

ASSESSMENT TOOLS FOR EVALUATING MOTOR ACTIVITY DIFFERENCES IN INFANTS WITH AUTISM SPECTRUM DISORDER UNDER SIX MONTHS OF AGE

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Abstract: Early motor development is a vital indicator of neurological functioning in infants. Research increasingly suggests that motor activity differences may emerge in infants later diagnosed with autism spectrum disorder well before the first signs of social or communication challenges. This article explores the current tools used to assess motor behaviors in infants under six months of age and their relevance for early identification of autism. Highlighting modern, evidence-based observational methods and standardized assessments, the article discusses how early motor markers could enhance screening accuracy and support earlier intervention.

Keywords: Autism spectrum disorder, infant motor activity, early detection, neurodevelopment, movement assessment, motor delay, observational tools

Introduction

Autism spectrum disorder is a neurodevelopmental condition characterized by difficulties in communication, social interaction, and repetitive behaviors. While core symptoms typically become more evident in the second year of life, subtle signs may appear much earlier, even during infancy. One such early domain is motor development. Research shows that motor delays or atypical movement patterns can be observed in infants who are later diagnosed with autism. Since motor development is tightly linked to the maturation of neural systems, its early assessment could provide important clues about broader neurodevelopmental trajectories. Motor development in infancy is closely connected to the functional maturation of the central nervous system. Subtle disruptions in this process may be among the earliest observable markers of neurodevelopmental conditions such as autism spectrum disorder. Although autism is not primarily diagnosed through motor deficits, mounting evidence suggests that deviations in motor behavior can precede social and communication symptoms by several months. Consequently, early motor assessment tools offer a unique window into the neurodevelopmental status of infants, even before behavioral signs of autism become apparent.

General Movement Assessment (GMA)

GMA is one of the most well-validated observational methods for assessing spontaneous motor activity in infants from birth to five months. Developed by Heinz Prechtl, it evaluates the quality and complexity of general movements—non-voluntary, spontaneous movement patterns involving the whole body. These movements are expected to evolve naturally, becoming increasingly variable and fluent over time.

In typical development, infants display "writhing movements" in early infancy, followed by the emergence of "fidgety movements" around nine to fifteen weeks post-term. Absence or abnormal quality of fidgety movements is strongly associated with neurological risk, including

autism. In infants later diagnosed with autism, studies have observed a lack of smoothness, monotonous motion, and decreased variability in spontaneous movements, indicating early central nervous system dysregulation.

One advantage of GMA is that it requires only a simple video recording and trained evaluators, making it practical in both clinical and research settings. Its predictive validity is especially high when paired with the Motor Optimality Score.

Motor Optimality Score (MOS)

The MOS complements the GMA by providing a standardized scoring system that quantifies qualitative aspects of general movements. It assesses parameters such as movement fluency, postural patterns, and symmetry. A lower MOS in early infancy has been found to correlate with developmental challenges in later childhood, including features consistent with autism.

Unlike GMA alone, the MOS allows for a finer-grained analysis, helping clinicians differentiate between various neurodevelopmental risks. It considers five domains and yields a cumulative score, making it useful for monitoring progress over time or evaluating the effects of early intervention.

Alberta Infant Motor Scale (AIMS)

AIMS is a standardized tool used to assess gross motor development in infants from birth to eighteen months. It involves structured observation of posture and movement in four positions: prone, supine, sitting, and standing. It is norm-referenced, allowing clinicians to compare an infant's motor performance to a typical developmental trajectory.

Although AIMS is not autism-specific, it has shown utility in identifying motor delays and atypical development patterns in infants who later receive an autism diagnosis. Delayed acquisition of head control, rolling, and antigravity movements may suggest broader neurodevelopmental disruption. Some research also indicates that infants with later-diagnosed autism may demonstrate plateauing or uneven motor progress on AIMS scoring.

Video-Based Analysis and Home Recordings

Retrospective analysis of home videos has been a valuable research method to identify early motor markers of autism. Subtle abnormalities, such as poor trunk stability, asymmetric limb movement, or reduced movement diversity, are often detectable by trained observers even at two to four months of age. Home video analysis helps researchers understand developmental patterns outside clinical settings, capturing spontaneous behavior in a natural environment.

Advances in computer vision have enabled automated video analysis that detects movement patterns, postural control, and coordination metrics. These technologies are increasingly used to complement human observation, reduce bias, and potentially scale up screening efforts.

