Association between antenatally detected placental dysfunction and early neurodevelopment in South African term infants

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Abstract

Background: Early neurodevelopment is shaped by the interaction between biological vulnerability and experience-dependent plasticity. Placental insufficiency, reflected by abnormal umbilical artery resistance index (UmA-RI), is a common antenatal exposure associated with fetal growth restriction and altered maturation of neuromotor control. Understanding how antenatal circulatory compromise influences early neurological development is essential for the clinical follow-up of infants during periods of heightened motor plasticity, particularly in low- and middle-income countries and other resource-constrained settings where placental insufficiency is prevalent.

Objectives: To describe early neurodevelopmental trajectories in term infants and examine associations between antenatally detected placental dysfunction and neurological outcomes during infancy.

Methods: This prospective, longitudinal cohort study included 74 term infants from Tshwane District, South Africa. Placental function was assessed in the third trimester using continuous-wave Doppler screening; infants were classified into normal (N) or abnormal (AbN) UmA-RI groups. Neurodevelopment was evaluated at scheduled follow-up visits using the Hammersmith Infant Neurological Examination (HINE), a standardised assessment of neuromotor function for infants aged 2–24 months. Total scores, sub-section scores, motor milestones and behavioural domain scores were compared between groups from 14 weeks to 18 months.

Results: Overall HINE scores were largely comparable between groups. At 9 months, infants with abnormal UmA-RI demonstrated significantly lower posture sub-section scores ($p = 0.028$) and lower total HINE scores (72.0 [69.0–74.0] vs 75.0 [72.5–76.5]; $p = 0.012$) compared with infants with normal UmA-RI. By 12 and 18 months, total scores were similar between groups. Motor milestone acquisition and behavioural profiles were largely comparable across assessments, with the exception of supported standing at 14 weeks.

Conclusion: Antenatally detected placental dysfunction was associated with transient posture-related neuromotor differences during mid-infancy, a key window of neuromotor plasticity. These findings support the value of early, evidence-based, motor-focused developmental surveillance to identify infants who may benefit from closer monitoring following antenatal circulatory compromise.

References

1. Kolb B, Mychasiuk R, Williams P, Gibb R. Brain plasticity and recovery from early cortical injury. Dev Med Child Neurol. 2011;53(Suppl 4):4–8. https://doi.org/10.1111/j.1469-8749.2011.04054.x

2. Dudink I, Hüppi PS, Sizonenko SV, Castillo-Melendez M, Sutherland AE, Allison BJ, et al. Altered trajectory of neurodevelopment associated with fetal growth restriction. Exp Neurol. 2022;347:113885. https://doi.org/10.1016/j.expneurol.2021.113885

3. Brown LD, Hay WW Jr. Impact of placental insufficiency on fetal skeletal muscle growth. Mol Cell Endocrinol. 2016;435:69–77. https://doi.org/10.1016/j.mce.2016.03.017

4. Mwaniki MK, Atieno M, Lawn JE, Newton CRJC. Long-term neurodevelopmental outcomes after intrauterine and neonatal insults: a systematic review. Lancet. 2012;379(9814):445–452. https://doi.org/10.1016/S0140-6736(11)61577-8.

5. Hlongwane T, Cronje T, Nkosi BSS, Pattinson RC. The prevalence of abnormal Doppler's of the umbilical artery in a low-risk pregnant population in South Africa. EClinicalMedicine. 2021;34:100792. https://doi.org/10.1016/j.eclinm.2021.100792