Published in final edited form as:

J Mot Learn Dev. 2018 June ; 6(1): 101–113. doi:10.1123/jmld.2016-0056.

Differences in Spontaneous Leg Movement Patterns Between Infants With Typical Development and Infants at Risk for Developmental Delay: Cross-sectional Observation Prior to Sitting Onset

Weiyang Deng,

Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA

Douglas L. Vanderbilt, and

Division of General Pediatrics, Keck School of Medicine, University of Southern California, Los Angeles, CA

Beth A. Smith

Division of Biokinesiology and Physical Therapy, University of Southern California, Los Angeles, CA

Abstract

Purpose: To investigate differences in the patterns of supine spontaneous leg movements produced before sitting onset between infants with typical development (TD) and infants at risk for developmental delay (AR).

Method: Cross-sectional, observational study. Thirty-five infants were included, 18 infants with TD (130.4 ± 38.0 days) and 17 infants AR (124.1 ± 65.7 days). Infants were placed in the supine position and video taped for 4 to 5 minutes while in an alert, content state. After the recording, videos were coded frame by frame to identify the type of each leg movement produced: single flexion, single extension, alternate flexion, alternate extension, parallel flexion, parallel extension, leg wave, leg circle, leg thump, foot rub, foot flexion, or foot rotation.

Results: Unilateral movements (single flexion and single extension) were the most common leg movements in TD group. Infants AR produced a significantly lower proportion of unilateral and foot rub movements than infants with TD.

Conclusion: These results provide a foundation of the types of leg movement pattern differences to build on in future research. Knowledge about differences in spontaneous movement patterns between infants AR and infants with TD has relevance both for early identification of neuromotor impairment and clinical practice.

Keywords

infant; leg movement; at risk; motor development; movement system

1. INTRODUCTION

With the development of obstetric and neonatal medicine, the mortality rate of high-risk infants has decreased (Alexander et al., 2003). Hence, an increasing number of infants with different kinds of neuromuscular impairments survive. These infants are classified at or before birth as at risk for developmental delay (AR), some of whom later exhibit developmental delay. A developmental delay exists if the infant's current level of functioning in developmental areas, such as cognitive and physical, etc., is significantly different (Ghassabian et al., 2016) from the expected level of development for the infant's age ("Eligibility Criteria," 2017). Early motor delays are often the initial signs of later child development (Ghassabian et al., 2016). An unsolved challenge in the field is early, accurate identification of neuromotor impairment in order to provide targeted intervention before other developmental delays are pronounced.

Spontaneous movements change across the first months of life and have been proposed to relate to motor control in the future (Piek, 1998). For example, spontaneous kicking movements in infancy are proposed to be related to the later functional skill of walking. Piek and Carman (Piek & Carman, 1994) used video coding to describe the developmental profiles of spontaneous leg movements in infants with typical development (TD) from 2 to 50 weeks of age. Thelen and her colleagues described longitudinally the emergence of different patterns of spontaneous leg movements. They used video coding for observer identification of types of leg movements (e.g., single leg kicks, leg circles) and kinematic analyses of movement patterns from birth to walking onset in infants with TD. They proposed that early movement patterns, such as alternating kicking in supine position, are precursor to walking as the spatiotemporal organization is similar to mature walking (Thelen, 1979; Thelen, Bradshaw, & Ward, 1981; Thelen & Fisher, 1983; Thelen, Ridley-Johnson, & Fisher, 1983).

Researchers have proposed that neurological deficits could be reflected by the quality of spontaneous movement patterns and we could use early leg movement patterns as an early diagnosis tool for future developmental disorders (Groen, de Blecourt, Postema, & Hadders-Algra, 2005; Hadders-Algra & Groothuis, 1999; Prechtl, 1997). With the usage of sensors and kinematic analysis systems, studies have demonstrated that kinematic variables, such as kicking frequency, spatiotemporal organization, interjoint and interlimb coordination are different between infants with TD and infants with AR; including infants with intellectual disability (Kouwaki, Yokochi, Kamiya, & Yokochi, 2014), myelomeningocele (Rademacher, Black, & Ulrich, 2008; Smith, Teulier, Sansom, Stergiou, & Ulrich, 2011), Down syndrome (McKay & Angulo-Barroso, 2006), as well as infants born preterm (Geerdink, Hopkins, Beek, & Heriza, 1996), with white matter disorder (Fetters, Chen, Jonsdottir, & Tronick, 2004), or very low birth weight (Jeng, Chen, & Yau, 2002). Further, Jeng found that the alteration of hip-knee correlation, kick frequency, intra-kick pause together with variability in interlimb coordination were all associated with a later onset of walking attainment in preterm infants (Jeng, Chen, Tsou, Chen, & Luo, 2004). Despite these studies showing kinematic differences between the leg movements of infants with TD and infants AR, video coding of the type of spontaneous leg movements produced in infants AR have not been described. Our purpose was to determine if there are differences in types of early

