

Motor Functioning in Children with Autism Spectrum Disorder

Chi-Mei Lee¹ and Jin Bo^{1,2}

Received: September 25, 2015; **Accepted:** October 01, 2015; **Published:** October 07, 2015

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, Cauraugh, 2010; Van Waelvelde, Oostra, Dewitte, Van Den Broeck, Jongmans, 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, Cauraugh, 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

1 Department of Psychology, Eastern Michigan University, 341 MJ Science Building, Ypsilanti, MI 48197, United States

2 Center for Human Growth and Development, University of Michigan, 300 N. Ingalls Street, Ann Arbor, MI 48109, United States

Corresponding author: Jin Bo

✉ jbo@emich.edu

Eastern Michigan University, 341 MJ Science Building, Ypsilanti, MI 48197, United States.

Tel: 734-487-3416

Fax: 734-487-1155

Citation: Lee CM, Jin Bo. Motor Functioning in Children with Autism Spectrum Disorder. *Acta Psychopathol.* 2015, 1:2.

(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, Mildenerger, 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

- 1 American Psychiatric Association (2000) Diagnostic and statistical manual of mental health disorders, Text Revision (DSM-IV-TR) (Forth Edition ed.) Washington.
- 2 Centers for Disease Control and Prevention (2014) CDC estimates 1 in 68 children has been identified with autism spectrum disorder.
- 3 Lai MC, Lombardo MV, Baron-Cohen S (2014) Autism. *Lancet* 383: 896-910.
- 4 Brian J, Bryson SE, Garon N, Roberts W, Smith IM, et al. (2008) Clinical assessment of autism in high-risk 18-month-olds. *Autism* 12: 433-456.
- 5 Fournier KA, Hass CJ, Naik SK, Lodha N, Cauraugh JH (2010) Motor coordination in autism spectrum disorders: a synthesis and meta-analysis. *Journal of Autism and Developmental Disorders* 40: 1227-1240.
- 6 Van Waelvelde H, Oostra A, Dewitte G, Van Den Broeck C, Jongmans MJ (2010) Stability of motor problems in young children with or at risk of autism spectrum disorders, ADHD, and or developmental coordination disorder. *Developmental Medicine and Child Neurology* 52: e174-178.
- 7 David FJ, Baranek GT, Wiesen C, Miao AF, Thorpe DE (2012) Coordination of precision grip in 2-6 years-old children with autism spectrum disorders compared to children developing typically and children with developmental disabilities. *Front Integr Neurosci* 6:122.
- 8 Jansiewicz EM, Goldberg MC, Newschaffer CJ, Denckla MB, Landa R, et al. (2006) Motor signs distinguish children with high functioning autism and Asperger's syndrome from controls. *J Autism Dev Disord* 36: 613-621.
- 9 American Psychiatric Association (2013) Diagnostic and statistical manual of mental disorders (DSM-5) (Fifth Edition ed.) Washington.
- 10 Leary MR, Hill DA (1996) Moving on: autism and movement disturbance. *Ment Retard* 34: 39-53.
- 11 Loh A, Soman T, Brian J, Bryson SE, Roberts W, et al. (2007) Stereotyped motor behaviors associated with autism in high-risk infants: a pilot videotape analysis of a sibling sample. *J Autism Dev Disord* 37: 25-36.
- 12 Lloyd M, MacDonald M, Lord C (2013) Motor skills of toddlers with autism spectrum disorders. *Autism* 17: 133-146.
- 13 Lane A, Harpster K, Heathcock J (2012) Motor characteristics of young children referred for possible autism spectrum disorder. *Pediatr Phys Ther* 24: 21-29.
- 14 Gernsbacher MA, Sauer EA, Geye HM, Schweigert EK, Hill Goldsmith H (2008) Infant and toddler oral- and manual-motor skills predict later speech fluency in autism. *J Child Psychol Psychiatry* 49: 43-50.
- 15 Noterdaeme M, Mildenerger K, Minow F, Amorosa H (2002) Evaluation of neuromotor deficits in children with autism and children with a specific speech and language disorder. *Eur Child Adolesc Psychiatry* 11: 219-225.
- 16 Bhat AN, Landa RJ, Galloway JC (2011) Current perspectives on motor functioning in infants, children, and adults with autism spectrum disorders. *Phys Ther* 91: 1116-1129.
- 17 Downey R, Rapport MJ (2012) Motor activity in children with autism: a review of current literature. *Pediatr Phys Ther* 24: 2-20.
- 18 Dziuk MA, Gidley Larson JC, Apostu A, Mahone EM, Denckla MB, et al. (2007) Dyspraxia in autism: association with motor, social, and communicative deficits. *Dev Med Child Neurol* 49: 734-739.
- 19 Leonard HC, Bedford R, Pickles A, Hill E (2015) Predicting the rate of language development from early motor skills in at-risk infants who develop autism spectrum disorder. *Res Autism Spectr Disord* 13: 15-24.
- 20 Ozonoff S, Young GS, Goldring S, Greiss-Hess L, Herrera AM, et al. (2008) Gross motor development, movement abnormalities, and early identification of autism. *J Autism Dev Disord* 38: 644-656.
- 21 Hellendoorn A, Wijnroks L, Van Daalen E, Dietz C, Buitelaar JK et al. (2015) Motor functioning, exploration, visuospatial cognition and language development in preschool children with autism. *Res Dev Disabil* 39: 32-42.
- 22 Freitag CM, Kleser C, Schneider M, Von Gontard A (2007) Quantitative assessment of neuromotor function in adolescents with high functioning autism and Asperger Syndrome. *J Autism Dev Disord* 37: 948-959.
- 23 Heiser M, Iacoboni M, Maeda F, Marcus J, Mazziotta JC (2003) The essential role of Broca's area in imitation. *Eur J Neurosci* 17: 1123-1128.
- 24 Iacoboni M, Wilson SM (2006) Beyond a single area: motor control and language within a neural architecture encompassing Broca's area. *Cortex* 42: 503-506.
- 25 Esposito G, Pasca SP (2013) Motor abnormalities as a putative endophenotype for Autism Spectrum Disorders. *Frontiers in Integrative Neuroscience* 7: 43.
- 26 Bhat AN, Galloway JC, Landa RJ (2012) Relation between early motor delay and later communication delay in infants at risk for autism. *Infant Behav Dev* 35: 838-846.
- 27 Sutera S, Pandey J, Esser EL, Rosenthal MA, Wilson LB, et al. (2007) Predictors of optimal outcome in toddlers diagnosed with autism spectrum disorders. *J Autism Dev Disord* 37: 98-107.