

The Effects of Family Functioning on Gross Motor Function, Activity, and Participation in Children with Cerebral Palsy

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Abstract

Objectives

The present study aimed to investigate whether family functioning (FF) could impact gross motor function, activity, and participation in children with cerebral palsy (CP).

Materials & Methods

Sixty-seven children with spastic diplegic CP who were admitted to the Special Education and Rehabilitation Clinic were included in the study. The guidelines of the American Academy of Neurology were followed for the diagnosis of spastic diplegia. The type of home where the family lives, the family's average income, the child's age, gender, and number of siblings, and the age and educational level of the child's primary caregiver were recorded. The gross motor function capacity of children with CP was assessed with the Gross Motor Function Classification System (GMFCS). The Pediatric Evaluation of Disability Inventory (PEDI) was used to evaluate activity and participation performance.

Results

The children living in detached houses had statistically higher PEDI mobility levels than those living in apartments ($p < 0.05$). PEDI's social function and self-care levels were higher in 12 to 18-year-old children with two siblings ($p < 0.05$). The age and educational status of the primary caregiver were found to have an important impact on the PEDI scores. According to the results, social function and self-care levels were higher in children whose primary caregivers were 30 to 65 years old and had high levels of education above high school ($p < 0.05$).

The effects of family income and gender on PEDI scores were statistically non-significant ($p > 0.05$). Variables related to family functioning had no statistically significant effect on GMFCS scores ($p > 0.05$).

Conclusion

These factors can enable healthcare providers to collaborate with the families to develop more comprehensive intervention plans emphasizing family strengths and supporting their needs.

Keywords: Cerebral Palsy; Spastic; Diplegic; Family Functioning; Gross Motor Function

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Introduction

The development resulting from the child's genetic characteristics and interactions with family and environment, known as "Family Ecology" (FE), has a significant impact on child development (1). During early childhood, FE plays a key role in children's daily activities, participation, and social and recreational activities (1). Hence, it is an important aspect when providing services to children with disabilities, such as cerebral palsy (CP), who may have a delay in the acquisition of their motor abilities, resulting in decreased levels of participation compared to peers with typical development (2).

Arising from non-progressive disturbances in the developing fetal or infant brain, CP describes a group of permanent disorders in the development of movement and posture that lead to activity limitation. It occurs in approximately 3.3 per 1000 live births (3,4). Three main determinants are identified as influential parameters in the acquisition of motor abilities in children with CP. These include family support, expectations of the

child's motor performance, and support available to the family (5). Depending on these determinants, children with CP demonstrate wide variations in their gross motor functions (3). For instance, while children classified in level V on the Gross Motor Function Classification System (GMFCS) are limited in their movements and require physical assistance for all gross motor functions, those classified in level I can walk without restrictions (3,5).

As an important aspect of FE, Family Functioning (FF) refers to the family's sociodemographic characteristics and the relationships, expectations, and support between family members and the child (6). It is a complex construct that involves multiple aspects of the family, such as commitment, communication, appreciation, encouragement, religious beliefs, adaptability, connectedness, family roles, and time (7). Families demonstrating strengths in these aspects are often considered successful and strong. Higher levels of FF are associated with better physical and psychological

health of parents of children with CP (6,8).

Studies have demonstrated an association between motor ability and FF in children with CP (6-8). However, studies investigating the effects of FF on children's gross motor function, activity, and participation are scarce. Therefore, the present study investigated whether FF could impact gross motor function, activity, and participation in children with CP. As the study's hypothesis, it was predicted that FF could be correlated with these parameters. Such a correlation would enable service providers to collaborate with families to develop comprehensive intervention plans emphasizing family strengths and supporting their needs.

Materials & Methods

Study Design

This study was designed as a cross-sectional study. Participants admitted to the Physical Medicine and Rehabilitation Outpatient Clinic were referred to Special Education and Rehabilitation Center. The children were evaluated in the laboratory by an experienced physiotherapist (SD) for the variables within the scope of the study.