spontaneous leg movements produced between infants AR and infants with TD before sitting onset. Knowing the differences of AR infants' preferred movement patterns may help early diagnosis of neuromotor diseases. Further, video coding of the leg movement types produced by infants AR before sitting onset may provide information about which specific movements are vital for learning functional motor skills.

2. METHODS

2.1. Participants

Data from 35 infants were included, 18 infants with TD (male=7, female=11) and 17 infants AR (male=11, female=6). All of them were singleton births. Infants were recruited by word of mouth, at Children's Hospital of Los Angeles High Risk Follow-Up Clinic, and at local primary care and early intervention provider locations. As this was a novel study, we did not have pilot data on which to base a power analysis. Previous studies have shown significant group differences in infant leg movement characteristics with 10 infants in each group (Fetters et al., 2004; Heathcock, Bhat, Lobo, & Galloway, 2005).

Infants AR: infants were defined as at risk in accordance with the definition set forth by the state of California. Briefly, infants are identified as at risk for developmental disability according to known, population-based criteria including preterm birth, complications at or after birth, etc. The definition is used to define at risk for developmental delay and eligible for state administered early intervention and can be found, in full, in the references and described for each infant in Table 1 ("Eligibility Criteria", 2017) This represents a heterogeneous AR group, with varying levels of developmental delay and risk different complications as seen in the clinical setting. Infants with TD: infants were all singleton, full-term gestation with score above 5th percentile on Alberta Infant Motor Scale (AIMS) (Piper & Darrah, 1994). All participants scored less than 8 on the sitting section of AIMS, which means they were not yet sitting independently. Infants with congenital limb malformations of the legs were excluded. The characteristics of the infants measured during visits are reported in Table 1 and 2.

2.2. Procedures

This research was approved by the Institutional Review Boards of the University of Southern California and by Oregon Health & Science University. A parent or legal guardian signed an informed consent form prior to their infant's participation. As this is a cross-sectional study, we only utilized one video clip from each infant. The data were collected either in our laboratory or in the participants' home. Infants were put in supine position and video taped for 4 to 5 minutes continuously while in an alert, content state. Because some participants in this project were also involved in another longitudinal study recording infants' leg movements across a whole day, some infants were wearing sensors on both legs (13/17 in AR group; 14/18 in TD group). Sensor data are not used in the present report. However, our previous research demonstrated that the sensors did not affect infants' leg movement production (Jiang et al.). A camera (Sony Handy Cam, 30 frames per second) was placed at infant level perpendicular to the right side or left side. We chose to investigate the age range

before sitting onset because the leg movement patterns will qualitatively change when infants shift to using their legs to stabilize sitting.

After the recording, videos were coded frame by frame using ELAN software (Lausberg & Sloetjes, 2009). Researchers were trained to code the video until they reached 80% agreement with the established coding. Spontaneous leg movements were identified as: unilateral movement (UM, including single flexion and single extension), alternating movement (AM, including alternate flexion and alternate extension), parallel movement (PM, including parallel flexion and parallel extension), leg wave (LW), leg circle (LC), leg thump (LT), foot rub (RUB), foot flexion (FF), or foot rotation (FR) based on previous coding of spontaneous infant leg movements (Thelen, 1979; Ulrich & Ulrich, 1995).

