ABSTRACT

Aim: We aimed to compare the academic outcomes of a cohort of very preterm (VPT, <32 weeks' gestation) and term born children at age 7 years, and assess the ability of a pre-academic skills screen at age 5 to predict later academic impairment in VPT children at age 7.

Methods: 194 VPT children (born with either gestational age <30 weeks or birth weight <1250 grams) and 70 term-born controls from a prospective birth cohort were compared on academic outcomes (Wide Range Achievement Test, WRAT4) at age 7 using regression analyses. Receiver Operating Characteristic curves were used to determine whether pre-academic skills (Kaufman Survey of Early Academic and Language Skills, K-SEALS) at age 5 predicted academic impairment at age 7 in 174 of the VPT cohort.

Results: At age 7 years, VPT children had lower mean word reading (-9.7, 95% CI: -14.7 to -4.6), spelling (-8.3, 95% CI: -13.3 to -3.3) and math computation (-10.9, 95% CI: -15.3 to -6.5) scores (all P values ≤ 0.001), compared with term controls, even after adjusting for social risk and time since school commencement. In terms of pre-academic screening, the Numbers, Letters and Words subtest of the K-SEALS had adequate sensitivity and specificity (70-80%) for predicting children with academic impairment at age 7.

Conclusions: VPT children underperformed in academic outcomes at age 7 compared with term controls. A pre-academic screening tool used at school entry can predict VPT children at risk of academic impairment at age 7, who could benefit from targeted early intervention.

Key Words Infant, premature; infant, very low birth weight; learning disorders; academic outcomes; sensitivity and specificity

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What Is Already Known On This Topic

1. Children born very preterm (VPT) are at increased risk of cognitive, behavioural and learning difficulties compared with children born at term.
2. Past studies have indicated that academic performances are one-half to three-quarters of a standard deviation lower in those born VPT compared with children born at term.
3. Children born VPT have more identifiable school readiness difficulties compared with term-born children.

What this paper adds

1. Despite ongoing improvement in neonatal care, academic underachievement persists in contemporary cohorts of children born VPT.
2. Screening of early academic ability in VPT children at **or prior to** school entry predicted academic impairment at age 7.

BACKGROUND

Very preterm (VPT; <32 weeks' gestation) children are at increased risk of a range of cognitive, behavioural and learning difficulties, which can persist into adulthood¹⁻³ compared with term-born controls (≥ 37 weeks' gestation).⁴⁻⁷ A gestational gradient exists, with those born most preterm being at greatest risk.^{5,7,8} Even VPT children who escape major neurodevelopmental or cognitive disabilities⁹ are at higher risk of academic underachievement.¹⁰⁻¹³

VPT children perform one-half to three-quarters of a standard deviation (SD) lower than children born at term on standardised measures of reading, spelling and mathematics,⁴ and this difference is not fully explained by intelligence test scores alone.^{10,11,14,15} Given the improvements in perinatal care and the increasing number of VPT infants now surviving to school age and beyond,^{9,16,17} ongoing assessment of contemporary cohorts is needed to determine whether this academic disadvantage persists. VPT children also have vulnerabilities in pre-academic skills at school entry compared with term-born peers.^{12,13,18}

While children with significant disability are readily identified for early intervention, children with milder deficits are harder to identify at school entry, and such deficits may remain undetected until academic difficulties are entrenched.¹⁹ As a result, effective developmental screening tools (recommended sensitivity and specificity of 70-80%)²⁰ are needed to identify children at risk of academic underachievement **before they start school.**

We aimed to characterise academic outcomes of a contemporary cohort of VPT children compared with term-born controls at age 7 years to investigate whether a simple screening measure of pre-academic skills at age 5 years could identify those VPT children with academic impairment at age 7 years.

METHODS

Participants

Participants were 224 VPT infants (gestational age <30 weeks or birth weight <1250 g) recruited shortly after birth to the Victorian Infant Brain Studies (VIBeS) cohort, at the Royal Women's Hospital, Melbourne, Australia between July 2001 and December 2003 who survived infancy and were free of genetic or congenital abnormalities known to affect development. 77 healthy term controls (37-42 weeks' gestation) were recruited either concurrently with the VPT cohort (n=46) or at age 2 years via Maternal Child Health Centres across metropolitan Melbourne (n=31). Ethics approval was obtained from the Human Research Ethics Committees of the Royal Women's Hospital and the Royal Children's Hospital, Melbourne. Written consent was obtained from the caregivers and financial compensation was offered for travel costs.