Participants

Participants were referred to the Special Education and Rehabilitation Clinic by a medical doctor specialized in Physical Medicine and Rehabilitation. Inclusion criteria were: diagnosis of spastic diplegic CP, non-walking and limited-walking children (GMFCS levels: II-V), and children aged 5 to 18 years (9-11). Exclusion criteria were: history of botulinum toxin injection or surgery within the past six months, having

pneumothorax and progressive chest infection, presence of contagious diseases, severe organic dysfunction, or severe psychosocial disorders (9-11).

Ethics Committee

Kırşehir Ahi Evran University Medical Faculty Clinical Research Ethics Committee approved this study. Before the study, written and verbal consent were obtained from all families, and the study was conducted following the Declaration of Helsinki.

Evaluation Methods

The guidelines of the American Academy of Neurology were followed for the diagnosis of spastic diplegia (12). According to the American Academy of Neurology, routine metabolic and genetic testing is not recommended unless there are features atypical of CP in the history and physical examination of the patient. All children diagnosed with CP are referred to neuroimaging, preferably MRI. If the MRI is normal, genetic or metabolic screening should be considered, particularly if the history does not support the diagnosis of CP (12). Clinical features that should draw the physician's attention to a diagnosis of spastic diplegia may include the absence of premature birth, parental consanguinity, bulbar dysfunction, family history of CP, bowel and bladder dysfunction, fluctuations in the level of motor disability, and severe cognitive impairment (13-22). Even though the clinical features may indicate an alternate diagnosis, the diagnosis of CP tends to persist. Various conditions can mimic spastic diplegia and should be excluded. These may include benign idiopathic (habitual) toe walking, dystonia, inherited myelopathies, multiple hereditary progressive ataxias, tethered

cord syndrome, leukodystrophies, disorders of amino and organic acid metabolism and urea cycle defects, and disorders of vitamin metabolism and nutritional deficiencies (13-22).

Family Functioning

The type of home where the family lives, the family's average income, the child's age, gender, and number of siblings, and the age and educational level of the child's primary caregiver were recorded.

Gross Motor Function Classification System

The GMFCS evaluates the gross motor function capacity of children with CP. It is a 5-level classification system emphasizing the child's performance in sitting, transfers, walking, and mobility (23). Distinctions between levels of the GMFCS are based on the child's need for assistive devices and/or caregiver's assistance. The scale is ordinal and has no intention that differences between levels would be considered equal or that children with CP would be equally distributed among five levels (24). A revised and extended version was published in 2007 to refresh the original system based on the new ideas of the International Classification of Functioning (ICF) (25,26). This revised version makes functional distinctions that are meaningful in daily living. Furthermore, an additional age band for youth from 12 to 18 was also added. Descriptions for 6-12 and 12-18 age bands encompass the effect of personal (e.g., social preferences and energy demands) and environmental factors (e.g., school and home environment) on mobility methods. Both versions are proven to be valid and reliable. This study

used 5- to 6-year-old, 7- to 11-year-old, and 12- to 18-year-old age bands. The relevant literature proves the content validity, construct validity, and inter-rater reliability of the GMFCS (23,27,28).

Pediatric Evaluation of Disability Inventory (PEDI)

Commonly used for evaluating activity and participation performance, PEDI assesses the capability and performance of young children during functional activities. It can be used as a parental report, or a structured interview can be conducted by a rehabilitation professional. The PEDI measures capability and performance in self-care, mobility, and social function (29-33). Functional skills for which the child has demonstrated mastery and competence are identified and rated on the Functional Skills Scale of the PEDI, which provides a direct measure of the functional capability of a child and simplifies identifying the clinical patterns of limitations in functional skill attainment. The child's performance in daily functional activities is measured based on the level of caregiver assistance that the child needs to accomplish (29-33), which is rated on the Caregiver Assistance Scale. The Modification Scale details the child's actual performance in functional activities. It includes environmental modifications and equipment a child uses in routine daily activities. The inventory consists of 197 items to evaluate functional skills and twenty to assess caregiver assistance and modifications. In Part I, the format is dichotomous, and the questions can be scored either 'capable' or 'not capable.' Part II (Caregiver Assistance scale) has six rank-ordered response choices, ranging from 0 (totally dependent) to 5 (independent). PEDI has

proved to be a valid and reliable instrument (29-33). Among different instruments for measuring the health and well-being of children with spastic CP, PEDI demonstrated higher internal consistency than the Pediatric Outcomes Data Collection Instrument (PODCI) and Child Health Questionnaire (34). This study used 5- to 6-year-old, 7- to 11-year-old, and 12- to 18-year-old age bands.

