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Language outcomes at 4 years of linguistically diverse children born very preterm: an Australian retrospective single-centre study

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ABSTRACT

Background Very preterm children are at increased risk of language delays. Concerns have been raised about the utility of standardised English language tools to diagnose language delay in linguistically diverse children. Our study investigated the incidence of language delay at 4 years in linguistically diverse very preterm children.

Methods Very preterm children born in South Western Sydney, Australia, between 2012 and 2016, were assessed with the Clinical Evaluation of Language Fundamentals Preschool-2 (CELF-P2) tool at 4 years of age. We sought to determine the incidence of language delay in this cohort using language scores from the CELF-P2 assessment tool, and explore potential predictors associated with language delay.

Results One hundred and sixty very preterm children attended the 4-year assessment out of the included 270 long-term survivors. At 4 years, 76 (52%) very preterm children had language delay diagnosed using the CELF-P2 assessment tool. Children who preferred a language other than English had lower average core language scores on the CELF-P2 assessment tool (75.1±14.4) compared with children that preferred English (86.5±17.9); p=0.002. Very preterm children growing up in households that preferenced a language other than English and those who were born from multiple births had higher odds of language delay at 4 years (AOR 10.30 (95% CI 2.82 to 38.28); p<0.001 and AOR 2.93 (95% CI 1.20 to 7.14); p=0.018, respectively). Assessing these children using an English language tool may have affected language scores at 4 years.

Conclusions In this metropolitan setting, very preterm children from linguistically diverse backgrounds were found to be vulnerable to language delays at 4 years. Further large-scale studies evaluating the language outcomes of linguistically diverse preterm children with more culturally appropriate tools are warranted. We question the utility of standardised English language tools to assess language outcomes of linguistically diverse populations.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Very preterm children are at increased risk of adverse neurodevelopmental outcomes, including language delays, compared with their peers born at term. The ideal way of assessing linguistically diverse preterm children is unknown, but concerns have been raised about the utility of standardised English language tools in children whose dominant language is not English.

WHAT THIS STUDY ADDS

⇒ This study confirms that linguistically diverse very preterm children (<30 weeks) are very vulnerable to language delays, especially children that prefer a language other than English, and those born from multiple births. Standardised English language tools should not be used in isolation to assess the language abilities of linguistically diverse preterm children, even when interpreters are present.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Further studies are warranted to explore culturally and developmentally appropriate ways of assessing language outcomes in linguistically diverse preterm children.

INTRODUCTION

It is well known that children born very preterm (<32 weeks gestation) are at increased risk of adverse neurodevelopmental outcomes compared with their peers born at term.[1 2] In Australia, almost 1 in 10 births (8.2%) occur prematurely.[3] Advances in perinatal and neonatal medicine have led to diminished rates of moderate to severe neurodevelopmental impairment in very preterm children.[4 5] Neurodevelopmental neonatal follow-up programmes allow close surveillance of this vulnerable population and early detection of neurodevelopmental impairments.[6]

Children born very preterm are predisposed to language delays.[7 8] Studies suggest that even in the absence of brain damage, preterm birth can affect linguistic development up to preschool years with some

children experiencing language difficulties up to 12 years.[9 10] Language delays can impact a child's academic achievements and friendship qualities.[11 12] Those with language delays extending into school years are at higher risk of psychosocial and emotional disorders in later life.[13 14]

Social variables, such as socioeconomic status and multilingual status, may influence the language development of preterm children.[15 16] Studies of language outcomes in preterm children from linguistically diverse populations are limited. This study evaluated the language outcomes of children born very preterm in a tertiary neonatal unit in South Western Sydney (Australia). South Western Sydney has one of the most culturally and linguistically diverse populations in Sydney and has significant pockets of socioeconomic disadvantage.[17 18] Up to 68% of households in this region speak a non-English language compared with 25% of households in the rest of Australia.[17]

There are many uncertainties relating to the language acquisition of bilingual children. It has been proposed that bilingual children may acquire their language skills simultaneously if exposed to both languages from a young age, or they may acquire their multilingual language skills sequentially.[19 20] Studies have demonstrated that simultaneous bilingual learners can attain their early language milestones at the same time as monolingual learners.[21–24] Proficiency, or dominance, in each language is variable and dependent on language exposure and opportunities provided to develop linguistic proficiency.[20 25] Bilingual children with a specific language impairment often face challenges in both languages and may learn each language at a slower pace compared with their typically developing bilingual peers.[25 26]

