IECBS 2024 Conference
The 4th International Electronic Conference on Brain Sciences
23–25 October 2024 | Online
MDPI

From Childhood to Old Age: A Magnetoencephalography-Based Review of Motor Control Development

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INTRODUCTION & AIM

Motor control (MC) is crucial for coordinating movements, reflected by neural oscillations (NOs) such as movement-related beta desynchronization (MRBD), post-movement beta rebound (PMBR), and movement-related gamma synchrony (MRGS).

Magnetoencephalography (MEG) has significantly advanced the study of brain development and MC due to its high temporal and spatial resolution. This study aims to elucidate changes in NOs throughout MC development and explore the underlying mechanisms from childhood to old age.

METHOD

A comprehensive literature search using keywords "magnetoencephalography," "motor control," "lifetime trajectory," and "aging" was conducted in Web of Science, PubMed, Scopus, PsycINFO, EBSCO, and Embase up to June 2024. Seventeen relevant studies were analyzed.

RESULTS & DISCUSSION

Systematic review of MEG studies revealed: 1) Childhood to adolescence: MC increases with enhanced MRBD in the primary motor cortex and decreased MRBD in the secondary motor cortex. Movement control improves, accompanied by enhanced PMBR and refined neural populations, leading to weakened MRGS. 2) Adolescence to early adulthood: MRBD, PMBR, and MRGS continue their trends, reaching maturity in early adulthood. 3)Early adulthood to old age: MC declines, but resting beta oscillations and MRBD are stronger than in young adults, while PMBR decreases with age.

CONCLUSION

MC development follows a trajectory of growth to maturity and eventual decline with age, reflected by changes in NOs. Increased resting beta oscillations and MRBD in older adults suggest compensatory mechanisms, while PMBR and MRGS show age-related changes. Further research is needed to clarify these mechanisms.

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