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Research Article

Differences in Functional Fitness Among Older Adults With and Without Risk of Falling

Yanan Zhao, PhD, * Pak-Kwong Chung, DPE

Department of Physical Education, Hong Kong Baptist University, Hong Kong

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SUMMARY

Purpose: This study aimed to identify the differences in functional fitness between older adults who were at risk of falling and those who were not.
Methods: A total of 104 older adults aged 65–74 years were recruited from a local community senior center. They were independent older adults without a history of falls in the preceding 12 months. Falling risk status was assessed using the Fall Risk Test. Five dimensions of functional fitness with seven testing parameters (i.e., 30-second chair stand test, 30-second arm curl test, 2-minute step test, chair sit and reach test, back scratch test, 8-foot up and go test, and body mass index) were evaluated by the Senior Fitness Test.
Results: Only 78 participants completed all the tests, of which 48 participants were identified with risk of falling, and 30 participants were free from risk of falling. Results from multivariate analysis of variance found significant differences on the combined outcome variables, especially in the 8-foot up and go test, 2-minute step test, and 30-second arm curl test. Results from discriminant analysis found a significant discriminant function among all the seven testing parameters, where the 8-foot up and go test, and the 2-minute step test contributed most.
Conclusions: Older adults who are at the early stage of risk of falling tend to have lower functional fitness capacities, especially in agility and dynamic balance, aerobic endurance as well as in a combined relationship among all the testing parameters.

Introduction

With an increase in various problems emerging as a result of an ageing society, preventing or delaying the onset of physical frailty of people who are 65 years old and over is a primary concern in gerontology studies and practice [1]. People with advancing age and decreasing physical activity in daily life were reported to have a higher probability of falling [2]. According to the World Health Organization [3], falls are the second primary cause of accidental or unintentional injury deaths worldwide, and one out of three adults older than 65 years would fall every year [4]. Fall-associated injuries (e.g., fracture) can result in older adults losing their independence, requiring hospitalization and even death [5]. In addition, postfall syndromes, such as decreased self-efficacy and increased fear of falling, limit fallers' participation in physical activities, which in turn make the adverse effects from falling become more severe [6].

Among the various ways to prevent falls, exercise-based fall prevention programs have been shown to be effective in preventing falls and fall-related injuries [7]. However, the effectiveness of exercise program varied depending on the falling risk status in various people [8,9]. Less effect from exercise programs were reported among older adults with no risk or very high falling risk [10]. Only those who are in the transition of frailty or in the process of losing their balance (low or moderate falling risks) can gain the most from balance training [11]. In addition, these people are more vulnerable to falls since they do not sufficiently realize the risks of falling, and, as a result, do not make sufficient preparation for falls prevention. Therefore, early identification for potential fallers plus the implementation of effective balance training in this population is essential to avoid falls [12].

There are various methods of early identification of potential fall candidates. Many studies have been conducted focusing on the comparison of physical or mental differences among older adults with or without a history of falling [13,14]. A battery of risk factors

* Correspondence to: Yanan Zhao, Department of Physical Education, Hong Kong Baptist University, AAB 927, Kowloon Tong, Hong Kong.
E-mail address: y.n.zhao@hotmail.com

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including history of falls, age, medical conditions, sedentary behavior, psychological status, nutritional deficiencies, impaired cognition, and visual impairments have been found to be correlated with falls and have been used to help identify potential fallers among older adults [15]. However, the logic behind these studies is questionable given the aim is to identify potential fallers (without falling experience) in the early stage. It is untenable to consider the possibility of identifying potential fallers from nonfallers using risk factors resulting from studies comparing fallers and nonfallers. Whereas, comparisons between nonfallers with risk of falling and nonfallers without risk of falling would be more appropriate for gathering comprehensive knowledge related to the deficiencies of potential fall candidates in the early stage of falls so as to avoid occurrence of falls.