The ideal way of evaluating the language skills of bilingual preterm children remains unknown. Assessing children who speak a non-English primary language using standardised English language tools can introduce bias against them.[25 27 28] Failing to identify children with language delays prohibits them from accessing early intervention services. Currently, best practice uses a combination of direct and indirect language measures, in both dominant and non-dominant languages to provide a more valid assessment.[25]

The primary aim of this study was to investigate the incidence of language delay at 4 years in very preterm children born in South Western Sydney, using a standardised English language tool. As this is a linguistically diverse region, a secondary aim was to explore potential predictors, including multilingual status, associated with language delay at 4 years in very preterm children.

METHODS

Study design

This was a retrospective cohort study of prospectively collected data. Our neurodevelopmental clinic follows up children born very preterm in a single tertiary level neonatal unit in South Western Sydney. Developmental assessment outcomes are entered into a standardised neonatal intensive care units' (NICUs) data registry; a database used by all the neonatal units in New South Wales (NSW) and the Australian Capital Territory (ACT) in Australia. A description of the NSW and ACT neonatal service organisation, and the validity of the NICUs database has been described in previous reports.[29]

Setting and participants

All children born less than 30 weeks gestation at Liverpool Hospital in South Western Sydney, between January 2012 and December 2016, were included in this study. Children born in this neonatal unit are followed up in the South Western Sydney neurodevelopmental follow-up clinic. Data were sourced from the NICUs data registry for children that fit our inclusion criteria. Data relating to preferred language spoken at home were sourced from the hospital electronic records. Children with congenital anomalies and genetic conditions were excluded from this study.

Participant and public involvement

Participants and/or the public were not involved in the design, conduct, reporting or dissemination plans of this study.

Language outcome measures and language assessment tool used

At 4 years, language outcomes were collected from a standardised English language assessment tool known as The Clinical Evaluation of Language Fundamentals, Preschool second Edition (CELF-P2); Australian and New Zealand Standardised Edition.[30] The CELF-P2 assessment tool was administered by speech therapists. Age was not corrected for prematurity at 4 years.

The CELF-P2 assessment tool evaluates the language development of children between the ages of 3 and 6. It is an in-depth assessment in the domains of core language, receptive language, expressive language, language content and language structure. Only core language scores were used in this study as a marker of language delay. This is because core language scores are a measure of general language ability and provide a reliable assessment of overall language performance.[31] The core language score is formulated from the following tests: word classes, formulated sentences, recalling sentences and semantic relationships. The core language score has a mean of 100 and an SD of 15. A score of 100 on this scale represents the performance of a typically developing child of a given age. A score of 78–85 on this scale represents mild language impairment or delay, a score of 71 –77 on this scale represents moderate language delay and a score of ≤70 on this scale represents severe language delay. These are all standardised cut-offs for identifying language delays in children using this tool.[31]

Outcome measures

The primary outcome measure was incidence of language delay at 4 years in this cohort of very preterm children

using the CELF-P2 assessment tool. A secondary outcome was to explore the distribution of potential predictors, including multilingual status, for children with language delay compared with those without language delay.

Families of preterm children included in this study recorded their preferred language spoken at home, and this information was sourced from the hospital electronic records. Preferred language was separated into English and language other than English. Interpreters were offered to all families attending the neurodevelopmental follow-up clinic. The number of families that requested the use of an interpreter was recorded. This information was used to compare the children that attended the 4-year assessment.

