# Evolution of Infant Motor Assessments for the Early Detection of Neurodevelopmental Disorders Through the Lens of Bibliometric Analyses

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## Introduction

- Early detection is critical in averting an infant's risk for a neurodevelopmental disorder (ND) by facilitating early intervention.
- The role of spontaneous movements in the development of infants' sensorimotor interactions that scaffold neurodevelopment is increasingly recognized.
- Early motor assessments, such as the General Movement Assessment (GMA), evaluates spontaneous movements and have been widely used to assess risks of ND.
- GMA was introduced by Dr. Heinz Prechtl in the 1990s. In GMA, videos of infant's spontaneous/general movements (GMs) are evaluated by a trained clinician.
- GMs are variable patterns of movement an infant exhibits in the arms, legs, and trunk. There are two classifications: writhing movements (birth-2nd mo) and fidgety movements (3rd-5th mo).

- Modern technologies, such as wearable sensors, machine learning models, digital video analysis have been integrated into GMA.
- Other motor assessments are used to evaluate infants and young children (e.g., Infant Motor Profile (IMP), Alberta Infant Motor Scale (AIMS), Touwen Infant Neurological Examination (TINE), Bayley Scales of Infant and Toddler Development (BSID or Bayley) , Movement Assessment Battery for Children- Second Edition (MABC-2)).

## Objective

To evaluate the evolution of infant motor assessments between 2000-2024 for the early detection of ND risk.

## Research Questions

What is the trend of early motor assessments for the prediction of neurodevelopment delays, especially in preterm infants? How can modern approaches be integrated in current diagnostics tools for motor abnormalities?

## Methodology

Search: "infant(s)" AND "motor" OR "movement" AND "assessment(s)" AND "neurodevelopment(s)"

Filters applied:
Classical articles, years in range: 2000-2024, infants (birth-23 months)

Web of Science | PubMed | MedLine | PsycInfo

Total publications found: 4552 articles

Zotero software

Duplicate articles were removed.
Articles unrelated to research project were removed

VOSViewer software

Total publications filtered: 834 articles

Map of co-occurrence network generated

Map of co-authorship network generated

## Results

Based on the bibliometric analyses shown in Figure 1:

- The emergence of "video recording" has an average publication year of 2019, and is related to terms such as "prediction", "video analysis", and "general movement assessment"
- "General movement(s) assessment" or "GMA" terms have the highest average publication year compared to other motor assessments displayed on the map
- The "fidgety movement" cluster is linked to "machine learning", "prediction", and "neurodevelopment outcomes"
- "Machine learning", "wearable electronic devices, and "pose estimation" are recent tools in motor assessments, with an average publication year of 2020

In Figure 2, some prominent researchers in the field of early motor assessments are shown in the high-density clusters of the co-authorship network (e.g, Christa Einspieler, Alicia J Spittle, Mijina Hadders-Algra)

## Discussion

- Early motor assessments, especially GMA have been used to predict the motor outcomes in infants
- The use of videos for motor assessments in GMA can be leveraged by more frequently videotaping of baby movements at home by parents using a cell phone.
- The integration of computer-based analysis and machine learning models can help to automate the evaluation of motor behaviors, which increases the accessibility of motor assessments.
- Recent studies have shown promising results in the motor assessment's ability to predict ND risk, but further research is needed to replicate the findings in a larger scale.
- The implementation of early, scalable diagnostics for ND can help identify a greater number of infants who would benefit from early intervention, reducing ND risk.

## Limitations

The influence of modern technologies on the analysis of writhing movements was omitted in the final bibliometric analyses due to a low citation count. The selected publications on the impact of motor assessments are mainly in areas with high resources to early development tools

## Bibliometric Analysis

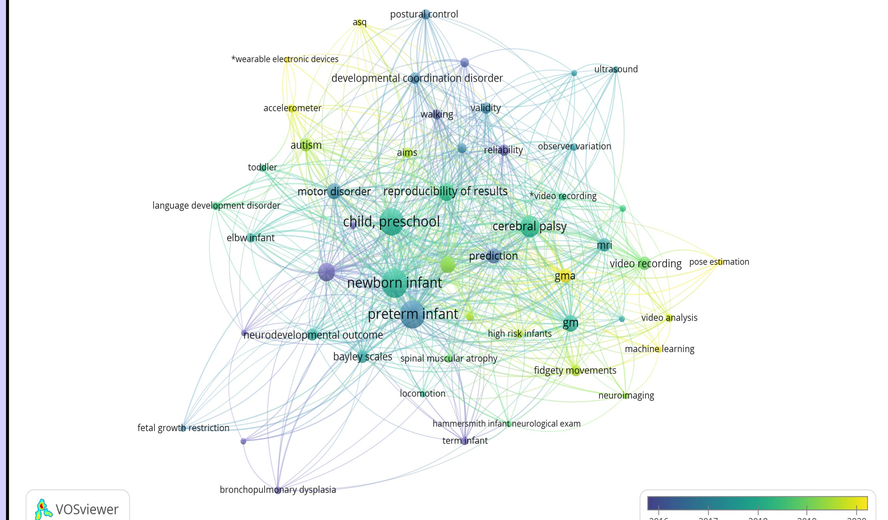


Figure 1. An overview visualization of co-occurrence networks based on text data

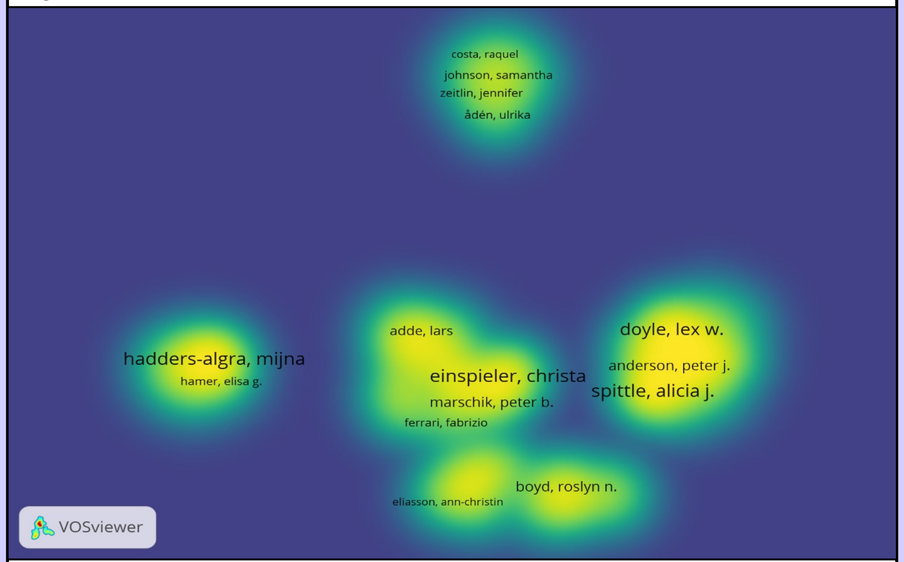


Figure 2. A density visualization of co-authorship networks based on bibliographic data

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## Figures

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## References

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