Data Collection and Measures

Birth and perinatal data were collected at recruitment and the cohort was followed up at ages 2, 5, and 7 years.^{18,21,22} Corrected age was used throughout to avoid a bias towards poorer outcomes for VPT children if age is uncorrected.²³ At the 2-year follow-up, a social risk questionnaire including six key domains (family structure, employment status and occupation of primary income earner, language spoken at home and maternal age at birth of child) was collected. Higher scores on this questionnaire corresponded to greater social risk.¹⁸

At age 5 years, pre-academic skills were measured using the Kaufman Survey of Early Academic and Language Skills (K-SEALS), which is validated for 3-6 year olds and comprises two subtests –a) Vocabulary, and b) Numbers, Letters and Words (NLW).²⁴

It is a rapid cognitive screening test that assesses knowledge of number concepts, letters and words (expressive and receptive language) and is often administered to pre-school aged children as part of a school readiness assessment.^{24,25} It has been shown to have robust reliability and validity, across a number of populations and clinical settings and

gives age based standard scores (mean = 100; standard deviation = 15).^{24,26 27,28} A parent reported questionnaire was used to assess whether the children had ever received developmental early intervention allied health support (occupational therapy, physiotherapy, psychology or speech pathology services).

At age 7 years, the word reading, spelling and math computation subtests of the Wide Range Achievement Test, Fourth Edition (WRAT4)²⁹ were used to assess current academic achievement. General cognitive ability at age 7 years was estimated using the Full Scale Intelligence Quotient (FSIQ) from the Wechsler Abbreviated Scale of Intelligence (WASI).³⁰ Age-standardised normative data was utilised and each of these measures have been shown to have robust reliability and validity.^{29,30} Impairment on the WRAT4 was defined as a standard score <85 (i.e. greater than 1 SD below the normative mean). Children too impaired to complete the WRAT4 or WASI were allocated a standard score of 55 (n=6). Moderate/severe cognitive impairment was defined as a FSIQ score <70. Further demographic data were collected at age 7 years via questionnaires and included current grade level, age and time since school commencement, and history of grade repetition. Need for additional educational assistance in school was assessed by parent reported questionnaire (aide support, pull out remedial education, individualised learning plan, speech therapy provided by the school, special accommodations in the classroom, modified curriculum, guidance counsellor support or additional other supports).

Statistical Analysis

Data were analysed using Stata/IC 12.0 for Mac (StataCorp LP, College Station, Texas). Between group variables were compared using descriptive statistics. Continuous variables were assessed using independent sample t-tests for parametric variables or Mann-Whitney U tests for non-parametric variables. Chi squared analysis was used for categorical data. Linear regression models, fitted with the Huber/White sandwich model to allow for clustering of multiple births (twins/triplets) from within one family, were

used to compare VPT and term groups at age 5 and 7 years. Logistic regression with odds ratios was used to examine the differences when categorical descriptors of impairment were used. All regression models were also adjusted for potential confounders (social risk and months since commencing formal schooling). Secondary analysis was performed excluding children with moderate/severe cognitive impairment (FSIQ score <70). Receiver operating characteristic (ROC) curves were used to determine sensitivity and specificity cut off points for the K-SEALS measures as a screening tool for academic impairment in the VPT group alone.

RESULTS

At 7 years, 194 of the VPT cohort (87% follow up) and 70 of the term cohort (91% follow up) were assessed using the WRAT4. 27 of the VPT cohort were lost to follow-up (10 withdrew, 11 declined, 3 relocated and 3 uncontactable) and 3 children could not complete any of the WRAT4 due to technical or behavioural issues on the day of testing. 7 term born controls were lost to follow-up (1 withdrew, 6 declined). Loss to follow-up analysis revealed that those VPT children who did not attend the 7 year follow-up were slightly more socially disadvantaged at age 2 years compared with those VPT children who attended 7 year follow-up ($P = 0.03$). However, all other major demographic and perinatal risk factors (including those listed in Table 1) were similar. 174 VPT children attended both the 5 and 7 year reviews and had data available to assess the role of pre-academic screening in predicting 7 year old academic outcomes.