Antenatal and perinatal characteristics were collected for all the children including multiple pregnancy, gender and gestational age. Major neonatal morbidities included proven late onset infection, intraventricular haemorrhage and/or periventricular leukomalacia, necrotising enterocolitis, chronic lung disease and retinopathy of prematurity requiring surgery as a neonate. Proven late onset infection, with an onset after 48 hours of life, could include bacteraemia (positive blood culture) or meningitis (positive cerebrospinal fluid result). Intraventricular haemorrhage related to grade 3 or grade 4 intraventricular haemorrhage as per Papile classification.[32] Necrotising enterocolitis related to cases that were proven radiologically or at surgery. Chronic lung disease was defined by the need of respiratory support, including oxygen therapy, at 36 weeks corrected age. Neurodevelopmental outcomes collected included cerebral palsy requiring walking aids corresponding with a level ≥3 on the gross motor function classification system, visual impairment and use of hearing aids. Visual impairment was bilateral (visual acuity of <6/60 from the better eye) or unilateral (visual acuity of <6/60 from the worse eye).

Statistical analysis

Descriptive statistics was used to compare the characteristics, major neonatal morbidities and language outcomes of our very preterm children. The association between potential predictors and language delay at 4 years was analysed using univariate logistic regression for categorical variables and a one-way analysis of variance for continuous variables. OR with a 95% CI was calculated for categorical variables and mean with SD was calculated for continuous variables. The level of statistical significance was set at p<0.05 using two-tailed comparisons. The significance level was not changed when multiple comparisons were performed. Backward elimination multiple regression models were conducted to determine the relationship between predictor variables and lower core language scores/language delay. Statistical analyses were performed using IBM SPSS Statistics for Windows, V.26.0 (IBM), and MedCalc Statistical Software, V.20.2.18 (MedCalc Software, Ostend, Belgium).

RESULTS

Out of 274 long-term survivors, 270 children born less than 30 weeks gestation between 2012 and 2016 were followed up in the South Western Sydney neurodevelopmental follow-up clinic (figure 1). Four children were excluded due to genetic or syndromic conditions. One child had Noonan syndrome and three children had chromosomal deletions that can impair development.

At 4 years, 146 children were able to complete the CELF-P2 assessment (core language scores could be obtained) and 14 children were not able to complete the CELF-P2 assessment. Four children were unable to complete the assessment due to behavioural issues, five children due to global developmental delay (including two with associated autism spectrum disorder), and two children were unable to complete it due to language barriers despite the use of an interpreter. A further two assessments were conducted by private psychologists who did not provide core language scores, and one child did not have a reason for having an incomplete CELF-P2 assessment.

Despite the high lost to follow-up (110 (41%) children) at 4 years, the characteristics and major neonatal morbidities did not differ greatly between those that attended the 4-year assessment and those that did not attend (table 1). More males attended the 4-year assessment. One-fifth of families that attended the 4-year assessment preferred to speak a language other than English. The most common languages spoken other than English were Arabic and Vietnamese (table 2). Out of the families that preferred to speak a language other than English and attended the 4-year assessment, only one-third requested an interpreter.

At the 4-year assessment, there were more males and children born more premature (<27 weeks gestation) in the group that preferred to speak a language other than English (table 3). The rate of major neonatal comorbidities was similar in both groups. The average age of children attending the 4-year assessment was 47 months.

Language delay was present in 52.1% of our very preterm children at 4 years (76 out of 146 children with complete CELF-P2 assessment scores). Children who preferred a language other than English had higher rates of mild, moderate and severe language delay compared with children that preferred English (table 4). Children that preferred a language other than English had increased odds of having language delay diagnosed using the CELF-P2 assessment tool at 4 years (OR 5.30 (95% CI 1.88 to 14.92); p=0.002). This group of children are more likely to have severe language delay compared with children who preferred English (OR 2.75 (95% CI 1.10 to 6.84); p=0.030). Other neurodevelopmental outcomes did not differ greatly between both groups of children, though numbers were small. Children that preferred a language other than English had lower average core language scores on the CELF-P2 assessment tool (75.1±14.4) compared with children that preferred English (86.5±17.9) (table 5).

