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Effects of aerobic, resistance and balance training in adults with intellectual disabilities

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ABSTRACT

Adults with intellectual disability (ID) have decreased cardiovascular fitness and strength present with lower rates of physical activity (PA), and often have balance and functional impairments. The purpose of this study was to investigate the effect of a combined PA program (CPAP) utilizing aerobic, strength and balance training on cardiovascular fitness, strength, balance and functional measures in a controlled clinical trial. Adults with mild to moderate ID were assigned into either the intervention group (IG; $n = 37$) or the control group (CG; $n = 29$). The IG trained 3 day/week, 1 h/day over 14 weeks, while the CG did not participate in any exercise program. Cardiovascular fitness, strength, balance, flexibility and functional ability were assessed pre-post training. The IG increased cardiovascular fitness (26.8 vs. 29.3 ml kg^{-1} min^{-1}), handgrip strength (19.2 vs. 21.9 kg), leg strength, and balance following the training period ($p < .05$). Body weight (70.1 vs. 68.1 kg) and body mass index (27.4 vs. 26.6 kg m^{-2}) decreased ($p < .05$) in the IG group. The CG showed no changes in any parameter. These data suggest a combined aerobic, strength and balance exercise training program is beneficial among individuals with ID.

1. Introduction

Adults with intellectual disability (ID), as shown by several studies, have decreased cardiovascular fitness, lower rates of physical activity (PA) and higher incidence of obesity compared to persons without ID (Baynard, Pitetti, Guerra, Unnithan, & Fernhall, 2008; Draheim, Williams, & McCubbin, 2002b; Fernhall & Pitetti, 2001; Frey, 2004; Skowronski, Horvat, Nocera, Roswal, & Croce, 2009; Temple, Frey, & Stanish, 2006). This impaired fitness is associated with several factors such as a sedentary lifestyle, possible lack of motivation and task understanding, an unhealthy diet, decreased muscle strength, hypotonia, aerobic capacity, increased fat-free mass, an increased prevalence of cardiovascular diseases and lower insulin

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sensitivity (De Winter, Magilsen, Van Alfen, Penning, & Evenhuis, 2009; Flore et al., 2008; Pitetti & Boneh, 1995; Skowronski et al., 2009).

Similar to the general population, cardiovascular disease is a problematic health concern with high morbidity and mortality rates for individuals with ID (Draheim, 2006; Patja, Molsa, & Iivanainen, 2001; Van den Akker, Maaskant, & Van der Meljdem, 2006). Furthermore, these disease rates have not declined among individuals with ID as they have compared to the general population (Draheim, 2006; Janicki, Dalton, Henderson, & Davidson, 1999). One contributing factor to this increased disease risk may be the high rates of obesity among persons with ID. In the United States, between 1997 and 2000, the rate of obesity (body mass index $\geq 30.0\ kg\ m^{-2}$) was 35% in persons with ID versus 21% in the general population (Yamaki, 2005). Related to obesity, physical inactivity and overnutrition also play an important role in cardiovascular disease risk (Sohler et al., 2009; Van Schrojenstein Lantman-de Valk, Linehan, Kerr, & Noonan-Walsh, 2007). Individuals with ID who participated in more frequent bouts of PA or who consumed lower dietary fat intakes lowered their risk for hyperinsulinemia and abdominal obesity by one third compared to those who participated in less frequent PA or who consumed higher fat intakes (Draheim, Williams, & McCubbin, 2002a).

At the same time, motor problems, balance, and difficulties in the integration of perceptual information into motor action are common in persons with ID (Cleaver, Hunter, & Ouellette-Kuntz, 2009). These problems may result in inadequate solutions to daily tasks, increase in falls and injury risks (Carmeli, Bar-Yossef, Ariav, Levy, & Liebermann, 2008; Cox, Clemson, Stancliffe, Durvasula, & Sherrington, 2010). There is moderate to strong evidence that PA positively affects health-related physical fitness parameters, like balance, muscle strength and quality of life in individuals with ID (Bartlo & Klein, 2011; Chanias, Reid, & Hoover, 1998; Heller, McCubbin, Drum, & Peterson, 2011), which provides credence for physical activity recommendations in this population.

Several endurance training studies with people with ID have reported large positive effects on cardiovascular endurance and muscle endurance, with a small positive effect on body composition and flexibility (Calders et al., 2011; Chanias et al., 1998; Fernhall, 1993; Millar, Fernhall, & Burkett, 1993; Varela, Sardinha, & Pitetti, 2001). Other studies focused on strength training, found significant increases in muscle strength (handgrip strength, leg strength) and balance, and small positive effects on body composition among individuals with ID (Carmeli, Zinger-Vaknin, Morad, & Merrick, 2005; Shields, Taylor, & Dodd, 2008; Suomi, 1998; Tsimaras & Fotiadou, 2004). Combined cardiovascular and strength exercise training programs have shown significant improvements in peak oxygen consumption (VO_2 peak), muscular strength, endurance and a slight reduction in body weight and fat mass (Calders et al., 2011; Elmahgoub et al., 2009; Mendonca, Pereira, & Fernhall, 2011; Rimmer, Heller, Wang, & Valerio, 2004). Specifically, Calders et al. (2011) demonstrated greater improvement in strength measures, functional measures, systolic blood pressure and total cholesterol using a combined aerobic-resistance training protocol (12 week) over an endurance –only training group, while both the combined and endurance-only training groups ($n = 15$ each group) experienced similar increases in aerobic capacity. Collectively, these studies suggest exercise training, and perhaps combined resistance-aerobic training, is beneficial in individuals with ID.

However, no substantially larger samples of adults with ID, with and without Down syndrome (DS), were reported in previous studies where combined aerobic, strength and balance exercise training was used during the intervention. The purpose of our study was to conduct a large controlled clinical trial to evaluate the effects of a combined PA program (CPAP) including aerobic, strength and balance training on aspects of fitness, such as aerobic fitness, strength, flexibility, balance, and anthropometrics versus a control group.

2. Methods

2.1. Participants

The 92 adults (51 males/41 females), from an Occupational Day Center for people with ID (Girona, Spain), between 20 and 60 years old, with mild to moderate ID were invited to participate in the present study. Most frequent activities in this center involved light physical work for 6–7 h/week. Exclusion criteria included contraindications to exercise, severe to profound ID and medication that may have an important effect to their physical response to exercise. All participants and parents and/or legal guardians signed an informed consent to participate. After signing the informed consent a health screening questionnaire was completed by each participant's parent(s) and/or guardian.

2.2. Study design

After the initial screening, 20 individuals out of 92 were not enrolled due to gait/mobility problems, or exercise medical contraindications, and/or use of medicines that may have an important effect to their physical response to exercise, which left a total of 72 adults with ID that met the study criteria to participate in the study. They were assigned to the intervention and/or control groups (IG or CG) taking into account the decision of the participants to be part of the exercise program as well as considering the institution's timetable which conditioned the organization of both groups. In the present study we used an attention-control clinical trial design.

The intervention group (IG) with 37 participants, followed a CPAP that included a combination of aerobic, strength and balance training over 14 weeks, at 1 h per session, 3 times a week. All the participants presented with ID, but in 25 participants we were not able to classify the cause of ID etiology. The other 12 were diagnosed as Down syndrome ($n = 9$),