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Strength of the dominant upper and lower extremities predicts skeletal muscle mass irrespective of age and gender

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Background

Sarcopenia is characterised by losses in muscle mass, strength and function. It is a contributing factor to numerous non-communicable diseases and frailty. Screening for sarcopenia typically requires measurements of handgrip strength, functional performance, and skeletal muscle mass. However, available tools do not tend to measure strength of the lower extremities. The aim of this study was to investigate associations between these measures and lower extremity strength with skeletal muscle mass in healthy young and older adults.

Methods

Fifty younger (mean ± SD age = 22.7 ± 5.4 years) and 50 older (age = 69.9 ± 4.3 years) individuals received the following measurements after an overnight fast: Skeletal Muscle Index (SMI) derived by dual-energy X-ray absorptiometry, gait speed, handgrip strength (HGS), and unilateral one-repetition maximum (1RM) leg extension strength. Muscle quality (MQ), was also determined as the ratio of grip strength to appendicular lean mass of the upper body[1].

Results

One older female and one older male were pre-sarcopenic and sarcopenic[2]. Upper extremity MQ was below established cut-points in 21 older participants[1].

SMI was positively associated with upper and lower extremity strength in all groups except older men, and negatively associated with upper extremity MQ in young males.

By multiple regression analysis, dominant HGS and dominant leg extension 1RM strength predicted SMI in the complete sample, accounting for 70.3% of the variance (B = 0.469 and 0.421, respectively; $P < 0.00001$). The equation for SMI is as follows:

4.568 + 0.025 x *dominant leg extension 1RM* + 0.059 x *dominant grip strength*

Table 1. Correlation coefficients with skeletal muscle index

Variable	Younger		Older	
	Males (*n* = 30)	Women (*n* = 20)	Males (*n* = 24)	Females (*n* = 26)
Body Composition				
Fat mass (kg)	0.29	0.02	0.73**	0.41*
Lean mass (kg)	0.79**	0.89**	0.61**	0.62**
%TFM	0.05	-0.18	0.48*	0.21
Functional Performance and Strength				
Dominant HGS (kg)	0.47**	0.60**	0.20	0.41*
Non-dominant HGS (kg)	0.45*	0.49*	0.36	0.19
Upper body muscle quality (kg/kg)	-0.42*	-0.08	-0.12	-0.19
6-m gait speed (m/s)	0.09	-0.02	0.14	-0.24
Dominant leg extension 1RM (kg)	0.64**	0.64**	0.25	0.48*
Non-dominant leg extension 1RM (kg)	0.59**	0.55*	0.30	0.29

* = significant at $p < 0.05$; ** = significant at $p < 0.01$

Conclusions

Since muscle mass is the foremost variable in determining sarcopenia, we support the inclusion of lower extremity strength testing in addition to that of handgrip strength to enable better prediction of SMI in both older and younger individuals. MQ determination is also recommended since established algorithms may fail to identify individuals with muscle weakness.

References

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