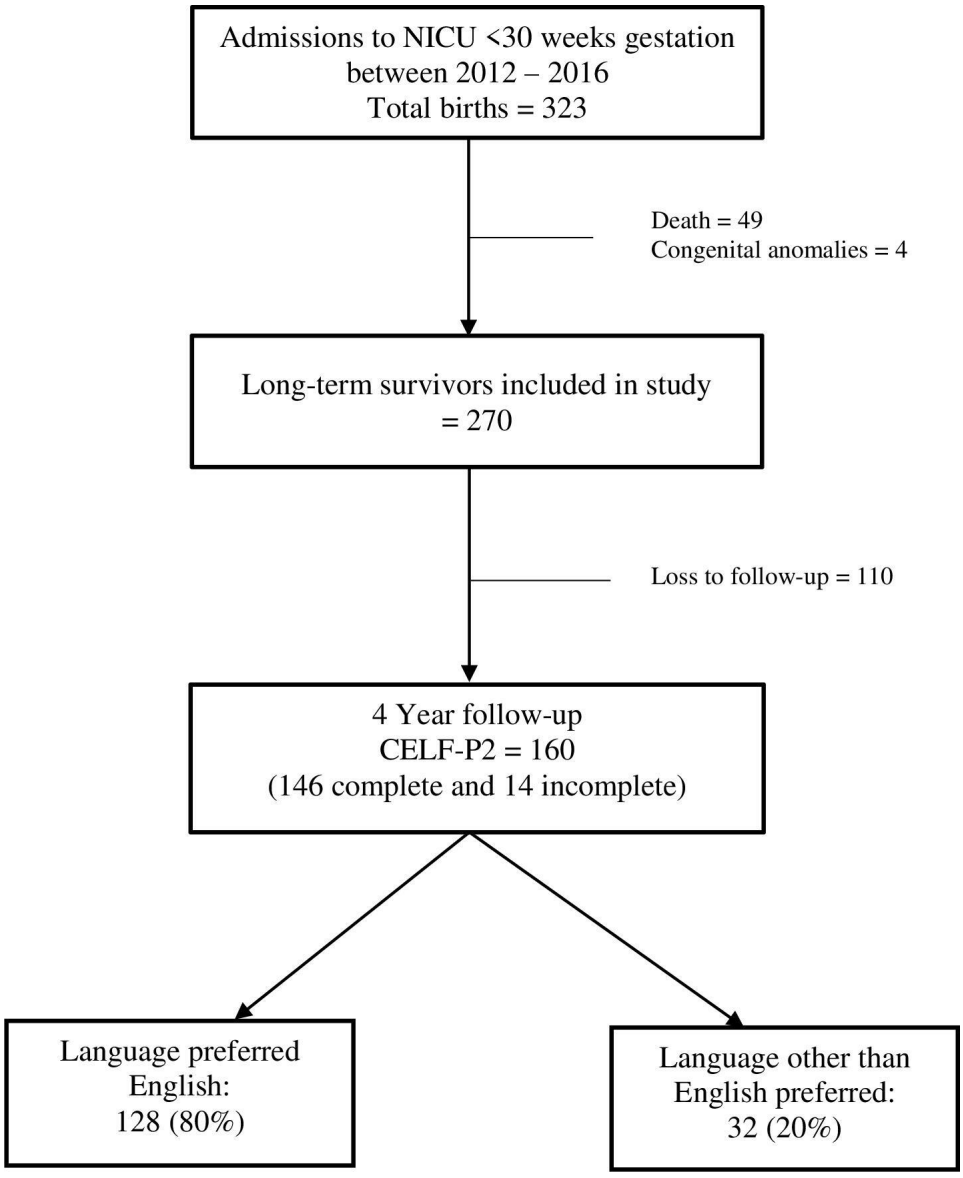

Figure 1 Profile of children from birth to follow-up among the study Group CELF-P2 denotes clinical evaluation of language fundamentals Preschool-2 tool. CELF-P2, Clinical Evaluation of Language Fundamentals Preschool-2; NICU, neonatal intensive care unit.

Multiple regression models showed that preferencing a language other than English (Adjusted OR 10.30 (95% CI 2.82 to 38.28); p<0.001) and multiple pregnancy (Adjusted OR 2.93 (95% CI 1.20 to 7.14); p=0.018) increased the odds of language delay and resulted in lower core language scores in our very preterm children at 4 years (table 6). Preference of a language other than English, male gender and multiple pregnancy explained up to 10% of variance in core language scores on the CELF-P2 assessment tool at 4 years (table 7).

