Gross Motor Outcomes of Children Born Prematurely in Northern Ontario and Followed by a Neonatal Follow-Up Programme

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ABSTRACT

Purpose: The developing brain of a premature infant is vulnerable to injury. As a result, the long-term consequences of a premature birth include motor deficits, cognitive and behavioural problems. It is crucial to identify motor dysfunction during the preschool period because it interferes with a child's ability to explore the world. The goals of this study were to (1) provide preliminary data on the gross motor outcomes of children born prematurely and (2) determine the proportion and characteristics of the children who had maintained delays over the course of follow-up. **Method:** A retrospective chart review was conducted on all infants monitored by a neonatal follow-up programme. Each child was assessed by a single physiotherapist from birth until age 2 years. Of the 107 cases identified, 97 individuals were retained for analysis; they had a mean gestational age of 31.1 (SD 2.9) weeks and a mean birth weight of 1.66 (SD 0.53) kilograms. **Results:** The majority of children assessed were found to have gross motor outcomes in the average range. Children with scores below the average range were most often born very preterm (VPT) or moderately preterm (MPT), with very low or low birth weight, respectively. A total of 17 participants were referred to physiotherapy to address the gross motor delays identified in the follow-up programme; 14 of these 17 had previously been identified as delayed and were being monitored. Late preterm (LPT) children ($n = 6$) were most often referred, followed by those born extremely preterm (EPT) and VPT ($n = 4$). In total, 56 children were identified as delayed at one assessment point but were found to be within normal limits by the end of the follow-up period. **Conclusion:** It is important to periodically monitor premature children. A longitudinal, population-based study is also needed to provide more data on the predictors and long-term motor outcomes of MPT and LPT children.

Key Words: gross motor development; neonatal follow-up; prematurity.

RÉSUMÉ

Objectif: le cerveau du nourrisson prématuré est vulnérable aux lésions. Conséquemment, des difficultés motrices, ainsi que des troubles cognitifs et comportementaux peuvent être observés. Il est essentiel de diagnostiquer les dysfonctions motrices pendant la période préscolaire, comme elles compromettent la capacité de l'enfant à explorer le monde. La présente étude cherchait à 1) fournir des données préliminaires sur la motricité grossière des enfants nés prématurément et 2) déterminer la proportion et les caractéristiques des enfants qui ont maintenu des retards au fil du temps. **Méthodologie:** les chercheurs ont effectué une analyse rétrospective des dossiers de tous les nourrissons ayant fait l'objet d'un programme de suivi néonatal. Une seule physiothérapeute a évalué chaque enfant entre la naissance et l'âge de deux ans. Des 107 cas, 97 ont été conservés en vue de l'analyse. À la naissance, l'âge gestationnel moyen était de 31,1 semaines (ÉT 2,9) et le poids moyen était de 1,66 kg (ÉT 0,53). **Résultats:** les résultats ont montré que chez la majorité des enfants, la motricité grossière se situait dans une plage moyenne. Les enfants dont les scores se situaient sous la moyenne étaient souvent très prématurés ou modérément prématurés et avaient un poids très faible ou faible à la naissance, respectivement. Au total, 17 participants ont été orientés en physiothérapie afin de cibler les retards constatés durant le programme de suivi. De ceux-ci, 14 avaient déjà été identifiés comme ayant un retard. Les enfants peu prématurés ($n = 6$) étaient les plus souvent orientés en physiothérapie, suivis des enfants extrêmement prématurés et très prématurés ($n = 4$). Au total, 56 enfants identifiés comme ayant un retard se sont rattrapés et se situaient dans les limites de la norme à la fin de la période de suivi. **Conclusion:** l'évaluation périodique des enfants prématurés est nécessaire. Une étude longitudinale à plus grande échelle est nécessaire afin de mieux comprendre le portrait clinique à long terme des enfants modérément prématurés et peu prématurés.

