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PREDICTORS OF GROSS MOTOR FUNCTION LEVEL IN SPASTIC TYPE CEREBRAL PALSY: A RETROSPECTIVE STUDY

ORIGINAL ARTICLE

ABSTRACT

Purpose: This study was conducted to identify the determinants of gross motor function in patients with spastic-type Cerebral Palsy (CP) who received physiotherapy from a single center for two years.

Methods: One hundred and eight children with spastic-type CP (mean age: 6.43±4.83 years) were evaluated twice, before and after the two-year physiotherapy. The outcomes were the Gross Motor Function Classification System (GMFCS), Manual Ability Classification System (MACS), Communication Function Classification System (CFCS), and Eating and Drinking Ability Classification System (EDACS). Binary logistic regression analysis was used to determine whether factors such as age, sex, topographical distribution, and levels of GMFCS, MACS, CFCS, and EDACS could predict the improvement in GMFCS level after the two-year physiotherapy.

Results: The odds ratio of improvement in GMFCS level was found to vary significantly with the topographical distribution, CFCS level, and EDACS level ($p<0.05$). Compared to the children with CFCS Level I, children with CFCS Level II, Level III, and Level IV were 0.001, 0.005, and 0.006 times less likely to improve in GMFCS level, respectively. Similarly, children with EDACS Level III and Level IV were respectively 1.605 and 1.548 times less likely to improve in GMFCS level compared to those with Level I.

Conclusion: CFCS and EDACS were significant predictors of gross motor function level in spastic-type CP. Healthcare professionals can use CFCS and EDACS to predict the progression of gross motor function levels, thereby providing more appropriate interventions and more realistic predictions.

Keywords: Cerebral Palsy, Classification, Communication, Eating, Motor Skills

SPASTİK TİP SEREBRAL PALSİDE KABA MOTOR FONKSİYON DÜZEYİNİN BELİRLEYİCİLERİ: RETROSPEKTİF BİR ÇALIŞMA

ARAŞTIRMA MAKALESİ

ÖZ

Amaç: Bu çalışma, iki yıl boyunca tek merkezden fizyoterapi alan spastik tip Serebral Palsi'li (SP) olgularda kaba motor fonksiyonun belirleyicilerini tespit etmek amacıyla yapıldı.

Yöntem: Spastik tip SP'li 108 çocuk (ortalama yaş: 6,43±4,83 yıl), iki yıllık fizyoterapi sürecinin öncesi ve sonrasında toplam iki kez değerlendirildi. Sonuç ölçütleri; Kaba Motor Fonksiyon Sınıflandırma Sistemi (KMFSS), El Becerisi Sınıflandırma Sistemi (EBSS), İletişim Fonksiyon Sınıflandırma Sistemi (İFSS) ve Yeme ve İçme Becerisi Sınıflandırma Sistemi (YİBSS) idi. Yaş, cinsiyet, topografik dağılım ve KMFSS, EBSS, İFSS ve YİBSS düzeyleri gibi faktörlerin iki yıllık fizyoterapiden sonra KMFSS düzeyindeki iyileşmeyi tahmin edip edemeyeceğini belirlemek için ikili lojistik regresyon analizi kullanıldı.

Sonuçlar: KMFSS düzeyindeki iyileşmenin olasılık oranının topografik dağılıma, İFSS düzeyine ve YİBSS düzeyine göre anlamlı düzeyde değiştiği bulundu ($p<0,05$). İFSS Seviye I olan çocuklarla karşılaştırıldığında, İFSS Seviye II, Seviye III ve Seviye IV olan çocukların KMFSS seviyesinde iyileşme olasılığı sırasıyla 0,001, 0,005 ve 0,006 kat daha azdı. Benzer şekilde, YİBSS Seviye III ve Seviye IV olan çocukların KMFSS seviyesinde iyileşme olasılığı Seviye I olanlara göre sırasıyla 1,605 ve 1,548 kat daha azdı.