The VPT children had spent less time at school compared with controls and were more likely to have repeated a grade. They were also more likely to receive additional educational assistance at school (both currently and at any stage since starting school) (Table 1).

At 7 years, VPT children had lower word reading, spelling and math computation scores compared with term-born children (Table 2). These differences remained even after adjustment for social risk and time since school commencement. Group differences in

academic achievement persisted after excluding children with moderate/severe cognitive impairment (FSIQ score <70), although group differences were no longer significant in spelling after adjustment for social risk and time spent in school (adjusted difference -4.2, CI 95% -9.2 to 0.9, $P = 0.11$).

A greater proportion of VPT children were classified as impaired (score <85) in word reading, spelling and math computation, compared with term-born children, both before and after controlling for social risk and time since school commencement (Table 3).

43% of VPT children had impairment in at least one academic domain, compared with 14% of the term controls. Of the 43% of VPT who had impairment in any one academic domain, only 51% were in current receipt of additional educational assistance.

Both subtests of the K-SEALS at age 5 were strong predictors of WRAT4 scores at age 7 for VPT children (all P values <0.001). The NLW subtest had the highest sensitivity and specificity for detecting impairment in all academic domains at age 7 years (AUC = 0.88 for reading, 0.87 for spelling, and 0.81 for mathematics) (Figure 1). The vocabulary subtest was less predictive of later academic impairment (AUC = 0.80 for word reading, 0.79 for spelling, and 0.74 for math computation). A score of <93 was the optimal cut point on the NLW subtest at school entry to predict impairment in word reading (sensitivity 71%, specificity 94%), spelling (sensitivity 70%, specificity 91%) and math computation (sensitivity 78%, specificity 74%) at age 7 years. No cut-points were identified on the vocabulary subtest that gave acceptable values for the combination of sensitivity and specificity (both >70%)²⁰ for any of the WRAT4 domains.

DISCUSSION

This study supports previous evidence that VPT children underperform in academic outcomes compared with term-born children at age 7 years and shows that VPT children who have academic impairments at age 7 can be identified using a simple pre-academic skills screen at school entry.

Despite ongoing improvements in neonatal care, academic outcomes of this contemporary cohort remained similar to those from preceding decades.^{4,7} Consistent with past studies,^{4,13} we found that VPT children at 7 years performed significantly worse (0.55 to 0.72 SD lower) on academic measures compared with controls. These conclusions persisted after adjusting for social risk, and the time spent in school, factors that may independently affect academic achievement.^{3,31,32}

The VPT children in this study performed most poorly in the mathematical domain, with 40% of children showing impairment at age 7. This finding is similar to others, who have found that VPT children are at high risk of mathematics-based learning difficulties, even when other factors such as **general intellectual** ability, social risk and major neurosensory disabilities have been accounted for.^{2,3,10,14,33} It has been postulated that these difficulties in numerical operations are related to specific impairments in working memory, attention or mental flexibility, which may be in part attributed to periventricular white matter abnormalities⁷ commonly seen on MRI scans in VPT infants.³⁴⁻³⁶

Early identification of VPT children at greatest risk of later academic underachievement is imperative to ensure appropriate interventions are implemented to support outcomes. It has previously been shown that our cohort of VPT children is at high risk of school readiness difficulties across a number of domains, despite most of these children appearing otherwise healthy and free from major impairment.¹⁸ A recent study by Pritchard and colleagues¹³ of a similar cohort found that VPT children with school readiness difficulties were more likely to exhibit academic impairments at both 6 and 9 years of age. In that study, over 60% of VPT children had some form of academic delay at 6 and 9 years, compared with around one-quarter of the term-born children.¹³

We showed that simple screening of basic early number and language concepts at 5 years of age can predict impairments in core academic skills such as word reading, spelling and math computation two years later in VPT children with adequate sensitivity and specificity. The NLW subtest of the K-SEALS is a simple test that takes less than 15 minutes to administer. Clinicians caring for these high-risk children can administer this test at school entry as a screen to identify children who may go on to have academic difficulties at school.²⁰

