Research in Developmental Disabilities 35 (2014) 2858–2883

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Review article

Gait characteristics in individuals with intellectual disabilities: A literature review

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ARTICLE INFO

Article history:
Received 8 May 2014
Accepted 7 July 2014
Available online

Keywords:
Gait
Walking
Instruments
Intellectual disabilities

ABSTRACT

Gait is a functionally highly relevant aspect of motor performance. In the general population poorer gait increases the risk of falls and is a predictor for future disability, cognitive impairment, institutionalization and/or mortality. People with intellectual disabilities (ID) show a delayed motor development, which brings to attention the abnormalities that might accompany gait in this population throughout childhood and adulthood. Therefore, this paper aims (a) to provide a focused review of the available literature on gait characteristics in individuals with ID and (b) to gain insight into available instrumentations measuring gait in this population. We searched the database of PubMed for relevant articles and the reference lists of included articles, resulting in 44 included articles. Forty one studies reported gait characteristics during over-ground walking and six studies during perturbed walking conditions. Most studies investigated syndrome-specific ID populations, only five studies investigated the general ID population. The studies show that gait abnormalities are evident during over-ground walking in the ID population, both in people with genetic syndromes and with ID without genetic syndromes. During perturbed conditions people with ID altered their gait with stability-enhancing adaptations. Abnormalities in gait may be partly explained by physical features, but the interrelatedness between gait and cognition may also be an explanation for the gait abnormalities seen in the ID population. Further research regarding gait characteristics of the ID population, and its relation to cognitive functioning, and adverse health outcomes is needed.

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http://dx.doi.org/10.1016/j.ridd.2014.07.017
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1. Introduction

Intellectual disability (ID) has been reported by the American Psychiatric Association to have an overall prevalence of approximately 1%, and is defined as "a disorder with onset during developmental period that includes both intellectual and adaptive functioning deficits in conceptual, social, and practical domains" (American Psychiatric Association, 2013). Despite the fact that this definition does not include a direct association to physical and motor functioning of individuals with ID, this topic has been lately given a considerable attention (Blomqvist, Olsson, Wallin, Wester, & Rehn, 2013; Hartman, Houwen, Scherder, & Visscher, 2010; Rintala & Loovis, 2013; Smits-Engelsman & Hill, 2012; Vuijk, Hartman, Scherder, & Visscher, 2010; Westendorp, Houwen, Hartman, & Visscher, 2011).

Delayed motor development is displayed by the children in this population (Molnar, 1978). While it is unlikely that cognition alone is the sole mechanism for the motor delay (Hreidarsson, Shapiro, & Capute, 1983), an association between cognitive and motor performance has been reported (Vuijk et al., 2010; Wuang, Wang, Huang, & Su, 2008). Individuals with lower measured Intelligence Quotient (IQ) more often showed poorer motor performance and needed more time to learn a motor task, than those with a higher measured IQ (Rousey & Eyman, 1995; Smits-Engelsman & Hill, 2012; Westendorp et al., 2011). This conclusion is supported as well by Hartman et al. (2010) who found that executive functioning in children with ID was impaired, and this was interrelated with the motor domain.

An intellectual disability could originate from a range of causes both genetic and environmental, resulting in a very heterogeneous population (Bessa, Lopes, & Maciel, 2012). When ID is associated with a genetic syndrome, there may be characteristic physical features (American Psychiatric Association, 2013). For example, children and adolescents with Down syndrome (DS) exhibit insufficient motor ability (Spanò et al., 1999; Wang, Long, & Liu, 2012). They acquire gross motor skills at a different age than their peers of typical development (TD), with the more complex the skills, the greater the time difference (Pereira, Basso, Lindquist, da Silva, & Tudella, 2013). Furthermore, less functional postural strategy is exhibited in DS over the age continuum (Rigoldi, Galli, Mainardi, Crivellini, & Albertini, 2011b), with a worse static and dynamic balance and a wide variability (Villarroya et al., 2012). This trend also extends to older persons with DS as they present poor sensory-motor performance (Carmeli, Ariav, Bar-Yossef, Levy, & Imam, 2012). People with Williams Syndrome (WS), Fragile-X syndrome, and Prader–Willi Syndrome (PWS) also achieve milestones in gross motor skills at a later stage in life (Largo & Schinzel, 1985; Plissart & Fryns, 1999; Reus et al., 2011). Furthermore, in certain genetic disorders such as Rett syndrome, there are periods of worsening (American Psychiatric Association, 2013), such as losing functional gross motor skills that have been already achieved (Foley et al., 2011; Hanks, 1990; Kerr, 1995).

Both also in children and adults with ID without genetic causes, motor performance seemed to be affected. Functional locomotor skills such as running, hopping, leaping, jumping, and walking were found to be less well developed in the ID population (Hartman et al., 2010; Rintala & Loovis, 2013; Spanò et al., 1999). Previously it was reported that children with ID show a significant delay in the mean age of walking onset compared to their peers of TD, with a later onset of walking with more severe ID (Hreidarsson et al., 1983). Such delayed walking skills bring to attention the abnormalities that might accompany gait in this population throughout childhood and adulthood. Gait is a functionally highly relevant aspect of motor performance, and has been linked to the level of functioning and to morbidity in the general older adult population, where poorer gait not only increased the risk of multiple falls (Callisaya et al., 2011), but also predicted future disability, cognitive impairment, institutionalization and/or mortality (Abellan van Kan et al., 2009). However, the predictive value of gait parameters in the general older population is based on a decline in physical fitness and general functioning during the aging process, while people with ID experience lifelong levels of low physical fitness (Black, Smith, Wu, & Ulrich, 2007; Golubovic, Maksimovic, Golubovic, & Glumbic, 2012; Hilgenkamp, van Wijck, & Evenhuis, 2012; Lahtinen, Rintala, & Malin, 2007; Oppewal, Hilgenkamp, van Wijck, & Evenhuis, 2013; Salaun & Berthouze-Aranda, 2012) and probably have learned different compensation strategies (Black et al., 2007; Rigoldi, Galli, & Albertini, 2011; Smith, Stergiou, & Ulrich, 2011). This might alter the way gait parameters need to be interpreted in people with ID, for example in relationship to falls. Additionally, next to being a physical function, gait has to be recognized as a cognitive function as well, considering that it

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