Tartışma: İFSS ve YİBSS, spastik tip SP'de kaba motor fonksiyon seviyesinin anlamlı belirleyicileriydi. Sağlık uzmanları, kaba motor fonksiyon seviyelerinin ilerleyişini tahmin etmek için İFSS ve YİBSS'yi kullanabilir, böylece daha uygun müdahaleler ve daha gerçekçi tahminler sağlayabilir.

Anahtar Kelimeler: Serebral Palsi, Sınıflandırma, İletişim, Yeme, Motor Beceriler

INTRODUCTION

Cerebral palsy (CP) is one of the most common childhood disabilities, including permanent motor skill disorders secondary to non-progressive brain lesions or anomalies that occur in the developing fetal or infant brain (1). The CP is classified as a spastic, dyskinetic, and ataxic type of CP (2). Children and adolescents with CP exhibit motor impairments and developmental problems, necessitating the evaluation of many developmental areas. A holistic perspective is needed to define health status, including functions such as eating, drinking, manual skills, communication, and ambulation and a multidisciplinary family-centered approach should be given for not only developing physical health but also maintaining a child's quality of life (3,4). Specific classification systems are used to determine the functional states of children and adolescents with CP. For instance, the Gross Motor Function Classification System (GMFCS) identifies gross motor functions; the Manual Ability Classification System (MACS) determines manual skills; the Communication Function Classification System (CFCS) determines communication skills; and the Eating and Drinking Ability Classification System (EDACS) determines eating and drinking abilities in children and adolescents with CP (5–7).

There is currently no practical measurement tool to predict functional development and ambulation in children with CP (8). Using classification systems to identify the present functional level of children and adolescents with CP may help predict functional development. Insights into the altered gross motor functions of children and adolescents with CP are also useful for improving programs to prepare children for adolescence and adulthood (5,9). Knowing early on what the functional prognosis is and what factors might affect maintaining functional ability, healthcare professionals might be able to set more realistic goals. This would help healthcare professionals make better use of treatment resources and design a better treatment plan to keep children and adolescents with CP from losing their functional skills (10).

The progression of motor functions in children and adolescents with CP has been followed only according to age in the previous studies (11,12). However, considering only age may not provide sufficient data. Predicting gross motor function progression in terms of manual abilities, communication skills, and eating and drinking abilities might provide more detailed information. Therefore, the present study aimed to identify the determinants of gross motor function in patients with spastic-type CP who received physiotherapy from a single center for two years.

METHODS

Study Design

This study was carried out in the Düzce Gökkuşağı Special Education Center and the Kdz. Ereğli Gökkuşağı Special Education Center. The data source for this retrospective study was stored medical records from February 2020 to February 2022. The Bolu Abant Izzet Baysal University Clinical Research Ethics Committee provided the ethical approval (approval number: 2022/127, approval date: May 10, 2022) and carried out following the Declaration of Helsinki. Participants were provided with verbal and written descriptions of the study, and parental consent was obtained for each participant. The study was registered on ClinicalTrials.gov with the registration number NCT05505149.

Participants

The child neurology specialist diagnosed CP in all participants, who ranged in age from 3 to 18 years old. For two years, the children and adolescents with CP received services from the Düzce Gökkuşağı Special Education Center and the Kdz. Ereğli Gökkuşağı Special Education Center. The inclusion criteria included having a diagnosis of spastic-type CP and having a parent who is literate in Turkish. The exclusion criteria were: (1) receiving botulinum toxin injection and orthopedic surgery during the study; (2) having a selective dorsal rhizotomy and intrathecal baclofen; and (3) suffering from chronic heart or lung problems.