2.3. Analysis

We determined the percentage of each type of spontaneous leg movement produced by each infant as a percentage of their total movements made. We determined that the percentage data were not normally distributed using the Shapiro-Wilk test. We used non-parametric analysis, the Mann-Whitney Test, to test for overall between group differences in percentage of different leg movement types. Finally, we tested for within group differences between unilateral movements and alternating movements in each group using a Wilcoxon Signed Ranks Test. We chose to compare these two movement patterns because they are the most frequent two patterns seen in our data and previous research has shown that there are different dominant patterns in different ages (Thelen et al., 1983). Statistical tests were performed using SPSS software (Version 22, IBM Corporation, Armonk, New York). Alpha level of significance was set at 0.05.

3. RESULTS

Figure 1 shows the mean proportions of the types of spontaneous leg movements produced by the TD and AR groups. Between group analysis showed that infants AR produced a significantly lower proportion of unilateral movements ($U = 93.00$, $p = 0.048$) and foot rub movements ($U = 94.00$, $p = 0.042$) compared to infants with TD (see Table 3). Within group analysis showed that infants with TD produced significantly more unilateral movements than alternating movements ($p < 0.01$). The difference between unilateral movements and alternating movements was not significant in infants AR ($p = 0.70$).

4. DISCUSSION

The results of our research showed that there are differences between the spontaneous leg movement patterns produced by infants with TD and infants AR before sitting onset. Infants AR demonstrated a smaller proportion of unilateral movements and foot rub movements than infants with TD. These results provide another “piece of the puzzle” in the effort to identify neuromotor impairment within the first months of life.

Unilateral movement means flexion or extension of the knee and/or hip of only one leg. A unilateral leg movement was not simultaneous with nor followed immediately by extension or flexion of the other leg. This meant there was a real-time, visually observable pause

between a unilateral movement and any other movement. Overall, we observed that unilateral movements were the most common movement in the TD group. The result is consistent with Thelen's data, which showed that infants demonstrated a high percentage of unilateral movements between 1 and 4 months and then synchronous movements became predominant by 6 months (Thelen et al., 1983). However, the difference between unilateral movements and alternating movement is not significant in AR group. Moreover, we found that infants AR made a significantly lower proportion of unilateral movements than infants with TD. This result is consistent with Ulrich's finding that infants with Down syndrome showed fewer of the most complex patterned leg movement (single leg kicks) than infants with TD (Ulrich & Ulrich, 1995). Similarly, Fetters and her colleagues also found that an inability to dissociate intralimb joints during spontaneous kicking movement can be observed in preterm infants with white matter disorder at one–two months of age (Fetters et al., 2004). Our results of fewer unilateral movements in infants AR may reflect less ability to isolate one limb from the other.

Many potential explanations for fewer unilateral movements in infants AR exist. One possibility could be related to the prolonged primitive reflexes. For example, asymmetrical tonic neck reflex (ATNR) could have a potent influence on infants' movements during the first four months in life when unilateral kicking is the most common movement. When ATNR is elicited, infants will show extension of one leg and flexion of the opposite one. If ATNR dominated the spontaneous leg movements, it would be much harder for AR infants to perform decoupled unilateral movements. However, Coryell claimed that ATNR appeared to influence posture of the legs only in the 1st week (Coryell & Cardinali, 1979). Thus this reason does not seem to be compelling in this situation. Another possible reason for the difference is the different age range in two groups as the leg movements change with maturation (Thelen et al., 1983).

Next, it has been found that preterm infants with white matter disorder are less likely to dissociate intralimb joint couplings during kicking (Fetters et al., 2004). This result could be attributed to damage of the cortico-spinal axons (Thelen et al., 1983). It is possible that cortico-spinal axon damage could lead to less production of isolated single limb unilateral movements, however further research with neural imaging would be required to determine this.

Another possible reason for a smaller proportion of unilateral movements in infants AR could be uneven rates of development in muscle size and strength and/or excitatory and inhibitory interlimb pathways. Thelen proposed that these variables will not always be equal in both legs (Thelen et al., 1983). Further, it is possible that differences may be even more prominent in infants AR, some of whom are at risk for conditions such as cerebral palsy where hemiparesis is common. Uneven maturation could result in a change in interlimb behavior resulting in a smaller proportion of unilateral movement production.

