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Test–retest reliability and minimal detectable change scores of twelve functional fitness tests in adults with Down syndrome

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ABSTRACT

Aim: The purpose of the study was to explore the test–retest reliability and minimal detectable change of selected functional fitness test items in adults with Down syndrome.
Methods: Forty-three adults with Down syndrome (24 men and 19 women) aged 18–50 years completed a battery of tests twice in a two-week period. The battery of tests consisted of two balance items, two flexibility items, five muscular strength and endurance items, two aerobic items, and one functional task. All items were considered valid and reliable tests in a general elderly or intellectually disabled population. The test–retest relative reliability for all repeated tests was assessed with intraclass correlation coefficient performing one-way analysis of variance. The test–retest absolute variability was measured by using the standard error of measurement (SEM) to calculate the minimal detectable change at the 90% confidence interval (MDC_{90}). Reliability data was visualised with a Bland–Altman plot.
Results: All tests showed excellent intraclass correlation coefficients (ICC's > 0.9). All SEM values demonstrated acceptable measurement precision (SEM $<$ SD/2). Values for MDC_{90} are provided for all 12 tests. The analyses indicated that there was no major systematic bias in the plots. The scatter around the Bland–Altman was distributed randomly.
Conclusion: All twelve functional fitness tests demonstrated adequate feasibility and relative and absolute test–retest reliability in adults with Down syndrome in South Africa. Information of this nature will help to monitor performance alterations over time and success of training interventions.

1. Introduction

Down syndrome (DS) occurs when there is a full or partial extra copy of the 21st chromosome. DS is the most prevalent chromosomal cause of intellectual disability (ID) (NDSS, 2014; Barnhart & Connolly, 2007). Individuals with DS are born with many health-related disorders, of which congenital heart disease (61% of all cases) is the most common (Abbag, 2006). These individuals have a greater risk of developing thyroid problems, leukaemia, epilepsy, diabetes and Alzheimer's disease (NDSS, 2014; Hermon, Alberman, Beral, & Swerdlow, 2001). Nowadays, most of these conditions are medically treatable, which

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explains the increase in life expectancy from 25 years (20 years ago) to 60 years (NDSS, 2014; Torr, Strydom, Patti, & Jokinen, 2010; Chicoine & McGuire, 1997).

Individuals with DS have sedentary lifestyles (Nordstrøm, Hansen, Paus, & Kolset, 2013; Esposito, MacDonald, Hornyak, & Ulrich, 2012; Shields, Dodd, & Abblitt, 2009) and the majority of these individuals are overweight or obese (Terblanche & Boer, 2013; Rubin, Rimmer, Chicoine, Braddock, & McGuire, 1998). Moreover, the aerobic capacity, muscular strength and functional capacity of individuals with DS are poor, not only when compared to the general population but also to individuals with ID without DS (Baynard, Pitetti, Guerra, Unnithan, & Fernhall, 2008; Baynard, Pitetti, Guerra, & Fernhall, 2004; Carmeli, Kessel, Merrick, & Bar-Chad, 2004; Carmeli, Barchad, Lenger, & Coleman, 2002; Croce, Pitetti, Horvat, & Miller, 1996; Fernhall et al., 1996; Pitetti, Climstein, Mays, & Barrett, 1992). Poor physical fitness and functional capacity are factors that further predisposes this population to the early development of serious health problems (González-Agüero et al., 2010; Torr et al., 2010; Carmeli et al., 2004). Furthermore, individuals with DS are known to age prematurely, characterised not only by a lower life expectancy compared to the general population but also by plummeting functional fitness and weight values at an significantly earlier age (Terblanche & Boer, 2013; Torr et al., 2010; Carmeli et al., 2004; Rubin et al., 1998).

The undesirable combination of an improved life expectancy and premature functional limitations in a population with Down syndrome could possibly impact on the quality of life and independence, especially in old age. Fortunately, outcomes of this nature can be prevented or reversed through structured exercise training as shown in a DS population (Mendonca, Pereira, & Fernhall, 2011; Cowley et al., 2010; Shields, Taylor, & Dodd, 2008; Rimmer, Heller, Wang, & Valerio, 2004). A description of the functional fitness capacities of individuals with DS is essential in order to optimise program prescription for improved functional capacity. Therefore, a specified scientific exercise program prescription should be based on a reliable, valid and specific measuring instrument for the population group studied. Rikli and Jones (2013) and Hilgenkamp, van Wijck, and Evenhuis (2012) developed specific instruments in the general elderly and intellectually disabled populations, respectively. However, due to their discernible functional fitness impairments, adults with DS should not be pooled with populations with general ID (Winnick & Short, 2014; Baynard et al., 2008). In fact, Winnick and Short (2014) acknowledged that an instrument they developed and validated made no distinction between intellectually disabled children and adolescents with and without DS, despite evidence that the presence of DS negatively affects fitness test performance. In addition, many adults with DS struggled to perform some of the tests and it was recommended that individuals with DS have their own functional fitness battery suited to their unique needs.

Using the information provided by Rikli and Jones (2013), Hilgenkamp et al. (2012) and the ACSM (2005), we proposed five parameters to describe functional fitness (balance, flexibility, functional ability, muscular strength and endurance, cardiovascular endurance). A thorough literature search was conducted to identify all possible measuring instruments based on their reliability and validity (especially tests used in an elderly or intellectually disabled population). A three-month pilot study ensued, after which the test choice was further refined with the help of experts in the field of DS research, physiotherapy, occupational therapy and disability sport. The pilot study was very significant in the pre-test planning for evaluating factors such as familiarisation with tests, development of test procedures and directions, preparation of participants, number of trials, obtaining the feel for equipment and space needed, preparation of worksheets, equipment checklists, and time needed to perform tests. Final test items were selected from the Bruininks-Oseretsky Test of Motor Proficiency (BOTMP), Brockport Physical Fitness Test (BPFT) and Senior Fitness Test (SFT) manuals. The feasibility of these tests in adults with DS has already been shown to be excellent in a large epidemiological study ($n = 371$) (Terblanche & Boer, 2013). However, before these tests can be used in adults with DS, further psychometric analyses are needed. It is imperative to establish population-specific reliability coefficients for adults with DS as has been established in the general, general elderly and ID population before embarking on epidemiological or experimental research studies (Rikli & Jones, 2013; Winnick & Short, 2014; Hilgenkamp et al., 2012; Welk & Meredith, 2008). Therefore, the primary aim of the study was to explore the test–retest reliability and minimal detectable change observed of selected functional fitness test items in an exclusively DS adult population.

2. Materials and methods

2.1. Participants

Forty-three adults with DS (24 men and 19 women) were recruited from three care centres for persons with intellectual disabilities (Huis Amelia, Uitkomsversorgd, Die Oord) in two provinces of South Africa. The study protocol was approved by the Health Research Ethics Committee (Humans) of the North-West University (NWU-00064-14-A1). The parent or legal representatives signed an informed consent form while the participant signed a consent form that was adapted for persons with intellectual disability. Professional caregivers working at the facility completed the health questionnaire (adapted Physical Activity Readiness Questionnaire). The questionnaire consists of seven questions regarding the health of the participant. If participants answered "yes" to any of the questions, a medical practitioner was contacted for further scrutiny. Individuals were included if they fulfilled the following inclusion criteria: Down syndrome, aged between 18 and 45 years, had the cognitive ability to understand and perform the exercises in a technically correct manner, if they provided written informed consent and lastly if they successfully completed the health questionnaire. Individuals were excluded if they suffered from congestive heart disease or any other physical, mental or medical condition that was considered a