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Does functional capacity, fall risk awareness and physical activity level predict falls in older adults in different age groups?

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ABSTRACT

The aims of this study were to examine whether: i) functional capacity and physical activity level differ between fallers and non-fallers older adults, by controlling for fall risk awareness; ii) functional capacity, fall risk awareness and physical activity differ between fallers and non-fallers older adults, by controlling for age; iii) variables and which may predict falls in different age groups. 1826 older adults performed a series of functional tests and reported their fall episodes, fall risk awareness and physical activity level. The overall incidence of falls was high (40.2%), and falls risk awareness scores reduced with age. The older adults with greater falls risk awareness and non-fallers presented better scores in all functional tests and physical activity level ($P < .05$). Functional tests and falls risk awareness differed among age groups and differed between fallers and non-fallers, irrespective of age group ($P < .05$). Falls risk awareness predicted falls in all age groups (odds ranging: 1.05–1.09). Handgrip strength and balance scores predicted falls until 79 years (OR = 1.04, 95%CI = 1.01–1.06). The physical activity level predicted falls up to 70 years (OR = 1.09, 95%CI = 1.06–1.12). Functional mobility was able to predict falls up to 80 years (OR = 1.06, 95%CI = 1.01–1.08). Therefore, according to age, functional capacity, physical activity level and falls risk awareness can be a predictor of falls in older adults.

1. Introduction

Falls and its related consequences are one of the major incidences in older adult's (Howard, Beitman, Walker, & Moore, 2016; Kenny, Romero-Ortuno, & Kumar, 2017). It has been reported that up to 42% of elderly aged 70 years or above experience at least one fall per year (World Health Organization, 2007), which can be a traumatic episode that reduces their physical activity level (Wijlhuizen, de Jong, & Hopman-Rock, 2007). Long-term reduced physical activity level can lead to a decline in balance, strength and mobility (Ambrose, Cruz, & Paul, 2015; Duray & Genç, 2017), thus, increasing the risk and severity of fall-related consequences (Smee, Berry, Anson, & Waddington, 2015). This may set off a vicious circle with increased fear of falling, come a reduction of physical activity and functional capacity levels, thereby increasing fall incidence (Allali, Ayers, Holtzer, & Verghese, 2017; Etman, Wijlhuizen, van heuvelen, Chorus, & Hopman-Rock, 2012; Moylan & Binder, 2007). Therefore, it can be assumed that functional capacity and physical activity levels are lower in fallers' older adults than in non-fallers.

Although the risk factors of falls are well documented in the literature, only few studies have analyzed whether the awareness of fall risk may lead people to adopt a more cautious strategy in daily tasks to avoid a fall, which is an essential preventive approach (Gillespie et al., 2012; Howard et al., 2016; Mihaljcic, Haines, Ponsford, & Stolwyk, 2017; Pohl et al., 2015). In this context, an older adult with an increased fall risk awareness may present different behavior, e.g., a cautious gait pattern while walking in wet or uneven surfaces, low light areas and under other hazardous conditions (Mihaljcic et al., 2017; Pohl et al., 2015), that may alter their gait thus, making them less prone to falling. Thus, it can be assumed that adult older fallers are less aware of falls risks than their non-fallers counterparts.

Another issue in the aging process is the amount of changes in balance, cognitive and musculoskeletal function of the individuals throughout different age groups. Thus, the impact of age-related changes in balance, cognitive and musculoskeletal function on the ability to recovering from a trip, slip or an external perturbation is probably different from decade to decade. However, little is known about this. Since such age-related changes have been described as a fall

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determinant (Gai, Gomes, Nóbrega, & Rodrigues, 2010), identifying differences in functional capacity, physical activity level and fall risk awareness among fallers and non-fallers older adults, regarding age group differences, may contribute to elucidate fall-related occurrences. In addition, according to age group, it can be assumed that functional capacity, physical activity level and fall risk awareness may present different contributions to predict a falls among older adults.

This study aimed to determine whether: i) functional capacity and physical activity level differ between fallers and non-fallers older adults, when fall risk awareness is considered; ii) functional capacity, fall risk awareness and physical activity differ between fallers and non-fallers older adults, when age is considered; and iii) which variables predict falls in different age groups. In this view, the results of the present study may provide relevant information to design fall preventive actions according to the participant's age.

2. Methods

2.1. Participants

This cross-sectional study was conducted in Curitiba, Brazil, a city of 1,751,907 of inhabitants, from which 11.3% is aged 60 or older and in 2016 the Municipal Health Secretary served 100,194 older adults across 9 city districts. Sample size was calculated using the Epiinfo calculator developed by Center of Disease Control and Prevention (Sullivan, 2003; Sullivan & Dean, 2009) using the following parameters: (i) the population served in 9 districts; (ii) 95% confidence level; (iii) sampling error of 3%; (iv) 50% of anticipated frequency, considering the maximum variance; (v) design effect of 1.5 to correct the sample selection biases; and (vi) 10% margin for possible losses and refusals. Therefore, the initial sample size estimated was 1760 older adults. All Health Units of the 9 districts of the city were involved and the number of participants from each Health Unit was determined to obtain a proportional fraction of the older adults served by the Municipal Health Secretary.

