Archives of Gerontology and Geriatrics 68 (2017) 44–48

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

A canonical correlation analysis on the relationship between functional fitness and health-related quality of life in older adults

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ARTICLE INFO

Article history:
Received 11 April 2016
Received in revised form 5 August 2016
Accepted 17 August 2016
Available online 24 August 2016

Keywords:
Functional fitness
Health-related quality of life
Older adult

ABSTRACT

Objective: This study aimed to explore the relationship between the functional fitness (FF) and health-related quality of life (HRQoL) in older adults, and to identify the key subdimensions of FF and HRQoL influencing their overall relationship.
Methods: This cross-sectional study was performed among 851 independent community members (65–84 years; men = 402). The Senior Fitness Test and the Short Form 36 Health Survey were used to measure FF and HRQoL, respectively. A canonical correlation analysis was conducted using seven fitness variables as predictors of eight HRQoL variables to examine the relationship between FF and HRQoL.
Results: The overall FF was positively correlated with the overall HRQoL in both men (canonical correlation = 0.350) and women (canonical correlation = 0.456). The up-and-go and 2-min step contributed the most to FF, and physical functioning contributed the most to HRQOL among men. Conversely, the up-and-go and 30-s chair stand contributed the most to FF, and physical functioning contributed the most to HRQoL in women.
Conclusions: There were positive and moderate relationships between overall FF and overall HRQOL in older adults. The FF has a significant influence on HRQoL, particularly physical functioning. The main FF components influencing the relationship between FF and HRQoL in men are balance and agility and aerobic endurance, whereas in women they are balance and agility and lower extremity muscle strength. Results from this study facilitate comprehensively understanding the relationship between FF and HRQoL, and generating critical insight into HRQoL improvement from the perspective of FF enhancement.

1. Introduction

With the progress of civilisation and industrialisation, the average life expectancy has increased dramatically during the 20th century (World Health Organization, 2011). However, this dramatic increase in life expectancy did not come with a proportionate increase in quality of life, particularly in older adults (Brown, 2015). One of the strongest determinants to maintain a high quality of life among older adults is the maintenance of good health (Forsén et al., 2010). Because of the ageing-related degradations in physical and cognitive functioning (Chung, Zhao, Liu, & Binh, 2016; James, Wilson, Barnes, & Bennett, 2011), older adults are often reported with social difficulties, mental problems (e.g., depression), chronic disease, and declined ability to live independently (Charles & Carstensen, 2010; Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013; Hung, Ross, Boockvar, & Siu, 2011).This would detrimentally influence older adults' health and quality of life.

Among various definitions on quality of life, health-related quality of life (HRQOL) is a multi-dimensional concept involving both physical and mental functioning (Wanderley, Silva, Marques, Oliveira, Mota, & Carvalho, 2011). Functional fitness (FF), which is defined as having the physical capacity to perform normal daily activities safely and independently without undue fatigue (Rikli & Jones, 2013), has been determined crucial for maintaining HRQOL in older adults (Takata et al., 2010). Additionally, there is a burgeoning popularity of FF complementing HRQOL in ageing-related studies (Chou, Hwang, & Wu, 2012). Both these findings to some extent indicate the close relationship between FF and HRQOL. Moreover, ageing-associated declines have been reported in both FF (Chung et al., 2016) and HRQOL (Hsu, Chen, Kuo, Fan, Lee, & Hsu, 2014), and a comprehensive understanding about their relationship would facilitate developing and implementing specific interventions.

A review of the extant literature indicated that most research has focused on the associations between each fitness component

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http://dx.doi.org/10.1016/j.archger.2016.08.007
0167-4943/

and the subdimensions of HRQoL. For example, Wanderley et al. (2011) found that older adults with higher aerobic endurance capacity reported higher scores in physical functioning, role limitations due to physical problems, and vitality, whereas those with superior upper arm muscle strength were more likely to score higher on RP and VT. Additionally, Samuel, Rowe, Hood, and Nicol (2012) reported moderate correlations between muscle strength and some specific dimensions of HRQoL (e.g. physical functioning) among older adults in the community. All of the preceding evidence has indicated specific associations between the various subdimensions of FF and HRQoL. However, both HRQoL and FF are multidimensional concepts, necessitating examination of relationships between overall FF and overall HRQoL, and exploration of the key subdimensions that would influence their overall relationships. To date, few studies have performed such examinations, hampering the understanding of relationships between overall FF and overall HRQoL.

