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Relationship between physical activity and physical fitness in school-aged children with developmental language disorders

Anneke G. van der Niet [a,*], Esther Hartman [a], Ben J. Moolenaar [b], Joanne Smith [a], Chris Visscher [a]

[a] Center for Human Movement Sciences, University of Groningen, University Medical Center Groningen, A. Deusinglaan 1, 9713 AV Groningen, The Netherlands
[b] School of Sport Studies, Hanze University of Applied Sciences, Zernikeplein 7, 9747 AS Groningen, The Netherlands

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ABSTRACT

Children with developmental language disorders (DLD) often experience difficulty in understanding and engaging in interactive behavior with other children, which may lead to reduced daily physical activity and fitness levels. The present study evaluated the physical activity and physical fitness levels of 8–11 year old children with DLD ($n = 27$) and compared this to typically developing (TD) age and gender matched controls ($n = 27$). In addition, it was investigated whether interrelationships existed between physical activity and physical fitness in children with DLD and in TD children. Physical activity was measured using accelerometers. Physical fitness was measured using five tests of the Eurofit test battery (standing broad jump (SBJ), sit-ups (SUP), handgrip (HG), 10×5 m shuttle run (10×5 m SR), and the 20 m shuttle run test (20 m SR)). Physical activity of children with DLD did not significantly differ from TD children. Physical fitness of children with DLD was significantly lower on the SBJ, SUP, HG and 10×5 m SR than TD controls, while no significant difference was found on the 20 m SR. Strong significant relationships were found between physical activity variables and sedentary behavior and some physical fitness measures (SBJ and SUP) in children with DLD, while in TD children a strong significant relationship was found between time spent in moderate to vigorous physical activity and performance on the SBJ. This study reveals important differences in fitness between children with DLD and TD children, which should be taken into account when creating physical activity interventions. Special attention has to be paid to children with DLD who show low physical activity and low physical fitness performance.

1. Introduction

Language is a complex social behavior that requires a combination of motor and perceptual processes (Jacob, 2013). Language competency is important for the application of social communication skills and the initiation and maintenance of interpersonal relationships (Marton, Abramoff, & Rosenzweig, 2005), as well as for inner speech and thought. Children with

* Corresponding author at: Center for Human Movement Sciences, University Medical Center Groningen, Section F, P.O. Box 196, 9700 AD Groningen, The Netherlands. Tel.: +31 050 363 8903; fax: +31 050 363 3150.
E-mail addresses: a.g.van.der.niet@umcg.nl (A.G. van der Niet), e.hartman@umcg.nl (E. Hartman), b.j.moolenaar@pl.hanze.nl (B.J. Moolenaar), j.smith@umcg.nl (J. Smith), c.visscher@rug.nl (C. Visscher).

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developmental language disorders (DLD) are characterized by delayed language in the absence of a mental or physical handicap or a specific sensory or emotional cause (Bishop, 1992). Due to this language delay, children with DLD face major challenges during their development and are at risk for behavioral and social difficulties (Lindsay, Dockrell, & Strand, 2007). The prevalence of language delay in children in the Netherlands has been estimated to be between 5 and 10% (Reep-Van den Berg, de Koning, de Ridder-Sluiter, van der Lem, & van der Maas, 1998), and is more likely to affect boys than girls. Individuals with DLD show nonverbal intelligence quotients in the average range. However, DLD are not limited to language, but co-occur with other disorders such as Attention Deficit Hyperactivity Disorder (Ullman & Pierpont, 2005). Furthermore, there is increasing evidence that children with DLD also have difficulties with nonlinguistic tasks like nonverbal executive functions (Henry, Messer, & Nash, 2012) and motor skills (Visscher, Houwen, Scherder, Moolenaar, & Hartman, 2007; Webster et al., 2006). This might be explained by a common genetic risk or by neurologic deficits (Bishop, 2002; Diamond, 2000), but also by environmental factors, as communication difficulties negatively influence social acceptance and participation in play activities and organized sport (Fujiki, Brinton, Hart, & Fitzgerald, 1999; Laws, Bates, Feuerstein, Mason-Apps, & White, 2012). Children with communication problems are therefore more likely to avoid activities that involve social interaction, which may result in less or less variable physical activity and consequently lower physical fitness levels.