In premature infants, motor skill impairment is a commonly reported negative outcome, with cerebral palsy (CP) being the most severe form.¹ Many preterm children do not go on to develop CP but still present with impaired motor skills.²

A review of preterm children born with a broad gestational age (GA; ≤ 37 weeks' gestation) and without CP revealed an increased likelihood of childhood motor skill impairment.² Prevalences of 19 of 100 and 40.5 of 100 has been reported for preterm children with moderate

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and mild to moderate impairment, respectively; in contrast, the prevalence of CP is estimated to be 6–8 of 100 in the general pediatric population.^{2,3}

It is crucial to identify and remediate motor dysfunction in children because it interferes with their ability to explore the world, be involved in social activities, and acquire future gross and fine motor skills.^{4,5} A better understanding of the motor trajectory of all preterm children is important given that the effects of motor skill impairment can extend beyond the motor domain and into educational, social, and behavioural domains.^{3,6–10} More research is needed to ensure greater clinical recognition of these impairments and to determine the underlying mechanisms associated with general motor impairment.⁶

The traditional adverse outcomes of the preterm infant have been widely published: CP and visual, auditory, and cognitive impairment. However, little is known about the presence of minor morbidities in premature children, even though a higher prevalence has been reported in the literature, including in infants born moderately preterm (MPT; 32–33 weeks' gestation) and late preterm (LPT; 34–36 weeks' gestation).^{3,11} These minor morbidities often present later and, although they are not disabling in the traditional sense, they can create significant challenges in school and social settings.¹⁰

MOTOR IMPAIRMENT IN EXTREMELY AND VERY PRETERM CHILDREN

Large epidemiological studies have been performed around the world on infants born extremely preterm (EPT; ≤ 28 weeks' gestation); examples include the EPI-Cure and EPI-Cure 2 studies in the United Kingdom, the Epipage study in France, the EPIBEL study in Belgium, and the EXPRESS study in Sweden.^{12–15} Overall, the results have demonstrated that, over time, the pattern of major neonatal morbidity and the proportion of premature infants affected were unchanged.^{12–15} The prevalence was shown to be significantly associated with GA, and the mean developmental quotients were lower than those of the general population.¹⁶

Among children born very preterm (VPT; 29–31 weeks' gestation), significantly higher rates of morbidity and mortality, as well as adverse long-term outcomes, have also been reported.⁴ For example, de Kieviet and colleagues¹⁷ investigated the relationship between GA and birth weight (BW) on motor development by completing a meta-analysis of infants born VPT and with very low birth weight (VLBW; 1,001–1,500 g). Their results demonstrated that compared with their peers born at term, VPT and VLBW children were behind, on average, -0.57 to -0.88 SD, as measured by three psychometrically sound and widely used motor tests. Difficulties were noted in balance skills, ball skills, manual dexterity, and fine and gross motor development. Furthermore, these delays persisted into elementary school and early adolescence.

MOTOR IMPAIRMENT IN MODERATELY AND LATE PRETERM CHILDREN

MPT and LPT infants have historically been perceived to have similar risks of developmental problems as neonates born at term;¹⁸ consequently, long-term surveillance of these children has not been a priority.¹⁹ More recently, it has been shown that MPT children are more likely to have developmental delays at preschool age.^{19,20} This information is important given that these infants account for the majority of preterm births.^{20,21} These studies have demonstrated that although they appear more mature, with more appropriate weights at birth, LPT infants are at increased risk of medical complications compared with their full-term peers.²²

These results from the literature demonstrate that further studies investigating the long-term follow-up of premature infants of all GAs are required to develop a better understanding of their neurodevelopmental trajectory. Also, ongoing education and collaboration with families and health care specialists are essential to support these children into their adult years.

METHOD

This study reviewed the neurodevelopmental outcomes of preterm infants who had been born or cared for at a hospital in Northern Ontario. This included children born in a Level III hospital and later transferred for regional care. Following this hospital's protocol, all infants born at less than 35 weeks' gestation are assigned to the hospital's neonatal follow-up programme (NFUP) when they are discharged, and they are evaluated over time, by the same health professionals, using a battery of tests that measure gross motor, fine motor, expressive language, and receptive language development. In this article, only the gross motor results are presented. This study received ethics approval from two research ethic boards.