Sample Size

The G*Power 3.1.9.2 power analysis software was used for the sample size calculation. The calculations were based on an odds ratio of 1.9 (calculated from the pilot study with randomly selected data),

the Pr(Y=1|X=1) H0 of 0.5, an alpha level of 0.05, the desired power of 80%, the R^2 other X of 0, the X parm μ of 0, and the X parm σ of 1 (13,14). Based on these parameters, a sample size of at least 93 was necessary. The study included a total of 108 volunteer children with spastic-type CP.

Assessments

To gather information on sociodemographic and medical variables such as age, gender, clinical type, topographical distribution, surgery and/or botulinum toxin history, and chronic issues, the medical records of eligible children and adolescents with CP were screened. The assessments were conducted in clinical settings at the beginning and two years later by the same researcher, a physical therapist with 10 years of expertise in pediatric rehabilitation (S.A.T.). Throughout the two-year trial period, the participants maintained consistent clinical follow-up.

The GMFCS is a classification system designed to categorize the gross motor functions of children and adolescents with CP, comprising five levels from 1 (most independent) to level 5 (fully dependent) (15). Classifications are based on self-initiated motions, focusing on sitting and walking in daily activities. The Turkish version of the GMFCS demonstrates high test-retest reliability, with an intraclass correlation coefficient (ICC) of 0.94 (16).

The MACS is a classification system designed to categorize the manual abilities of children and adolescents with CP, comprising five levels from 1 (most independent) to level 5 (fully dependent). Classifications are based on the capability to self-manage objects during daily activities. Mini-MACS was used in the present study (17). The Turkish version of the MACS has high test-retest reliability, with an ICC of 0.96 (18).

The CFCS is a classification system designed to categorize the communication abilities of children and adolescents with CP, consisting of five levels ranging from 1 (most independent) to 5 (fully dependent). Classifications are based on the daily performance of all communication methods, including speech, gestures, eye gaze, facial expressions, and augmentative and alternative communication. The

