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ORIGINAL ARTICLE

Health-related Quality of Life and Muscle Functions among Pre-frail Elderly Outpatients: Stronger Correlation with Gait Speed than Handgrip Strength

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Abstract

Introduction: Frail elderly has an increased risk of having debilitating health outcomes that lead to poor health-related quality of life (HR-QoL). The central manifestation of frailty syndrome is the muscle functions. The aim of this study was to evaluate the correlation between muscle functions and HR-QoL among pre-frail elderly outpatients.

Methods: This was a cross-sectional study using secondary data from a previous double blind RCT that investigated the effect of metformin on frailty syndrome among pre-frail elderly outpatients aged ≥ 60 years based on Cardiovascular Health Study and/or Frailty Index 40 items, recruited from March 2015 to June 2016 at Cipto Mangunkusumo Hospital. Muscle function was evaluated based on handgrip strength measured using hydraulic hand dynamometer and usual gait speed based on 15-feet walking test. HR-QoL was evaluated using *Euro Quality of Life-5 Dimensions* (EQ-5D) questionnaire. Spearman correlation test was used to analyze the correlation between HR-QoL and muscle function.

Results: EQ-5D index score had significant moderate positive correlation with gait speed (r = 0.566; p < 0.05) and significant weak positive correlation with handgrip strength (r = 0.355; p < 0.05).

Conclusion: The HR-QoL among pre-frail elderly outpatients had stronger correlation with gait speed than with handgrip strength.

Keywords

Elderly, Gait speed, Handgrip strength, Health-related quality of life, Pre-frail

Introduction

Frailty is defined as a syndrome of age-related decreased in physiological reserved capacity across multiple organ systems and capability to cope with stressors which represent the biological age. Frail elderly has an increased risk of having debilitating health outcomes (e.g. falls, worsening mobility, disability, and hospitalization) that lead to poor health-related quality of life (HR-QoL) [1,2]. The Hispanic Established Populations Epidemiologic Studies of the Elderly (the Hispanic EPESE) showed that after adjusting for socio-demographic factors and other relevant health variables, subjects with pre-frail and frail status showed lower physical and cognitive HR-

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QoL based on *The Medical Outcomes Study Short Form-36* (MOS SF-36) compared to robust subjects [3].

HR-QoL is a multidimensional subjective measure that focus on the quality of functioning (e.g. physical, emotion, social, and role functioning) and pain which affect health status, satisfaction, and happiness in daily life. Energy, freedom from pain, functional status (i.e. ability to do daily activities), and mobility are the main factors that contribute to HR-QoL in the elderly [2,4]. It is expected that improvement of physical performance is in line with improvement of HR-QoL [4].

The central manifestation of the physical component of frailty syndrome is the age-related decline of muscle mass and functions (sarcopenia) [1]. Muscle functions are evaluated by measuring handgrip strength and gait speed [5,6].

There is no specific instrument to measure HR-QoL in individuals with frailty. However, both self-reported and performance-based measurement of HR-QoL would complement each other with weak to moderate correlation between the two methods [2,7]. The aim of this study was to evaluate the correlation between preference-based (self-reported) HR-QoL instrument and muscle functions as performance-based measurement of HR-QoL among pre-frail elderly outpatients.

Methods

Design

This was a cross-sectional study using secondary data from subjects who completed the intervention in a previous double blind randomized controlled trial (RCT) that investigated the effect of metformin on frailty syndrome [8]. The study received ethical clearance from Ethical Committee of Faculty of Medicine Universitas Indonesia/Cipto Mangunkusumo Hospital and written informed consent was obtained from all subjects. The complete methods and protocol has already published elsewhere [8].

Eligibility

Subjects were non-diabetic pre-frail elderly outpatients aged 60 years or older who consecutively recruited from March 2015 to June 2016 at Cipto Mangunkusumo Hospital, Jakarta, Indonesia. The exclusion criteria were patients with depression, cognitive impairment, under-nutrition, acute phase of disease(s), and contraindication(s) to metformin.

Data collection

Data collection consists of subjects' demographic data (age, sex), co-morbidities, functional status (Barthel index Basic Activity of Daily Living/B-ADL), level of activity (Physical Activity Scale for the Elderly/PASE), frailty status, handgrip strength, usual gait speed, and HR-QoL.

Frailty status was assessed according to Cardiovascular Health Study (CHS) [1] and/or Frailty Index 40 items (FI 40 items) [9] criteria. Usual gait speed was measured based on 15-feet walking test. Handgrip strength of dominant hand was measured using JAMAR hydraulic handheld dynamometer model J00105 according to the recommended procedure by American Society of Hand Therapist (ASHT) [10]. According to the Asian Working Group of Sarcopenia (AWGS) criteria, the cut-off point for low handgrip strength among male and female were < 26 Kg and < 18 Kg respectively, whereas the cut-off point for slow gait speed was < 0.8 meter/second for both sex [5].