The sample consisted of all children born between 2009 and 2014 ($N = 107$). Exclusion criteria were infants with a specific disorder or condition (e.g., a genetic syndrome or CP; $n = 10$); no deaths occurred. Because long-term outcome correlation is more relevant to GA than BW, participants were grouped into the following GA categories: EPT, VPT, MPT, and LPT. However, because developmental outcomes have historically been reported according to BW, participants were also categorized according to the following BW categories: low BW (LBW; 1,501–2,500 g), VLBW (1,001–1,500 g), and extremely low BW ($\leq 1,000$ g).¹¹

The final sample consisted of 97 children, with an almost equal distribution of boys ($n = 46$) and girls ($n = 51$). The largest proportion of the sample was born VPT (35.1%), followed closely by those born MPT (25.8%) and those born LPT (23.7%). The mean GA was 31.1 (SD 2.9) weeks, and the mean BW was 1.66 (SD 0.53) kilograms. The highest proportion of children were born with LBW (53.6%), followed by VLBW (32.0%).

Table 1 Participants' Characteristics

Characteristic	Group; no. of participants (<i>n</i> = 97)			
	EPT (<i>n</i> = 15)	VPT (<i>n</i> = 34)	MPT (<i>n</i> = 25)	LPT (<i>n</i> = 23)
Girls	10	18	16	7
Boys	5	16	9	16
GA, wk, mean (SD)	26.30 (1.30)	30.10 (0.85)	32.30 (0.46)	34.70 (0.93)
BW, kg, mean (SD)	0.95 (0.22)	1.47 (0.38)	1.83 (0.32)	2.16 (0.43)
BW category				
ELBW	7	>5	0	0
VLBW	6	17	5	>5
LBW	>5	13	20	17
Normal BW	0	0	0	>5
Missing data	0	1	0	0
SGA	>5	>5	>5	5
4/5 assessments, %	94.7	91.2	96.0	91.3

EPT = extremely preterm (≤ 28 weeks' gestation); VPT = very preterm (29–31 weeks' gestation); MPT = moderately preterm (32–33 weeks' gestation); LPT = late preterm (34–36 weeks' gestation); GA = gestational age; BW = birth weight; ELBW = extremely low birth weight; VLBW = very low birth weight; LBW = low birth weight; SGA = small for gestational age; 4/5 assessments = proportion of infants who had completed 4 of 5 assessment points.

It is important to note that, in some cases, the characteristics of the participants in each subgroup did not represent the prevalence rates described in national and international population-based studies. For example, a higher prevalence rate of infants born small for gestational age (SGA) was noted in the LPT group. The participants' characteristics are presented in Table 1.

The same children were assessed over time by a multidisciplinary team consisting of a developmental pediatrician, a physiotherapist, an occupational therapist, and a speech-language pathologist. Consequently, the results give a picture of the developmental motor trajectory among these participants. At the time the study took place, these assessments had been conducted by the same therapists when the babies were aged 2, 6, 9, 12, 18, and 24 months, using the same assessment tools and after correcting for prematurity.

The physiotherapist used the Alberta Infant Motor Scales (AIMS)²³ with non-ambulatory children and, once the children became ambulatory, the gross motor component of the Early Intervention Developmental Profile (EIDP).²⁴ The participants in this study all became ambulatory; thus, all children were administered the AIMS first, then the EIDP. Developmental gross motor and fine motor scales are often used in early intervention settings as part of the evaluation process to make intervention decisions.²⁵

The AIMS is a standardized tool that evaluates the motor development of non-ambulatory children aged 0–18 months and aims to identify children with delayed motor development and children with atypical motor development.²³ The EIDP consists of six scales and can be used with children aged 0–6 years.²⁴ The scales were not established by testing the items with a representative population; instead, items were assigned to specific ages on the basis of a review of the literature. The EIDP has

been strongly correlated with other motor scales, such as the Peabody Developmental Motor Scale–2,²⁶ and despite its lack of normative data, it is widely used in early intervention settings, including NFUPs.²⁷

To determine the average scores obtained on the gross motor assessments, the score given at each appointment and for each participant was retained for statistical analysis. For the AIMS, a score below the 5th percentile was considered below average; for the EIDP, a delay of 3 months or more was considered below average. It is fairly common practice for therapy services to be offered to children when their gross motor age, as determined by the EIDP, is 3 months or more below age-related norms.²⁶

