IS GRIP STRENGTH A GOOD MARKER OF PHYSICAL PERFORMANCE AMONG COMMUNITY-DWELLING OLDER PEOPLE?

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Abstract: Introduction: There is increasing interest in physical performance as it relates to both the current and future health of older people. It is often characterised using the Short Physical Performance Battery (SPPB) which includes assessment of gait speed, chair rises and standing balance. However this battery of tests may not be feasible in all clinical settings and simpler measures may be required. As muscle strength is central to physical performance, we explored whether grip strength could be used as a marker of the Short Physical Performance Battery. Objective: To examine associations between grip strength and components of the Short Physical Performance Battery in older community dwelling men and women. Methods: Grip strength measurement and the Short Physical Performance Battery were completed in 349 men and 280 women aged 63–73 years taking part in the Hertfordshire Cohort Study (HCS). Relationships between grip strength and physical performance (6m timed-up-and-go [TUG], 3m walk, chair rises and standing balance times) were analysed using linear and logistic regression, without and with adjustment for age, anthropometry, lifestyle factors and co-morbidities. Results: Among men, a kilo increase in grip strength was associated with a 0.07s (second) decrease in 6m TUG, a 0.02s decrease in 3m walk time, and a 1% decrease in chair rises time (p<0.001 for all). Among women, a kilo increase in grip strength was associated with a 0.13s decrease in 6m TUG, a 0.03s decrease in 3m walk time, and a 1% decrease in chair rises time (p<0.001). Higher grip strength was associated with better balance among men (p=0.01) but not women (p=0.57). Adjustment for age, anthropometry, lifestyle and co-morbidities did not alter these results. Conclusions: Grip strength is a good marker of physical performance in this age group and may be more feasible than completing a short physical performance battery in some clinical settings.

Key words: Sarcopenia, grip strength, physical performance, frailty, elderly.

Introduction

There is increasing interest in physical performance as it relates to both the current and future health of older people (1). Physical performance is often characterised using the Short Physical Performance Battery (SPPB) which includes assessment of gait speed, chair rises and standing balance (2) and which has been effectively utilised in a range of research settings. Studenski (3) and colleagues have also suggested that the SPPB was suitable for use in clinical settings in the United States but older people admitted acutely to hospital in the United Kingdom characteristically have mobility impairment as well as multiple co-morbidities (4). Use of the SPPB in this context could potentially be very challenging and simpler measures of physical performance may be required. As muscle strength is central to physical performance, we explored whether grip strength could be used as a marker of the Short Physical Performance Battery.

The relationship between muscle strength and physical performance has been studied previously. However, not all studies have considered grip strength as their marker of muscle strength, or have measured physical performance directly, and few have considered whether the association between muscle strength and physical performance is linear or curvilinear. Sirola et al studied 1,166 post-menopausal women who participated in the Kuopio Osteoporosis Risk Factor and Prevention (OSTPRE) study and demonstrated that the women who had better performance on balance and squat tests had greater grip and quadriceps strength (as measured using strain gauge dynamometers) (5). Davis et al studied 705 community dwelling older Japanese women resident in Hawaii (mean age 74) and demonstrated associations between greater quadriceps, triceps and grip strength and improved physical performance across a panel of measures comprising walking speed, the get up and go test, chair stands, functional reach, and hand and foot reaction times (6). Visser et al demonstrated that low leg muscle strength was associated with poorer performance on a repeated chair-stands test among men and women, aged 70 to 79 years, who participated in the Health, Aging and Body Composition Study (7). Baker et al have shown that performance of a leg cycle ergometry test is influenced by a muscular contribution from the upper body and by upper body strength (8). Stenholm studied 2,208 subjects aged 55 years and older and demonstrated associations between reduced grip strength and walking limitation (difficulty walking 0.5km or maximum walking speed <1.2m/s) (9). Hughes et al studied 485 men and women aged sixty years and older and showed that lower grip strength at baseline was associated with decline in a timed manual performance test across a two year follow-up period (10).

