Compromised approximate number system acuity in school-aged children born extremely preterm

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The ability to visually estimate and compare numbers, and to detect specific difficulties in mathematical abilities at school, are fascinating topics that have been receiving increasing attention in the last few years with a specific interest in children born preterm.

It is well known that preterm birth can influence brain volume and maturational processes. It also reduces cortical organization with a disturbance of the connections between different cortical areas and possible subsequent impairment of specific abilities, even when cerebral lesions are not detected by conventional brain imaging. Recent studies have reported major vulnerability of the dorsal stream in low-risk preterm children, as demonstrated by studies on perception of motion, depth, simultaneous perception, attention, and the ability to survey a complex scene. The anatomical area that contributes to the processing of all these functions is the intraparietal sulcus in the parietal lobe, an area that also has an important role for processing numbers.[1]

Aarnoudse-Moens et al.[2] have demonstrated that deficits in numerical reasoning skills and mathematics/arithmetic are common in very preterm children and can already be detected at preschool age and then persist at school age. There are at least two different mechanisms underlying number representation: the approximate number system (ANS) and the exact number system (ENS). The ANS is already functioning at preverbal age and allows comparison of two combinations of objects without the possibility of counting them. This ability appears to be present from very early in life; it is innate and independent of language. The ENS develops later in life and is more associated with formal instruction, language development, and knowledge of symbolic numbers. ANS can predict ENS.[3] Functional magnetic resonance imaging studies have demonstrated the activation of different areas of the intraparietal sulcus in response to tasks requiring ANS and ENS abilities.[4]

The study of Hellgren et al.[5] is an important contribution to this topic, reporting on the ability to visually estimate and compare numbers in a group of extremely preterm-born infants and in a group of term-born infants, by using an ANS acuity psychophysical task. The study provides further evidence that in preterm children ANS can already be impaired at 6.5 years of age and is associated with specific difficulties in mathematical abilities at school, but not with cognitive abilities, working memory, attention, or processing speed.

The study also highlights that in extremely preterm children the dorsal stream is vulnerable to early insults, with impairment of all the competences mediated by this stream.

The relatively small number of preterm children assessed did not allow full exploration of the possible different mechanisms of attention and, as acknowledged by the authors, this needs to be further investigated in larger cohorts.

Nevertheless, the results of the present study support the need for an early diagnosis of mathematical difficulties, which could then be addressed with specific modalities of intervention.

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