RESULTS

Information about each assessment point can be found in Table 2, including the mean GA, BW, and corrected age (CA) of each participant. The GA and BW categories, as well as the SGA status, for those infants who did not achieve developmental expectations for their CA are also provided. In some cases, there was variability in the age ranges of the participants. The NFUP expects to complete an assessment of each child at ages 2, 6, 9, 12, 18, and 24 months; however, because of clinic scheduling, travel, and illness, it is not always possible to follow this schedule exactly. It is important to note, however, that the participants were always evaluated according to their CA and according to the developmental milestones expected for that CA. Because individual scores for every participant were analyzed over time, the mean age at each assessment did not influence the results.

In total, 56 children (57.7%) were identified as falling behind at some point during the NFUP. Of these, 17 were referred to physiotherapy services for motor impairment, 14 of which (82.4%) had been previously identified as delayed. In the group referred for physiotherapy,

Table 2 Assessment Results

Results	Assessment, no. (%) of participants*							Rx (n = 31)
	1st (n = 88)	2nd (n = 91)	3rd (n = 94)	4th (n = 88)	5th (n = 76)	6th (n = 54)	Total (n = 491)	
GA, wk, mean (SD)	30.0 (3.4)	31.3 (2.9)	31.6 (2.6)	30.9 (2.4)	29.3 (3.2)	31.5 (3.3)	n/a	31.4 (3.8)
BW, kg, mean (SD)	1.37 (0.45)	1.57 (0.52)	1.62 (0.43)	1.56 (0.39)	1.54 (0.59)	1.64 (0.58)	n/a	1.62 (0.56)
CA, mo, mean (SD)	3.4 (1.3)	7 (3.3)	13.2 (4.4)	17.0 (7.4)	20.3 (4.5)	23.0 (7.8)	n/a	n/a
Assessment result								
Within normal limits	74 (84.1)	81 (89.0)	78 (83.0)	73 (83.0)	60 (78.9)	32 (59.3)	n/a	n/a
Below average	14 (15.9)	10 (11.0)	16 (17.0)	15 (17.0)	16 (21.0)	22 (40.7)	93	17 (17.5)
Previously delayed	n/a	2 (20.0)	8 (50.0)	7 (46.7)	7 (43.8)	13 (59.1)	37	14 (82.4)
Below average								
EPT	4 (28.6)	2 (20.0)	2 (12.5)	1 (6.7)	7 (43.8)	3 (13.6)	19 (20.4)	4 (23.5)
VPT	6 (42.9)	2 (20.0)	6 (37.5)	8 (53.3)	4 (25.0)	9 (40.9)	35 (37.6)	4 (23.5)
MPT	2 (14.3)	3 (30.0)	3 (18.8)	4 (26.7)	4 (25.0)	4 (18.2)	20 (21.5)	3 (17.6)
LPT	2 (14.3)	3 (30.0)	5 (31.3)	2 (13.3)	1 (6.3)	6 (27.3)	19 (20.4)	6 (35.3)
ELBW	3 (21.4)	1 (10.0)	1 (6.3)	2 (13.3)	3 (18.8)	3 (13.6)	13 (14.0)	3 (17.6)
VLBW	6 (42.9)	5 (50.0)	6 (37.5)	6 (40.0)	3 (18.8)	7 (31.8)	33 (35.5)	4 (23.5)
LBW	5 (35.7)	4 (40.0)	9 (56.3)	7 (46.7)	9 (56.3)	10 (45.5)	44 (47.3)	9 (52.9)
SGA	2 (14.3)	1 (10.0)	2 (12.5)	1 (6.7)	2 (12.5)	2 (9.1)	10 (10.8)	3 (17.6)

*Except where otherwise indicated.

Rx = participants referred to physiotherapy; GA = gestational age; BW = birth weight; CA = chronological age; n/a = not applicable; below average = assessment result below the average range; previously delayed = number of participants identified as delayed in a previous assessment; EPT = extremely preterm (≤ 28 weeks' gestation); VPT = very preterm (29–31 weeks' gestation); MPT = moderately preterm (32–33 weeks' gestation); LPT = late preterm (34–36 weeks' gestation); ELBW = extremely low birth weight; VLBW = very low birth weight; LBW = low birth weight; SGA = small for gestational age.

