Motor Functioning in Children with Autism Spectrum Disorder

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Autism spectrum disorder (ASD), a group of neurodevelopmental disorders that are characterized by deficits in social interaction, communication, and repetitive behavior, is one of the most frequently observed disorders in childhood (American Psychiatric Association, 2000) [1]. The latest report from the Centers for Disease Control and Prevention (CDC) on March 27, 2014 [2] reveal that surveillance studies identified 1 in 68 children (1 in 42 boys and 1 in 189 girls) as having ASD (CDC, 2014) [2]. Although motor impairments are not currently considered as core symptoms of ASD, it is of great importance not to ignore them due to the high prevalence rates and significant impacts on social development and quality of life (Lai, Lombardo, Baron-Cohen, 2014) [3]. It is estimated that 21 to 100% of children with ASD display a number of different motor deficits (Green et al., 2009; Pan, 2009), suggesting that motor impairment is a significant, but variable deficit among children with ASD.

Studies reveal that motor abnormalities in ASD can occur very early in developmental trajectory (Brian et al., 2008) [4] and be persistent over time (Fournier, Hass, Naik, Lodha, Carraugh, 2010; Van Waervelde, Oostra, Dewitte, Van Den Broeck, Jomans, 2010) [5, 6]. Clumsiness and a delay of fundamental motor skills development are commonly observed in children with ASD. Coordination of precision grip in 2-6 years-old children with autism spectrum disorders compared to children developing typically and children with developmental disabilities [7]. Although the Diagnostic and Statistical Manual of Mental Disorders, 4th Text Revision (DSM-IV-TR, American Psychiatric Association, 2000) [1] suggest that Asperger’s disorder, but not Autism, is associated with motor clumsiness, current evidence finds that both clinical groups are uncoordinated and exhibit motor deficits (e.g., Jansiewicz et al., 2006) [8]. More recent studies even suggest that motor difficulties should be considered as a “cardinal feature” of ASD (e.g., Fournier, Hass, Naik, Lodha, Carraugh, 2010) [5]. However, minimal description of motor impairment has been addressed in current diagnostic systems (e.g., DSM-5, APA, 2013) [9]. The absence of motor impairment criteria and the lack of awareness on motor deficits in ASD may prohibit appropriate diagnosis and intervention.

Discussion of the motor dysfunction in ASD has typically focused on stereotyped and repetitive movements, such as hand flapping or body rocking (APA, 2000; Leary & Hill, 1996) [1, 10]. Stereotyped movement and repetitive postures, including nonfunctional arm wave and awkward “hand-to-ear” posture, are often observed among infants with ASD as early as 12 months (Loh et al., 2007) [11]. Although stereotyped and repetitive motor behavior is one of the diagnostic criteria for ASD, parents and mental health providers have commonly reported a wide range of motor problems, such as delays of motor milestones in early development and appearance of atypical motor patterns of both fine and gross motor skills (Lloyd, MacDonald, Lord, 2013) [12]. Clinically, infants with ASD often display gross motor delays in supine, prone, and sitting skills in their first year of life (Lane, Harpster, Heathcock, 2012) [13]. Delay in crawling, walking, and achieving other motor milestones are frequently observed in toddlerhood (Lloyd, MacDonald, Lord, 2013) [12]. In addition, difficulties in fine motor skills, such as reaching, clapping, and pointing are existed in individuals with ASD (Gernsbacher, Sauer, Geye, Schweigert, Hill Goldsmith, 2008) [14]. These motor difficulties persist well into childhood, affecting a wide range of sensorimotor tasks, such as playing with blocks and puzzles, turning doorknobs, handwriting, and ball catching, as well as tasks requiring balance, agility, and speed (Jansiewicz et al., 2006; Noterdaeme, Mildenberger, Minow, Amorosa, 2002) [8, 15]. Other motor deficits documented in empirical studies, including poor postural control (e.g., less static and dynamic symmetry standing position), abnormal gait (e.g., swing leg, waddling gait, etc.), atypical motor planning and sequencing (e.g., slow
preparation in simple goal-directed motor tasks), and oromotor impairments, are often critical signs to distinguish children with ASD (Bhat, Landa, Galloway, 2011; Downey & Rapport, 2012; Dziuk et al., 2007; Ozonoff et al., 2008) [16-20].

We believe that motor deficits should be considered as a core feature of ASD because they not only can be used to differentiate children with ASD from others with neurodevelopmental disorders (Fournier et al., 2010; Ozonoff et al., 2008) [5, 20], but also affect the development of functions that are critical to social, language and communication development (Dziuk et al., 2007) [18]. For example, difficulties with initiation of speech, slowness in responding to another person, or stopping or freezing during activities are examples of how movement disturbance influences social activities and communication. Stereotypic movements that seem to be unrelated to interactions (e.g., hand-flapping) may lead to misunderstanding that individuals with ASD are not interested in the interaction, but prefer to engage in repetitive behaviors.

Recent studies reveal that the motor impairment profile predicts the severity of core ASD symptoms. It has been found that the scores on motor development in infancy relate to the rate of language and communicative impairments in children who were later diagnosed with ASD (Leonard, Bedford, Pickles, Hill, 2015) [19]. Early fine motor skill development predicts later language, visuospatial cognition, and object exploration (Hellendoorn et al., 2015) [21]. The severity of motor deficits correlates with the degree of social withdrawal and the severity of social abnormality (Freitag, Kleser, Schneider, Von Gontard, 2007) [22]. Moreover, neuroimaging data support the link between motor dysfunction and other core symptoms of ASD. Areas of the brain implicated in language functions (e.g., Broca's area) are found to be involved in motor tasks (e.g., the execution, imagination, imitation, and observation of finger movements (Heiser, Iacoboni, Maeda, Marcus, Mazziotta, 2003) [23]. Similarly, brain structures related to motor functioning are activated during language tasks (Iacoboni & Wilson, 2006) [24]. All the evidence strongly suggests a close link between motor impairments and ASD symptomology, although, at this point, it is difficult to determine the influence of one on the other, as well as how they might influence each other.

In sum, there is an emerging evidence suggests that motor deficits should be considered as one of the core symptoms of ASD (e.g., Downey & Rapport, 2012) [17], though the current diagnosis criteria have minimal description of motor impairment in ASD. Since motor abnormalities and delays in motor milestones often present within the first year of life and usually precede communicative or social deficits (Leary & Hill, 1996) [10], evaluations on children's motor functioning can assist with early identification and monitoring intervention progress (Esposito & Pasca, 2013) [25]. It has been reported that approximately 70% of high-risk infants (i.e., siblings with ASD) who presented with early motor delays developed deficits in communication later in their life (Bhat, Galloway, Landa, 2012) [26]. Better motor performance in 2-year-old children with ASD predicts better outcomes later at the age of 4 (Sutera et al. (2007) [27]. Taking together, we believe that motor functioning is an important piece in the overall picture of ASD symptomology. Future studies aimed to uncover motor functioning in children with ASD are warranted for early identification, intervention development, and prognosis prediction of ASD.
References
2 Centers for Disease Control and Prevention (2014) CDC estimates 1 in 68 children has been identified with autism spectrum disorder.