In Victoria, Australia, approximately 20% of all children in the educational system are reported to have special educational needs but less than 4% receive additional funding.³⁷

Given that resources are limited, it is often only those children with the most severe difficulties who are prioritised for educational psychology assessments and funded assistance at school, and these assessments often occur well after problems are entrenched. Early identification of VPT children with less obvious deficits is vital, to allow appropriate educational planning, which accounts for the individual's strengths and weaknesses with an aim to remediate difficulties and maximise outcomes.³⁸

Although preterm children are known to be high users of additional educational assistance in the school setting³, a number of studies have shown that many of these children with documented deficits do not receive any additional supports.^{13,39} In our study 28% of VPT children were in current receipt of additional educational assistance in the school setting. However of the 43% of VPT children with impairment in at least one academic domain, only approximately half (51%) were receiving some form of special additional educational assistance. Given a broad definition of special assistance was used for this study (parental report ranging from minor supports through to full time aide support), it is likely that in many cases, the support that the child was receiving was not specific to their academic deficits. While identifying more at risk children at school entry may initially place added burden on school resources, it is unlikely that all of these children will require funded support. Rather, these at-risk

children can be flagged to teachers and families for further monitoring and evaluation so that specific support can be provided.

The strengths of the study include the large, prospective cohort, the high follow-up rates of both groups, and the comparison group of term-born controls. Important confounders including social disadvantage, which is prevalent in the VPT population, were included in our analyses. A unique aspect of this study is the identification of a brief pre-academic screening tool that can be readily administered by clinicians caring for these high-risk children, in order to inform school transition planning. Although the K-SEALS has been validated on a North American sample and has not been widely used in the Australian context, it has been shown to be valid across a range of populations and applications, particularly in the area of school readiness^{24-28,40}. Hence it is well suited as a rapid and cost efficient school-entry screening test in this context. Finally the use of the ROC curves in predicting outcomes means that specificity and sensitivity of the cut points can be tailored to suit individual applications. For example sensitivity can be maximised if the aim is to identify the majority of at-risk individuals (for example, when planning resource allocation at a policy level), or specificity can be maximised if the aim is to identify with precision the individuals at the highest risk of academic difficulties (for example, when planning individual learning supports).

Potential limitations of the study were that the academic outcomes were based on standardised tests of achievement, and no teacher ratings of achievement were available for comparison. However validity testing has previously shown that there is a high correlation between WRAT4 results and teacher ratings.²⁹ Other factors such as attention difficulties and impaired social-emotional function, which are known to be prevalent in this population and may affect academic functioning in school, were not included in these analyses. Finally the receipt of additional educational assistance at school was reliant on parental report of additional supports in place, rather than school

reports. It is possible that parental perception and recollection of supports may differ to that provided.

Our study showed that a simple pre-academic screener can predict academic outcomes two years later. Future work should focus on whether this predictive ability applies to outcomes persisting beyond the first two years of schooling. Ongoing review of our cohort will be essential to track the academic based trajectories of these VPT children, and to see whether the relative weakness in mathematical abilities noted in our study at age 7 years persist over time.

Conclusion

This contemporaneous cohort of VPT children is at increased risk of academic underachievement, especially in mathematics, compared with term-born children, even after adjusting for potential confounders. Early identification of VPT children at risk of academic impairment at 7 years of age is possible using a simple pre-academic screening tool at 5 years of age. This may assist school transition planning and allow for further monitoring, evaluation or additional supports.