We also found that infants AR demonstrate a smaller proportion of foot rub movements than infants with TD. These results may have some relation to results from Prechtl's General Movement Assessment showing that the absence of fidgety movements at 9–16 weeks post-term age is highly predictive of cerebral palsy (Einspieler & Prechtl, 2005). Although they

are not the same movements, they may be related as they both involve rotational movements at the distal segment. Foot rubs involve the rotation of the ankle and foot medially in order to rub it along the other leg (Thelen, 1979) while fidgety movements are small amplitude, moderate speed, variable acceleration movements that, in the legs, can be observed at the ankle (distal segment) (Einspieler, Prechtl, Ferrari, Cioni, & Bos, 1997; Prechtl, 1997). We did not, however, find a significantly smaller proportion of foot flexions and foot rotations in infants AR, which we would also expect to be related.

Different from previous research, our results did not show that alternating movement production was different between the two groups. Droit, for example, found that low risk infants exhibited more alternating leg movements than infants with brain damage (Droit, Boldrini, & Cioni, 1996). This could possibly resulted by the range of our participants' age and different at risk conditions. The variability here could then influence the statistical significance level.

All in all, infants AR showed different spontaneous movement patterns before sitting onset compared to infants with TD. Infants AR demonstrated a smaller proportion of unilateral and foot rub movements. From a clinical practice perspective, it is unknown whether increasing the proportion of these types of movements would be a beneficial intervention strategy. We do know, however, that previous researchers have demonstrated that an out-of-phase pattern can be learned by infants through contingent mobile reinforcement (Chen et al., 2002). In future research we will continue to explore the ability of these early differences in leg movement patterns to predict later neurodevelopmental outcomes in infants AR as well as any benefit of intervention to change these patterns.

5. LIMITATIONS

In this study, we did not directly consider the effects of chronological age, instead we looked at the period before sitting onset. At sitting onset, we expect leg movement behavior to shift greatly. Infants in our AR group are a heterogeneous population in regard to chronological age, developmental rate, and risk level. We have purposely chosen this heterogeneous clinical classification of AR in an effort to start where the clinical world currently is. From a scientific perspective, a homogenous group (eg: infants at high risk for cerebral palsy, infants between 3 and 4 months adjusted age in a low risk preterm group) would allow us to pursue mechanism of altered leg movement patterns. Our approach here was, instead, to start with the current broad clinical definition in an effort to identify general group differences to be pursued in more controlled research going forward. Some of the infants AR will have developmental delay, while others will not. Early group differences may indicate a potential way to target early intervention services to the AR infants. We believe that our results here provide support for pursuing foot rub and unilateral leg movements as a potential early indicator, however our results need to be interpreted with caution due to the preliminary nature of this investigation and the variability in the AR group. Follow-up studies with consistent group parameters are needed to address the variability in the AR group as the results we found may represent some risk factors but not others.

Additional limitations include that video coders were not blinded to the group classification of the infants. This is not possible as it is often visually apparent which group the infant is in. We did have one coder code 20% of 4 videos where the group assignment was unknown and not visually apparent, and above 80% reliability was achieved. Moreover, the videos are short, and do not necessarily represent the infant's full repertoire of movement capability, but only a sample of their performance. The light and auditory stimuli were not controlled, but were kept consistent across all trials and all infants were tested in a comfortable and typical environment. We also did not record their head posture during the visit, which could possibly influence the leg movement patterns. The movement behavior and developmental trajectories may also be influenced by different environmental contexts (e.g., neonatal intensive care unit) of the AR group. While early intervention has the potential to influence the movement patterns, it is highly variable and we did not have the ability to measure it in this cross-sectional, observational study. Despite these limitations, we observed some significant differences in early movement patterns between infants AR and infants with TD that can inform future research questions.

6. CONCLUSION

We observed significant differences in early spontaneous leg movement patterns between infants AR and infants with TD; infants AR demonstrated less unilateral and foot rub movements than infants with TD. In the future, we will determine the relationship between the observed movement patterns and developmental outcomes of the infants AR, which could help improve the early identification of neuromotor impairments and support targeted early intervention in clinical practice.

ACKNOWLEDGMENTS

Thank you to the infants and their families. Thank you to Children's Hospital Los Angeles, and Total Education Solutions. Thank you to Rosana Abeyta-Torres, Alexis Arak, Elizabeth Ballance, Andrea Carlow, Alexandra Corley, Bethany Hart, Hal Huynh, Lindsay Kirlin, Raquel Lopez, Jessie Maguire, and Bailey Ouellette. Dr. Smith's salary was supported by the Foundation for Physical Therapy (NIFTI to BAS); currently her salary and research are supported in part by [K12-HD055929](K. Ottenbacher). Study data were collected and managed using REDCap electronic data capture tools hosted at Oregon Health & Science University (OHSU) [UL1 RR024140] and in collaboration with Southern California Clinical and Translational Science Institute (SC CTSI)[UL1TR000130].

