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Characterisation of Relative Muscle Power and Physical Function Status among Community-dwelling Older Persons

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ABSTRACT

Muscle power has been demonstrated to decline earlier and more quickly than muscle strength with advancing age. Studies revealed that muscle power is a critical determinant of physical functioning in older persons. Thus, this study is designed to examine muscle power and physical function status among community-dwelling older persons. This study was a cross-sectional study conducted among 50 community-dwelling older persons in Selangor. Sit-to-stand (STS) test, Frailty Index, 4.5 meters walking time, gait speed, hand grip, and Body Mass Index (BMI) were measured. Muscle power performance was estimated by the STS test. Overall, the mean age of the respondents was 65.0 ± 5 years. More than half (60.0%) of the respondents were female. The mean muscle power was 1.52 ± 0.36 W/(kg × m). There were no significant differences of muscle power between the sociodemographic parameters and smoking status. Among the respondents, 36% were categorized in low muscle power group (1.19 ± 0.14 W/(kg × m)), 30% in medium muscle power group (1.48 ± 0.08 W/(kg × m)), and 34% in high muscle power group (1.92 ± 0.26 W/(kg × m)). Significant differences among groups of muscle power were revealed in terms of frailty index. Those with a higher frailty index have lower muscle power compared to those with lower frailty index (p<0.05). Although other physical functional parameters reported a non-significant p-value, calculation of effect size using eta squared exhibited a medium effect size for walking time, gait speed, and BMI. In conclusion, more than one-third of the respondents have low muscle power. Those with a higher frailty index exhibited lower muscle power compared to those with a lower frailty index. The findings provide beneficial information in developing muscle

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power training interventions to prevent frailty and retain functional ability, and independence in old age.

Keywords: Frailty, muscle power, older person, physical activity, physical function

INTRODUCTION

Ageing is associated with significant declines in the neuromuscular system including muscle function and muscle structure (Aagaard et al., 2010). Despite the establishment of the role of muscle strength in determining functional limitations, muscle power has been demonstrated to decline earlier and more quickly than muscle strength with advancing age (Reid & Fielding, 2012). Studies revealed that muscle power is a critical determinant of physical functioning in older persons (Simpkins & Yang, 2022). Thus, this study is designed to examine relative muscle power and physical function status among community-dwelling older persons.

METHODS

This study was a cross-sectional study conducted among 50 community-dwelling elderly in Selangor. The Frailty Index was assessed according to the criteria established by Fried et al. (2001). Sit-to-stand (STS) was measured as the respondents stood up and sat down as quickly as possible on a firm, padded, armless chair for five cycles. Walking time was measured as participants walked 4.5 meters, and gait speed was derived from the time of walking and the distance. Jamar dynamometer was used to assess hand grip strength while body mass index (BMI) was calculated from the weight and height of the respondents. Relative muscle power was determined using the equation provided by Simpkins and Yang (2022):

$$\text{Relative STS mean power} = \frac{0.9 \times g \times [\text{body height} \times 0.5 - \text{chair height}]}{\text{five STS time} \times 0.1 \times \text{body height}}$$

g = the acceleration due to gravity (9.81 m/s2).

Descriptive statistics were shown as mean (standard deviation) for continuous variables and frequency for categorical variables. An independent t-test was applied to compare research variables between two groups, while one-way Analysis of Variance (ANOVA) was utilised for comparisons involving more than two groups.

RESULTS AND DISCUSSION

Overall, the average age of the responders was 65.0 ± 5 years. More than half (60.0%) of the participants were female. The mean relative muscular power was 1.52 ± 0.36 W/(kg × m). The relative muscle power was not significantly different between male (1.56 ± 0.40 W/kg) and female (1.50 ± 0.33 W/(kg × m)), and between age group 50-60 years (1.50 ± 0.40 W/(kg × m)), 61-70 years (1.50 ± 0.30 W/(kg × m)) and 71 years and above (1.68 ± 0.51 W/(kg × m)). There were no significant differences of relative muscle power between other sociodemographic parameters and smoking status as shown in Table 1. Among the respondents, 36% were categorized in low muscle power group

Table 1
Mean comparison of relative muscle power for sociodemographic characteristics and the relative muscle power group

	n (%)	Relative Muscle Power (mean)	(SD)	*p*-value
Age (years old)				
50-60	10 (20)	1.50	0.40	0.43
61-70	32 (64)	1.50	0.30	
71-80	8 (16)	1.68	0.51	
Gender				
Male	20 (40)	1.56	0.40	0.58
Female	30 (60)	1.50	0.33	
Marital status				
Single	3 (6)	1.97	0.42	0.07
Married	42 (84)	1.51	0.35	
Divorced/widowed	5 (10)	1.40	0.29	
Educational level				
College/university	18 (36)	1.58	0.35	0.63
Secondary education	20 (40)	1.47	0.29	
Primary education	12 (24)	1.53	0.47	
Working status				
Retiree	35 (70)	1.56	0.38	0.57
Pensioner	9 (18)	1.40	0.34	
Still working	2 (4)	1.66	0.30	
Unemployed/housewife	4 (8)	1.42	0.14	
Smoking status				
Current smokers	1 (2)	1.22		0.67
Never smoked	40 (80)	1.54	0.33	
Stopped	9 (18)	1.50	0.49	
Relative muscle power group				
Low	18 (36)	1.19	0.14	<0.001
Medium	15 (30)	1.48	0.08	
High	17 (34)	1.92	0.26	

Abbreviation: n = frequency, SD = standard deviation

(1.19 ± 0.14 W/(kg × m)), 30% in medium muscle power group (1.48 ± 0.08 W/(kg × m)), and 34% in high muscle power group (1.92 ± 0.26 W/(kg × m)). Table 2 shows significant differences in relative muscle power among groups based on the frailty score. Those with a higher frailty index have lower muscle power compared to those with a lower frailty index ($p<0.05$). Although other physical functional parameters reported a non-significant *p*-value, calculation of effect size using eta squared exhibited medium effect size for walking time, gait speed, and BMI.

Table 2
Mean comparison of physical functional parameters according to the relative muscle power group

	Relative Muscle Power Group (mean±SD)			*p*-value	ES
	Low	Medium	High		
Frailty index	1.50*±0.63	1.13±0.74	0.81*±0.75	**0.03**	0.15
Walking time (seconds)	5.04±1.30	4.46±1.06	4.31±0.87	0.15	0.08
Gait speed (m/s)	0.95±0.26	1.06±0.25	1.08±0.21	0.27	0.06
Hand grip (kilogram)	20.93±7.33	20.68±7.37	22.13±5.55	0.82	0.01
BMI	28.94±5.02	27.11±3.90	25.61±3.26	0.08	0.11

Abbreviation: SD = standard deviation; ES = eta squared effect size; BMI = body mass index

CONCLUSION

In conclusion, more than one-third of the respondents have low relative muscle power. Those with a higher frailty index exhibit lower muscle power compared to those with a lower frailty index. The findings provide beneficial information in developing muscle power training interventions to prevent frailty and retain functional ability and independence in old age.

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