The role of the family in early intervention of preterm infants with abnormal general movements

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ABSTRACT

الأهداف: تحديد تأثير التدخل العائلي على الوظيفة الحركية عند الخدج.

الطريقة: تم تصميم هذه الدراسة كتجربة معشاة ذات شواهد خلال الفترة من أغسطس 2015م وسبتمبر 2016م. تم اختيار 42 رضيع خديج بصورة عشوائية وتقسيمهم بالتساوي بين مجموعة التدخل على أساس الأسرة، تتألف من العلاج الطبيعي والعائلي مكون (8 ذكور ، 8 إناث متوسط العمر 91±3.09 يومًا)، ومجموعة التدخل المبكر التقليدية (8 إناث ، 8 ذكور ، متوسط العمر: 91.06±2.4 يوم). تلقت كلتا المجموعتين برنامج علاج يعتمد على نهج النمو العصبي خلال 3 إلى 12 شهرًا. تم تقييم المجموعات في الأعمار المصححة للأشهر الثالثة والسادسة والتاسعة عشر والثانية والعشرين والرابعة والعشرين باستخدام مقياس بايلي لتنمية الرضع والأطفال الصغار ، الإصدار الثالث (Bayley-III).

النتائج: كانت التغييرات ضمن المجموعة مع مرور الوقت ذات دلالة إحصائية باستخدام اختبارات متعددة المتغيرات للحركة الدقيقه (تحليل متعدد المتغيرات من التباين (MANOVA)؛ F=1515.27, p<0.001) الحركة الكبيرة (MANOVA؛ F=1950.59, p=0.001). ومع ذلك، لم يكن هناك تفاعل بين المجموعات في حالة جيدة (MANOVA ؛ P=0.872، F=0.027) وتطور الحركة الكبيرة (MANOVA; F=0.022, p=0.883).

الخاتمة: أن طريقة التدخل المبكر تساعد في تطور الوظيفة الحركية الدقيقة والجسيمة عند الخدج في السنة الأولى من العمر.

Objectives: To determine the effect of family-based intervention on motor function in preterm infants.

Methods: This study was designed as a randomized controlled trial between August 2015 and September 2016. Forty-two preterm infants were randomized and split equally between the family-based intervention group, composed of a physiotherapeutic and a familial component (8 males, 8 females; mean age 91±3.09 days), and the traditional early intervention group (8 females, 8 males, mean age: 91.06±2.4 days). Both groups received a treatment program based on a neurodevelopmental approach during 3- to 12-months-old. The groups were evaluated at corrected ages of the third, sixth, ninth, twelfth, and 24th months using the Bayley Scale of Infant and Toddler Development, Third Edition (Bayley-III).

Results: Within-group changes over time were statistically significant using multivariate tests of fine motor (Multivariate analysis of variance (MANOVA); F=1515.27, p<0.001) and gross motor (MANOVA; F=1950.59, p=0.001) development. However, there was no interaction between groups in fine (MANOVA; F=0.027, p=0.872) and gross motor development (MANOVA; F=0.022, p=0.883).

Conclusion: The early intervention approaches might support fine and gross motor function development in preterm infants in the first year of life.

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There is growing evidence that the first year of life is critical for brain development.[1,2] The neuronal differentiation process, including the formation of dendrites and axons, as well as the production of neurotransmitters and synapses, is especially active during the prenatal period and continues to be active postnatally.[2,3] Myelination starts in the second trimester of pregnancy and progresses rapidly in the first year of life.[1,4] Recent studies suggest that interventions during infancy, when high plasticity is observed in the brain, might be more effective than interventions during childhood.[5,6] Early diagnosis of infants at high-risk for major developmental disorders, such as cerebral palsy (CP) or minor motor and neurological dysfunction,[7,8] is therefore important in providing appropriate interventions.[9] Even if early interventions cannot change the physical outcome for infants with neurodevelopmental disorders, intervening with these high-risk infants helps to decrease secondary musculoskeletal system disorders and increase their functional abilities.[10] However, it is still unclear which interventions are the most successful. The literature shows that early interventions effectively support cognitive development, but do not or only slightly affect motor development.[5,11] With the increase in the survival of preterm infants, comprehensive follow-up programs have been developed to determine appropriate interventions to support them1. One of these, entitled Coping with and Caring for Infants with Special Needs (COPCA), was developed by Dierks et al.[12] As a new family-based approach aimed to provide active involvement of the family in the intervention. This program's approaches are based on both family education and neural group selection theory for infants. In a randomized controlled study, Hielkema et al[13] demonstrated no difference in outcomes between Traditional Infant Physical Therapy (TIP) and the COPCA program for infants with an abnormal General Movements Assessment (GMA). A recent review by Hielkema et al[14] demonstrated a medium level of evidence on early interventions and family education and called for high-quality studies on these subjects. Dirks and Hadders-Algra et al[15] indicated that the importance of the role of the family in early intervention for infants with special needs has increased, and high-quality studies are now required to investigate the effect of family-based care.