Sample Size

The sample size was calculated based on the study by Ferre et al., in which they investigated the effects of caregiver-directed home-based intensive bimanual training in young children with unilateral spastic CP (35). For a statistically significant level of 5%, a statistical power of 80% using G*Power Software (ver. 3.1.9.2), and an effect size of 0.8, a minimum required sample size for one-way analysis of variance was calculated as 60 participants. With a 10% dropout rate, sixty-seven subjects were recruited into the study.

Statistical Analysis

The IBM® SPSS® Statistics for Windows software (ver. 20.0; IBM Corp., NY, USA) was used to analyze the data. The variables were investigated using visual (histograms, probability plots) and analytical methods (Kolmogorov-Smirnov/Shapiro-Wilk's test) to determine whether or not the data were normally distributed (25). Parametric analysis was used for the normally distributed data. Values were expressed as mean \pm standard deviation (mean \pm SD), standard error of the mean (SEM), and confidence intervals (95% CI) for continuous variables. In addition, values were expressed as a ratio (%) for categorical variables.

One-way analysis of variance (one-way ANOVA) was used to investigate the effects of family functioning on gross motor function, activity, and participation in children with CP. Bonferroni post-hoc comparisons were conducted when the results from the one-way ANOVA were significant to determine how the two groups differed. The level of significance was set at $p < 0.05$.

Results

Sixty-seven individuals (41.5% female) with CP were enrolled in the study. All participants were evaluated ($n=67$), and descriptive statistics of the participants are presented in Table 1.

Table 1. Descriptive statistics of the participants

The children living in detached houses had statistically higher PEDI mobility levels than those living in apartments ($p < 0.05$, Table 2). PEDI's social function and self-care levels were higher in 12- to 18-year-old children with two siblings ($p < 0.05$, Table 3). The age and educational status of the primary caregiver were found to have an important impact on the PEDI scores. According to the results, social function and self-care levels were higher in children whose primary caregivers were 30 to 65 years old and had high levels of education above high school ($p < 0.05$, Tables 4 & 5). The effects of family income and gender on PEDI scores were statistically non-significant ($p > 0.05$). Variables related to family functioning had no statistically significant effect on GMFCS scores ($p > 0.05$).

Discussion

This study investigated whether family functioning was an effective factor in gross motor function,

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Table 1: Descriptive statistics of participants.

Variables	%
Female / Male	41.5 / 58.5
Type of home	
detached house/apartment	37.8 / 62.2
Age group	
5- to 6-year-old / 7- to 11-year-old / 12- to 18-year-old	20.7 / 20.7 / 58.6
Siblings	
No/ 1 sibling / 2 siblings / 3 or above siblings	25.6 / 23.2 / 32.9 / 18.3
Family income	
0-2019 TL / 2020-3000 TL / 3001 TL and above	24.4 / 39.0 / 36.6
Primary caregiver' age	
18- to 29-year old / 30- to 45-year old / 46- to 65-year old	18.3 / 67.1 / 14.6
Primary caregiver' education status	
primary school / secondary school / high school / university	42.7 / 30.5 / 14.8 / 12.0

TL: Turkish Lira.

Table 2: Comparison of PEDI and GMFCS Scores by Gender and Home Type

Variables	Gender	Mean±SD	p	Variables	Home type	Mean±SD	p
PEDI mobility	male	30.77±17.11	.666	PEDI mobility	detached	36.13±17.46	.014*
	female	29.06±18.39			apartmen	26.37±16.73	
PEDI social function	male	45.13±17.45	.875	PEDI social function	detached	49.45±17.83	.129
	female	45.79±20.77			apartmen	42.94±19.08	
PEDI self-care	male	28.58±17.80	.658	PEDI self-care	detached	33.16±18.446	.149
	female	30.44±19.75			apartmen	27.04±18.46	
GMFCS	male	3.02±1.24	.773	GMFCS	detached	3.25±1.15	.119
	female	2.94±1.20			apartmen	2.82±1.24	