Individuals below 60 years old, suffering from neurological or musculoskeletal problems that limited their accomplishment in all procedures and those who were unable to finish the functional tests were excluded from the study. Thus, from 1889 older adults that agreed to participate in the study, and 63 individuals (3,3%) were excluded (unable to complete all assessments [questionnaires and functional tests]). Therefore, 1826 older adults were included in the study. The University Ethics Committee approved the procedures and all individuals gave written consent prior to study participation.

2.2. Procedures

Data collection was conducted through face-to-face interviews; participants were accompanied with their companions or caregivers whom could aid to give a more complete answer during the interview. Data collection occurred between March and October 2016. Participants were evaluated on a single session lasting on average a duration of one hour and a half. The sequence of the evaluation was conducted as follows: participants performed an initial screening with personal data and cognitive status, followed by physical activity level, falls episodes, falls risk awareness, and functional tests. All experimenters attended to a qualification program to standardize all experimental procedures.

2.3. Descriptive variables

Information regarding age and sex were obtained during the interview. The Mini Mental State Examination (Folstein, Folstein, & McHugh, 1975) is a 30-point questionnaire in which higher scores denotes better cognition (Tombaugh & Mclntyre, 1992). The weekly time spent in physical activities, sports and leisure according to energy expenditure was assessed using the Minnesota Leisure Time Activities Questionnaire (Lustosa et al., 2011). The weekly volume of physical activities was classified as either: Insufficiently active (< 150 min/week) and sufficiently active (≥ 150 min/week) (Chodzko-Zajko et al., 2009).

2.4. Falls episodes and falls risk awareness

The episodes of falls were assessed using a customized questionnaire designed to identify whether participants experienced a fall during the last 12 months. The circumstances that participants felt were also examined. A fall was defined as an unintentional event that resulted in changing the position to a lower level, relative to his/her initial position, irrespective if an injury was caused (Buchner et al., 1997). The Falls Risk Awareness Questionnaire (FRAQ) was applied to determine the risk of falls perception. The higher the score (maximum 32 points), the better the awareness of falls risks (Lopes & Trelha, 2013).

2.5. Functional tests

The functional tests were performed in a standard order and the rest period between tests were three to five minutes. Participants performed a familiarization trial for each test (Sposito et al., 2013). The tests included: (a) Handgrip strength of the dominant hand (Jamar® dynamometer) (de Souza Vasconcelos et al., 2016); (b) lower body power (five times sit to stand test from an armless chair and having both hands crossed against the chest) (Whitney et al., 2005); (c) functional mobility (timed up and go test by walking 3 m around a cone and returning to a seated position at their normal gait speed) (Podsiadlo & Richardson, 1991); (d) gait speed (4 m Walk Test at normal gait speed) (Rogers, Rogers, Takeshima, & Islam, 2003); and balance (Berg balance scale) (Miyamoto, Lombardi, Berg, Ramos, & Natour, 2004). The detailed description of the tests can be found elsewhere (Benavent-Caballer et al., 2016; Guralnik et al., 1994).

2.6. Data analysis

Descriptive statistics (mean and standard deviation) were performed to characterize the participants, which were grouped according to the age: Young Older Adults (YOA: 60.0–69.9 years; 46.6%), Old Older Adults (OOA: 70.0–79.9 years; 40.4%) and Very Old Adults (VOA: $\geq$ 80.0 years; 13.1%). The Kolmogorov-Smirnov test demonstrated that all variables were not normally distributed. Comparison of sex, physical activity level, number of falls and fall risk awareness (stratified by median in Lower and Higher scores) between groups (YOA, OOA and VOA) was performed using the Chi-square test. The Kruskal Wallis and General Linear Model were performed to compare fall risk awareness (Stratified by median in Lower and Higher scores) and fall history (fallers vs. non-fallers). Thus, the Mann Whitney test was performed to compare fall history (fallers vs. non-fallers) and age groups (YOA, OOA and VOA). In addition, a binary logistic regression (enter method) was applied to determine the probability of fall episodes having as predictors the variables with statistical difference between groups (fall history and age). Functional capacity, fall risk awareness and physical activity level were used as independent variables to predict fall episodes in YOA and OOA groups, whereas lower body power, functional mobility, balance, falls risk awareness and physical activity level were considered as independent variables to predict fall episodes in VOA group. Spearman rho were used to determine the correlations among physical activity level and falls risk awareness and cognition. The significance level was set at $P < 0.05$ and all statistical procedures were performed using SPSS (version 22) statistical package.

3. Results

The examined population consisted of 1826 older adults aged between 60.0–96.00 years (mean [M] = 70.94 years; standard deviation