In addition to them, the quality of mother-infant interaction is one of the most important aspects of normal development.[16] In comparison with mothers of full-term infants, mothers of preterm infants have a higher risk of postpartum depression after infants' discharge.[17] This might be caused the effect of premature birth and maternal separation (with prolonged stay in the Neonatal Intensive Care Unit) on hormones in both the mother and infant, which are crucial for managing the adaptive maternal behavior and emotional changes.[18] In a randomized controlled trial, Hane et al[16] investigated the impact of Family Nurture Intervention (FNI) to improve the developmental trajectories via increasing emotional connection between mothers and their premature infants. These authors proved that infants in FNI had increased cognitive and language scores on the Bayley-III at 18-months-old and decreased risk of attention problems, autism spectrum disorders, and postpartum depression of mother.[16] In the other valuable study, Myer et al[19] showed an improvement in the frontal cortical brain region (which is responsible for attention, behavior adaptation and cognitive development) in preterm infants that received FNI. Also, Welch et al[20] demonstrated greater developmental changes and increased brain activity between brain regions in the FNI group. These studies promote the importance of the mother-infant relationship for normal neurodevelopmental processes. Based on these results, integrating the mothers in early intervention programs is essential for physiotherapy approaches.

In the literature, many studies investigated the effect of the early intervention approaches by comparing the traditional infant physiotherapy on infants' motor development.[21-23] However, these studies could not prove any significant effects on motor development after early intervention. The possible explanation of the absence of the differences in motor development between the experimental and control group might be the heterogeneity of interventions, less specificity of the assessment tools to present the changes in development, and the impact of the normal growth process of infants.[6,13] It is, therefore, difficult to compare interventions based on randomized controlled trials.[13] There is a need for high-quality research that investigates the effects of physiotherapy interventions on gross and fine motor development of the high-risk infants to determine more useful, inexpensive, and accessible interventions for mothers, infants, and clinicians. The present study aimed to determine the effects of a family-based COPCA intervention program on fine and gross motor function in preterm infants.

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Methods. The study design was an assessor-blind randomized controlled trial. The University Ethics Committee approved this study (Project: GO 15/740) and written informed consent was obtained from each participant and guardian.

Participants. Fifty-eight preterm infants were referred by pediatric neurologists to the Department of Physiotherapy between August 2015 and September 2016. The inclusion criteria were: (1) infants whose birth weights were 1500 g or lower, (2) corrected ages were 3 months of age, and (3) infants who had abnormal general movements. The exclusion criteria were: (1) infants with any congenital malformation or epilepsy, (2) had undergone multiple surgeries, and (3)

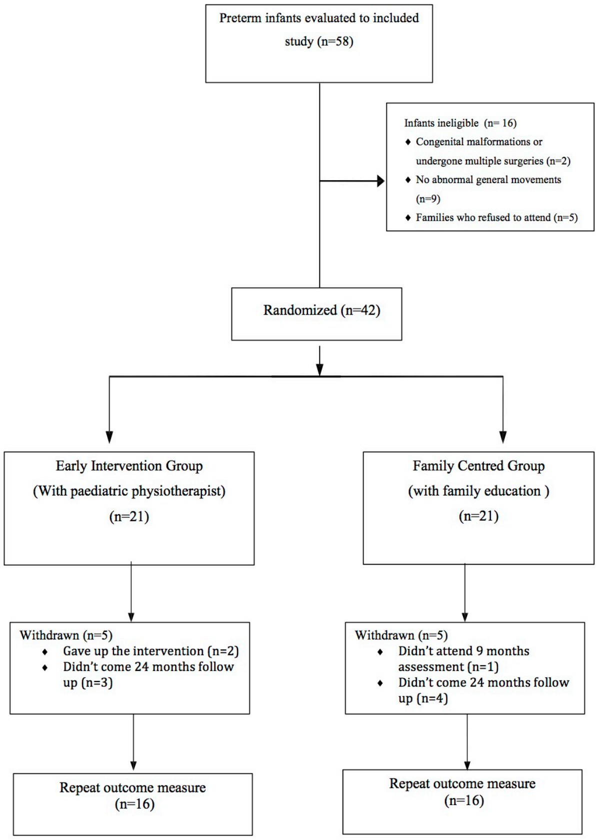

Figure 1 - Follow up diagram.