Table 3: Comparison of PEDI and GMFCS Scores by Age and Number of Siblings

Variables	Age group	Mean±SD	F / p	Variables	Siblings	Mean±SD	F / p
PEDI mobility	5- to 6-year-old	22.41±8.81	2.63/.07	PEDI mobility	no	22.43±13.06	2.53/.06
	7- to 11-year-old	28.41±16.89			1	30.32±15.92	
	12- to 18-year-old	33.35±19.36			2	36.11±17.90	
					≥3	29.53±21.47	
PEDI social function	5- to 6-year-old	37.00±19.48	3.38/.03*	PEDI social function	no	35.62±18.40	3.33/.02*
	7- to 11-year-old	41.94±19.36			1	47.21±18.04	
	12- to 18-year-old	49.60±17.40			2	52.00±14.79	
					≥3	44.93±22.39	
PEDI self-care	5- to 6-year-old	16.12±8.92	7.54/<.001*	PEDI self-care	no	20.48±11.45	4.06/.01*
	7- to 11-year-old	27.18±16.73			1	25.74±16.13	
	12- to 18-year-old	34.81±19.42			2	37.52±18.19	
					≥3	31.67±24.31	

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Variables	Age group	Mean±SD	F / p	Variables	Siblings	Mean±SD	F / p
GMFCS	5- to 6-year-old	2.82±0.72	0.19/.82	GMFCS	no	2.71±1.10	1.61/.19
	7- to 11-year-old	3.00±1.17			1	3.00±1.15	
	12- to 18-year-old	3.04±1.38			2	3.37±1.11	
					≥3	2.66±1.54	

i) 5- to 6-year-old:1; 7- to 11-year-old:2; 12- to 18-year-old:3 [Based on Bonferroni post-hoc analysis, Group 1-3:statistically different; Group 2-3:statistically different.]

ii) no sibling:1; one sibling:2; two siblings:3; ≥3 siblings:4 [Based on Bonferroni post-hoc analysis, Group 1-3:statistically different; Group 1-4:statistically different; Group 2-3:statistically different; Group 2-4:statistically different.]

Table 4: Comparison of PEDI and GMFCS Scores by Family Income and Age of Primary Caregiver

Variables	Family income (TL)	Mean±SD	F / p	Variables	Primer caregiver' age	Mean±SD	F / p
PEDI mobility	0-2019	27.70±18.16	0.77/.46	PEDI mobility	18- to 29-year old	21.07±8.19	2.93/.05
	2020-3000	33.06±18.10			30- to 45-year old	31.18±18.97	
	≥3001	28.43±16.68			46- to 65-year old	36.17±16.15	
PEDI social function	0-2019	40.35±19.49	1.11/.33	PEDI social function	18- to 29-year old	35.27±19.57	3.06/.05
	2020-3000	45.75±19.20			30- to 45-year old	46.93±18.53	
	≥3001	48.40±17.74			46- to 65-year old	51.08±15.37	
PEDI self-care	0-2019	23.90±17.70	1.37/.26	PEDI self-care	18- to 29-year old	18.33±8.72	5.57/.005*
	2020-3000	32.63±19.93			30- to 45-year old	29.82±19.71	
	≥3001	29.50±17.39			46- to 65-year old	41.00±14.94	
GMFCS	0-2019	2.90±1.33	0.32/.72	GMFCS	18- to 29-year old	21.07±8.19	0.39/.67
	2020-3000	3.12±1.15			30- to 45-year old	31.18±18.97	
	≥3001	2.90±1.24			46- to 65-year old	36.17±16.15	

Table 5: Comparison of PEDI and GMFCS Scores by Primary Caregiver's Educational Status

