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The relationship of motor skills and adaptive behavior skills in young children with autism spectrum disorders[☆]

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ABSTRACT

Objective: To determine the relationship of motor skills and adaptive behavior skills in young children with autism.

Design: A multiple regression analysis tested the relationship of motor skills on the adaptive behavior composite, daily living, adaptive social and adaptive communicative skills holding constant age, non-verbal problem solving, and calibrated autism severity. **Setting:** Majority of the data collected took place in an autism clinic.

Participants: A cohort of 233 young children with ASD ($n = 172$), PDD-NOS ($n = 22$) and non-ASD (developmental delay, $n = 39$) between the ages of 14–49 months were recruited from early intervention studies and clinical referrals. Children with non-ASD (developmental delay) were included in this study to provide a range of scores indicted through calibrated autism severity.

Interventions: Not applicable.

Main outcome measures: The primary outcome measures in this study were adaptive behavior skills.

Results: Fine motor skills significantly predicted all adaptive behavior skills ($p < 0.01$). Gross motor skills were predictive of daily living skills ($p < 0.05$). Children with weaker motor skills displayed greater deficits in adaptive behavior skills.

Conclusions: The fine and gross motor skills are significantly related to adaptive behavior skills in young children with autism spectrum disorder. There is more to focus on and new avenues to explore in the realm of discovering how to implement early intervention and rehabilitation for young children with autism and motor skills need to be a part of the discussion.

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1. Introduction

Autism spectrum disorder (ASD) is a pervasive developmental disorder characterized by deficits in social communicative skills and repetitive or restricted interests (APA, 1994, 2000, 2013). ASD affects 1 in 88 individuals (CDC, 2012) and a recent national survey indicated that ASD affects 1 in 50 school-aged children (Blumberg et al., 2013). In addition to the hallmark characteristics of ASD, social communicative deficits, children also display motor skill deficits (Landa & Garrett-Mayer, 2006; Lloyd, MacDonald, & Lord, 2013; Provost, Heimerl, & Lopez, 2007; Provost, Lopez, & Heimerl, 2007; Teitelbaum, Teitelbaum, Nye, Fryman, & Maurer, 1998; Yirmiya & Ozonoff, 2007). In fact, in some of the original clinical descriptions of what is now called ASD, Asperger attached considerable weight to motor clumsiness (Frith, 1991).

Motor skill deficits appear early in life for many young children with ASD, and become prominent around 14–24 months of age (Chawarska et al., 2007). Delayed infant motor milestones have been reported and these late milestones (especially walking) have acted as initial developmental concerns to parents, who later received an ASD diagnosis for their child (Chawarska et al., 2007; Flanagan, Landa, Bhat, & Bauman, 2012; Landa & Garrett-Mayer, 2006; Lloyd et al., 2013; Teitelbaum et al., 1998).

For the most part the use of motor skill performance in an ASD diagnosis is embedded in gestures, stereotypies and imitation (Lord et al., 2000; Luyster et al., 2009). However it has been suggested that one of the earliest detectable signs and a cardinal feature of the disability may reside in motor skill ability early in life (Flanagan et al., 2012; Fournier, Hass, Naik, Lodha, & Cauraugh, 2010; Sutura, Pandey, Esser, & Rosenthal, 2007; Teittelbaum, Teittelbaum, Nye, Fryman, & Maurer, 1998). When a group of children at high-risk for ASD (children who had a sibling diagnosed with ASD), were studied prospectively three groups emerged for comparison, children with language delay, ASD and typical development (Landa & Garrett-Mayer, 2006). Deficits in fine motor skills were evident in children with ASD at 6 months of age and significantly worsened fine and gross motor skills were evident at 14 and 24 months of age (Landa & Garrett-Mayer, 2006). This prospective study suggested early motor skill deficits as a potential diagnostic distinction between children with ASD and children with other developmental delays (language delay) (Landa & Garrett-Mayer, 2006). These findings corroborated previous studies suggesting motor skill delays early in development may act as some of the first signs for developmental concern (Teittelbaum et al., 1998). Through video analysis Teittelbaum et al. (1998) found oral motor deficits as well as delays in motor milestones such as lying, righting, sitting, crawling and walking were present in young children with ASD long before a diagnosis was conclusive.

In a large cross-sectional study of young children with ASD ($n = 162$, aged 14–36 months) fine and gross motor skill deficits became significantly worse within a short chronological timeframe (6–18 months) (Lloyd et al., 2013). The same study confirmed cross-sectional findings through a longitudinal analysis of children who had two motor skill assessments approximately one-year apart. When the same children were studied over time, they displayed significantly worse motor skill deficits as they aged (Lloyd et al., 2013).

Other motor deficits areas have been found in gait and postural control. Children with ASD (aged 4–6 years) demonstrated a short step length and irregular body oscillations during locomotion consistent with a less stable and more variable posture compared to a control group without a disability (Vernazza-Martin et al., 2005). Young children with ASD (<2 years) displayed similar gait and postural control deficits (Esposito & Venuti, 2008). At 20 months of age children with ASD showed deficits in gait parameters which included performing abnormal heel-to-toe patterns, odd arm posturing and generally higher frequencies of anomalies in movement including waddle walking (Esposito & Venuti, 2008). Postural sway in school-aged children with ASD was significantly greater than typically developed controls in mediolateral, anteroposterior and normalized sway (Fournier, Hass, et al., 2010; Fournier, Kimberg, et al., 2010; Memari et al., 2013). Similarly, postural sway in the mediolateral direction was greater in children with autism during dynamic movements such as walking (Fournier, Kimberg, et al., 2010).

Consistent with other motor skill deficits at a young age, motor planning deficits were evident when children with ASD were unable translate motor intention into a global motor action (mean age 7.6 years), but rather treated each motor task involved in an overall action as an independent task (Fabbri-Destro, Cattaneo, Boria, & Rizzolatti, 2009). Vernazza-Martin et al. (2005) found that young children with ASD (4–6 years) had difficulty defining the goal of the motor action. Even when the task was adapted in a highly motivating fashion, children appeared to understand the instruction, marked in their purposeful action of moving toward the object, but the final motor goal could not be completed, indicating shortfalls in motor planning (Vernazza-Martin et al., 2005). These children were able to perform simple motor tasks but unable to chain multiple motor tasks together into a more complex motor action.

Descriptive studies have clearly demonstrated that motor skill deficits exist in children with ASD at a young age and have even gone so far as to suggest early motor skill deficits as a preliminary diagnostic marker and a cardinal characteristic of the disability (Flanagan et al., 2012; Fournier, Hass, et al., 2010; Matson, Mahan, Fodstad, Hess, & Neal, 2010; Teittelbaum et al., 1998). These deficits in young children with autism range in nature and across tasks (Berkeley, Zittel, Pitney, & Nichols, 2001; Rinehart et al., 2006; Staples & Reid, 2010; Sutura et al., 2007; Teittelbaum et al., 1998; Vernazza-Martin et al., 2005). Even though evidence suggests motor deficits are prominent and pervasive across time and age very little has been discussed in terms of how motor skill deficits interact with the core-characteristics of autism, deficits in social communication skills (Berkeley et al., 2001; Fournier, Hass, et al., 2010; Landa & Garrett-Mayer, 2006; Staples & Reid, 2010). It is well known that deficits in social communicative skills are core diagnostic characteristics of ASD. For young children this includes skills such

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