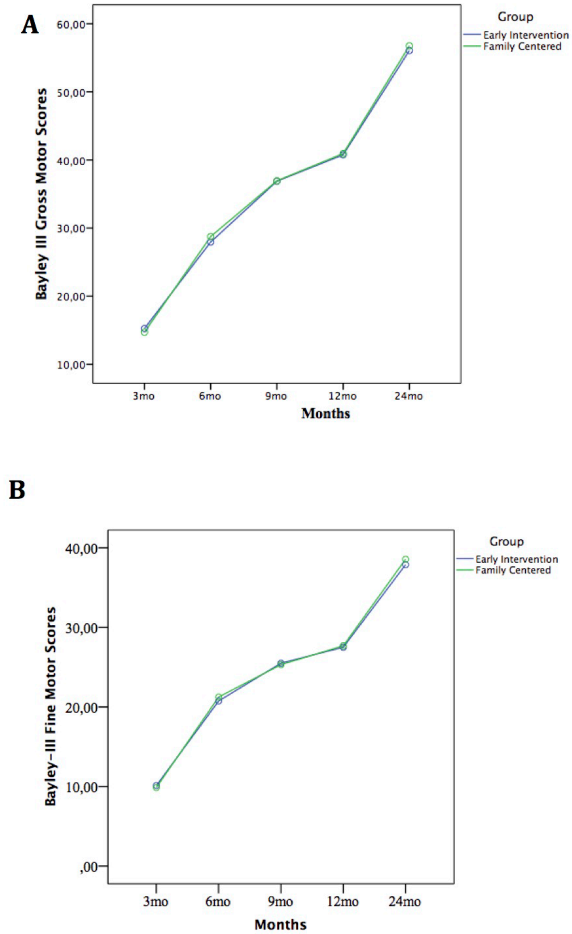

Figure 2 - Changes by time in motor development in groups A gross motor B Fine motor.

infants whose parents refused permission for them to participate.

Sixteen infants were excluded from the study, as 2 infants had major congenital malformations, 9 had no abnormal general movements, and 5 were refused to attend study.

Procedure. The infants were pre-stratified according to gender and General Movements Assessment (GMA) [absent Fidgety Movements (FMs) abnormal-sporadic FMs, 3 variables].[24-26] The infants were randomly allocated to either the family-based intervention group (study group) or the traditional early intervention group (control group) using a simple randomization technique using sequentially numbered and opaque sealed envelopes. Of the total 42 infants, 21 were randomized to the study group and 21 infants to the control group, as shown in the flow-chart (**Figure 1**). The GMA was applied by the fourth author (A. M.), who had 10 years experience in GMA.

In the study group, one of the infants did not attend the assessment at 9 months (corrected age), and 4 of them did not come to the follow-up assessment at 24 months (corrected age), and these 5 infants were excluded from the study. In the control group; 2 of the infants did not continue the intervention program, and three did not come to follow-up evaluations at 24 months (corrected age). These infants were excluded from the study. Therefore, 16 infants were included in both groups.

The intervention started at a corrected age of 3 months and continued until a corrected age of 12 months. In this way, both groups were treated at 2 times per week for 60 min per session over a period of 36 weeks (totaling 72 sessions).

Interventions. Study group. The study group received the family-based intervention program, which was based on Coping with and Caring for Infants with Special

Table 1 - Content of intervention.