Table 3 Characteristics of Children Referred to Physiotherapy and within Normal Limits

Category	EPT		VPT		MPT		LPT	
	WNL (n = 11)	Rx (n = <5)	WNL (n = 30)	Rx (n = <5)	WNL (n = 22)	Rx (n = <5)	WNL (n = 17)	Rx (n = 6)
Gestation, wk, mean (SD)	26.4 (1.3)	26.0 (1.41)	30.0 (0.83)	30.5 (1.0)	32.3 (0.48)	32 (0.0)	34.5 (0.72)	35.3 (1.21)
BW, kg, mean (SD)	0.96 (0.24)	0.92 (0.21)	1.46 (0.38)	1.53 (0.42)	1.85 (0.33)	1.71 (0.04)	2.19 (0.43)	2.1 (0.45)
Male, no.	<5	<5	14	<5	7	<5	13	<5
Female, no.	7	<5	16	<5	15	<5	<5	<5
Mother's age, mean (SD)	28.3 (6.0)	27.0 (5.6)	26.6 (4.8)	32.0 (1.4)	27.6 (5.4)	29.5 (12.0)	34.0 (4.86)	32.7 (3.8)
Drug/alcohol use, no. (%)	0	0	<5	0	<5	0	<5	<5
CAS, no. (%)	0	0	<5	0	<5	<5	<5	<5
SGA, no. (%)	2 (18.2)	0	<5	0	<5	0	<5	<5
BW category, no. (%)								
LBW	<5	0	11 (36.7)	<5	17 (77.3)	<5	13 (76.5)	<5
VLBW	<5	<5	16 (53.3)	<5	5 (22.7)	0	<5	<5
ELBW	5 (45.5)	<5	<5	<5	0	0	0	0
RDS	<5	<5	15 (50.0)	<5	<5	<5	<5	<5
BPD	<5	<5	6 (20.0)	0	0	<5	0	0

Note: Percentages are not reported for values < 5.

EPT = extremely preterm (≤ 28 weeks' gestation); VPT = very preterm (29–31 weeks' gestation); MPT = moderately preterm (32–33 weeks' gestation); LPT = late preterm (34–36 weeks' gestation); WNL = within normal limits; Rx = participants referred to physiotherapy; BW = birth weight; CAS = involvement of CAS during follow-up; SGA = small for gestational age; LBW = low birth weight; VLBW = very low birth weight; ELBW = extremely low birth weight; RDS = respiratory distress syndrome; BPD = bronchopulmonary dysplasia.

most were born LPT ($n = 6$; 35.3%), followed by those born EPT ($n = 4$; 23.5%) and VPT ($n = 4$; 23.5%).

For each GA category, participants referred to physiotherapy services for motor impairment and those within normal limits were then compared on the basis of the risk factors that were reliably available in their medical charts: sex, maternal age, drug or alcohol use during

pregnancy, involvement of the Children's Aid Society during follow-up, SGA status, BW category, diagnosis of respiratory distress syndrome, and diagnosis of bronchopulmonary dysplasia. This information is presented in Table 3. Because MPT and LPT infants have been historically perceived to have low risks of developmental problems, a statistical comparison was then completed

Table 4 Comparison of MPT and LPT Participants with and without Motor Delay

Category	MPT infants, mean (SD)		<i>t</i> -test results			LPT infants, mean (SD)		<i>t</i> -test results		
	Motor delayed	Within normal limits	<i>t</i>	<i>df</i>	<i>p</i> -value	Motor delayed	Within normal limits	<i>t</i>	<i>df</i>	<i>p</i> -value
Mother's age, y	29.5 (12.0)	27.6 (5.4)	0.44	18	0.05*	32.7 (3.8)	32.6 (4.9)	0.17	14	>0.05
Birth weight, kg	1.7 (0.04)	1.85 (0.33)	-0.73	23	>0.05	2.1 (0.45)	2.2 (0.40)	-0.45	21	>0.05
Mann-Whitney results										
			Mann-Whitney U-test	<i>Z</i>	<i>p</i> -value			Mann-Whitney U-test	<i>Z</i>	<i>p</i> -value
Sex			21.5	-1.16	>0.05			37.5	-1.19	>0.05
Drug/alcohol use during pregnancy			27.0	-0.79	>0.05			50.5	-0.04	>0.05
CAS			25.0	-1.19	>0.05			37.0	1.68	>0.05
SGA			31.5	-0.38	>0.05			31.5	-1.91	0.05*
BW category			25.5	-0.91	>0.05			51.0	0.00	>0.05
RDS			24.5	-0.83	>0.05			50.5	-0.50	>0.05
BPD			22.0	-2.71	0.01*			51.0	0.00	>0.05