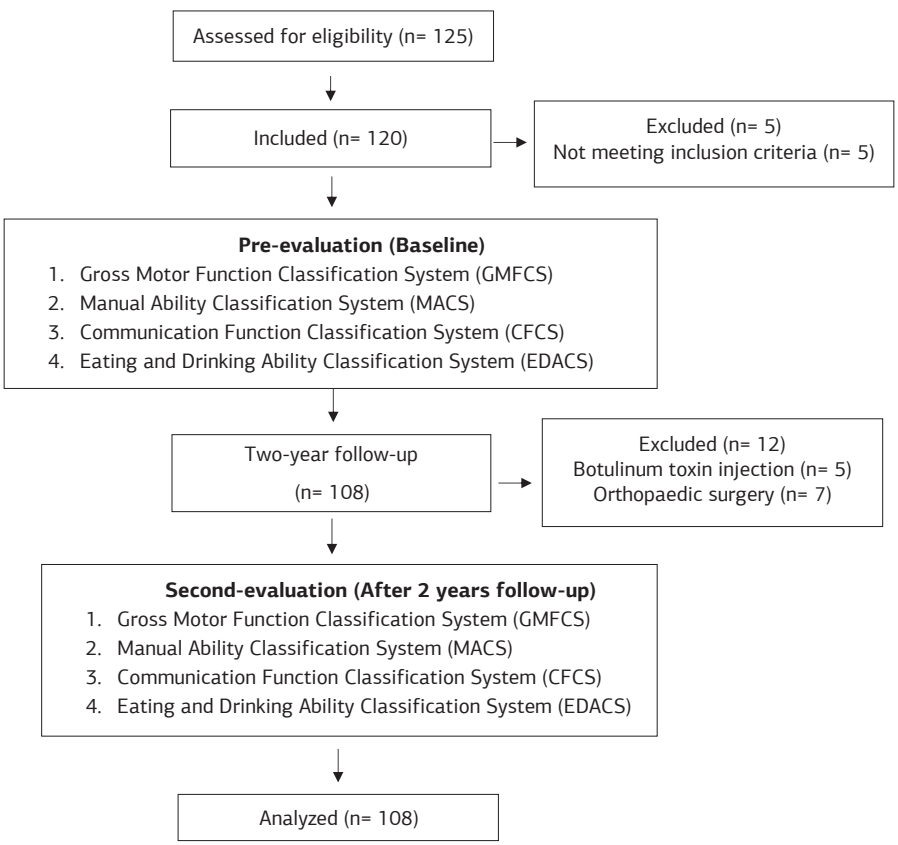

Figure 1. Design of the study

Table 1. Characteristics of Children and Adolescents with CP

Characteristics	Total (3-18 years) N=108	Grup 1 (3-6 years) n=65	Grup 2 (7-12 years) n=29	Grup 3 (13-18 years) n=14
	Number (%)			
Age (yr), Mean±SD	6.43±4.83	3.11±1.74	9.41±1.84	15.64±1.90
Sex				
Girl	45 (41.66)	24 (35.92)	19 (65.51)	2 (14.28)
Boy	63 (58.33)	41 (63.07)	10 (34.48)	12 (85.71)
Type of cerebral palsy				
Quadriparetic spastic-type cerebral palsy	50 (46.29)	36 (55.38)	8 (27.58)	6 (42.86)
Hemiparetic spastic-type cerebral palsy	53 (49.08)	25 (38.46)	21 (72.42)	7 (50.00)
Diparetic spastic-type cerebral palsy	5 (4.63)	4 (6.15)	0 (0)	1 (7.14)
GMFCS				
Level I	44 (40.74)	18 (27.69)	18 (62.06)	8 (57.14)
Level II	12 (11.11)	6 (9.23)	4 (13.79)	2 (14.28)
Level III	12 (11.11)	10 (15.38)	1 (3.44)	1 (7.14)
Level IV	13 (12.03)	9 (13.84)	3 (10.34)	1 (7.14)
Level V	27 (25.00)	22 (33.84)	3 (10.34)	2 (14.28)
MACS				
Level I	15 (13.89)	3 (4.61)	8 (27.58)	4 (28.57)
Level II	39 (36.11)	19 (29.23)	15 (51.72)	5 (35.71)
Level III	25 (23.14)	20 (30.76)	2 (6.89)	3 (21.42)
Level IV	11 (10.19)	8 (12.30)	3 (10.34)	0 (0)
Level V	18 (16.66)	15 (23.07)	1 (3.44)	2 (14.28)
CFCS				
Level I	63 (58.33)	30 (46.15)	21 (72.41)	12 (85.71)
Level II	13 (12.03)	9 (13.84)	4 (13.79)	0 (0)
Level III	6 (5.55)	5 (7.69)	1 (3.44)	0 (0)
Level IV	8 (7.40)	6 (9.23)	2 (6.89)	0 (0)
Level V	18 (16.66)	15 (23.07)	1 (3.44)	2 (14.28)
EDACS				
Level I	56 (51.85)	26 (40.00)	21 (72.41)	9 (64.28)
Level II	23 (21.29)	16 (24.61)	4 (13.79)	3 (21.42)
Level III	13 (12.03)	10 (15.38)	2 (6.89)	1 (7.14)
Level IV	10 (9.25)	7 (10.76)	2 (6.89)	1 (7.14)
Level V	6 (5.55)	6 (9.23)	0 (0)	0 (0)

GMFCS: Gross Motor Function Classification System, MACS: Manual Ability Classification System, CFCS: Communication Function Classification System, EDACS: Eating and Drinking Ability Classification System, SD: Standard Deviation.

Turkish version of the CFCS has high test-retest reliability, with an ICC of 0.82 (19).

The EDACS is a classification system designed to categorize the eating and drinking abilities of children and adolescents with CP, consisting of five levels ranging from 1 (most independent) to 5 (fully dependent). It defines the functional eating and drinking skills of children aged 3 years and older with CP at mealtime (20). The Turkish version of the EDACS has high test-retest reliability, with an ICC of 0.97 (21).