Positions	Movement	Aims
Supine	-Weight bearing through head, neck, and shoulder with trunk elongation -Pelvis rotation -Stimulation of upper and lower extremities with different surfaces	-Increase strength and control of the anterior shoulder and chest muscles -Increase strength and balance. Control of the anterior and posterior neck muscles -Improve proximal stabilization and proprioceptive inputs -Maintain the head up and in the midline
Prone	-Weight bearing through upper limbs with vestibular stimulations; intermittent compression through shoulders -Pelvis stabilization	-Increase strength and balance of the anterior and posterior shoulder muscles -Increase strength, balance, and control of the anterior and posterior neck and upper back muscles
Side lying	-Bilateral upper limb activities and dissociated movement in lower extremities	-Scapula stabilization -Strength and control of shoulder girdle to provide a stable base for head lifting and turning -Bring the hands to mouth -Improve selective movements in hips
Sitting	-Reaching forward, backward and sides with trunk elongation	-Increase the strength of back extensors and abdominal muscles -Improve anterior, posterior and sideway balance -Provide postural control -Reach to toy with hands and grasp
Standing	-Reaching forward and sideways while standing, weight bearing of lower extremities in front of the mirror, cruising around furniture	-Increase the strength of back and hip extensors and abdominal muscles -Increase the strength of gluteus medius to provide the hip stabilization in the stance phase of walking
Transition Positions	-Sitting to stand, rolling supine to prone, supine to sit	-Increase the strength of back and trunk extensors -Minimize the asymmetry -Improve the balance and postural control -Increase the strength of the trapezius and quadriceps muscle

Needs (COPCA) by Hielkema et al[14] and Dirks et al.[12] The family-based COPCA program has 2 components: (1) an educational component that focuses on the family, and (2) a motor component based on neural group selection theory. The major goals of the COPCA programme are to improve family participation and infants' functional mobility. **Table 1** shows the content of the family-based intervention. According to the infants' needs, the contents were applied to the infants by the mothers of preterm infants via coaching with the physiotherapist. The program aims to inform the family about what their infant needs and what they can do, based on physiotherapist coaching. The coach does not have an instructional role but encourages the family to cope with the problems and uncover goals or desires. The family-based COPCA program was applied twice per week for 1 h in the infant's home during the 9-month intervention period by the first author (O. K. K), who has 10 years experienced and attended the neurodevelopmental basic and advance courses. The study group did not attend the traditional early intervention program.

Control group. The control group received the traditional early intervention program (TEIP), also called the routine infant physiotherapy. The TEIP is an integrated approach to improve functionality and independence in children based on the principles of the neurodevelopmental approach, based on motor, learning, and social cognitive theories. This approach uses guided or facilitated movements as a treatment strategy to ensure coordination of the input from the tactile, vestibular, and somatosensory receptors in the body with motor function.[27] The importance of intervention approaches involving both fine and gross skills in the development of motor function is known. Our intervention programs consisted of fine and gross motor functions in the direction of this information. The program engages motor development in the process of movement management by addressing the main components necessary for infants' gross motor function: (i) Supine, (ii) Prone, (iii) Sidelying, (iv) Sitting, (v) Standing, and (vi) Transition Positions. For preterm infants, the fine motor functions were also activated by adding activities involving the functional

Table 2 - Demographic characteristics of preterm infants.

Demographic characteristics	Study Group (n=16)	Control Group (n=16)	*P*-value
	Median (min-max)		
Corrected age (d)	90(85-96)	90.5(87-95)	0.89
Weight (g) at 3 m	5445(4100-6980)	5465(4300-6500)	0.72
Height (cm) at 3 m	59.5 (50-64)	59(53-65)	0.85
Gestational age (wk)	28.85 (26.43-32)	29 (27-32)	0.49
Birth weight (g)	1285 (710-1500)	1360 (920-1500)	0.57
Maternal age (yr)	32.6±5.9	30.37±4.5	0.14
Gender n(%)			
Girls	8 (50)	8 (50)	1.00
Boys	8 (50)	8 (50)	
Genreral movement analysis (Fidgety Movements - FM) n(%)			
Absent FM	6	6	
Sporadic/Abnormal FM	10	10	1.00
IVH gr. (1-2)	5 (31.3)	6 (37.5)	1.00
IUGR	1 (6.3)	2 (12.5)	1.00

Values are given as median (minimum-maximum) for continuous variables, and frequency for categorical variables. [a]Mann-Whitney's U-test for continuous variable, [b]Chi-square test for categorical variables. *P*-values of <0.05 were considered significant. X - mean, SD - standard deviation, d - days, g - grams, cm - centimeter, wk - weeks, yr - years, IVH - intraventricular hemorrhage, gr - grade, m - months, IUGR - intrauterine growth retardation

Table 3 - Fine and Gross Motor Scale Scores of Bayley-III.