REFERENCES

- Alexander GR, Kogan M, Bader D, Carlo W, Allen M, & Mor J (2003). US birth weight/gestational age-specific neonatal mortality: 1995–1997 rates for whites, hispanics, and blacks. *Pediatrics*, 111(1), e61–66. [PubMed: 12509596]
- Chen Y-P, Fetters L, Holt KG, & Saltzman E (2002). Making the mobile move: Constraining task and environment. *Infant Behavior and Development*, 25(2), 195–220.
- Coryell J, & Cardinali N (1979). The asymmetrical tonic neck reflex in normal full-term infants. *Phys Ther*, 59(6), 747–753. [PubMed: 441119]
- Droit S, Boldrini A, & Cioni G (1996). Rhythmical leg movements in low-risk and brain-damaged preterm infants. *Early Hum Dev*, 44(3), 201–213. [PubMed: 8654313]
- Einspieler C, & Prechtl HF (2005). Prechtl's assessment of general movements: a diagnostic tool for the functional assessment of the young nervous system. *Ment Retard Dev Disabil Res Rev*, 11(1), 61–67. doi: 10.1002/mrdd.20051 [PubMed: 15856440]

- Einspieler C, Prechtl HFR, Ferrari F, Cioni G, & Bos AF (1997). The qualitative assessment of general movements in preterm, term and young infants - Review of the methodology. *Early Hum Dev*, 50(1), 47–60. doi: 10.1016/s0378-3782(97)00092-3 [PubMed: 9467693]
- Eligibility Criteria. (2017). Retrieved April 23, 2017, from <https://govt.westlaw.com/calregs/Document/I4CC53000D60711DE88AEDDE29ED1DC0A?viewType>
- Fetters L, Chen YP, Jonsdottir J, & Tronick EZ (2004). Kicking coordination captures differences between full-term and premature infants with white matter disorder. *Hum Mov Sci*, 22(6), 729–748. doi: 10.1016/j.humov.2004.02.001 [PubMed: 15063051]
- Geerdink JJ, Hopkins B, Beek WJ, & Heriza CB (1996). The organization of leg movements in preterm and full-term infants after term age. *Dev Psychobiol*, 29(4), 335–351. doi: 10.1002/(SICI)1098-2302(199605)29:4<335::AID-DEV3>3.0.CO;2-R [PubMed: 8732807]
- Ghassabian A, Sundaram R, Bell E, Bello SC, Kus C, & Yeung E (2016). Gross Motor Milestones and Subsequent Development. *Pediatrics*, 138(1). doi: 10.1542/peds.2015-4372
- Groen SE, de Blecourt AC, Postema K, & Hadders-Algra M (2005). General movements in early infancy predict neuromotor development at 9 to 12 years of age. *Dev Med Child Neurol*, 47(11), 731–738. doi: 10.1017/s0012162205001544 [PubMed: 16225735]
- Hadders-Algra M, & Groothuis AM (1999). Quality of general movements in infancy is related to neurological dysfunction, ADHD, and aggressive behaviour. *Dev Med Child Neurol*, 41(6), 381–391. [PubMed: 10400172]