DISCUSSION

Early identification of language delays in linguistically diverse preterm children is crucial to ensure timely referral to early intervention services. Our study provides a cross-sectional analysis of language outcomes of very preterm children born in South Western Sydney, a culturally and linguistically diverse region in Australia.[17] At 4 years, 76 (52%) very preterm children had language delay using the CELF-P2 assessment tool. This is a very high rate of language delay, and it is unclear how much is due to the impact of assessing these children with a standardised English language tool.

Very preterm children are known to have poorer language outcomes compared with their term peers.[7 10 28 33 34] In a New Zealand study by Foster-Cohen *et al*,[33] very preterm children had increased rates of mild, moderate and severe language delay at 4 years compared with full-term children, diagnosed using the CELF-P assessment tool. Lean *et al*[34] reported lower core language scores on the CELF-P2 assessment tool for very preterm children (88.43±17.7) compared with full-term children

Table 1 Antenatal and perinatal characteristics and major neonatal morbidities among children followed up and lost to follow-up

Characteristic	Followed up (n=160)	Lost to follow-up (n=110)	OR (95% CI); p value
Multiple pregnancy	43 (26.9)	33 (30.0)	1.17 (0.68 to 2.00); 0.575
Male gender	89 (55.6)	48 (43.6)	0.62 (0.34 to 1.01); 0.053
Gestational age (weeks) Gestational age <27 weeks	27.5±1.7 61 (38.1)	27.5±1.6 40 (36.4)	1.02 (0.88 to 1.19); 0.773 0.93 (0.56 to 1.53); 0.769
Late onset systemic bacteraemia Confirmed meningitis	18 (11.3) 1 (0.6)	8 (7.3) 0 (0)	0.62 (0.26 to 1.48); 0.280 –
Intraventricular haemorrhage grade 3 or 4 or PVL	4 (2.8)	1 (1.1)	0.38 (0.04 to 3.46);0.391
Necrotising enterocolitis	7 (4.4)	5 (4.5)	1.04 (0.32 to 3.37); 0.947
Chronic lung disease	55 (34.4)	41 (37.3)	1.13 (0.68 to 1.88); 0.625
Retinopathy of prematurity requiring surgery	10 (6.3)	3 (2.7)	0.42 (0.11 to 1.57); 0.196
Preferred language English	128 (80.0)	89 (80.9)	1.06 (0.57 to 1.96); 0.853
Preferred language other than English Interpreter requested Interpreter not requested	32 (20.0) 11 (34.4) 21 (65.6)	21 (19.1) 6 (28.6) 15 (71.4)	0.94 (0.51 to 1.74); 0.853 0.78 (0.28 to 2.18); 0.638 1.28 (0.46 to 3.57); 0.638

Data are presented as n (%) or mean±SD followed up was set as a referent for OR and 95% CI calculation.
PVL, periventricular leukomalacia.

(103.56±13.7) at 5 years. Using the same language tool, our cohort of very preterm children had a similar average core language score of 84.4±17.9.

The CELF-P2 assessment tool has the advantage of assessing the complex receptive and expressive language function of preschool children. Very preterm children have been reported to have poorer receptive and expressive language skills compared with their term counterparts.[33] While most very preterm children demonstrate catch-up of their language functioning during childhood, a third of them continue to exhibit poor language functioning throughout childhood without any evidence of catch-up even at 13 years of age.[7]

Our study aimed to explore the effect of predictors, in particular multilingualism, on the language outcomes of very preterm children. Parents of the children included in the study were asked to nominate their preferred language. This information was used to compare the outcomes of children from families that preferred to speak English and families that preferred to speak a

Table 2 Language outcomes at 4 years using Clinical Evaluation of Language Fundamentals Preschool-2 (CELF-P2) tool and language characteristics among families attending 4-year assessment

Language outcomes and characteristics	Result (n=146)
Average language core score on CELF-P2	84.4±17.9
Language outcomes based off CELF-P2 core scores	Delay 76 (52.1%) No delay 70 (47.9%)
Families that preferred English language*	128/217 (58.9)
Families that preferred language other than English†	32/53 (60.4)
Other preferred languages at 4-year assessment	
Arabic	5/16 (31.3)
Vietnamese	6/11 (54.5)
Other languages‡	21/26 (80.8)
Interpreter requested by families that prefer a language other than English§	11/17 (64.7)

Data are presented as n (%) or mean±SD.
*Denominator is total families that preferred English language.
†Denominator is total families that preferred a language other than English.
‡Other languages include Chinese, Assyrian, Indonesian, Thai, Spanish, Krio, Chaldean-Neoaramaic, Hindi, Khmer Cambodian, Serbian, Farsi, Gujrati, Urdu, Bengali and Paakayanti.
§Denominator is total number of families that requested an interpreter out of long-term survivors included in study.