Bayley-III	Study Group (n=16)		Control Group (n=16)	
Months	Median	25-75%	Median	25-75%
Fine motor				
3	10	9.25-12	11	9.25-12
6	22	19.5-24.5	21	19.25-22
9	26	23.25-28	25	24-28
12	28.5	25.5-30.75	28.5	25-30
24	40.5	37.25-41	38	36.25-41
Gross Motor				
3	14.5	13.25-18	15.5	14-18
6	29	27-33	28	27-30.75
9	38	34.5-40	37.5	36-39.75
12	41.5	30.25-45.25	41.5	37.5-43.75
24	59	54.25-60.75	57.5	55-59.75

hand movements to these positions. All other details can be seen in **Table 1**.

The program consisted of 72 sessions delivered over 9 months (1-h sessions held 2 weekly) by the second author (S. S), a physiotherapist who has 9 years of experience.

Measurements. Bayley Scale of Infant and Toddler Development-Third Edition (Bayley-III). Bayley-III is a standardized assessment used to assess the developmental functioning of infants from 1 to 42 months of age.[28,29] The main purpose of the Bayley-III is to identify children with developmental delay, to provide information for intervention implementation, and to examine the functioning of clinical groups or following intervention.[29] The Bayley-III evaluation of the 2 groups was made by a pediatric physiotherapist (B. N. Y) who attended a Bayley-III course and was blinded to the groups. The preterm infants were evaluated using the motor scales of the Bayley-III at 5 times when infants were at the corrected ages of 3-, 6, 9-, 12-, and 24-months-old. Each evaluation took approximately 30 min.

The Bayley-III consists of the 5 scales; Cognitive Scale, Motor Scale, Social-Emotional Scale, Language Scale, Social-Emotional Scale, and Adaptive Behaviour Scale. In our study, we used only the Motor Scale to assess the motor functioning development with fine and gross motor subtests in preterm infants. This includes a fine motor subtest that measures skills associated with perceptual-motor coordination, object manipulation, reaching, motor planning, response speed, and grasping, as well as functional hand skills and responses to tactile information. The gross motor subtest evaluates the movements of the extremities and the trunk in dynamic and static positions (dynamic position: locomotion, coordination, and balance; static position: sitting and standing).

The Bayley-III provides four types of norm-referenced scores: scale score, composed score, classification percentage, and growth score.[29] Scores can be identified for each subtest in different age groups. Each scale has confidence intervals, and the subtests include the developmental equivalence of age. Also, previous studies have shown that these are reliable and valid for infants with different corrected age.[30,31]

Statistical analysis. The statistical package for the social sciences 21.0 (IBM SPSS Statistics; IBM Corporation, Armonk, NY, USA) analysis program designed for the Macintosh operating system was used for the statistical analysis of data. Based on the work of Hielkema et al,[14] the sample size calculation was the total score of the Infant Motor Profile (IMP) at 18 months. To achieve 80% power to detect a difference with 95% confidence using a clinically relevant change of 7.5 points in the total IMP score (SD=8.2), a sample size of 19 participants was required for each group, not including losses to follow-up.[14] We accepted the standard deviation value in this publication and, when we perform power analysis again according to the scales that we use, the number of sample groups that we aim

Table 4 - Changes by time in fine and gross motor development.

Bayley-III	Study Group		Control Group		Changes by time in fine and gross motor development within groups				Changes by time in fine and gross motor development between groups		
	X/SD		X/SD		Study Group		Control Group		Z	p[b]	Effect size (d[b])
					Z	p[a]	Z	p[a]			
Differences Between Months											
Fine motor											
6-3	11.37	2.12	10.62	1.99	-3.536	<0.001*	-3.552	<0.001*	-1.555	0.12	0.36
9-6	4.06	1.73	4.75	0.77	-3.360	0.001*	-3.573	<0.001*	-1.989	0.32	0.51
12-9	2.37	1.45	2	1.89	-3.335	0.001*	-3.207	0.001*	-1.081	0.28	0.21
24-12	10.87	1.92	10.37	2.09	-3.526	0.001*	-3.528	<0.001*	-0.534	0.61	0.24
Gross motor											
6-3	14.06	3.31	12.68	2.77	-3.522	<0.001*	-3.538	<0.001*	-1.223	0.22	0.45
9-6	8.18	2.45	8.93	0.77	-3.553	<0.001*	-3.621	<0.001*	-0.779	0.43	0.41
12-9	4	2.06	3.87	2.65	-3.528	<0.001*	-3.570	<0.001*	-0.693	0.48	0.054
24-12	15.81	2.58	15.31	2.33	-3.524	<0.001*	-3.540	<0.001*	-0.609	0.54	0.203