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References

- 1 Doyle LW, Anderson PJ. Adult outcome of extremely preterm infants. *Pediatrics*. 2010; **126**: 342-51.
- 2 Litt JS, Gerry Taylor H, Margevicius S, Schluchter M, Andreias L, Hack M. Academic achievement of adolescents born with extremely low birth weight. *Acta Paediatr*. 2012.
- 3 Johnson S, Hennessy E, Smith R, Trikić R, Wolke D, Marlow N. Academic attainment and special educational needs in extremely preterm children at 11 years of age: the EPICure study. *Arch. Dis. Child. Fetal Neonatal Ed*. 2009; **94**: F283-9.
- 4 Aarnoudse-Moens CS, Weisglas-Kuperus N, van Goudoever JB, Oosterlaan J. Meta-analysis of neurobehavioral outcomes in very preterm and/or very low birth weight children. *Pediatrics*. 2009; **124**: 717-28.
- 5 Bhutta AT, Cleves MA, Casey PH, Cradock MM, Anand KJ. Cognitive and behavioral outcomes of school-aged children who were born preterm: a meta-analysis. *JAMA*. 2002; **288**: 728-37.
- 6 Bora S, Pritchard VE, Moor S, Austin NC, Woodward LJ. Emotional and behavioural adjustment of children born very preterm at early school age. *J. Paediatr. Child Health*. 2011; **47**: 863-9.
- 7 Anderson P, Doyle LW. Neurobehavioral outcomes of school-age children born extremely low birth weight or very preterm in the 1990s. *JAMA*. 2003; **289**: 3264-72.
- 8 Aarnoudse-Moens CS, Oosterlaan J, Duivenvoorden HJ, van Goudoever JB, Weisglas-Kuperus N. Development of preschool and academic skills in children born very preterm. *J. Pediatr*. 2011; **158**: 51-6.
- 9 Doyle LW, Roberts G, Anderson PJ. Outcomes at age 2 years of infants < 28 weeks' gestational age born in Victoria in 2005. *J. Pediatr*. 2010; **156**: 49-53.
- 10 Pritchard VE, Clark CA, Liberty K, Champion PR, Wilson K, Woodward LJ. Early school-based learning difficulties in children born very preterm. *Early Hum. Dev*. 2009; **85**: 215-24.
- 11 Grunau RE, Whitfield MF, Davis C. Pattern of learning disabilities in children with extremely low birth weight and broadly average intelligence. *Arch. Pediatr. Adolesc. Med*. 2002; **156**: 615-20.
- 12 Dall'oglio AM, Rossiello B, Coletti MF, *et al*. Do healthy preterm children need neuropsychological follow-up? Preschool outcomes compared with term peers. *Dev. Med. Child Neurol*. 2010; **52**: 955-61.
- 13 Pritchard VE, Bora S, Austin NC, Levin KJ, Woodward LJ. Identifying very preterm children at educational risk using a school readiness framework. *Pediatrics*. 2014; **134**: e825-32.
- 14 Johnson S, Wolke D, Hennessy E, Marlow N. Educational outcomes in extremely preterm children: neuropsychological correlates and predictors of attainment. *Dev. Neuropsychol*. 2011; **36**: 74-95.

- 15 Lee ES, Yeatman JD, Luna B, Feldman HM. Specific language and reading skills in school-aged children and adolescents are associated with prematurity after controlling for IQ. *Neuropsychologia*. 2011; **49**: 906-13.
- 16 Berger TM, Steurer MA, Woerner A, Meyer-Schiffer P, Adams M. Trends and centre-to-centre variability in survival rates of very preterm infants (<32 weeks) over a 10-year-period in Switzerland. *Arch. Dis. Child. Fetal Neonatal Ed*. 2012; **97**: F323-8.
- 17 Fanaroff AA, Stoll BJ, Wright LL, *et al*. Trends in neonatal morbidity and mortality for very low birthweight infants. *Am. J. Obstet. Gynecol*. 2007; **196**: 147 e1-8.
- 18 Roberts G, Lim J, Doyle LW, Anderson PJ. High rates of school readiness difficulties at 5 years of age in very preterm infants compared with term controls. *J. Dev. Behav. Pediatr*. 2011; **32**: 117-24.
- 19 Lyon G, Fletcher J, Shaywitz S, *et al*. Rethinking learning disabilities In: Finn Jr C, Rotherham A, Hokanson C, eds. *Rethinking special education for a new century*. Thomas B. Fordham Foundation & Progressive Policy Institute, Washington, DC, 2001; 259-87.
- 20 Council on Children With Disabilities, Section on Developmental Behavioral Pediatrics, Bright Futures Steering Committee, Medical Home Initiatives for Children With Special Needs Project Advisory Committee. Identifying infants and young children with developmental disorders in the medical home: an algorithm for developmental surveillance and screening. *Pediatrics*. 2006; **118**: 405-20.
- 21 Howard K, Roberts G, Lim J, *et al*. Biological and environmental factors as predictors of language skills in very preterm children at 5 years of age. *J. Dev. Behav. Pediatr*. 2011; **32**: 239-49.
- 22 Roberts G, Howard K, Spittle AJ, Brown NC, Anderson PJ, Doyle LW. Rates of early intervention services in very preterm children with developmental disabilities at age 2 years. *J. Paediatr. Child Health*. 2008; **44**: 276-80.
- 23 Wilson-Ching M, Pascoe L, Doyle LW, Anderson PJ. Effects of correcting for prematurity on cognitive test scores in childhood. *J. Paediatr. Child Health*. 2014; **50**: 182-8.
- 24 Kaufman AS, Kaufman NL. *Kaufman Survey of Early Academic and Language Skills (K-SEALS)*. Circle Pines, MN: American Guidance Service, Inc; 1993.
- 25 Black M, Powell D. Commonly used assessment and screening instruments. HIPPI USA; 2004.
- 26 Uyanik Ö, Kandir A. Adaptation of the Kaufman Survey of Early Academic and Language Skills to Turkish Children Aged 61 to 72 Months. *Educational Sciences: Theory & Practice*. 2014; **14**: 682-92.
- 27 Roopnarine JL, Krishnakumar A, Metindogan A, Evans M. Links between parenting styles, parent-child academic interaction, parent-school interaction, and early academic skills and social behaviors in young children of English-speaking Caribbean immigrants. *Early Childhood Research Quarterly*. 2006; **21**: 238-52.