Wearable Sensors and Digital Biomarkers

Recent technological innovations have introduced wearable motion sensors that provide precise measurements of limb movement, frequency, range, and velocity. Using accelerometers or gyroscopes, these devices track motor activity continuously and objectively. Research shows that infants with elevated autism risk may exhibit reduced movement variability and atypical postural transitions as measured by sensors.

These data can be transformed into digital biomarkers that, when combined with behavioral metrics, may improve the sensitivity of early autism screening. While these tools are still in the early stages of validation, they represent a promising step toward real-time, low-burden motor analysis.

Clinical Implications and Limitations

While early motor assessment offers significant promise, several challenges remain. First, many motor abnormalities seen in autism overlap with those in other neurodevelopmental disorders, such as cerebral palsy or developmental coordination disorder. Thus, specificity remains limited, and these tools should not be used for diagnosis in isolation.

Second, most current assessments rely on trained professionals and can be time-consuming or resource-intensive in routine care. Widespread adoption will require further simplification, training, and integration into pediatric screening systems.

Third, cultural and environmental factors can influence motor development, potentially affecting scoring on norm-referenced scales like AIMS. Future research must ensure that these tools are validated across diverse populations to avoid misclassification or diagnostic delay.

Nevertheless, when combined with family history, genetic risk profiles, and behavioral assessments, early motor assessment tools offer a valuable strategy for identifying children who may benefit from early intervention. Intervening in the first year of life, when brain plasticity is highest, can significantly alter developmental outcomes for children with autism.

Infants typically show a progression of motor skills, from spontaneous movements in the neonatal period to purposeful reaching and head control by six months. Deviations in this developmental path—such as reduced variability of movement, poor head and trunk control, or asymmetry—may indicate underlying neurological differences. Identifying and measuring these deviations requires sensitive and reliable assessment tools designed for early infancy.

Several standardized and observational tools are currently used to assess motor development in infants under six months of age, particularly those at risk for autism. These tools are primarily designed to capture quality, coordination, and timing of spontaneous and intentional movements.

One widely used method is **General Movement Assessment (GMA)**, which evaluates the spontaneous movement patterns of infants from birth to five months. GMA focuses on the presence and quality of “fidgety movements,” which typically emerge around three months. In infants later diagnosed with autism, studies have reported abnormalities in these movements, such as reduced complexity or variability. GMA is considered a reliable and non-invasive early screening tool for neurodevelopmental disorders, including autism.

Another tool is the **Motor Optimality Score (MOS)**, which builds upon GMA by offering a more detailed scoring system to quantify movement quality. Infants with lower scores often show increased risk of developmental disorders. MOS evaluates not only general movements but also postural patterns, symmetry, and movement fluency, which are all sensitive to neurological functioning.

Additionally, **the Alberta Infant Motor Scale (AIMS)** is a norm-referenced observational tool used to assess gross motor development in infants from birth to eighteen months. It examines posture and movement in prone, supine, sitting, and standing positions. While not autism-specific, AIMS has been applied in early risk detection due to its ability to reveal motor delays or unusual developmental timing.

Video-based analysis has also gained traction, particularly in research settings. Home videos or structured recordings analyzed by developmental specialists can reveal subtle motor signs that are often missed during routine pediatric examinations. These include unusual limb postures, asymmetrical kicking, or a lack of anticipatory postural control.

More recently, **wearable sensors and computer-vision-based technologies** have been developed to objectively quantify infant movement. These tools track limb movement trajectories, frequency, and coordination, offering high-resolution data for early risk profiling.

Such technologies are still emerging but hold promise for future large-scale screening applications.

Collectively, these tools enable clinicians and researchers to detect early motor markers that may signal elevated autism risk, allowing for earlier monitoring and potentially earlier intervention.

Conclusion

Differences in motor activity during the first six months of life may serve as early indicators of autism spectrum disorder. Through validated assessment tools like the General Movement Assessment, Motor Optimality Score, and Alberta Infant Motor Scale, along with emerging technologies, it is now possible to detect atypical motor patterns well before traditional behavioral symptoms emerge. Early identification based on motor function could play a vital role in timely diagnosis and early support strategies. Continued research and refinement of these tools are essential to improve early screening accuracy and to better understand the developmental pathways leading to autism.

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