Model 1: crude; Model 2: adjusted for age;

✝ No sarcopenia was set as the reference.

# The EFI is already adjusted for age.

For abbreviations see Table 1.

### Table 3b. Association between falls and low muscle mass and mechanography performance tests respectively.

|                      | Females Model 1 | Females Model 2 | Males Model 1 | Males Model 2 |
|----------------------|-----------------|----------------|--------------|--------------|
|                      | OR (95%-CI)      | OR (95%-CI)    | OR (95%-CI)  | OR (95%-CI)  |
| ASM/h\(^2\) (kg/m\(^2\))| 0.95 (0.52-1.75)| 1.00 (0.54-1.85)| 0.71 (0.38-1.34)| 0.82 (0.42-1.60)|
| Sarcopenia\(^†\) | 0.76 (0.16-3.69)| 0.79 (0.16-3.87)| 1.47 (0.38-5.72)| 1.14 (0.28-4.65)|
| 2LJP\(_{rel}\) (W/kg)| 0.90 (0.83-0.97)**| 0.91 (0.83-1.01)| 0.99 (0.91-1.07)| 1.05 (0.95-1.16)|
| EFI (%)              | na              | 0.96 (0.93-0.98)**| 1.01 (0.98-1.05)|
| 2LJ\(_v\) (m/s) (unit 0.1)| 0.79 (0.67-0.94)**| 0.81 (0.66-1.00)| 0.96 (0.81-1.14)| 1.10 (0.87-1.39)|
| 2LJ\(_h\) (m) (unit 0.1)| 0.42 (0.19-0.93)*| 0.56 (0.22-1.44)| 0.75 (0.37-1.50)| 1.21 (0.46-3.18)|
| CRT\(_rel\) (W/kg)| 0.78 (0.64-0.96)*| 0.81 (0.63-1.04)| 1.05 (0.84-1.30)| 1.17 (0.91-1.50)|
| CRT\(_v\) (m/s) (unit 0.1)| 0.77 (0.61-0.98)*| 0.81 (0.61-1.08)| 1.11 (0.86-1.43)| 1.26 (0.94-1.70)|

The risk was modeled for having sarcopenia versus no sarcopenia.

*p<0.05, **p<0.01, ***p<0.001;

Model 1: crude; Model 2: adjusted for age;

✝ No sarcopenia was set as the reference.

# The EFI is already adjusted for age.

For abbreviations see Table 1.
with our findings, previous articles applying other measurement techniques to estimate muscle power output have described the relationship between muscle power and prospective falls using a portable force transducer or a leg extensor power rig, suggesting that low muscle power output of the lower legs could be a relevant predictor of fall risk among the elderly.

Former studies have demonstrated that there is no clear linearity between muscle function and muscle mass and that the age-associated decline in muscle function is much stronger related to adverse health outcomes than loss of muscle mass. In line with those findings our results illustrate that ASM/h² was neither associated with self-reported falls nor impairment in the activities of daily living indicating that muscle power output might be more relevant for functional ability in older adults than muscle mass alone. Because of this disassociation, other authors argue that the loss of muscle function should be discussed separately from the loss of muscle mass and the term “dynapenia” has been coined to define the loss of muscle force and torque associated with aging. Others have suggested that lean mass measures may become relevant only after subjects are already affected by physical impairments because the amount of lean mass reflects not only the level of physical impairment but also the overall health status. Hence, in well-functioning community-dwellers as in our study the assessment of muscle power might be more meaningful than the assessment of muscle mass.

The Esslinger Fitness Index (EFI) reflects the percentage of the mean value of the peak 2LJP rel matched for sex and age group. Accordingly, it takes into account the most relevant confounding factors. The EFI was about 10% lower in sarcopenic females and female fallers and 15% lower in sarcopenic males compared to controls. However, future research should focus on the determination of optimal cut-off values of the EFI concerning the onset of disability and fall risk in a larger longitudinal study to identify those who might benefit from a preventive exercise intervention for reducing or postponing the consequences of sarcopenia, age-associated falls and ADL impairment.

In line with other studies in physical competent elderly subjects as well as older subjects with osteoporosis and vertebral fractures, no adverse events with jumping mechanography occurred in our population-based study. Older adults who are unable to jump might benefit from CRT mechanography as a safe meaningful tool.

As physical exercise directly affects muscle function and muscle size, it might be considered as the first therapeutic option. In a meta-analysis of 49 trials, Peterson et al. demonstrated that lean body mass can be increased with resistance training among healthy older adults, particularly through higher volume programs. In a Cochrane meta-analysis of 121 trials, Liu and Latham show that progressive resistance training performed 2-3 times per week not only has a modest to large effect on muscle function but also a small but significant effect on functional disability in older adults. In the present study, we discovered an association between muscle power output and sarcopenia or falls among the elderly, which raises the question of whether muscle power can be reversed by specific exercise regimes and whether this increase is helpful to postpone functional disability. Current evidence suggests that a high-velocity resistance muscle power program can not only restore muscle power of the lower legs, but also shows a benefit on balance and functional performance such as sit-to-stand time or gait speed. Although no adverse events with high velocity training have been reported amongst elderly persons with a self-reported disability or subjects older than 80 years, the efficacy and safety in older adults suffering from osteoarthritis or osteoporosis as well as the value in the prevention of falls still needs to be determined.

Our study has some limitations that must be considered. When retrospectively assessing falls, the data might be inaccurate due to recall bias. For this reason, prospective fall monitoring with regular postal questionnaires or telephone interviews are been recommended. All of the subjects in this study were relatively healthy, well-functioning older men and women, given that participants unable to walk without a walking aid were excluded. The degree of impairment in the activities of daily living was comparatively low and no significant difference in the ADL score between sarcopenic and non-sarcopenic subjects or between fallers and non-fallers could be observed. Therefore, selection bias towards well-functioning adults might have influenced the results. Furthermore, the study had an explanatory character and was not powered for the outcomes sarcopenia or fall status; hence, the unequal prevalence of falls and sarcopenia between the sexes could have resulted in diverse parameters found to be statistically significant. After all, the results of this preliminary study can be helpful for estimating the optimal sample size in future longitudinal studies focusing on the association of muscle power tests applying mechanography and the outcomes sarcopenia, falls and ADL impairment.

Conclusions

In conclusion, measuring the peak power of countermovement jumps and chair-rising with mechanography is a safe and useful tool to assess muscular function in older adults. The findings of our study suggest that low muscle power needs to be considered as a relevant and modifiable risk factor of sarcopenia, age-associated falls and ADL impairment. From the perspective of primary prevention, the assessment of peak muscle power with mechanography can be helpful to identify those who are at high risk for future functional decline at an early stage. Additionally, it may provide a useful tool to monitor and evaluate preventive strategies for combating functional decline.

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