- Heathcock JC, Bhat AN, Lobo MA, & Galloway JC (2005). The relative kicking frequency of infants born full-term and preterm during learning and short-term and long-term memory periods of the mobile paradigm. *Phys Ther*, 85(1), 8–18. [PubMed: 15623358]
- Jeng SF, Chen LC, Tsou KI, Chen WJ, & Luo HJ (2004). Relationship between spontaneous kicking and age of walking attainment in preterm infants with very low birth weight and full-term infants. *Phys Ther*, 84(2), 159–172. [PubMed: 14744206]
- Jeng SF, Chen LC, & Yau KI (2002). Kinematic analysis of kicking movements in preterm infants with very low birth weight and full-term infants. *Phys Ther*, 82(2), 148–159.
- Kouwaki M, Yokochi M, Kamiya T, & Yokochi K (2014). Spontaneous movements in the supine position of preterm infants with intellectual disability. *Brain Dev*, 36(7), 572–577. doi: 10.1016/j.braindev.2013.08.003 [PubMed: 24055340]
- Lausberg H, & Sloetjes H (2009). Coding gestural behavior with the NEUROGES--ELAN system. *Behav Res Methods*, 41(3), 841–849. doi: 10.3758/brm.41.3.841 [PubMed: 19587200]
- McKay SM, & Angulo-Barroso RM (2006). Longitudinal assessment of leg motor activity and sleep patterns in infants with and without Down syndrome. *Infant Behav Dev*, 29(2), 153–168. doi: 10.1016/j.infbeh.2005.09.004 [PubMed: 17138271]
- Piek JP, & Carman R (1994). Developmental profiles of spontaneous movements in infants. *Early Hum Dev*, 39(2), 109–126. [PubMed: 7533076]
- Piek JP, (1998). The influence of preterm birth on early motor development. Champaign: Human Kinetics Publ.
- Piper MC, & Darrah J (1994). *Motor Assessment of the Developing Infant*. Philadelphia, PA: WB Saunders.
- Prechtl HF (1997). State of the art of a new functional assessment of the young nervous system. An early predictor of cerebral palsy. *Early Hum Dev*, 50(1), 1–11. [PubMed: 9467689]
- Rademacher N, Black DP, & Ulrich BD (2008). Early spontaneous leg movements in infants born with and without myelomeningocele. *Pediatr Phys Ther*, 20(2), 137–145. doi: 10.1097/PEP.0b013e3181720248 [PubMed: 18480712]
- Smith BA, Teulier C, Sansom J, Stergiou N, & Ulrich BD (2011). Approximate entropy values demonstrate impaired neuromotor control of spontaneous leg activity in infants with myelomeningocele. *Pediatr Phys Ther*, 23(3), 241–247. doi: 10.1097/PEP.0b013e3182289ae4 [PubMed: 21829116]
- Thelen E (1979). Rhythmical stereotypies in normal human infants. *Anim Behav*, 27(Pt 3), 699–715. [PubMed: 556122]
- Thelen E, Bradshaw G, & Ward JA (1981). Spontaneous kicking in month-old infants: manifestation of a human central locomotor program. *Behav Neural Biol*, 32(1), 45–53. [PubMed: 7259716]