Additionally, because the samples in previous studies mainly comprised women (Hsu et al., 2014; Wanderley et al., 2011), the generalisability of the results may be compromised as a consequence of potential sex differences. According to the limitations of existing research findings, this study was conducted to explore the relationship between overall FF and overall HRQoL in older men and women separately, and to identify the key subdimensions of FF and HRQoL influencing their overall relationship. Results from this study can facilitate comprehensively understanding the relationships between FF and HRQOL and generating critical insight into HRQOL improvement from the perspective of FF enhancement.

2. Methods

2.1. Study design

This is a cross-sectional, parallel study of a group of older adults recruited from a programme named 'Functional Fitness Norms in Hong Kong Older Adults' with the main purpose of establishing norms of FF for the older adults in different age groups.

2.2. Participants

Participants were recruited from multiservice senior centres located in various Hong Kong communities (Kowloon = 8, New Territories = 10, and Hong Kong Island = 4) through a convenience sampling method. Eligible participants were those who self-reported being healthy, were aged between 65 and 84 years, and were living independently in the local communities. The independent living in this study includes, but not limited to, dressing, cleaning, cooking, and shopping without assistance from other people. Participants with congestive heart failure, severe bodily pain, dizziness, or uncontrolled high blood pressure (exceeding 160/100 mmHg) were excluded from this study. A written informed consent form was required from each participant prior to participation in this study.

2.3. Ethical considerations

This study was approved by the Committee on the Use of Human and Animal Participants in Teaching and Research of the university.

2.4. Measurement

2.4.1. Health-related quality of life

Of the various HRQoL measurements, the Short Form 36 Health Survey (SF-36) is one of the most widely accepted tools for use with older adults (Olivares, Gusi, Prieto, & Hernandez-Mocholi, 2011). The SF-36 consists of 36 items in eight dimensions, namely physical functioning (PF), role limitations due to physical problems (RP), role limitations due to emotional problems (RE), social functioning (SF), mental health (MH), vitality (VT), body pain (BP), and general health perception (GH). These eight dimensions can be further divided into physical components, comprising PF, RP, RE, and SF, and mental components, comprising MH, VT, BP, and GH. The Chinese version of the SF-36, which was translated and validated by Li, Wang, and Shen (2003), has shown high convergent validity and discriminant validity, where the Cronbach α ranged from 0.72 to 0.88 for most dimensions; the SF-36 also demonstrated high test-retest reliability ($r = 0.66–0.94$).

2.4.2. Functional fitness

FF was assessed using the Senior Fitness Test (SFT; Rikli & Jones, 2013). The SFT was developed for early identification of older people who are at risk of losing functionality. The SFT comprises seven testing items that assess five components of FF: the body mass index (BMI) for body composition, the 30-s arm curl (AC) and 30-s chair stand (CS) tests for upper and lower extremity muscle strength, the back scratch (BS) and chair sit-and-reach (SR) tests for upper and lower body flexibility, the 8-foot up-and-go (UG) test for agility and balance, and the 2-min step (Step) test for aerobic endurance. Each test was strictly conducted according to the *Senior Fitness Test Manual* (2nd version; Rikli & Jones, 2013).

2.5. Data collection

All data were collected between March 2014 and April 2015 in the community senior centres. FF was assessed by a group of qualified fitness assessors provided by the Hong Kong Physical Fitness Association. A group of undergraduate students majoring in physical education completed a training workshop, where they were invited to help collect data from the SF-36. They were educated on the procedures of data collection for older adults, including how to assist participants in completing the SF-36; this training was necessary to ensure the consistency and accuracy of the data collection.

2.6. Data analysis

Pairwise deletion was applied to data that were greater than 5 standard deviations from the mean. A principal components analysis was performed on each set of variables to identify multicollinearity problems (eigenvalues at or near zero). Descriptive statistics were used to report the demographic and clinical characteristics of the participants, and the canonical correlation analysis (CCA) was applied to analyse the relationship between FF and HRQoL. The CCA was conducted using seven fitness variables as predictors of eight HRQoL variables to examine the relationship between FF and HRQOL in men and women separately; the determinant variables that influence their whole relationships were found in both FF and HRQOL. The threshold for statistical significance was set at $p < 0.05$. According to Cohen (1988), $r = 0.10$, 0.30, and 0.50 represent the small, medium and large correlation. All data were analysed using SPSS (v23; SPSS Inc., Chicago, IL, USA).

3. Results

According to the inclusion and exclusion criteria, 93 out of the 944 recruited participants were not eligible to be included in the study. Therefore, the following results are from the 851 qualified older adults (men = 402, women = 449). Table 1 presents the main demographic and clinical characteristics of the participants. Overall, this group of participants had an average age of 74.4 years (men = 74.3 years, women = 74.4 years). The men had a lower