Table 3 Antenatal and perinatal characteristics and major neonatal morbidities among children born 23–30 weeks gestation and assessed at 4 years

Characteristic	Preferred language english (n=128)	Preferred language other than english (n=32)	OR (95% CI); p value
Multiple pregnancy	36 (28.1)	7 (21.9)	0.72 (0.28 to 1.80); 0.477
Male gender	69 (53.9)	20 (62.5)	1.43 (0.64 to 3.16); 0.383
Gestational age (weeks) Gestational age <27 weeks	27.6±1.7 46 (35.9)	27.0±1.7 15 (46.9)	0.83 (0.66 to 1.04); 0.099 1.57 (0.72 to 3.44); 0.257
 Late onset systemic bacteraemia Confirmed meningitis	15 (11.7) 1 (0.8)	3 (9.4) 0 (0)	0.78 (0.21 to 2.87); 0.708 –
Intraventricular haemorrhage grade 3 or 4 or PVL	3 (2.6)	1 (3.7)	1.46 (0.15 to 14.62); 0.747
Necrotising enterocolitis	5 (3.9)	2 (6.3)	1.64 (0.30 to 8.87); 0.566
Chronic lung disease	45 (35.2)	10 (31.3)	0.84 (0.37 to 1.92); 0.678
Retinopathy of prematurity requiring surgery	9 (7.0)	1 (3.1)	0.43 (0.05 to 3.50); 0.427

Data are presented as n (%) or mean±SD, and OR; 95% CI. English as the preferred language was set as a referent for OR and 95% CI calculation.
PVL, periventricular leukomalacia.

language other than English. Arabic and Vietnamese were the most common non-English languages spoken. This is consistent with the language demographics in South Western Sydney, where Arabic and Vietnamese are the most common non-English languages spoken at home.[17] It is recognised that some children that preferred English may belong to multilingual households, but children were divided this way to ensure consistency and to minimise selection bias. Therefore, the predictor assessed is not multilingualism, but proficiency of a dominant language as indicated by parents. This limitation highlights the challenges faced in studies relating to multilingualism.

Our results showed that children from families that preferred to speak a language other than English had increased odds of language delay at 4 years (AOR 10.30 (95% CI 2.82 to 38.28); p<0.001). Similar associations have been replicated in other studies. Lowe *et al*[35] reviewed the effect of primary language on language and cognitive outcomes in extremely preterm children (<28 weeks gestation) at 18–22 months, using a standardised assessment tool known as the Bayley Scales of Infant and Toddler Development, third Edition. This assessment tool measures the global development of children (language, cognition and motor domains) up to 36 months. This study identified that extremely preterm children with Spanish as their primary language had lower language scores compared with extremely preterm children with English as their primary language, despite both groups having similar cognitive function.[35]

Table 4 Neurodevelopmental outcomes among children born 23–30 weeks gestation and assessed at 4 years

Characteristic	Preferred language english (n=128)	Preferred language other than english (n=32)	OR (95% CI); p value
Age at assessment (months)	47.5±2.4	47.4±3.0	0.97 (0.81 to 1.17); 0.762
No language delay (CELF-P2 language score ≥86)*	65 (54.6)	5 (18.5)	0.19 (0.07 to 0.53); 0.002
Mild language delay (CELF-P2 language score 78–85)*	16 (13.4)	5 (18.5)	1.46 (0.49 to 4.42); 0.500
Moderate language delay (CELF-P2 language score 71-77)*	17 (14.3)	7 (25.9)	2.10 (0.77 to 5.72); 0.147
Severe language delay (CELF-P2 language score ≤70)*	21 (17.6)	10 (37.0)	2.75 (1.10 to 6.84);0.030
Any level of language delay*	54 (45.4)	22 (81.5)	5.30 (1.88 to 14.92); 0.002
Cerebral palsy requiring walking aids (GMFCS≥3)	0	2 (6.3)	–
Bilateral visual impairment Unilateral visual impairmen	0 1 (0.8)	0 0	 – –
Hearing aids required Cochlear implants required	1 (0.8) 1 (0.8)	0 0	 – –

