Early Motor Indicators for Toddlers with suspected Autism Spectrum Disorder: Implications for Occupational Therapy Practice

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**Abstract:** Most early identification of Autism Spectrum Disorder (ASD) has focused on social, communication and language domains. Therefore, a review of early motor markers of ASD is necessary as well for OT practice. The purpose of this study was to conduct a systematic review on specific early motor indicators described in the literature associated with later ASD in children under 3 years old. Four databases were used for the search and 25 articles were included in the final analysis. Eleven studies used developmental scales and only four studies used motor assessment tools to capture motor challenges; three studies analyzed achievement of motor milestones; and, seven studies observed motor patterns or specific movements in children. Most studies described delays in motor development or attainment of motor milestones for both siblings and toddlers with ASD, but so far, there is no definite type of motor delay or specific failure in motor milestones indicative of a later diagnosis of ASD. Three studies described differences between autistic children and controls in static and dynamic symmetry in prone, supine and sitting; and, one study observed fewer transitions and object manipulation in ASD children. These three studies were based on retrospective information which limits the accuracy of its findings. OTs are skillful in recognizing motor dysfunctions in ASD, and we can contribute in selecting the most appropriate motor scales, designing structured clinical observations or developing proper research methodologies in order to capture motor issues associated with this population. Much more research should be done from OT field.

**Introduction:** Scientific research has shown differences in the developmental trajectory of children later diagnosed with ASD; however most of this research has been focused on establishing quantitative or qualitative deviance in early social behaviors, play and language; and recognizing which of them could be early signs of ASD (Filipeck, et al, 2000; Landa and Garrett-Mayer, 2006; Ozonoff and Iosif, 2010; Young and Rogers, 2011; Zwaigenbaum, et al, 2009).

Scientific literature is still inconsistent in identifying particular early motor signs of autism. Even so, some literature has been focused on estimating the weight and role of motor symptoms in this condition. Some authors have reported gross motor delay, hypotonia, motor apraxia, stereotyped motor behaviors and other motor issues (Fournier, et al, 2010; Loh, et al, 2007; Ming, et al, 2007; Ozonoff, et al, 2008). Tough OTs may be able to recognize early motor challenges in children, there is little research led by OTs in this domain (Flanagan et al, 2012; Mulligan and White, 2012).

A few systematic reviews have been done to describe motor challenges in the autistic population and its potential contribution to early identification. Most of those reviews are focused on autistic children over 3 years old (Baranek, 2002; Downey, et al, 2012; Fournier, et al, 2010; Gowen and Hamilton, 2013; Williams, et al, 2004). This current systematic review is a first step to broaden the knowledge of motor challenges in early stages of child development and its association to later ASD. The research question was: Are there specific early motor indicators described in the literature of the last ten years that are associated with a subsequent diagnosis of ASD in children under 3 years old?
**Methods:** Databases including PubMed, Web of Science, CINAHLPlus and Scope were used for the search. Search terms included: ASD, autism, PDD-NOS, motor development, motor dysfunction, motor skills, motor delay, motor challenges, fine and gross motor skills, dyspraxia, early motor signs and early motor markers. Inclusion criteria were peer-reviewed journal articles published in English from 2003 to 2013, which were focused on motor characteristic/performance of toddlers under 3 years old with suspected or diagnosed of ASD. An initial search yielded 90 articles that met inclusion criteria; after applying exclusion criteria, thirty-one full-text articles were reviewed and graded according to its level of evidence based on standards from evidence-based medicine (Sackett et al, 2000). Twenty-five articles were included in the final analysis.