Physical activity is defined as all bodily movement produced by the muscular system that increases energy expenditure above normal physiological demands (Ortega, Ruiz, Castillo, & Sjöström, 2008), while physically inactive or sedentary behavior is marked by low energy expenditure. Physical activity can vary in type, duration and intensity (light, moderate, vigorous). Physical fitness is a set of attributes associated with the capacity to perform a variety of physical activities (Chaddock, Pontifex, Hillman, & Kramer, 2011; Ortega et al., 2008). Physical fitness consists of several dimensions of which muscular strength, muscular endurance, speed and cardiovascular endurance are the most important. Physical fitness and physical activity have been related to general health and mental well-being in children (Ortega et al., 2008; Strong et al., 2005). Besides, it is suggested that being physically active is important for the cardiovascular fitness of children (Andersen, Riddoch, Kriemler, & Hills, 2011; Strong et al., 2005). For example, it has been found that typically developing (TD) children aged 7–10 years who showed high levels and intensity of physical activity had less risk to develop overweight or obesity and performed better on an aerobic fitness test (Hussey, Bell, Bennett, O'Dwyer, & Gormley, 2007).

To date, no studies have investigated the daily physical activity behavior of children with DLD. In addition, there is little information on the physical fitness levels of these children. An observational study on playground behavior showed that children with DLD aged 7–11 years were less active than their TD peers (Fujiki, Brinton, Isaacson, & Summers, 2001). They also showed that children with DLD spent significantly more time isolated from peers, and that children with DLD were not able to compensate for their language difficulties by engaging in nonverbal games. Furthermore, it is possible that withdrawal from physical activity opportunities as a consequence of language and possible comorbid motor impairment, will result in fewer opportunities to improve existing and develop new physical abilities. This can affect functioning in daily life, and may result in decreased physical fitness levels in DLD children compared to their TD peers (see also Golubović, Maksimović, Golubović, & Glumbić, 2012; Hands & Larkin, 2006). In a study on sensorimotor function, it was found that children with mild DLD performed significantly worse on a vertical jump test compared to TD peers, probably due to a deficient ability to coordinate the leg muscles (Müürsepp, Aibast, Gapeyeva, & Pääsuke, 2014). However, children with mild DLD showed similar performance on a handgrip strength test compared to TD peers (Müürsepp et al., 2014). This test measures static force generation capacity. No other physical fitness measures were analyzed in the study by Müürsepp et al. (2014). In addition, it remains unclear how the fitness performances are related to physical activity behavior of children with DLD.

So far, no studies have evaluated the developmental profiles of children with DLD across physical activity and physical fitness domains. The aim of the current study was to evaluate physical activity and physical fitness of children with DLD and compare these results to age and gender matched TD children. In addition, we investigated whether interrelationships exist between physical activity and physical fitness of children with DLD and TD children. It was hypothesized that children with DLD would be less physically active and less physically fit than their TD peers. Furthermore, it was hypothesized that more active children in both groups would have higher scores on physical fitness measures.

2. Materials and methods

2.1. Participants

A total of 36 children with DLD (26 boys, 10 girls) between 8 and 11 years old were recruited for this study. All children had been diagnosed as language-impaired, with both severe receptive and expressive deficits, and received special education for children with DLD in the northern Netherlands. Three children were excluded from analyses because they were categorized as having impaired hearing (loss of >35 dB), and six children were excluded as they had an IQ below 80. This resulted in a sample of 27 children (18 boys, 9 girls), of which 9 children were diagnosed with Attention Deficit Hyperactivity Disorder or Attention Deficit Disorder. Table 1 shows the scores on two subtests of the CELF-4-NL (Clinical Evaluation of Language Fundamentals-4th edition-NL) (Kort, Schittekatte, & Compaan, 2008) and the PPVT-3-NL (Peabody Picture Vocabulary Test-3rd edition-NL) (Schlichting, 2005), for all participants and boys and girls separately. No statistical differences were found between boys and girls on non-verbal intelligence quotient (IQ) and scores on the CELF-4-NL subtests and PPVT-3-NL (Table 1).