**p* < 0.05.

MPT = moderately preterm (32–33 weeks' gestation); LPT = late preterm (34–36 weeks' gestation); CAS = implications of CAS during follow-up; SGA = small for gestational age; BW = birth weight; RDS = Respiratory Distress Syndrome; BPD = bronchopulmonary dysplasia.

to determine if the presence of certain risk factors was significantly correlated with a referral to physiotherapy services. This information can be found in Table 4.

DISCUSSION

The main goal of this study was to provide preliminary data on the gross motor development of preschool children born prematurely and without major neurodevelopmental disability. We also sought to determine the prevalence and characteristics of the children who had maintained delays over the course of the follow-up.

The assessment results (see Table 2) revealed delays across the continuum of GA and BW. However, it is important to note that a decrease in the follow-up rate occurred for the last assessment, which may have introduced attrition bias, particularly in the LPT group. Most often, children with scores below the average range at one assessment point were born VPT (*n* = 35; 36.1%), with LBW (*n* = 44; 45.4%), or both, followed by those born MPT (*n* = 20; 20.6%), with VLBW (*n* = 33; 34.0%), or both. The proportion of children identified as delayed at each assessment point varied from 11.0% to 40.7%. The proportion of those who had received a subnormal score at a previous assessment point also varied and ranged from 20.0% to 59.1%. Cases were then analyzed individually to determine whether the same participants (*n* = 56) had been identified as delayed over time. This was not the case, thereby demonstrating fluctuating gross motor development in this cohort.

Some authors have described childhood development as a fluctuating trajectory, with bursts of skill acquisition, followed by periods of stability.⁴ These results support this description from the point of view of gross motor

development because individual participants, as well as the proportion of total individuals identified as delayed varied from one assessment to another.

The concept of a behavioural phenotype has been used to describe the cluster of behavioural, cognitive, motor, and social difficulties seen in individuals with a common biological disorder, and this concept provides a framework of understanding for professionals working with this population.^{4,9–11} The preterm infant has been described as having a unique neurodevelopmental and behavioural phenotype, including delays in the development of motor skills, cognition, executive functioning, attention, vision, hearing, and behaviour.¹¹ In this cohort, gross motor delays were noted in approximately 20.0% of the sample at 2 years CA.

These results are especially important given that all children were assessed by the same registered health professional, using either a standardized or a criterion-referenced tool evaluating gross motor outcomes over time. Given the children's young age at the end of the follow-up, it is unknown whether they experienced spontaneous recovery or whether there was a progression to limitation in motor function. It is also unknown whether delays developed later in children who had otherwise been identified as being within normal limits. It is possible that the difficulties observed in this study are precursors to the long-term complications or minor morbidities reported in the current literature.

Because of the retrospective nature of this project, antenatal, postnatal, and parental demographic data were found to be inconsistent; however, the information that was reliably available was included for analysis. Participants referred to physiotherapy services for motor

impairment and those within normal limits were compared on the basis of these risk factors (see Table 3).

As MPT and LPT were most often referred for therapy, statistical analyses were conducted to determine which risk factors were significantly associated with a physiotherapy referral (see Table 4). For children born MPT, maternal age ($p > 0.05$) and diagnosis of bronchopulmonary dysplasia (BPD; $U = 22.0$, $Z = -2.71$, $p > 0.05$) were significant and suggested that advanced maternal age or the presence of BPD are risk factors for gross motor delay. In LPT children, SGA status ($U = 31.5$, $Z = -1.91$, $p > 0.05$) was significant; SGA participants were therefore more often referred to physiotherapy.