Data are presented as n (%) or mean±SD, and OR; 95% CI. Preferred language English was set as a referent for OR and 95% CI calculation.
* Denominator is 119 children that preferred English and 27 children that preferred a language other than English (completed CELF-P2 assessment)
CELF-P2, Clinical Evaluation of Language Fundamentals Preschool-2; GMFCS, gross motor function classification system.

Table 5 Univariate ANOVA analysis of impact of variables on Clinical Evaluation of Language Fundamentals Preschool-2 (CELF-P2) core language scores at 4 years

Variables	Core language scores on CELF-P2*	P value
Preferred language		
English	86.5±17.9	0.002
Language other than English	75.1±14.4	
Gestational age		
<27 weeks	84.2±18.9	0.903
≥27 weeks	84.6±16.1	
Chronic lung disease		
Yes	82.8±15.9	0.463
No	85.2±18.7	
Any other major neonatal morbidity†		
Yes	82.5±17.8	0.550
No	84.8±17.8	
Multiple pregnancy		
Yes	78.2±16.4	0.015
No	86.5±17.9	
Male gender		
Yes	82.6±15.4	0.200
No	86.4±20.2	
Interpreter use		
Yes	70.8±12.4	0.280
No	77.2±15.1	

*Data are presented as mean±SD.
†Any other major neonatal morbidity includes proven infection, intraventricular haemorrhage (grade 3 or 4) and/or PVL, necrotising enterocolitis, retinopathy of prematurity requiring surgery, vision impairment and use of hearing aids.
ANOVA, analysis of variance; PVL, periventricular leukomalacia.

Table 6 Multiple logistic regression model to identify variables associated with any level of language delay at 4 years

Variables*	AOR (95% CI)	P value
English preferred	Referent	Referent
Language other than English preferred	10.39 (2.82 to 38.28)	<0.001
Multiple births	2.93 (1.20 to 7.14)	0.018
Male gender	1.54 (0.72 to 3.28)	0.268
ROP requiring surgery	2.53 (0.56 to 11.43)	0.228

Data presented as OR; 95% CI.
*Backward regression, enter variable if, p<0.05, remove variables if, p>0.3. Variables not included in the model included gestational age, proven infection, necrotising enterocolitis, chronic lung disease, intraventricular haemorrhage (grade 3 or 4) and/or PVL, vision impairment, use of hearing aids and interpreter use.
AOR, adjusted odds ratio; PVL, periventricular leukomalacia; ROP, retinopathy of prematurity.

Adams-Chapman *et al*[15] also found that non-English-speaking preterm children had poorer language outcomes compared with English-speaking preterm children at 30 months, using the Bayley Scales of Infant Development-IIR. Even in non-preterm children, there is still an association between non-English speaking background (where English is not the dominant language) and low expressive and receptive language status diagnosed with the CELF-P2 assessment tool at 4 years (OR 6.96 (95% 3.75 to 12.89); p<0.001 and OR 2.97 (95% CI 1.62 to 5.43); p<0.001, respectively).[36] This raises concerns that the use of standardised English language tools may not be appropriate for some populations and may introduce bias against non-English-speaking children born preterm. Failure to identify language delays in children prohibits them from accessing early intervention services at an adaptive young age and it may impact the school readiness of the child.

One of the biggest limitations of the CELF-P2 assessment tool is that it is only available in English and Spanish. Only the English version of this test was available at our neurodevelopmental follow-up clinic. All families were given access to an interpreter if requested. At the 4-year assessment, only one-third of the families who preferred to speak a language other than English requested the use of an interpreter. However, two children that preferred to speak a language other than English were not able to complete the CELF-P2 assessment due to language barriers, even though interpreters were present for the assessments. It is also likely that some families would have benefited from the use of an interpreter, but this was declined when they were asked. This highlights that some forward planning is required to understand families' dominant English language skills and understand the reason for declining the use of interpreters despite challenges in using English effectively.