Other studies in the literature have assessed physical performance indirectly by considering self-reported markers of customary physical activity or difficulties in activities of daily living. Glenmark et al studied 55 men and 26 women at 16 and
27 years of age and found a positive correlation between hand grip strength and physical activity during leisure time among women at both ages but no association among men at either age (11). Bassey et al. studied longitudinal changes in grip strength and physical activity across an eight year follow-up period among 350 men and women aged 65 years and older and found that reduced self-reported use of the handgrip muscles was associated with greater reductions in hand grip strength (12). Martin et al. found that higher muscle strength and physical performance were associated with higher levels of physical activity among older women but not men but did not examine the associations between grip strength and physical performance (13).

The relationship between muscle strength and mass is linear (14). The relationship between muscle mass and physical performance may therefore be of the same nature as the relationship between physical performance and muscle mass and grip strength may be a good marker of physical performance.

The objective of this study was to examine the nature of the relationship between grip strength and directly measured markers of physical performance among older community dwelling men and women who participated in the Hertfordshire Cohort Study (HCS) (17).

Methods

Study population

The HCS has been described in detail previously (17). In brief, in 1998, a total of 3,822 men and 3,284 women born in Hertfordshire between 1931 and 1939 and still living in the county were traced with the aid of the NHS central registry in Southport and confirmed as currently registered with a general practitioner in Hertfordshire. Permission to contact 3,126 (82%) men and 2,973 (91%) of these women was obtained from their general practitioner in Hertfordshire. Permission to contact 3,126 (82%) men and 1,418 (92%) of these women using a Jamar handgrip dynamometer (Promedics, Blackburn, UK). Participants were given standardised encouragement to squeeze the dynamometer as hard as possible (18).

Assessment of co-morbidity was as follows. Participants who had not reported an existing diagnosis of diabetes attended the morning clinics after fasting overnight and completed a 2 hour oral glucose tolerance test (OGTT) using 75 g anhydrous glucose; diabetes mellitus and impaired glucose tolerance were classified according to WHO criteria. Blood pressure was recorded as the mean of three measurements taken with a Dinamap Model 8101 (GE Medical Systems, Slough, UK) after the subject had been seated for 5 minutes. An ECG was also performed, and graded for ischaemic changes, according to the Minnesota protocol. Clinical examination was used to assess presence of hand osteoarthritis.

Physical performance was tested at clinic in the West Hertfordshire phase of the fieldwork (349 men and 280 women) using an adaptation of Guralnik’s (2) short physical performance battery (SPPB) of tests. This consisted of a 6 metre timed-up-and-go (TUG), a 3 metre walk from a standing start, 5 chair rises, and a one-legged balance test (flamingo stand) for up to 30 seconds. Standard instructions and encouragement were given for each part of the test. Participants were allowed to use walking aids if necessary, and could stop at any point during a test if they felt unable to complete it. Intra- and inter-observer studies were carried out at regular intervals during the fieldwork to ensure comparability of measurements within and between observers. The study received ethical approval from the Hertfordshire and Bedfordshire Local Research Ethics Committee, and all subjects gave written informed consent.

Statistical methods

The best of the six grip strength measurements was used to characterise muscle strength. The time taken to complete five chair rises was loge transformed to a normal distribution for analysis. The standing-balance time variable was highly bimodal, with participants either losing balance very quickly or remaining balanced for the full 30 seconds. This was therefore coded to a binary variable with a ‘good balance’ group (≥5 seconds) contrasted with a ‘poor balance’ group (<5 seconds). Only two men and four women used a walking aid to complete the timed up and go, 3m walk or chair rises tests and only two men failed to complete all five chair rises; the times obtained for the tests by these individuals were excluded from the relevant analyses.

Height and weight were highly correlated (r = 0.45, P<0.001 for men; r=0.28, P<0.001 for women). A standardized residual of weight adjusted for height was therefore coded as a marker of weight which could be included simultaneously in a regression model with height without concern about multicollinearity problems.

Participant characteristics were described using means and standard deviations, medians and inter-quartile ranges and frequency and percentage distributions. The relationships