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Original article

Relationship between physical performance and self-reported function in healthy individuals across the lifespan

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ABSTRACT

Background: Functional outcome measures in clinical trials of musculoskeletal conditions need to be meaningful to individuals.
Objectives: To investigate the relationship between physical performance and self/proxy-reported function in 1000 healthy children and adults.
Design: Cross-sectional observational study (1000 Norms Project).
Methods: One thousand males and females aged 3–101 years, healthy by self-report and without major physical disability, were recruited. Twelve performance-based tests were analysed: vertical and long jump, two hand dexterity tests, four balance tests, stepping reaction time, 30-second chair stand, timed up-and-down stairs, and six-minute walk. Self/proxy-reported function was assessed using the Infant-Toddler Quality of Life questionnaire, Child Health Questionnaire, Assessment of Quality of Life (AQoL)-6D Adolescent, AQoL-8D, International Physical Activity Questionnaire and work ability question. Bivariate and multivariate correlational analyses were constructed for infants (3-4y), children (5-10y), adolescents (11-17y), adults (18-59y) and older adults (60+).
Results/findings: Socio-demographic characteristics were similar to the Australian population. Among infants/children, greater jump and sit-to-stand performance correlated with higher proxy-reported function ($p < 0.05$). There were no significant relationships observed for adolescents ($p > 0.05$). Greater jump, dexterity, balance, reaction time, sit-to-stand, stair-climbing and six-minute walk performance correlated with higher self-reported function in adults ($r = -0.097$ to.231; $p < 0.05$) and older adults ($r = -0.135$ to 0.625; $p < 0.05$). Multivariate regression modelling revealed a collection of independent performance measures explaining up to 46% of the variance in self/proxy-reported function.
Conclusions: Many performance-based tests were significantly associated with self/proxy-reported function. We have identified a set of physical measures which could form the basis of age-appropriate functional scales for clinical trials of musculoskeletal conditions.

1. Introduction

For individuals with musculoskeletal conditions, a primary goal of therapy is to minimise pain and optimise physical function (Bellamy et al., 1997). Physical function describes the ability to perform daily activities (Terwee et al., 2006), encompassing physical as well as cognitive, behavioural and affective dimensions (Wright et al., 2011). Measurement of physical function is fundamental for evaluating interventions for musculoskeletal conditions (Pham et al., 2004).

Assessment of physical function encompasses performance-based tests and self (or proxy)-reported measures (Stratford and Kennedy, 2006; Dobson et al., 2013). Performance-based tests measure *actual* ability, while self-reported measures assess *perceived* ability (Terwee et al., 2006). In clinical practice self-

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reported measures, also called patient-reported outcomes (PROs), are often preferred due to time, cost and ease of administration (Mizner et al., 2011). Self-reported measures also yield key information from the individual's perspective and may be more sensitive (Nilsdotter et al., 2001; Kreibich et al., 1996; Steultjens et al., 1999), although results are influenced by cognition, language, and expectations (Wright et al., 2011; Steultjens et al., 2001). By comparison, physical measures are more objective and may have greater ability to detect functional gains in longitudinal studies (Mizner et al., 2011; Stratford et al., 2006). Performance-based measures such as sit-to-stand are preferred over impairment variables such as muscle strength as they are more sensitive and are more strongly correlated with self-reported function (Nilsdotter et al., 2001; Juhakoski et al., 2008).

To ensure all dimensions of patient function are captured, performance-based measures are necessary to complement self-reported information (Dobson et al., 2013). When selecting tests for use in clinical practice and research, measures must be meaningful to patients. Performance-based measures which correlate with, and hence represent relevant aspects of, self-reported function should be prioritised. Higher perceived function has been linked with greater balance, walking speed and sit-to-stand ability for healthy older adults (Davis et al., 2015), and with sit-to-stand, stair-climbing and six-minute walk performance for adults with osteoarthritis (Juhakoski et al., 2008; Lin et al., 2001; McCarthy and Oldham, 2004). However, physical performance determinants of self (or proxy)-reported function for younger adults and children, and with a broader range of measures, have not been fully explored.

