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Motor trajectories from 4 to 18 months corrected age in infants born at less than 30 weeks of gestation

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ABSTRACT

Background: Preterm infants are recognised as developing at a significantly slower rate than their full-term peers and with different movement quality.
Aim: This study aimed to describe the longitudinal gross motor trajectories of these infants in the first 18 months of (corrected) age and investigate factors associated with gross motor development.
Study design: A longitudinal study was conducted with convenience samples of 58 preterm infants born ≤29 weeks of gestation and 52 control full-term infants in Australia.
Outcome measures: The infants were assessed at 4, 8, 12 and 18 months of (corrected) age using the Alberta Infant Motor Scale (AIMS).
Results: Forty-six preterm and 48 control infants completed all four assessments. The preterm group scored significantly lower on various sub-scores at all age levels. Almost half of the preterm infants demonstrated less progression in the sit sub-scale from 4 to 8 months (corrected) age, possibly due to an imbalance between flexor and extensor strength in the trunk. At 12 and 18 months of (corrected) age, lack of rotation and fluency in their movements were evident in some preterm infants. Presence of intra-ventricular haemorrhage and chronic lung disease were associated with poor motor performance at 4 months and use of postnatal steroids was associated with poor motor performance at 4, 8 and 18 months of corrected age.
Conclusion: The imbalance between flexor and extensor muscle strength in preterm infants had a stronger impact on motor development than usually expected. The AIMS appears to be a sensitive assessment tool to demonstrate the unique movement characteristics in this preterm cohort.

1. Introduction

The survival rate of very preterm or extremely preterm born infants has been significantly increasing in the last 2 decades due to advances in perinatal medicine [1,2]. The worldwide trend shows that there has been an increase in the number of neurologically intact premature children than those with cerebral palsy [3]. However preterm infants have been shown to have motor delay when compared with their full-term peers [4]. Preterm infants have also been shown to have some atypical postures, e.g. hyperextension of the neck and the trunk and reduced active flexion power when compared with their full-term counterparts [5]. These atypical postures are commonly believed due to the loss of physiological flexion because of the premature birth and the reinforcement of extended postures as a result of medical procedures in the intensive care unit [6].

De Groot and colleagues [7–9] demonstrated that the discrepancies between the active muscle power and passive muscle tone in preterm infants influenced their capability in independent sitting and variations in their movements. As the investigators did not use standardised assessment tools in these studies, the validity of their findings is not clear, particularly with regard to the emphasis on the quality of movement in the infants.

A study of 800 healthy preterm infants (GA = 29.4 weeks, SD 1.7) showed that the infants exhibited very different developmental profiles in the first 18 months CA using the Alberta Infant Motor Scale (AIMS) [10]. This study was a mixed cross-sectional and longitudinal study design, in which some preterm infants were seen more than once for testing during the 18 months post-term period. Due to the nature of the study, individual motor trajectories of the preterm infants might have been overlooked and could not be described thoroughly [10].

The objective of this study was to systematically investigate and document the development of motor skills in this cohort of infants born ≤29 weeks GA at four time points during their first 18 months post-term compared with a contemporary group of typically developing full-term controls. Possible associated factors for their motor development during early infancy were also examined.

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2. Methods

The recruitment of preterm and control infants was described in detail in our previous report [11]. In brief, the preterm infants were recruited from one of the four tertiary neonatal intensive care units (NICU) in Melbourne, Australia and were born ≤29 completed weeks GA. Infants with known congenital abnormalities and syndromes were excluded. A convenience sample of typically developing full-term infants (born ≥37 completed weeks GA) acted as controls. Ethical approval was sought prior to the commencement of the study from the Human Research Ethics Committees of the Mercy Hospital for Women and the University of Melbourne. Informed consent was obtained from the parent of each participant.

One hundred and three infants born ≤29 weeks GA were admitted to the NICU between April 2006 and February 2007, with 86 infants eligible for the study. Twelve families declined to participate in the study for personal reasons. Eleven infants died before the families were approached for the study and one infant was missed due to a very short hospital stay. As a result, consent was obtained from the parents of 62 infants (Table 1). Three infants died before the full set of assessments was completed. Results from one infant were discarded due to a confirmed diagnosis of pseudobulbar palsy at 18 months CA, a condition with definitely abnormal movement patterns, which was inappropriate to be assessed with the AIMS [12], leaving 58 preterm infants in the study. There was no significant difference in the mean gestation age and birth weight of the recruited and non-recruited preterm infants (independent samples *t*-test with equal variance not assumed, $p = 0.644$ and 0.126 respectively) (Table 2). Hence, it was reasonable to believe that the recruited infants were a typical cohort of preterm infants admitted to the NICU (Fig. 1).

Having contacted parents of 61 full-term born infants from parents' groups in various child health centres and via personal contact in the community, 53 infants were recruited. One infant was withdrawn after her 4-month assessment because of a late diagnosis of hip dysplasia, leaving 52 control infants in the study (Fig. 1).

The Alberta Infant Motor Scale (AIMS) is a norm-referenced standardised assessment tool for gross motor maturity in infants from birth until 18 months of age [12]. It was designed to identify infants with motor delay and to evaluate the motor development over time in infants under 18 months of age [12]. Based on observation, the AIMS requires minimal handling of the infant and emphasises the movement quality of tested motor skills. The AIMS consists of 58 items assessed in prone (21 items), supine (9 items), sitting (12

Table 1
Comparisons of characteristics of preterm and control infants.