- 28 Ellingsen K. Learning and applying knowledge. In: Majnemer A, ed. *Measures for Children with Developmental Disability: An ICF-CY Approach*. Mac Keith Press, London, 2012.
- 29 Wilkinson GS, G.J. R. *Wide Range Achievement Test 4 (WRAT4)*. Available from: <http://www4.parinc.com/Products/Product.aspx?ProductID=WRAT4> [accessed 23rd May 2015].
- 30 Weschler D. *Wechsler Abbreviated Scale of Intelligence*. San Antonio, TX: The Psychological Corporation / A brand of Harcourt Assessment, Inc; 1999.
- 31 Gross SJ, Mettelman BB, Dye TD, Slagle TA. Impact of family structure and stability on academic outcome in preterm children at 10 years of age. *J. Pediatr.* 2001; **138**: 169-75.
- 32 Taylor HG, Klein N, Drotar D, Schluchter M, Hack M. Consequences and Risks of <1000-g Birth Weight for Neuropsychological Skills, Achievement, and Adaptive Functioning. [Article]. *J. Dev. Behav. Pediatr.* 2006; **27**: 459-69.
- 33 Taylor HG, Espy KA, Anderson PJ. Mathematics deficiencies in children with very low birth weight or very preterm birth. *Developmental disabilities research reviews*. 2009; **15**: 52-9.
- 34 Treyvaud K, Ure A, Doyle LW, *et al.* Psychiatric outcomes at age seven for very preterm children: rates and predictors. *J. Child Psychol. Psychiatry*. 2013; **54**: 772-9.
- 35 Rogers CE, Anderson PJ, Thompson DK, *et al.* Regional cerebral development at term relates to school-age social-emotional development in very preterm children. *J. Am. Acad. Child Adolesc. Psychiatry*. 2012; **51**: 181-91.
- 36 Woodward LJ, Clark CA, Pritchard VE, Anderson PJ, Inder TE. Neonatal white matter abnormalities predict global executive function impairment in children born very preterm. *Dev. Neuropsychol.* 2011; **36**: 22-41.
- 37 Victorian Auditor General's Office. *Programs for Children with Special Learning Needs* 2012. Available from: <http://www.audit.vic.gov.au/publications/20120829-Special-Learning-Need/20120829-Special-Learning-Need.pdf> [accessed 2nd July, 2013].
- 38 Marlow N, Johnson S. What the teacher needs to know. *Arch. Dis. Child.* 2007; **92**: 945.
- 39 Litt J, Taylor HG, Klein N, Hack M. Learning disabilities in children with very low birthweight: prevalence, neuropsychological correlates, and educational interventions. *J. Learn. Disabil.* 2005; **38**: 130-41.
- 40 Haney M, Hill J. Relationships between parent - teaching activities and emergent literacy in preschool children. *Early Child Development and Care*. 2004; **174**: 215-28.