Functional fitness, defined as having the physical capacity to perform normal daily activities safely and independently without undue fatigue [16], is essential for people to maintain quality of life in later life [17]. Functional fitness is an essential indicator of independence and life quality for older adults in the late years; it is also one of the most commonly reported indicators in fall-related studies. Among the various physical fitness parameters, muscle strength, endurance, and response time have contributed most to balance and postural stability [18]. In addition, one cross-sectional study revealed a close relationship between functional fitness and risk of falling, and physical functionality accounted for 24.0% of risk of falling [19]. A series of studies were conducted to explore the differences in functional fitness-related parameters between fallers and nonfallers among older adults, in which certain physical parameters were found, such as muscle strength and muscle power in the lower limbs [20], muscle endurance [21], response time for postural instability, flexibility [22], and agility and balance [12,18]. Several of these fitness-related parameters were applied to the prediction of falls, such as muscle strength of the lower limbs [23], agility and balance [24]. Differences in functional fitness between fallers and nonfallers have been well-documented [20], however little is known about these differences in nonfallers with or without risk of falling. Therefore, the purpose of this study was to identify the differences of the physical parameters associated with functional fitness among older adults with and without risk of falling.

Although previous research has well demonstrated the differences between fallers and nonfallers in a variety of physical parameters, the differences in functional fitness between nonfallers with and without risk of falling has not been sufficiently specified. Thus, the important degradation of functional fitness in the very early stage of falling would not have been recognized or examined. This study examined the functional fitness levels of older nonfallers with and without risk of falling, and showed the differences in the physical parameters related to functional fitness. The current results can contribute to an understanding of functional fitness of older adults at the early stage of falls, and also contribute to the early identification of potential fall candidates.

Methods

Study design

This was a descriptive study designed to identify the differences in functional fitness between older adults who were at risk of falling and those were not.

Setting and samples

A fall refers to the sudden, unintentional change of position causing individuals to land on the ground, floor or any other object [3]. According to the general definition [9], nonfallers in the present study refer to older adults with no history of falls in the preceding 12 months. A total of 104 nonfallers, aged from 65 to 74 years, were recruited from a senior center in Hong Kong. They were apparently healthy people living independently in the community. Exclusion criteria for participants included having cognitive impairment as tested by the Chinese version of Mini-Mental State Examination (with scores < 24) [25], uncontrolled hypertension (systolic blood pressure > 160 mmHg), joint replacement, incontinence, and dizziness. Finally, 78 participants were qualified to take part in this study.

Ethical consideration

This study was conducted after receiving approval from the Committee on the Use of Human and Animal Subjects in Teaching and Research of the Hong Kong Baptist University. In a briefing workshop, all participants were informed of the purpose, protocols, risks and benefits of this study. Participants were asked to sign a informed consent form prior to the start of this study. Additionally, participants were reminded to stop at any time if there was any physical discomfort during the testing process.

Measurements

Fall risk test

All participants were first assessed on their risks of falls with the Fall Risk Test (FRT) by the Biodex Balance System SD (Biodex Medical Systems, New York, USA). The Biodex Balance System consists of a movable balance platform that can provide up to 20 degrees of surface tilt in a 360-degree range of motion. The platform is interfaced with computer software (Biodex, Version 3.1) that enables the device to serve as an objective assessment of dynamic balance [26,27], The overall stability index (OSI), as the outcome of the FRT, represents the variance of platform displacement in degrees from level in both the anterior/posterior and medial/lateral directions. A larger OSI indicates poorer balance control on a moveable supporting platform. Previous evidence has indicated that the FRT is a reliable measurement for assessing balance abilities (intraclass correlation coefficient (ICC) = .80) [28]. Finn et al [29] in their study demonstrated that the FRT was an effective test in measuring and distinguishing the balance of people aged over 50 with various balance abilities. Meanwhile, a normative range for people without balance deficits were established accordingly (i.e., 54–71 yr: OSI = 1.79–3.35; 72–89 yr: OSI = 1.90–3.50) [26,29]. A participant is at risk of falling if performing outside of the age-dependent normal stability scores. In addition, the higher the OSI, the higher falling risk the participant would be at.

In accordance with the operation manual, the resistance levels of the platform in the present study were set from Level 12 to Level 8 [27]. Each participant completed three trials, with two practice trials in advance. Each trial lasted for 20 seconds, separated with 10 seconds of rest. At the beginning of the FRT, participants stood on a static platform with feet shoulder-width apart in their preferred foot position. The center point of the platform was within the vertical line of the center of the body. No foot movements were allowed after they settled on their preferred foot position. During the whole testing process, participants were asked to keep their eyes on the screen, and to adjust their body posture to hold the center of body within the smallest zone for as long as they were able. Participants were told to put their hands beside bodies and not to touch the handrail unless they felt so unstable that they might fall.

Functional fitness test

The functional fitness of older adults was measured using the Senior Fitness Test (SFT) battery [16]. The SFT is a widely used