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Learning disabilities among extremely preterm children without neurosensory impairment: Comorbidity, neuropsychological profiles and scholastic outcomes

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ABSTRACT

Background: Children born extremely preterm are at high risk for intellectual disability, learning disabilities, executive dysfunction and special educational needs, but little is understood about the comorbidity of intellectual and learning disabilities in this population.
Aims: This study explored comorbidity in intellectual disability (ID) and learning disabilities (LD) in children born extremely preterm (EP; $<26^{+0}$ weeks' gestation).
Subjects and study design: A UK national cohort of 161 EP children and 153 term-born controls without neurosensory impairments was assessed at 11 years of age (the EPICure Study).
Outcome measures: IQ, mathematics and reading attainment, executive function, visuospatial processing and sensorimotor skills were assessed using standardised tests, and curriculum-based attainment and special educational needs (SEN) using teacher reports.
Results: Overall, 75 (47%) EP children and 7 (4.6%) controls had ID or LD (RR 10.12; 95% CI 4.81, 21.27). Comorbidity in ID/LD was more common among EP children than controls (24% vs. 0%). EP children with comorbid ID/LD had significantly poorer neuropsychological abilities and curriculum-based attainment than EP children with an isolated disability or no disabilities. LD were associated with a 3 times increased risk for SEN. However, EP children with ID alone had poorer neuropsychological abilities and curriculum-based attainment than children with no disabilities, yet there was no increase in SEN provision among this group.
Conclusions: EP children are at high risk for comorbid intellectual and learning disabilities. Education professionals should be aware of the complex nature of EP children's difficulties and the need for multi-domain assessments to guide intervention.

1. Introduction

Extremely preterm birth (EP; $<26^{+0}$ weeks' gestation) places children at high risk for neurodevelopmental disability and intellectual impairment later in life, and there is growing interest in educational outcomes as key predictors of an individual's life chances. The poorest scholastic outcomes are observed among those born EP [1–3], with up to two thirds having special educational needs (SEN) [4,5]. Moreover, SEN are not confined only to EP children with severe disabilities [5–9].

Studies using low attainment definitions have shown an increased risk for learning difficulties (LD) in EP or extremely low birthweight (ELBW;<1000 g) children compared with term-born peers [5,7,10–13]. There is also evidence of an increased risk for *specific* LD in these populations where discrepancy based definitions are applied, the most frequent of which are mathematics learning difficulties (MLD) [7,8,10,13]. In contrast to reading and literacy, group differences in mathematics attainment are frequently not accounted for by low IQ [5,6,10,14]. Other neuropsychological processes such as attention, executive function, sensori-motor and visuo-spatial skills contribute to scholastic attainment in typically developing and preterm children [7,10,15–18] and may be core cognitive deficits in this population [19–21].

Abbreviations: ELBW, extremely low birthweight (<1000 g); EP, extremely preterm; ID, intellectual disability; LD, learning disability; MLD, mathematics learning disability; MPC, Mental Processing Composite; RLD, reading learning disability; SEN, special educational needs.

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Previous studies have also shown that EP/ELBW children are more likely to have impairments in multiple neurodevelopmental domains, such as in neurological, motor, cognitive and behavioural function, than children born at term [12,22]. However, comorbidity among intellectual and learning disabilities is poorly understood. Where studies have been conducted, a greater frequency of comorbid intellectual disability (ID) and LD has been observed in very preterm preschoolers (<32 weeks' gestation) compared with term-born controls [23,24]. At school age, ELBW has been associated with an increased risk for comorbidity of LD in mathematics and reading [7], but this study included only a small sample of ELBW children without ID and the children were born in the 1970s, before the dawn of modern neonatal care. More recently, children born <34 weeks' gestation have been shown to have comorbid LD at early school age [8].

As yet, we are not aware of any studies that have explored patterns of comorbidity in ID and LD in a contemporary EP population, or the underlying neuropsychological profiles of children with isolated versus multiple deficits. Such investigations are important for elucidating the mechanisms underlying academic difficulties, identifying the educational needs of children with different comorbidities and informing the provision of intervention strategies.

In a national, population-based cohort of EP children without neurosensory impairments who were born in the 1990s, we explored the prevalence and comorbidity of ID and LD in both reading and mathematics. The aims of the present study were to (1) describe the rates of ID and LD and explore the extent to which these are comorbid among EP children, (2) explore the neuropsychological profiles of EP children with specific and comorbid disabilities and (3) investigate the impact of specific versus comorbid disabilities on scholastic outcomes.

Given the high risk for poor general cognitive processing observed in this population, we hypothesised that EP children without neurosensory impairments would have significantly higher rates of ID and LD and a greater risk for comorbid ID/LD than children born at term. We also hypothesised that ID and LD would be associated with poor neuropsychological abilities and that EP children with comorbid ID/LD would have the poorest performance on tests of executive function, sensorimotor and visuo-spatial skills and a significantly greater reliance on SEN provision.