Variables	Educational Status	Mean±SD	F / p	Variables	Educational Status	Mean±SD	F / p
PEDI mobility	primary school	26.50±19.93	1.62/.20	PEDI social function	primary school	25.32±11.21	3.16/.04*
	secondary school	27.60±15.69			secondary school	26.77±11.46	
	high school	34.06±14.75			high school	32.44±14.52	
	university	35.13±19.83			university	34.57±12.78	
PEDI self-care	primary school	28.86±16.76	3.29/.03*	GMFCS	primary school	2.88±1.32	0.15/.86
	secondary school	29.43±13.21			secondary school	3.00±1.26	
	high school	35.42±15.75			high school	3.05±1.02	
	university	37.74±16.51			university	3.09±1.15	

primary school:1; secondary school:2; high school:3; university:4 [Based on Bonferroni post-hoc analysis, Group 1-3:statistically different; Group 1-4:statistically different; Group 2-3:statistically different; Group 2-4:statistically different.]

activity, and participation levels in 5- to 18-year-old children with spastic diplegic CP. The family functioning assessment model was established based on sociodemographic features of the families. According to the study results, living in a detached house was associated with higher levels of mobility in children with CP. Factors affecting children's social function and self-care levels were being 12 to 18 years old, having more siblings, and having a primary caregiver between 30 and 65 years of age with an education level higher than high school. Over the past several years, family-centered care has been the prominent focus in pediatric health service delivery. This approach is especially applicable to families and children with neurodevelopmental disorders and/or complex medical or mental health problems (36). In a collective approach, the 'Copernican Revolution' puts the family at the center rather than the health system (37). Family-centered service encompasses values, attitudes, and approaches to providing services for children with special needs and their families. In such service, each family is considered unique, emphasizing that the family is constantly present in the child's life and that they are the experts in the abilities and needs of the child (36,37).

Family functioning is an important aspect of family-centered service (36). There is evidence in the relevant literature on the beneficial effects of high-quality FF on outcomes in various domains, such as better child development, enhanced child psychological adaptation, improved parental psychological well-being (reduced levels of stress, anxiety, depression), and higher satisfaction levels (38-40). In their study on 176 five- to eight-

year-old children with CP, Beckung & Hagberg reported participation restrictions in 63% of the patients regarding educational activities and in 57% of them regarding social activities (41). Colver et al. reported that during recreational activities, children with CP's physical, social, and behavioral environment significantly affected their performance levels and roles in social life (42). The fact that the social function and self-care levels are higher in children between the ages of 12 and 18 years compared to other age groups can be explained in relation to motor development curves. Consistent with the results of Colver et al. (42), the authors believe that having siblings is an important factor in developing behavioral abilities. Heah et al. reported that environmental problems, such as difficulties in transportation and the type of surfaces that would hinder children's mobility, could adversely affect their participation (43). According to Heah et al. (43), this study also demonstrated that living in houses (with a private backyard or garden) provides more environmental interaction opportunities than multi-story apartments/residences.

Most studies indicate that FF does not differ based on children's gross motor function levels, which is an encouraging finding that contrasts with earlier assumptions that FF was inversely related to the severity of the child's health condition. In order to add depth to the research, LaForme Fiss et al. found no differences in family ecology between children with and without disabilities. Compared to primary caregivers of children in GMFCS level I, primary caregivers of children in GMFCS level II reported higher levels of achievement orientation (44). The same study reported that primary caregivers

of children with CP perceived moderate levels of social support, regardless of their children's gross motor abilities (44). This study's results support the fact that the primary caregiver's education level and his/her perception of the development process of the child with CP are important parameters in the development of the child's social function and self-care abilities (44).

Limitations

One limitation of the current study is that the results do not clearly distinguish whether the studied variables were associated with gross motor function, activity, and participation. Therefore, there is a need for further studies with a prospective design in this subject.

In Conclusion

These factors can enable healthcare providers to collaborate with the families to develop more comprehensive intervention plans emphasizing family strengths and supporting their needs. FF is an important consideration for therapists working with young children in early childhood. FF, including the family sociodemographic perspective, should be discussed, and families should be actively involved in developing interventions for young children with CP and their families.

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Author's Contribution

Muhammed Samed DALAKÇI planned the study topic and collected the data. Anıl ÖZÜDOĞRU provided guidance in finding the study topic. Caner

KARARTI assisted in statistical analysis of the data. All authors contributed to the interpretation of the data

Conflict of Interest

The authors have no conflicts of interest to declare

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