Furthermore, normative reference data for self-reported measures are essential to facilitate interpretation of results (Hunsaker et al., 2002). The Assessment of Quality of Life 8-Dimension (AQoL-8D) utility instrument provides a valid and reliable measure of physical function assessing independent living, pain, and physical senses, generating an aggregate physical super dimension (Richardson et al., 2014). However, reference data for the AQoL-8D have only been reported for adults aged 18–69 years, limiting generalisability of these data to older adults (Richardson et al., 2012). Therefore the primary aim of this study was to investigate the relationship between physical performance and self/proxy-reported function in healthy infants, children, adolescents, adults and older adults. A secondary aim was to present normative reference data for the AQoL-8D for adults aged 18–101 years.

2. Methods

2.1. Participants

The 1000 Norms Project is an observational study investigating 1000 individuals aged 3–101 years, stratified by age and gender (McKay et al., 2016). Individuals living in the Greater Sydney metropolitan area (in which one-fifth of Australia's population reside (Australian Bureau of Statistics (2012))) were targeted via a structured convenience sampling approach through local council and community groups, sporting groups, independent-living facilities and educational institutions. Participants were healthy by self-report and did not report major physical disability, although minor musculoskeletal impairments were not excluded to ensure generalisability of results to individuals with mild musculoskeletal disorders. Potential participants were asked the following questions:

1. "Do you consider yourself healthy for your age?"
2. "Are you able to participate in normal daily activities with respect to your age?"

Individuals who responded "yes" to both questions were screened for the following exclusion criteria:

1. Inability to follow age-appropriate instructions in English;
2. Self-reported health conditions or factors substantially affecting physical performance; and
3. Presence of the following conditions: history of joint replacement or other surgery substantially affecting physical performance; infectious or inflammatory arthropathies; diabetes; malignant cancers; demyelinating, inflammatory or degenerative neurological conditions; body mass index (BMI)$\geq$40; pregnancy; severe cardiac, pulmonary or musculoskeletal disease affecting performance of daily activities (including end-stage osteoarthritis); and mobility limitations requiring dependence on mobility aids.

Ethnicity was collected according to the Australian Standard Classification of Cultural and Ethnic Groups (Australian Bureau of Statistics (2011)). Using participants' country of birth, ethnicity was then classified into one of three groups: British/European; Aboriginal/Torres Strait Islander; and Other (Asian/American/African). Socio-economic status was evaluated using the Socio-Economic Indexes for Areas (Index of Relative Socio-economic Advantage and Disadvantage), allocating a percentile score to residential postcodes from 0 (most disadvantaged) to 100 (most advantaged) (Trewin, 2001). The study was approved by the institutional Human Research Ethics Committee (2013/640).

2.2. Self/proxy-reported measures

Self/proxy-reported function was assessed using age-appropriate health-related quality of life (HRQoL) questionnaires. For children, the Infant-Toddler Quality of Life Questionnaire Parent Short Form-47™ (ITQoL) (Landgraf, 1994) (3-4 year-olds) and the Child Health Questionnaire Parent Form-28™ (CHQ) (HealthActCHQ, 2013) (5-10 year-olds) were completed by the parent/guardian-proxy. Domains for physical abilities (ITQoL), physical functioning and role limitations-physical (CHQ), scored from 0 to 100 where 100 represents highest function, were used. The AQoL-6D Adolescent was completed by adolescents (11–17 years), and the independent living dimension was examined (Moodie et al., 2010). Adults aged 18–101 years completed the AQoL-8D (Richardson et al., 2009), and the independent living dimension and physical super dimension (comprising independent living, pain, and physical senses) were used. AQoL dimensions were scored from 0 to 1 where 1 reflects best health.

In adults, work ability was assessed using a validated single-item question within the Work Ability Index, asking participants to rate their current work ability compared to their lifetime best from 0 (unable) to 10 (best) (Ahlstrom et al., 2010). Participants not working considered daily activities as work. Physical activity level was measured using the International Physical Activity Questionnaire (IPAQ) long form (Craig et al., 2003) (18–69 years) or IPAQ-elderly (Hurtig-Wennlöf et al., 2010) (70–101 years). Total physical activity in the past week was calculated in MET-minutes, and a category of 'Low', 'Moderate' or 'High' was allocated. IPAQ data were managed in accordance with IPAQ Group protocols (International Physical Activity Questionnaire Group, 2005). Lifetime prevalence of musculoskeletal pain for the neck, shoulder, back and knee was