	Preterm	Control	*p*-value[a]
Number of infants recruited	62	53	–
Gender — male	30/60 (50)	32/53 (60)	NS
Mean gestational age (SD) (weeks)	26.95 (1.14)	39.55 (1.17)	<0.001
Mean birth weight (SD) (grams)	918 (230)	3546 (479)	<0.001
Small for gestation[b]	7/60 (12)	1/53 (2)	NS
Apgar score at 5 min	7.9 (SD 1.6)	9.1 (SD 0.5)	<0.001
Use of antenatal steroid	53/60 (88)	0	–
Use of postnatal steroid (hydrocortisone)	7/60 (12)	0	–
CLD	28/60 (47)	0	–
IVH ≥ grade III	6/60 (10)	0	–
ROP ≥ stage 3	7/60 (12)	0	–
V–P shunt insertion	2/60 (3)	0	–
Seizure	4/60 (7)	0	–
NEC with abdominal surgery	2/60 (3)	0	–
Passed in hearing test[c]	52/59 (88)	53/53 (100)	0.035
Plurality			
Singletons	37/59 (62)	51/53 (96)	<0.001
Twins	20/59 (33)	2/53 (4)	
Triplets	3/59 (5)	0/53 (0)	
Maternal education level[c]			
Secondary or below	22/59 (37)	6/53 (11)	<0.001
Higher education	17/59 (29)	10/53 (19)	
University or above	20/59 (34)	37/53 (70)	

Number in brackets represents percentage unless stated otherwise; CLD — chronic lung disease defined as dependency on oxygen at 36 weeks GA; IVH — intra-ventricular haemorrhage [18]; ROP — retinopathy of prematurity [19]; NEC — necrotising enterocolitis; SD — standard deviation.

[a] Chi-square for gender, small for gestation, plurality, pass in hearing test and maternal education level or independent sample *t*-test with equal variances not assumed for gestation age, birth weight and Apgar score.

[b] Defined as less than 10th percentile of the birth weight corresponding to the gestational age [37].

[c] Missing data for the preterm infant who died after 4-month-old testing.

Table 2
Independent samples *t*-tests of preterm ($n = 46$) and control ($n = 48$) groups from 4 to 18 months of age (corrected for preterm group).

	Group	Mean	SD	SEM	t	df[a]	*p*-value
4 months (CA)							
Prone sub-score	Preterm	4.61	1.33	0.20	−3.41	90.26	0.001
	Control	5.50	1.20	0.17			
Supine sub-score	Preterm	4.17	0.64	0.10	−2.92	91.90	0.004
	Control	4.56	0.65	0.09			
Sit sub-score	Preterm	1.35	0.57	0.08	−2.96	84.52	0.004
	Control	1.77	0.81	0.12			
Stand sub-score	Preterm	1.91	0.35	0.05	-1.44	84.55	0.154
	Control	2.06	0.50	0.07			
Total score	Preterm[b]	12.02 (11.4, $n = 26$)	1.94 (2.00)	0.29 (0.39)	−4.42	91.76	<0.001
	Control[c]	13.88 (17.90, $n = 122$)	2.13 (4.15)	0.31 (0.58)			
8 months (CA)							
Prone sub-score	Preterm	11.33	3.05	0.45	−0.51	91.65	0.609
	Control	11.67	3.39	0.49			
Supine sub-score	Preterm	7.89	1.66	0.25	−0.35	84.79	0.725
	Control	8.00	1.29	0.19			
Sit sub-score	Preterm	5.70	2.73	0.40	−7.93	65.40	<0.001
	Control	9.25	1.36	0.20			
Stand sub-score	Preterm	2.72	0.54	0.08	−2.46	73.12	0.016
	Control	3.13	1.00	0.15			
Total score	Preterm[b]	27.63 (33.4, $n = 20$)	5.58 (8.89)	0.82 (1.99)	−3.88	91.56	<0.001
	Control[c]	32.04 (39.8, $n = 220$)	5.44 (8.69)	0.79 (1.22)			
12 months (CA)							
Prone sub-score	Preterm	18.91	2.35	0.35	−3.17	81.01	0.002
	Control	20.25	1.67	0.24			
Supine sub-score	Preterm	8.80	0.78	0.12	−0.21	78.00	0.833
	Control	8.83	0.52	0.08			
Sit sub-score	Preterm	11.50	0.91	0.14	−2.27	72.88	0.026
	Control	11.85	0.55	0.08			
Stand sub-score	Preterm	8.28	2.71	0.40	−2.88	89.80	0.005
	Control	9.81	2.42	0.35			
Total score	Preterm[b]	47.30 (48.8, $n = 66$)	5.70 (5.25)	0.84 (0.65)	−3.28	85.16	0.002
	Control[c]	50.77 (54.6, $n = 124$)	4.45 (4.52)	0.64 (0.63)			
18 months (CA)							
Prone sub-score	Preterm	20.87	0.40	0.06	−2.21	45.00	0.032
	Control	21	0	0			
Supine sub-score	Preterm	9	0	0	–	–	–
	Control	9	0	0			
Sit sub-score	Preterm	11.85	0.36	0.05	−2.84	45.00	0.007
	Control	12	0	0			
Stand sub-score	Preterm	14.87	2.19	0.32	−2.91	58.28	0.005
	Control	15.88	0.87	0.13			
Total score	Preterm[b]	56.59 (56.9, $n = 49$)	2.54 (2.65)	0.38 (0.38)	−3.26	54.91	0.002
	Control[c]	57.88 (57.7, $n = 30$)	0.87 (0.64)	0.13 (0.09)			

SD — standard deviation; SEM — Standard error of mean.

[a] Variances not assumed and degrees of freedom rounded up to nearest whole number.

[b] Numbers in brackets are normative data from the study by van Haastert et al. [10].

[c] Numbers in brackets are normative data from the AIMS manual [12].