**Statistically significant at $p<0.05$. *P*-value (superscript a) for within-group change calculated using Wilcoxon signedrank test. *P*-value (superscript b) for between-group difference in baseline scores calculated using Mann Whitney-U tests. X - mean, SD - standard deviation, Effect Size: db >0.80

for the same standards is 15 infants. Therefore, we aimed to complete our study by including a few additional infants to account for the risk of loss. The variables were analyzed for their normality distribution using the Kolmogorov-Smirnov test. Descriptive analyses were shown as the median, minimum, and maximum values for the abnormally distributed variables. The Bayley-III fine and motor scores were indicated with median (minimum, maximum) values since they were abnormally distributed. Multivariate analysis of variance (MANOVA) was used to examine the effects of treatment on outcome measures. A Greenhouse-Geisser correction was used when the sphericity assumption was violated. An overall 5% type-I error level was used to infer statistical significance. The change of fine and gross motor development over time was shown using the Friedman analysis within groups. The Wilcoxon signed-rank test was used to compare the difference in fine and gross motor development within groups. Changes over time in fine and gross motor development were evaluated using the Mann-Whitney U Test between groups. Effect sizes (ESs) were calculated using GPower V.3.1.7 (University of Kiel, Kiel, Germany) and ES represents a large effect size when greater than 0.8, a medium effect size when 0.5 to 0.8, and a small effect size when less than 0.5.

Results. The demographic characteristics of the preterm infants are shown in **Table 2**. There were no statistically significant differences between the groups in terms of gender, weight, and height at the corrected age of 3 months, birth weight, gestational age at birth, maternal age, fidgety movements, intraventricular hemorrhage, and intrauterine growth retardation ($p>0.05$).

The Bayley-III fine and gross motor scale scores of the study and control groups are shown in **Table 3**. The changes over time in fine and gross motor development are shown in **Figure 2**. The group × time interaction was statistically significant in the multivariate test for fine motor (MANOVA; F=1515.27, $p<0.001$) and gross motor (MANOVA; F=1950.59, $p=0.001$) development. In the study group, there was a significant increase in fine and gross motor development after the 9-month intervention and follow-up period (KFineMotor=63.24, $p<0.001$; KGrossMotor=64, $p<0.001$). A significant increase was observed in the fine and gross motor development of the control group after the 9-month intervention and follow-up period (KFineMotor=63.5, $p<0.001$; KGrossMotor=64, $p<0.001$). However, there was no interaction between groups in fine (MANOVA; F=0.027, $p=0.872$) and gross motor development (MANOVA; F=0.022, $p=0.883$).

Comparisons of the changes over time for fine and gross motor development within and between groups, as well as effect sizes, are shown in **Table 4**. Comparing the 2 groups, small effect sizes and medium effect size (db < 0.5) are showed in fine and gross motor development during the 9-month treatment and follow-up periods. There were significant differences between months (6–3 vs. 9–6 vs. 12–9 vs. 24–12) in fine and gross motor development within groups ($p<0.001$). However, there were no statistical differences between groups in fine and gross motor development.

In the follow-up period, in the control group at the corrected age of 24 months, 4 (25%) infants were diagnosed with Cerebral Palsy (CP) and one (6.3%) with minor neurological disorders; in the study group, 4 (25%) infants were diagnosed with CP and one (6.3%) with minor neurological disorders.

Discussion. In this assessor-blind randomized controlled study, the preterm infants with abnormal/sporadic FMs and absent FMs- were included in the family-based program and compared with a traditional early intervention program. The interventions were performed 2 times per week for 60 min per session over a period of 36 weeks. This study differs from previous studies in that we assessed the gross and fine motor development with the Bayley-III test, and applied a long-term intervention program. Our primary findings indicate that the intervention approaches might support improvements in fine and gross motor development in preterm infants with abnormal/sporadic FMs and no FMs. However, we detected no significant differences between the groups. These results show that early intervention approaches might improve fine and gross motor development in preterm infants through the coaching of the pediatric physiotherapist. Also, this study demonstrates the importance of the role of family care in fine and gross motor development in preterm infants.