Table 1 Characteristics of very preterm and term-born children

Variable	VPT n = 194	Term n = 70	P-value
Child Characteristics			
Gestational Age (weeks), mean (SD)	27.5 (1.9)	39.1 (1.3)	<0.001
Birth Weight (grams), mean (SD)	962 (223)	3323 (508)	<0.001
Male, n (%)	102 (53%)	34 (49%)	0.57
Singleton, n (%)	111 (57%)	66 (94%)	<0.001
Family Demographics at 2 years			
Social Risk Score, median (IQR) †	2 (1-3)	1 (0-2)	<0.001
Characteristics at 5 years			
Developmental early intervention, n (%) ‡			
Ever	80 (45)	13 (21)	0.001
Currently	37 (21)	5 (8)	0.02
Characteristics at 7 years			
Corrected age at assessment (years), mean (SD)	7.5 (0.3)	7.6 (0.3)	<0.001
Cerebral Palsy, n (%)	11 (6%)	0 (0%)	0.04
Full Scale IQ, mean (SD)	96 (15.1)	107 (12.8)	<0.001
Corrected age at school commencement (years), mean (SD)	5.4 (0.5)	5.3 (0.5)	0.29
Time since school commencement (months), mean (SD)	25.8 (6.6)	28.4 (7.1)	0.007
Grade at school, n (%)			0.004
Grade Preparatory	2 (1%)	0 (0%)	

Grade 1	77 (43%)	15 (22%)	
Grade 2	90 (50%)	50 (72%)	
Grade 3	11 (6%)	4 (6%)	
Grade Repetition, n (%)	21 (12%)	2 (3%)	0.03
Additional educational assistance, n (%)			
Since school commencement §	78 (41%)	6 (9%)	<0.001
Currently ¶	55 (28%)	4(6%)	<0.001

‡2 year old social risk score available for 177 VPT and 63 term children

‡, Developmental early intervention data available for 177 VPT and 63 term children.

§ Additional educational assistance (since school commencement) data available for 188 VPT and 67 term children.

¶, Additional educational assistance (current) data available or 193 VPT and 68 term children

VPT, very preterm; SD, standard deviation; IQR, interquartile range; IQ, intelligence quotient

Table 2 Academic ability at age 7 years for very preterm (n = 194) and term-born (n = 70) children

Academic Domain	VPT Mean (SD)	Term Mean (SD)	Mean difference (95% CI)	P-value	Adjusted Mean Difference † (95% CI)	Adjusted P-value†
Word reading	98.2 (19.6) ‡	107.9 (16.9)	-9.7 (-14.7 to -4.6)	<0.001	-7.3 (-12.5 to -2.1)	0.006
Spelling	97.9 (19.2) §	106.2 (16.5)	-8.3 (-13.3 to -3.3)	0.001	-6.1 (-11.4 to -0.8)	0.024
Math computation	88.8 (18.4) ¶	99.7 (14.1)	-10.9 (-15.3 to -6.5)	<0.001	-8.9 (-13.5 to -4.3)	<0.001

† Adjusted for social risk (at 2 years) and time since school commencement.

‡ n = 193, § n = 192, ¶ n = 193

VPT, very preterm; SD, standard deviation; CI, confidence interval

Table 3 Very preterm (n=194) and term-born (n=70) children with impairment (standard score <85) in academic domains at age 7

Academic Domain	VPT n (%)	Term n (%)	OR (95% CI)	P-value	Adjusted OR (95%CI) †	Adjusted P-value†
Word reading	42 (22) ‡	5 (7)	3.6 (1.4 to 9.5)	0.009	4.4 (1.2 to 15.4)	0.022
Spelling	39 (20) §	4 (6)	4.2 (1.4 to 12.3)	0.009	4.4 (1.3 to 15.3)	0.02
Math computation	78 (40) ¶	8 (11)	5.3 (2.3 to 11.8)	<0.001	5.3 (2.1 to 13.7)	<0.001

†Adjusted for social risk (at 2 years) and time since school commencement.

‡ n = 193, § n = 192, ¶ n = 193

VPT, very preterm; OR, odds ratio; CI, confidence interval

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