The question remains whether standardised English language tools are best suited for our linguistically diverse cohort. English language tools, such as the CELF-P2, are not appropriate for linguistically diverse preterm children, especially when used in isolation. It is possible that the use of this English language tool could have had an impact on the language scores of our linguistically diverse population. A combination of direct and indirect language measures in dominant and non-dominant languages should be used to provide a robust and reliable language assessment.[25] Indirect language measures, such as feedback from teachers, preschools, day care providers and medical professionals, provide useful feedback about the child. These indirect language measures form part of the overall assessment at our neurodevelopmental follow-up clinic but need to be further formalised.

Table 7 Multiple regression model of variables impacting Clinical Evaluation of Language Fundamentals Preschool-2 assessment core language scores at 4 years

Variables*	Coefficient	SD	T	P value
Constant	90.36			
Language other than English preferred	−11.53	3.63	−3.17	0.002
Male gender	−3.13	2.82	−1.11	0.27
Multiple pregnancy	−8.55	3.23	−2.661	0.009

*Backward regression, enter variable if, p<0.05, remove variables if, p>0.3. Variables not included in the model included major complication and gestational age. R^2=10%.

Another indirect measure that can be implemented is the analysis of language samples.[37 38] The use of the CELF-P2 assessment tool and the analysis of language samples has been found to be a useful way of assessing the language development of urban Aboriginal preschool children.[37] Further exploration of culturally and developmentally appropriate ways of assessing language outcomes in linguistically diverse preterm children is warranted, and such research needs to be prioritised.

The incidence of language delay in our very preterm children based off the CELF-P2 assessment tool is certainly alarming. Preference of a non-English language, male gender and multiple pregnancy only explained 10% of variance in CELF-P2 core language scores at 4 years. Other predictor variables including major neonatal morbidities and other neurodevelopmental outcomes, were not able to explain our findings. It is known that very preterm children have an increased risk of neurodevelopmental outcomes, such cerebral palsy, cognitive delay and emotional/behavioural adjustment problems.[28] The CELF-P2 assessment tool is not able to screen for cognitive and motor impairments, as it is strictly a language assessment tool. Assessing other developmental domains at 4 years would provide further insight into these children and allow us to differentiate between a specific language impairment and a more serious issue with cognitive or executive functioning, or motor development. Administering the CELF-P2 assessment concomitantly with a test of cognitive functioning, such as the Wechsler Preschool and Primary Scale of Intelligence tool, may help answer this question and provide useful information prior to school commencement. We did not collect this data for the purpose of the current study.

Another limitation of this study is that it did not include socioenvironmental predictors as they were not prospectively collected during the study period. Low maternal education levels, low maternal IQ and poor communication skills are predictive of poorer language outcomes in very preterm children at 5 years.[34 36 39 40] These variables may also potentially explain some of the variance in CELF-P2 core language scores at 4 years. Information relating to parental education skills is routinely collected at the neurodevelopmental follow-up clinic now, but additional data on socioeconomic status and language(s) spoken at home would be beneficial.

Lost to follow-up at 4 years was our biggest limitation. This resulted in a smaller number of children attending the 4-year assessment, potentially affecting the power of our study. Although it was reassuring that the characteristics and major neonatal morbidities of the children lost to follow-up did not differ greatly compared with those that did attend their 4-year assessment, it would be worthwhile exploring the reasons for lost to follow-up at 4 years since there are likely children in this group with language delays. This was beyond the scope of this study.

CONCLUSION

Neurodevelopmental surveillance of very preterm children is crucial. Our study found that half of our linguistically diverse very preterm children attending the 4-year assessment had language delay, diagnosed with the CELF-P2 assessment tool. Concerns have been raised regarding the utility of standardised English language tools in linguistically diverse very preterm children, and these should only be used in conjunction with indirect language measures. Very preterm children growing up in households that speak a language other than English had higher odds of language delays at 4 years. But to determine the full effect of multilingualism on language outcomes of very preterm children, other socioenvironmental factors and developmental domains need to be explored in more detail. Further large-scale studies evaluating the language outcomes of linguistically diverse preterm children are warranted.

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