Even though MPT and LPT infants have historically been perceived to have a low risk of developmental problems, our results support the need for more investigation into the gross motor outcomes of children with a broader range of GA.^{2,4,11} Kerstjens and colleagues²⁰ demonstrated that MPT infants had more frequent problems than their peers with fine motor, communication, and personal-social functioning, but not with gross motor functioning or problem solving. Conversely, in the study by Kalia and colleagues,²⁸ 28% of LPT infants qualified for physical therapy. After controlling for comorbidities associated with prematurity, these authors found that LPT infants had the same risk as VPT infants of requiring interventional therapies.

In our study, the highest proportion of children referred to physiotherapy services were also those born LPT. However, a large number of LPT participants were born with LBW, SGA, or both, proportionally higher than the prevalence rates derived from national and international population-based studies. Although these findings are important, a large-scale, multi-site study would be required to confirm these results.^{14,15}

While preliminary in nature, our results highlight the important role of NFUPs in health care. It has been reported that neonatal follow-up has evolved from evaluating the impact of care on infants in the neonatal intensive care unit (NICU) to providing monitoring and early intervention to high-risk infants and their families.²⁹ Because motor skills allow a child to explore his or her world, be involved in social activities, and acquire future skills, the early identification of dysfunction is crucial.^{5,6,30,31} To examine all possible avenues of adverse neurodevelopmental prognosis programmes, it is necessary to examine the neonatal complications, the social and environmental factors, and the type of long-term consequences exhibited by post-NICU children in all regions of Canada. In this clinic, developmentally appropriate information is given to parents by the physiotherapist, as are suggestions for promoting motor development at home. It is possible that this information, given in a timely manner, promoted better outcomes in the children who had been identified as delayed at some point during follow-up.

This study has several limitations; these include a small sample size and the retrospective aspect of the research design. However, even though the overall sample was small, all preterm infants born in the area were included in the study. The biggest limitation is the attrition bias for the last assessment in the follow-up schedule, particularly in the LPT group. The high loss of assessments in this group may be attributed to the referrals for physiotherapy treatment. However, it should be noted that, for each group of preterm children (EPT, VPT, MPT, LPT), 91%–96% of the participants received at least three assessments between 6 and 24 months CA, demonstrating consistent follow-up regardless of attrition.

Small-*n* research designs play an important role in data collection and knowledge translation because they provide information that is directly relevant to the individual participants being studied.³² The data obtained by this study could be used by other NFUPs or early intervention programmes to better understand the developmental domains that can be at risk in premature infants and monitor them accordingly. Finally, this information could also be used to plan larger confirmatory studies.

CONCLUSION

The results obtained in this study have several implications. First, the follow-up of premature children is essential. Second, studies investigating neurodevelopmental outcomes of children born prematurely should be longitudinal and multidisciplinary, and occur from birth into the school years. This research design would allow clinicians to identify the prenatal and postnatal risk factors that affect social and academic success. Although our results are preliminary and need to be interpreted with caution, they suggest the presence of mild motor delays in children who, until recently, were generally considered to be at decreased risk.

In many follow-up programmes, these children fall outside the inclusion criterion for monitoring. Although evidence for motor outcomes in MPT and LPT children is emerging, more information is needed to make recommendations about their place in neonatal follow-up. Large-scale longitudinal and population-based studies are required to provide more data on the predictors, risk factors, and long-term outcomes of MPT and LPT children. The conclusions drawn from these studies would help determine whether these children are at increased risk of delays and should be included in NFUPs.

KEY MESSAGES

What is already known on this topic

Physiotherapists play a role in monitoring motor development and identifying the presence of delays, as well as educating parents regarding the known difficulties that can be observed in this population. Although motor skill impairment in premature infants is a commonly reported negative outcome, little is known regarding the presence of minor morbidities in MPT and LPT children.

What this study adds

This study found that the participants born MPT and LPT were also at risk of impairments in the development of their gross motor skills. These results highlight the importance of neonatal follow-up clinics in the surveillance of all children born prematurely. The need for a longitudinal, population-based study is also emphasized to provide more data on the predictors and long-term motor outcomes of MPT and LPT children.

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