Hielkema et al[13] analyzed the effect of early intervention on motor outcomes in a randomized, controlled study of 46 infants with a developmental disorder. The COPCA program was given for the infants in the treatment group with special needs. The Traditional Infant Physical Therapy (TIP) was applied to the control group. This study showed no difference between the scores of the COPCA and TIP groups before, during or after the intervention.[13] In their study on 105 preterm infants with a major cranial ultrasound abnormality, Weindling et al.[32] applied Neurodevelopmental Therapy (NDT) as an early physiotherapy program to one group and the Traditional Physiotherapy Program to a control group. No differences were found between the 2 groups in evaluations at the 12th and 30th months.[32]

Mayo[21] applied NDT to 17 infants diagnosed with spastic CP once per week and to another 12 infants once per month for 6 months. Application of intensive NDT was found to produce better motor development.[33] There is limited evidence as to the short-term positive effect of the Newborn Individualized Developmental Care and Assessment Program (NIDCAP) and infant massage.[22] Maguire et al[22] analyzed the effect of NIDCAP on neuromotor outcomes in a randomized controlled study of 164 preterm infants born before the 32nd week. No differences were found between the control and study groups in terms of neuromotor outcomes.[22] Another study evaluated the results of the NIDCAP program at the corrected age of 2 years using the Bayley-II, and no significant differences were found between the 2 groups in the indexes of mental and psychomotor development.[34] Elbasan et al.[23] investigated the effect of the family-centered physiotherapy with NDT principles and found no significant differences between the study and control group in motor and cognitive development in preterm infants. Similarly, there were no significant differences between the family-based and the traditional early intervention group in our study and the effect sizes were low and medium. However, in our study, the median effect size was found in the fine motor test at the 6th- and 9th-month assessments. This result might show that the experienced physiotherapist was more effective in fine motor development than the family. Future studies should investigate the quality of fine motor development with more detailed evaluation tools.

Dirks et al[35] demonstrated that COPCA has a significant effect on the development of sitting abilities. These authors found that higher sitting time at 6 months was associated with the Pediatric Evaluation of Disability Inventory (PEDI) scores in COPCA.[35] Our study also shows a significant increase in fine and gross motor development within groups. This might be caused by the gradual increase of fine and gross motor abilities along with growth. Future studies should investigate the quality of fine and gross motor abilities in the family-based early intervention program.

Brogna et al[36] evaluated the quality of spontaneous movements in late preterm (34-0/7 to 36-6/7 weeks) infants. These authors evaluated 574 infants at the age of 2 years using the GMA in the writhing and fidgety periods and neurodevelopmental tests. These authors also show that fidgety movements had the most sensitivity in predicting neurological disorders and were important in deciding early intervention.[36] In this current study, 62.5% of the infants with sporadic FMs or absent FMs- were diagnosed with neurological disorders by pediatric neurologists at 24 months of age. This confirmed the indispensability of fidgety movements in deciding on early physiotherapy treatment and their high sensitivity in the estimation of neurological outcomes at 24 months of age.

The present study had several strengths. First, our study was designed as a randomized controlled trial. One of the other strengths was that experienced pediatric physiotherapists conducted the treatments and all evaluations were performed by the independent researcher who was blinded to the group allocation. Additionally, Bayley-III, which is a valid and reliable outcome measure, was used to evaluate gross and fine motor development. As stated in the literature, Bayley-III composite scores might underestimate developmental delay.[37] It is thought that motor learning can be increased in the first year of life and the motor development of high-risk infants can be supported with early neurodevelopmental therapies.[37] Therefore, we used fine and gross motor scale scores that are more objective evaluation methods to show the degree of effectiveness of treatment and improvement in motor development. This is a strength of our study because it allows the investigation of improvement of motor development in fine and gross motor subtests.

Our study had some limitations. Also, although it is known that the brain develops quickly in the first 2 years, in this study, the details of brain development during treatment are not known; which is the first limitation of our study. Future studies using neuroimaging and electroencephalographic methods are needed to resolve this question. Another limitation of our study was that we did not investigate the mother-infant interaction and these effects on developmental trajectories. The family-based intervention program might improve the preterm infants' fine and gross motor development via education of the mothers. Relative to the TIP, this is an inexpensive approach and might be positively influencing mother-infant interactions that affect the cognitive development of preterm infants.

In conclusion, neurodevelopmental improvements in the fine and gross motor areas were not different when comparing the family-based group and the traditional early intervention group. The family-based intervention program might also support fine and gross motor development in preterm infants. The role of the family is critical to improving the motor development of infants in their first year of life.

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