Statistical Analysis

All statistical analyses were conducted with Statistical Package for Social Science (SPSS) version 21.0 for Windows software (SPSS, Inc., Chicago, IL, USA). The Kolmogorov-Smirnov test was utilized to test the data distribution before doing the statistical analysis. Descriptive statistics were calculated, including frequency and percentage for categorical variables, and mean and standard deviation for continuous variables. All data were categorized into three age groups: 3-6 (preschool), 7-12 (school age), and 13-18 (adolescence). Binary logistic regression analysis was used to determine whether factors such as age, sex, topographical distribution, and levels of GMFCS, MACS, CFCS, and EDACS could predict the improvement in GMFCS level after two years of physiotherapy. The Enter method was used, and the Hosmer-Lemeshow (H-L) test was conducted to assess the goodness of fit of the fitted logistic regression model. The outcomes

were assessed regarding the model fit statistics and parameter significance, and the significance level was set at p<0.05.

RESULTS

One hundred and twenty-five children with spastic-type CP were assessed for possible eligibility. Seventeen children were excluded for different reasons (Figure 1), leaving a total of 108 (mean age: 6.43±4.83 years, 45 girls). Table 1 presents the demographic and baseline characteristics of the participants. About 46.3% of the children had quadriparetic spastic-type CP, and 49.1% had unilateral spastic-type CP. Most of the children scored GMFCS Level I, MACS Level II, CFCS Level III, and EDACS Level I.

Table 2 demonstrates the levels of GMFCS, MACS, CFCS, and EDACS at baseline and follow-up. None showed deterioration in the level of the GMFCS. A total of 27 children showed an improvement in level, while 81 showed no change. All age groups showed stability in EDACS levels IV and V over a two-year period.

Table 3 shows the results of a logistic regression analysis of the factors that predict an improvement in GMFCS level after treatment. The logistic regression analysis revealed a distinct set of significant predictors for the improvement in GMFCS level. The odds ratio (OR) of improvement in GMFCS level was found to vary significantly with the topographical distribution, CFCS level, and EDACS level (p<0.05). Children with quadriparetic spastic-type CP are 0.011 times less likely to have an improvement in GMFCS level compared to those with hemiparetic spastic-type CP (p=0.033). In addition, compared to children with CFCS Level I, those with Level II, Level III, and Level IV are 0.001, 0.005, and 0.006 times less likely to have an improvement in GMFCS level, respectively (p=0.043, p=0.021, and p=0.012, respectively). Similarly, children with EDACS Level III and Level IV are 1.605 and 1.548 times less likely to have an improvement in GMFCS

Table 2. Levels of GMFCS, MACS, CFCS, and EDACS in Children and Adolescents with CP