The *Euro Quality of life-5 Dimensions* (EQ-5D) questionnaire was used to assess the HR-QoL. The EQ-5D is a generic preference-based instrument that commonly used to measure HR-QoL among elderly patients which consists of two parts. The first part contains 5 dimensions of HR-QoL including mobility, self-care, daily activities, feeling of pain or discomfort and anxiety or depression. The EQ-5D questionnaire use 3 Likert-scale representing three levels of severity. The second part or the EQ-5D VAS is a visual analog scale (0-100) of subject's perception (i.e. self-rating) on their own overall health status [2,11].

The EQ-5D questionnaire with 3 Likert scale (EQ-5D-3L) was used instead of EQ-5D with 5 Likert-scale (EQ-5D-5L) because it had been validated among elderly patients in Indonesia with good reliability and validity [12]. The EQ-5D-3L index score was interpreted based on Japanese population data since it was the only available data that hold resemblance to Indonesian population.

Data analysis

The value of α was set at 5%, while the statistical power was set at 80%. Based on the correlation coefficient formula and the value of r in previous studies ($r \approx 0.3$) [13], the minimum sample size was set to be 85 subjects. SPSS version 20 was used to analyze the data. Normality test was performed using Kolmogorov-Smirnov test. Mean (standard deviation) was used to present the data with normal distribution and median (minimal-maximal) was used to present the data with abnormal distribution. The Spearman correlation test was used to determine the correlation between HR-QoL and muscle functions since the data were not normally distributed. Partial correlation test was used to adjust the correlation for control variables which were the chronological and biological age [FI 40 items score (frailty index)].

Results

This study included 91 subjects. The subjects' characteristics are shown in Table 1. Most of the subjects was female, aged < 75-years-old, with CIRS score > 5, and could function independently in their daily activities. The median EQ-5D index score was 0.77 (0.52-1.0), whereas the median EQ-5D VAS score was 75 (50-100)

Table 1: Subjects characteristics.

Characteristics	N = 91
Age group (years), n (%)	
< 75	76 (83.5)
≥ 75	15 (16.5)
Age (years), mean (SD)	68.97 (5.34)
Sex, n (%)	
Male	34 (37.36)
Female	57 (62.64)
Co-morbidity, n (%)	
Hypertension	77 (84.62)
Dyslipidemia	61 (67.03)
Knee osteoarthritis	53 (58.24)
Coronary artery disease	28 (30.77)
CIRS score, n (%)	
≤ 5	39 (42.86)
> 5	52 (57.14)
Barthel index (ADL Score), n (%)	
Independent (ADL score = 20)	82 (90.1)
Mildly dependent (ADL score 16-20)	9 (9.9)
PASE score (Kcal/week)	1,365 (500.15-3,192)
Male, mean (SD)	1,428.6 (690.09)
Female, median (min-max)	1,365 (500.15-2,772)
Handgrip strength (Kg), median (min-max)	22 (11-40)
Male, mean (SD)	29.35 (5.53)
Female, median (min-max)	20 (11-34)
Gait speed (meter/second), mean (SD)	1.22 (0.29)
Male	1.34 (0.27)
Female	1.16 (0.28)
Health-related quality of Life: EQ-5D index score, median (min-max)	0.77 (0.52-1.0)
Male, median (min-max)	0.89 (0.65-1.0)
Female, median (min-max)	0.77 (0.52-1.0)
Health-related quality of life: EQ-5D VAS score, median (min-max)	75 (50-100)
Male, mean (SD)	76.47 (10.48)
Female, median (min-max)	75 (50-100)

SD: Standard deviation; min-max: Minimal-maximal.

with significant weak positive correlation between them (r = 0.314; r^2 = 0.099; p = 0.002).

Based on Spearman correlation test, gait speed had significant moderate positive correlation with HR-QoL (r = 0.566; $p < 0.05$), while handgrip strength had weak positive correlation (r = 0.355; $p < 0.05$) as shown in Table 2. In adjusted model for chronological and biological age, both handgrip strength and gait speed still had significant positive correlation with HR-QoL.

Discussion

This study showed that gait speed among pre-frail elderly outpatients had stronger correlation with HR-QoL than handgrip strength. Though both handgrip strength and gait speed represent muscle functions, they differ in term of physical function hierarchy. Handgrip strength is considered as basic component of physical function hierarchy, whereas gait speed is the first level of integration of physical function hierarchy [4]. In addition, handgrip strength declining is faster than declining in gait speed with relatively constant muscle mass or slightly decreased muscle mass [13].

