

Early Screening for Cerebral Palsy-A Systematic Review

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Abstract

Background: Cerebral palsy (CP) is the most common motor disability in childhood.¹ Preterm infants, particularly those born before 28 weeks' gestation or extremely low birth weight, are at an increased risk for CP²; therefore, early identification and intervention for CP are critical to optimize neurodevelopmental outcomes and quality of life. The purpose of this systematic review was to critically evaluate the predictive accuracy and clinical utility of various neonatal screening methods in facilitating the early diagnosis of CP.

Materials and Methods: A comprehensive systematic review of evidence-based research was conducted using MEDLINE (PubMed), Embase (Elsevier), and Web of Science (Clarivate). Inclusion criteria included preterm infants at high risk for CP, CP diagnosis prior to 12 months of age, and evaluation of early intervention. After duplicates were removed, 2,283 citations were screened by two reviewers each; 154 citations were identified and reviewed in full, with 44 studies selected for inclusion.

Results: The studies spanned multiple countries and utilized diverse methodologies. Sample sizes ranged from 16 to over 1,000 infants, with CP diagnosis assessed between term-equivalent age and up to five years. A total of 20 screening tools were evaluated, either alone or in combination with other tools. Five major categories of screening tools were identified: neuroimaging, motor performance assessments, neurologic examinations, technological tools, and other biomarkers. MRI findings were recognized as important for predicting neurodevelopmental outcomes in all studies³⁻¹⁰ except for one.¹¹ When MRI was used in combination with other tools such as the General Movements Assessment (GMA), its predictability for CP improved.¹² The GMA was useful in predicting CP¹³⁻¹⁵ particularly in identifying high risk trajectories¹⁶ predictive of early neurodevelopmental outcomes.¹⁷ Three studies combined the GMA with tools such as heart rate variability, finding correlations between lower heart rate variability and poor repertoire general movements later diagnosed with CP.¹⁸ Combining other tools such as CUS with the FMA predicted CP better than each tool alone.¹⁹

In relation to motor performance, tools such as the Hammersmith Infant Neurological Examination (HINE) were found to be predictive of CP.^{20,21} When testing knee-jerk responses, tonic responses from 4 months corrected age onward were observed in infants later diagnosed with CP.²² Computer-based analysis^{23,24} and use of deep machine learning^{25,26} showed good sensitivity for predicting CP with high accuracy. Other studies have explored the use of maternal serum biomarkers and found that lower mean PaPP-A and β -HCG levels were associated with CP diagnosis.²⁷ Heart rate patterns in preterm infants with low variability after birth and recurrent acceleration in heart rate at term CA also predicted CP.²⁸

Conclusions: Early screening for CP in preterm infants using a combination of neuroimaging, motor performance, and neurologic assessments significantly improves diagnostic accuracy before 12 months of age. Tools such as the GMA and MRI are especially effective, particularly when used together and when utilized in combination with other screening tools.

Keywords: cerebral palsy, early screening, early identification, early diagnosis, preterm

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