- Thelen E, & Fisher DM (1983). The organization of spontaneous leg movements in newborn infants. *J Mot Behav*, 15(4), 353–377. [PubMed: 15151867]
- Thelen E, Ridley-Johnson R, & Fisher DM (1983). Shifting patterns of bilateral coordination and lateral dominance in the leg movements of young infants. *Dev Psychobiol*, 16(1), 29–46. doi: 10.1002/dev.420160105 [PubMed: 6825965]
- Ulrich BD, & Ulrich DA (1995). Spontaneous leg movements of infants with down syndrome and nondisabled infants. *Child Development*, 66(6), 1844–1855. [PubMed: 8556903]

Fig. 1.

Proportion of different leg movements in TD (typical development) & AR (at risk for developmental delay) groups. UM=unilateral movement, AM=alternating movement, PM=parallel movement, LW=leg wave, LC=lege circle, LT=leg thump, RUB=rub, FF=foot flexion, FR=foot rotation.

Table 1:

Individual health status and parameters in AR group

Infant	Health status summary	Gestational age (weeks)	Chronological age (days)	Adjusted age (days)	Gender (m= male, f=female)	Weight (kg)	Length (cm)	Head circumference (cm)	Alberta Infant Motor Scale (sitting)	Alberta Infant Motor Scale (total)
1	preterm, high blood pressure	27	125	33	m	4.22	51.5	36.2	1	9
2	brain damage noted, swallowed meconium, thickened left ventricle, reflux	38	160	NA	m	7.63	67.0	41.5	4	20
3	umbilical cord wrapped around head, brain damage noted, seizures	39	102	NA	f	6.39	62.5	40.0	1	9
4	congenital heart defects, brain damage noted, percutaneous endoscopic gastrostomy tube, on oxygen	37	262	NA	m	5.40	55.9	40.6	4	15
5	preterm, on oxygen	28	98	18	m	3.83	50.0	37.0	1	6
6	preterm, no complications	27	305	213	f	6.30	61.6	41.3	7	27
7	preterm, congenital heart defects	25	196	88	m	5.41	59.0	40.0	3	11
8	preterm, hydrocephalus, patent ductus arteriosus, on oxygen, percutaneous endoscopic gastrostomy tube, laryngomalacia	24	317	207	m	9.47	70.0	43.0	4	17
9	preterm, hydrocephalus, NG tube, respiratory distress	32	139	83	m	14.80	63.5	47.8	1	5
10	preterm, bronchopulmonary dysplasia, ileostomy, hernia repaired, grade 4 intraventricular hemorrhage	27	283	190	m	7.26	61.0	42.5	4	15
11	preterm, colostomy, catheter, on oxygen	29	149	73	f	5.05	54.0	37.5	1	8
12	preterm, no complications	30	224	154	f	6.34	63.5	41.2	4	18
13	preterm, intraventricular hemorrhage, on oxygen	33	184	138	m	6.97	67.0	40.2	3	13

Infant	Health status summary	Gestational age (weeks)	Chronological age (days)	Adjusted age (days)	Gender (m= male, f=female)	Weight (kg)	Length (cm)	Head circumference (cm)	Alberta Infant Motor Scale (sitting)	Alberta Infant Motor Scale (total)
14	preterm, hypoplastic left heart syndrome, seizures	36	79	49	f	2.66	52.0	33.3	1	6
15	preterm, vision impairment	23	295	175	m	7.80	66.0	40.6	4	21
16	preterm, on oxygen	27	258	169	m	7.12	71.1	42.0	4	21
17	preterm, intrauterine growth restriction	31	211	147	f	5.20	59.0	40.0	3	17
		30.2± 5.0	199.2± 77.9	124.1± 65.7	6 f, 11 m	6.6± 2.7	60.9± 6.5	40.3± 3.2	2.9± 1.7	14.0± 6.3

Table 2:

Individual health status and parameters in TD group

Chronological age (days)						Alberta Infant Motor Scale (sitting)	Alberta Infant Motor Scale (total)
Infant		Gender (m=male, f=female)	Weight (kg)	Length (cm)	Head circumference (cm)		
1	118	m	8.32	63.5	44.4	3	20
2	150	m	7.63	70.5	43.8	4	22
3	148	f	7.56	63.5	41	5	21
4	150	m	7.2	62.2	40.5	5	26
5	162	f	6.9	62.5	41.5	4	22
6	60	f	4.23	55.9	38.6	1	9
7	93	m	6.84	60.8	41.25	1	10
8	66	f	5.84	57	39	1	6
9	153	f	7.34	61	41	4	20
10	155	f	6.24	63.5	39.0	4	15
11	115	f	6.59	62.5	42.5	1	17
12	155	f	6.36	60.0	40.0	3	16
13	179	f	6.40	61.0	43.0	6	29
14	58	f	5.96	60.0	39.0	1	9
15	121	m	6.80	65.0	41.5	4	20
16	169	m	8.30	65.0	45.5	3	22
17	152	m	7.61	66.0	41.2	4	21
18	143	f	7.17	64.8	43.0	4	24
<i>130.4 ± 38.0</i>		<i>7 m, 11 f</i>	<i>6.9 ± 1.0</i>	<i>62.5 ± 3.4</i>	<i>41.4 ± 2.0</i>	<i>3.2 ± 1.6</i>	<i>18.3 ± 6.3</i>

Table 3:

Statistical Results from Group Comparisons

	LW	LC	LTh	RUB	FF	FR	UM	AM	PM
Mann-Whitney U	121.000	135.000	132.000	94.000	99.500	136.500	93.000	123.000	132.000
Z	-1.056	-.610	-.943	-2.030	-1.768	-.545	-1.980	-.990	-.693
Asymp. Sig. (2-tailed)	.291	.542	.346	.042 [*]	.077	.586	.048 [*]	.322	.488

LW=leg wave, LC=lege circle, LT=leg thump, RUB=rub, FF=foot flexion, FR=foot rotation, UM=unilateral movement, AM=alternating movement, PM=parallel movement.

^{*} Significant difference between TD and AR groups at alpha = 0.05.