Most of the subjects in this study were independent as reflected by the Barthel ADL index score and only 9.9% were mildly dependent in their daily life activities. The median handgrip strength and the mean gait speed for both sex group among the subjects were still normal according to Asian Working Group of Sarcopenia [5] as well as CHS [1] criteria, though it could be considered as low normal for handgrip strength. Moreover, this study excluded patients with cognitive impairment and/or depression. Therefore, the EQ-5D index score and EQ-5D VAS score were relatively good with median value of 0.77 (0.52-1.0) and 75 (50-100) respectively. The EQ-5D index score was in line with EQ-5D VAS score, although only weakly correlated.

This study found that HR-QoL based on EQ-5D index score had weak positive correlation with handgrip strength. The Hertfordshire Cohort Study reported that low handgrip strength was associated with poor score

Table 2: Correlation between health-related quality of life with handgrip strength and gait speed.

Health-related quality of life (EQ-5D index score)						
Study outcome	**Unadjusted**			**Adjusted***		
	***r* (95% CI)**	***r*²**	***p***	***r* (95% CI)**	***r*²**	***p***
Handgrip strength	0.355 (0.179-0.503)	0.126	0.001	0.304 (0.115-0.472)	0.092	0.004
Gait speed	0.566 (0.405-0.711)	0.320	0.000	0.504 (0.314-0.653)	0.254	0.000

*Adjusted for chronological age and biological age [FI 40 items (frailty index) score].

for physical functioning domain of SF-36 in both unadjusted and adjusted model [14]. Similarly, Neto, et al. [15] reported that handgrip strength had weak positive correlation with the dimension of physical function (r = 0.35) and role-physical (r = 0.37) on SF-36. Contrastingly, Haider, et al. [16] reported that handgrip strength had significant moderate positive correlation with overall QoL (r = 0.522; r^2 = 0.272; p = 0.017) based on German version of the World Health Organization Quality of Life-BREF assessment (WHOQOL-BREF) and the German version of the World Health Organization Quality of Life-OLD assessment (WHOQOL-OLD). This disparity might be due to inclusion of frail elderly and different QoL instrument used in Haider, et al. study [16]. This study revealed that HR-QoL had stronger correlation with gait speed than handgrip strength. The coefficient of determination (r^2) results in this study showed that 32% of the total variation in HR-QoL can be explained by the linear relationship between HR-QoL and gait speed, compared to 12.6% for handgrip strength. This result regarding gait speed was in line with one of the dimension assessed in EQ-5D on mobility which describes the ability to walk and move around [7]. Moreover, in contrast to what was reported in Europe (UK and Netherlands), the mobility affected preference values the most in the final Indonesian EQ-5D-5L value set [17].

Farag, et al. [7] reported that gait speed had the highest AUC for performance-based measurement (0.72; 95% CI 0.65-0.81), compared to strength or balance test. The gait speed also had the highest effect size for external responsiveness which is the ability of a tool to detect change in a reference measure. Thus, it suggested that compared to strength and balance measurement, gait speed was more likely to identify the improvement in HR-QoL assessed with EQ-5D instrument [7].

It seems that gait speed is more relevant in the daily activity of the elderly. Haider, et al. [16] reported that daily physical activity assessed by the Physical Activity Scale for the Elderly (PASE) was associated with physical performance in the Short Physical Performance Battery (SPPB) test which consist of gait speed, balance skill, and chair stand assessment, but not handgrip strength. In addition, gait speed also had significant weak positive correlation with social participation (r = 0.387; r^2 = 0.150; p = 0.001) [18]. Analysis on National Health and Nutrition Examination Survey (NHANES) data showed similar result that slower gait speed was significantly associated with social participation limitation (OR = 3.1; 99% CI 1.5-6.2) [18]. This ability to be involved in social participation may contribute to social functioning and affect the HR-QoL.

This was the first study that addressed the correlation between HR-QoL and muscle functions among pre-frail elderly outpatients in Indonesia. Nevertheless, due to its cross sectional design, this study was not able to draw causal relationship between the variables. Further study on the impact of intervention to improve muscle functions, especially gait speed, on HR-QoL should be conducted.

Conclusion

Gait speed among pre-frail elderly outpatients had stronger correlation with HR-QoL than handgrip strength. Gait speed is probably more relevant in the daily activity of the elderly compared to handgrip strength. Compared to other muscle functions, gait speed was more likely to identify the improvement in HR-QoL according to EQ-5D as preference-based HR-QoL instrument.

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Disclosure Statement

The authors declare no conflict of interest.

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