**Results:** After detailed review of twenty-five full-text articles, three thematic categories came up from the current review according to recurring similarities in outcomes measures, used in the selected studies, to capture motor problems in autistic children. 1) *Motor Scales (15 studies):* the most frequent scale used to assess global development, including motor skills, was the Mullen Scale of Early Learning (10 articles). Only four studies used specific motor assessment tools such as PDMS-2 or AIMS. Most scales described delays in motor development for both siblings and toddlers with ASD, but there is no definite type of motor delay associate with an ASD. Only two studies showed a potential specific motor delay associated with ASD (Bhat et al, 2012; Flanagan et al, 2012) such us delayed head control and low scores in lying at prone and supine. 2) *Motor Milestones (3 studies):* Studies used retrospective information to identify timing of motor milestones (home-videos and caregiver reports); they described delay in attainment of sitting, crawling and walking for siblings and children with ASD, but none of them mentioned specific failure in motor milestones that could be strongly related to a later diagnosis of ASD. 3) *Observed Motor Behaviors (7 studies):* Studies analyzed abnormal motor patterns and movements in postural symmetry, posture and transitions, object manipulation, gait and movement through three axes. Esposito et al (2009, 2011) obtained considerable differences between autistic children and controls in static and dynamic symmetry in prone, supine and sitting. And Mulligan & Prudhomme (2012) observed that siblings group at 12 months exhibited significantly fewer transitions and object manipulation than typically developing children. These studies were replicated by other authors and they did not obtain similar findings (Ozonoff et al, 2008; Koterba et al, 2012)

**Discussion and Implications:** Evidence is not enough to establish and identify specific early motor indicators of ASD, which is consistent with reports in the scientific literature. Thus, the presence of some particular deviance, delay or detention of motor development or milestones in toddlers at risk for or with an ASD remains controversial. The identification of specific abnormal motor patterns and odd movements associated with the diagnosis of ASD is unclear as well.

Even though studies described motor delays in toddlers with ASD or in their siblings, most of the scales used were not in-depth motor evaluations, that OTs are proficient in administrating. For instance, MSEL assesses global development, VABS is a caregiver questionnaire, among others; these types of instruments are not designed to capture motor performance specifically. This fact could be a factor that contributes to inconsistent findings. Consequently, OTs may be involved in applying proper motor scales, and/or developing adequate instruments to evaluate motor problems in autistic population. We might also use current motor assessments that register differences between groups of ASD children and controls (other developmental disorders or typically developing children).

Main limitations of all studies were small sample sizes, reliance on retrospective information, lack of follow-up and missing data. These limitations particularly affected the studies based on motor milestones and observed motor behaviors (10 studies). Eight of these ten studies pointed out some evidence of specific motor challenges related to ASD (Esposito et al, 2009, 2011; Esposito &
However, these eight studies were based on caregiver reports or retrospective video analysis which weakens validity and accuracy of the findings. Four of ten studies had small sample sizes which also limits the results.

Using methodologies that imply direct observation of motor skills by OTs, in children at risk for or with an ASD, might be a more accurate strategy. Direct observation might consist of structured clinical observations, coding and analyzing recent home videos or filming certain movements or movement patterns, among others. OTs are trained to analyze motor performance, we should participate in designing proper research methodologies in order to capture motor issues associated with ASD.

A highlighted fact is that only three studies were conducted by OTs. Future research should be done from the OT field since we have the knowledge and background of motor development, motor control, praxis and motor assessment strategies. OTs play a key role in interdisciplinary teams that are focused on early identification of ASD, we are skillful in contributing to the early identification of motor dysfunction in conditions such as ASD. OTs have been associated with treatments of long-term effects of disabilities; however, advances in medicine and the improvement of OT practice have seen a shift into prevention programs, which involve more OTs being part of those programs. OTs should perfect our skills to detect early signs of conditions with potential future disabilities; this was one intention for this current review.

Conclusions: When comparing findings of the studies of this review, there were more statistically significant differences between ASDs and controls in the studies based on observed motor behaviors. Several of these studies identified specific motor behaviors that could be the bases for setting the presence of early motor markers in children with AS; but they were based on retrospective information which limits the accuracy of its findings. In contrast, the studies based on motor scales or motor milestones tended to show more unspecified findings for the identification of early motor signs; motor delays could be part of multiple developmental delays that children with ASD exhibit. However, a few studies described some evidence of specific motor delay associate with later manifestation of ASD, but they have small sample sizes. These results are still inconsistent in categorizing motor impairments in autism.

Much more research from the OT field is necessary. OTs can contribute in selecting the most appropriate motor scales, designing structured clinical observations or developing proper research methodologies in order to capture motor issues associated with Autism Spectrum Disorders. OT should perfect our skills to identify early signs, especially motor early signs, since more OTs are being a part of prevention programs for those pediatric populations at risk for future disabilities.

References:
References marked with asterisk indicate studies included in the Systematic Review.


*Matson JL, Mahan S, Kozlowski AM, Shoemaker M. (2010). Developmental milestones in


