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Handwriting capacity in children newly diagnosed with Attention Deficit Hyperactivity Disorder

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ABSTRACT

Preliminary evidence suggests that children with Attention Deficit Hyperactivity Disorder (ADHD) may exhibit handwriting difficulties. However, the exact nature of these difficulties and the extent to which they may relate to motor or behavioural difficulties remains unclear. The aim of this study was to describe handwriting capacity in children newly diagnosed with ADHD and identify predictors of performance. Forty medication-naïve children with ADHD (mean age 8.1 years) were evaluated with the Evaluation Tool of Children's Handwriting-Manuscript, the Movement Assessment Battery for Children (M-ABC), the Developmental Test of Visual Motor Integration (VMI) and the Conner Global Index. An important subset (85.0%) exhibited manual dexterity difficulties. Handwriting performance was extremely variable in terms of speed and legibility. VMI was the most important predictor of legibility. Upper extremity coordination, as measured by the M-ABC ball skills subtest, was also a good predictor of word legibility.

Conclusion: Poor handwriting legibility and slow writing speed were common in children newly diagnosed with ADHD and were associated with motor abilities. Future studies are needed to determine whether interventions, including stimulant medications, can improve handwriting performance and related motor functioning.

1. Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is the most common neurobehavioural disorder encountered in childhood with an estimated prevalence ranging from 3% to 12% of the school-age population (Faraone, Sergeant, Gillberg, & Biederman, 2003). Symptoms of ADHD include lack of sustained attention, forgetfulness, disorganization, distractibility, restlessness and impulsivity. This disorder appears as a single diagnosis, and as a comorbidity with a variety of other diagnoses, including Oppositional Defiant Disorder, Anxiety Disorder (August, Realmuto, MacDonald, Nugent, & Crosby, 1996) and Developmental Coordination Disorder (DCD) (Pitcher, Piek, & Hay, 2003; Watemberg, Waiserberg, Zuk, & Lerman-Sagie, 2007). Discrete motor difficulties and differences in motor processes have also been described in this population (Buderath et al., 2009; Piek, Pitcher, & Hay, 1999; Pitcher et al., 2003; Schoemaker, Ketelaars, van Zonneveld, Minderaa, &

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Mulder, 2005). It is increasingly appreciated that academic productivity, leisure and recreational activities, and social-emotional well-being are negatively impacted by this condition (Barkley, 1998). Nevertheless, the extent to which these motor differences and/or difficulties contribute to the presence of activity limitations in everyday meaningful activities has not been explored.

Handwriting is an example of an important life skill that if impaired, can lead to academic challenges or failure and diminished self esteem (Maeland, 1992). Although most children are now exposed to computers at an early age, handwriting is still used on a daily basis in the classroom and everyday life. Research has shown that children spend 31–60% of their school days performing fine motor tasks, and 85% of this time is devoted to paper–pencil tasks such as handwriting (McHale & Cermak, 1992). This has not changed much in the last decade, despite the increasing integration of computers into the school environment. Traditional handwriting is still the primary medium of written expression required by teachers (Latio, 2009).

Handwriting is a complex task that requires the integrity of different sensorimotor components to be performed successfully. Kinaesthesia (Levine, Oberklaid, & Meltzer, 1981; Tseng & Cermak, 1993), motor planning (Tseng & Murray, 1994), in-hand manipulation (Cornhill & Case-Smith, 1996), and visual-motor skills (Cornhill & Case-Smith, 1996; Tseng & Murray, 1994; Weil & Amundson, 1994) were all identified as being associated with good handwriting legibility in typically developing children. Cognitive and psychosocial components are also known to influence handwriting performance (Amundson & Weil, 2001).

Handwriting difficulties are not specific to children with ADHD. Estimates of the incidence of poor performance in typically developing children have ranged from 10% to 30% (Karlsdottir & Stefansson, 2002). Preliminary evidence suggests that handwriting deficits in terms of speed and legibility are not uncommon in children with ADHD. Nevertheless, the majority of studies that have examined this important life skill in this population have only utilized observational evaluations of handwriting in small samples of children. Furthermore, children studied were often being treated with psychostimulant medications, which could have influenced handwriting performance parameters (Tucha & Lange, 2001). The precise nature of handwriting difficulties and the predictors of performance remain unclear at this point (Brossard-Racine, Majnemer, Shevell, & Snider, 2008). The relationship between the role of underlying motor impairments and handwriting capacity remains to be determined in this population. Since children with ADHD are already at higher risk for learning difficulties, poor handwriting legibility and speed may further challenge their learning progress. Therefore, the objectives of our study were: (1) to describe the handwriting legibility and speed of children newly diagnosed with ADHD using a standardized measure; and (2) to determine the extent to which these difficulties are associated with motor skills and behavioural difficulties in this population.

2. Methods

2.1. Participants

Children 6–11 years of age, newly diagnosed with ADHD were recruited for this study. Recruitment took place in the Montreal region, a bilingual environment, and therefore both French-speaking and English-speaking children were invited to participate. Exclusion criteria included children with: (a) an intellectual quotient (IQ) <80; (b) currently taking daily medication that may have an effect on behaviour or motor skills (e.g. psycho-stimulants, anti-epileptics); (c) a congenital malformation affecting the dominant upper limb or using a support (hand splint or prosthesis) to improve hand function; (d) a co-existing neurological or developmental disorder associated with an established developmental disability (e.g. cerebral palsy, pervasive developmental disorder, genetic syndrome, Gille de la Tourette syndrome); (e) currently using cursive handwriting for more than 2 months at school, and (f) current or prior receiving rehabilitation services addressing handwriting or motor performance. Ethical approval from the Montreal Children's Hospital Research Ethics Board was obtained, as well as scientific approval from the Montreal Children's Hospital Research Institute.

2.2. Measures

2.2.1. Handwriting

The Evaluation Tool of Children's Handwriting-Manuscript (ETCH-M) (Amundson, 1995) is a criterion-referenced standardized tool developed to assess children's handwriting speed and legibility, with 7 specific tasks similar to those required in the classroom. These tasks include: writing the alphabet from memory using lower and upper case letters, writing numerals from memory (1–12), a near-point and a far-point copying task, the dictation of non-words and numbers and sentence composition. Word, letter and numeral legibility are scored according to specific criteria for each task and are reported on an ordinal scale that ranges from 0% to 100% (or 0 to 1). The percent legibility for each task is averaged together, when appropriate, and gives a total percentage of legibility for word, letter and numeral. Time to complete each task is measured in seconds for the alphabet and numeral writing tasks and is then transformed to a speed score as represented by number of letters per minute for the two copying tasks and the sentence composition task. Content validity has been established in three pilot editions of the instrument. The inter-rater reliability was acceptable (Pearson coefficients average $r = 0.84$) between experienced raters (Feder & Majnemer, 2003). Pearson coefficients for test–retest reliability was between $r = 0.63$ and 0.77. The reliability estimates for legibility was more consistent for the total score than for the individual tasks (Diekema, Deitz, & Amundson, 1998).