2. Material and methods

2.1. Participants

Participants were members of the UK EPICure Study cohort. From 1st March through 31st December 1995, all babies born $<26^{+0}$ weeks' gestational age and admitted for neonatal intensive care in the whole of the UK and Ireland were identified ($n = 811$) and surviving children ($n = 314$) were invited to participate in follow-up assessments. For the first two assessment waves, response rates were 90% ($n = 283$) at two years of age [25] and 78% ($n = 241$) at six years of age [26]. Data for the present report relate to the results of the 11 year outcome evaluation carried out when children were in the final year of primary school. At this age, 219 of 307 (71%) survivors were assessed [27].

A contemporaneous reference group of 153 children born at term (≥37 weeks' gestation) was also assessed at 11 years of age. These children were selected from the classmates of EP children in mainstream schools at either the 6 or 11 year follow-up, and were matched for age, sex and ethnicity, to their EP classmate. Although controls could not be selected for every EP child, including those in special schools, there were no significant differences in age, sex and ethnicity between EP children and classmates assessed at 11 years of age (see [27] for a detailed description of the cohort).

Of the 219 EP children assessed at 11 years, 50 (23%) had neurosensory impairment (moderate/severe vision, hearing impairment or gross motor impairment) and were excluded from the present analyses in order to explore outcomes among those free of major neurological sequelae. A further eight (4%) EP children with incomplete data on the 11 year outcome measures were excluded as neuropsychological profiles could not be explored for these children. In the term control group, there were no children with neurosensory impairments, but 1 (1%) child did not complete the outcome assessments. As such, the final sample for the present report comprised 161 EP children and 152 term-born controls without neurosensory impairment; this represents 74% and 99% of the total EP and control sample assessed at 11 years (Fig. 1). Table 1 shows the characteristics of the final sample. There were no significant differences in age, sex and socio-economic status (SES) between EP children and term-born controls. However, EP children had significantly poorer IQ and neuropsychological skills and were more likely to have SEN than term-born controls (Table 1).

2.2. Procedure

Parents provided informed consent for their child's participation and the study was approved by the Southampton and South West Hampshire Research Ethics Committee. Children were initially offered an assessment at school, however in cases in which a school assessment was not possible or where the parents preferred their child to be assessed out of school hours, a home or clinic based assessment was offered to maximise response rates. In total, 193 (88%) EP children were assessed at school, 22 (10%) at home and 4 (2%) at a clinic. Among the term-born controls, 151 (99%) were assessed at school and the remaining 2 (1%) were assessed at home. The assessment protocol was identical in each setting.

2.3. Standardised tests

The Kaufman Assessment Battery for Children (K-ABC) [28] was used to assess children's general cognitive ability, from which an age standardised Mental Processing Composite score (MPC) score, equivalent to IQ, was derived (*Mean* 100; *SD* 15; *range* 40–160). Intellectual disability (ID) was defined as MPC scores <−2 SD using the mean and SD of the term control group (i.e., MPC <82). The use of contemporaneous reference data for defining disability is recommended to account for the Flynn Effect, the secular upward drift in IQ scores over time [27,29,30].

Academic attainment was assessed using the Wechsler Individual Achievement Test-II^{UK} (WIAT-II^{UK}) [31] from which age standardised composite scores were derived for proficiency in reading and mathematics (*Mean* 100; *SD* 15; *range* 40–160). LD were classified using standardised scores <−2 SD of the term control group (Reading standardised score < 74; Mathematics standardised score < 69) [32]. To explore how neurodevelopmental sequelae manifest in this population, we investigated comorbidity in ID and LD, such that LD could occur in isolation or co-exist with ID. As such, LD were classified as *specific* if the LD occurred in the absence of ID (i.e., where attainment was <−2SD and IQ was ≥−2 SD of the mean of the control group).

Neuropsychological abilities commonly affected by EP birth were assessed using the NEPSY Developmental Neuropsychological Test [33] from which age standardised scores (*Mean* 100; *SD* 15; *range* 50–150) were derived for the three core domains of (1) attention/executive function (derived from the tower, auditory attention and response set, and visual attention subtests administered to assess planning, shifting, sustained and selective attention), (2) sensorimotor skills (derived from the fingertip tapping, imitating hand positions and visuomotor precision subtests administered to assess manual dexterity and fine motor skills) and (3) visuo-spatial processing (derived from the design copying and arrows subtests to assess visuo-motor integration and judgement of line orientation). Assessments were carried out by one of three psychologists blind to the children's clinical history and study group allocation. Prior to commencing data collection, the psychologists simultaneously scored tests during assessments carried out with non-