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Energy expended by adults with and without intellectual disabilities during activities of daily living

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ABSTRACT

The aims of this study were to (1) determine the energy expenditure of adults with and without intellectual disabilities during common activities of daily living (ADL), (2) use these values to evaluate the accuracy of equivalent activity values reported in the Compendium of Physical Activities (CPA), and (3) identify ADL that may confer a health benefit for adults with intellectual disabilities when undertaken regularly. Energy expenditure was measured for adults with intellectual disabilities ($N = 31$; 29.0 ± 8.6 yr) and adults without intellectual disabilities ($N = 15$; 30.4 ± 9.6 yr) while undertaking each of seven ADL: sitting quietly (SitQ); sitting watching television (SitTV); sitting and standing while completing an assembly task (SitAT, StaAT); and walking at a slow (WalkS, 3.0 km h^{-1}), quick (WalkQ, 6.0 km h^{-1}) and fast (WalkF, 9.0 km h^{-1}) speed, under laboratory conditions. Adults with intellectual disabilities were found to expend significantly more energy than adults without intellectual disabilities for SitQ, WalkS, WalkQ and WalkF ($p < 0.05$). Energy expended by both populations was significantly more than CPA values for SitQ, SitTV, SitAT, WalkS, and WalkQ ($p < 0.02$) and significantly less for WalkF ($p < 0.01$). Walking at the speed of 3.0 km h^{-1} (50 m min^{-1}) was found to be sufficient to achieve moderate-intensity energy expenditure, surpassing the intensity threshold for conferring a health benefit. Energy expenditure inaccuracies of the CPA have important consequences when estimating prevalence of engagement in health enhancing physical activities among population subgroups. The identification of slow walking as a moderate-intensity physical activity offers significant health promotion opportunities for adults with intellectual disabilities through active transport and leisure.

1. Introduction

1.1. Physical activity and health

Emerging evidence suggests that people with intellectual disabilities experience markedly more health ailments and risks than the general population (van Schrojenstein Lantman-de Valk, 2009). The protective effect on the biological, psychological, and sociological health of people from regular participation in physical activity is well established (Dunn, Trivedi, & O'Neal, 2001; National Preventative Health Taskforce, 2009). Sedentary behaviour (physical inactivity) has been found to independently contribute to the burden of disease (Hamilton, Hamilton, & Zderic, 2007). Combined, these human behaviours represent fundamentally important determinants of health, particularly for individuals with a disability (Beange,

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McElduff, & Baker, 1995; Pitetti, Rimmer, & Fernhall, 1993). Yet research focussed on adults with intellectual disabilities and physical activity is very limited (Temple, Stanish, & Frey, 2006), and this limitation continues to constrain efforts to create evidence-based, health-focussed programs for adults with intellectual disabilities (Centers for Disease Control and Prevention, 2007).

Few nation-specific physical activity guidelines exist that include adults with disabilities, however the United States of America Physical Activity Advisory Committee recommend all adults, including those with disabilities, participate in at least 150 min of moderate-intensity physical activity per week (US Department of Health & Human Services, 2008). While the meaning of the time element of this prescription is self-evident, understanding of intensity as related to energy expenditure during physical activity is less well understood (Behrens, Dinger, Heesch, & Sisson, 2005; Centers for Disease Control and Prevention, 2009a). In respect to physical activity, absolute intensity is defined relative to energy expenditure (Centers for Disease Control and Prevention, 2009b), most often using a unit of measurement known as a metabolic equivalent (MET) (Ainsworth et al., 2000). Categorisation of energy expenditure has occurred, with 'rest' being 1.0 MET, and light-, moderate- and vigorous-intensity physical activity being 1.1–2.9 METs, 3–5.9 METs and 6+ METs, respectively (Ainsworth et al., 2000). A listing of energy expenditure estimates for adults for typical work-, leisure-, home- and community-related activities of daily living (ADL) has been developed and is reported in the Compendium of Physical Activities (CPA) (Ainsworth et al., 2000).

1.2. Energy expenditure during ADL

Despite widespread acceptance and use of the CPA in market-developed countries, researchers and public health officials have questioned the effect of gender, age, and disability on energy expenditure among adults (Brown, Ringuet, Trost, & Jenkins, 2001; Mil et al., 2000; Ohwada, Takeo, Suzuki, Yokoyama, & Ishimaru, 2005; Pi-Sunyer, 2000). Specifically, energy expenditure rates assigned to rest, household tasks, walking, leisure and occupational activities have been reported to be different for some within population sub-groups, including women (Brown et al., 2001; Buchholz, Rafii, & Pencharz, 2001; Manini et al., 2006), people aged 60 years or more (Yue et al., 2007) and people with disabilities (Brooks et al., 2004; Brown et al., 2001).

Variability in energy expenditure during ADL has been identified among sub-groups with the population of people with disabilities. Adult men with intellectual disabilities were found to expend more energy during sitting, standing and walking than gender, age, height and weight matched counterparts without a disability (Iwaoka et al., 1998). In a follow-up study, excess body movement by adult males with intellectual disabilities while undertaking these tasks was revealed as the cause of higher energy expenditure when compared to adult males who did not have intellectual disability (Ohwada et al., 2005). At rest, energy expenditure was found to be significantly lower in people with Down syndrome compared to adults without Down syndrome (Allison et al., 1995). Likewise during walking, biomechanical inefficiencies and higher energy expenditure at various speeds was found among these individuals (Agiovlasitis, McCubbin, Yun, Pavol, & Widrick, 2009). In contrast, others found no difference in energy expenditure at rest (Fernhall et al., 2005), or while walking (Mendoça, Pereira, & Fernhall, 2009), existed for adults with and without Down syndrome. Combined, the limited research suggests the current evidence about the energy expended by adults with intellectual disabilities is inconclusive, and in turn the energy expenditure rates reported in the CPA and commonly applied to adults with intellectual disabilities may be misleading, or at least remain to be confirmed as accurate.

1.3. Study objectives

Worldwide, public health campaigns are underway to encourage more participation in moderate-intensity physical activity and less in sedentary behaviour (Bauman and Craig, 2005). Commonly, these campaigns typically target groups identified as engaging in insufficient physical activity, and the identification is most often determined by population-based survey approaches that are underpinned by energy expenditure rates referenced from the CPA. To obtain accurate population-level physical activity participation data for adults with intellectual disabilities, there is an immediate need to determine the energy expenditure by adults with intellectual disabilities during ADL. Furthermore, in order to be able to support adults with intellectual disabilities to engage in ADL that generate moderate-intensity energy expenditure and confer some health benefit, it is first necessary to know which activities generate this physiological response. Together, this information will enable evidence-based decisions to be made regarding physical activity participation and guide recommendations in health promotion (van Schrojenstein Lantman-de Valk, 2009; Yue et al., 2007), as well as impact on the identification of those in need of physical activity intervention programs. Therefore, the purpose of this study was to objectively measure the energy expended by adult men and women with and without intellectual disabilities undertaking common ADL, under controlled laboratory conditions, and compare these values to those reported in the CPA and identify which activities cause moderate-intensity energy expenditure.

2. Methods

2.1. Ethical approval

Prior to the commencement of this study, approval for all procedures was gained from the Royal Melbourne Institute of Technology (RMIT University) Human Research Ethics Committee. Participants and/or legal guardians provided informed