Variables	Total (N=108) (3-18 years)		Grup 1 (n=65) (3-6 years)		Grup 2 (n=29) (7-12 years)		Grup 3 (n=14) (13-18 years)	
	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up	Baseline	Follow-up
	Number (%)		Number (%)		Number (%)		Number (%)	
GMFCS								
Level I	44 (40.74)	54 (50.00)	18 (27.69)	25 (38.46)	18 (62.06)	21 (72.41)	8 (57.14)	8 (57.14)
Level II	12 (11.11)	15 (13.88)	6 (9.23)	11 (16.92)	4 (13.79)	2 (6.89)	2 (14.28)	2 (14.28)
Level III	12 (11.11)	6 (5.55)	10 (15.38)	6 (9.23)	1 (3.44)	0 (0)	1 (7.14)	1 (7.14)
Level IV	13 (12.03)	12 (11.11)	9 (13.84)	7 (10.76)	3 (10.34)	4 (13.79)	1 (7.14)	1 (7.14)
Level V	27 (25.00)	21 (19.44)	22 (33.84)	17 (26.15)	3 (10.34)	2 (6.89)	2 (14.28)	2 (14.28)
MACS								
Level I	15 (13.89)	21 (19.44)	3 (4.61)	6 (9.23)	8 (27.58)	11 (37.93)	4 (28.57)	4 (28.57)
Level II	39 (36.11)	48 (44.44)	19 (29.23)	31 (47.69)	15 (51.72)	12 (41.37)	5 (35.71)	5 (35.71)
Level III	25 (23.14)	16 (14.81)	20 (30.76)	10 (15.38)	2 (6.89)	3 (10.34)	3 (21.42)	3 (21.42)
Level IV	11 (10.19)	6 (5.55)	8 (12.30)	4 (6.15)	3 (10.34)	2 (6.89)	0 (0)	0 (0)
Level V	18 (16.66)	17 (15.74)	15 (23.07)	14 (21.53)	1 (3.44)	1 (3.44)	2 (14.28)	2 (14.28)
CFCS								
Level I	63 (58.33)	74 (68.51)	30 (46.15)	40 (61.53)	21 (72.41)	22 (75.86)	12 (85.71)	12 (85.71)
Level II	13 (12.03)	10 (9.25)	9 (13.84)	6 (9.23)	4 (13.79)	4 (13.79)	0 (0)	0 (0)
Level III	6 (5.55)	2 (1.85)	5 (7.69)	1 (1.53)	1 (3.44)	1 (3.44)	0 (0)	0 (0)
Level IV	8 (7.40)	8 (7.40)	6 (9.23)	7 (10.76)	2 (6.89)	1 (3.44)	0 (0)	0 (0)
Level V	18 (16.66)	14 (12.96)	15 (23.07)	11 (16.92)	1 (3.44)	1 (3.44)	2 (14.28)	2 (14.28)
EDACS								
Level I	56 (51.85)	62 (57.40)	26 (40.00)	32 (49.23)	21 (72.41)	21 (72.41)	9 (64.28)	9 (64.28)
Level II	23 (21.29)	25 (23.14)	16 (24.61)	17 (26.15)	4 (13.79)	5 (17.24)	3 (21.42)	3 (21.42)
Level III	13 (12.03)	5 (4.62)	10 (15.38)	3 (4.61)	2 (6.89)	1 (3.44)	1 (7.14)	1 (7.14)
Level IV	10 (9.25)	10 (9.25)	7 (10.76)	7 (10.76)	2 (6.89)	2 (6.89)	1 (7.14)	1 (7.14)
Level V	6 (5.55)	6 (5.55)	6 (9.23)	6 (9.23)	0 (0)	0 (0)	0 (0)	0 (0)

GMFCS: Gross Motor Function Classification System, MACS: Manual Ability Classification System, CFCS: Communication Function Classification System, EDACS: Eating and Drinking Ability Classification System.

Table 3. Logistic Regression Analysis of Predictors of Improvement in GMFCS Level in Children and Adolescents with CP

Predictor	B	SE	Wald	df	P value	Odds Ratio
Age	0.068	0.131	0.273	1	0.605	1.071
Sex						
Girl[R]						
Boy	-3.100	1.882	2.713	1	0.104	0.045
Type of cerebral palsy						
Quadriparetic spastic-type CP[R]			4.464	2	0.108	
Hemiparetic spastic-type CP	18.333	1.365	0.000	1	0.992	9.161
Diparetic spastic-type CP	-4.400	2.083	4.464	1	***0.033****	0.011
GMFCS						
Level I[R]			4.217	4	0.374	
Level II	-28.512	4.430	0.000	1	0.994	0.001
Level III	-31.674	4.430	0.000	1	0.994	0.001
Level IV	-27.850	4.430	0.000	1	0.994	0.001
Level V	-29.917	4.430	0.000	1	0.994	0.001
MACS						
Level I[R]			0.351	4	0.981	
Level II	-17.756	7.098	0.000	1	0.981	0.001
Level III	-16.758	7.098	0.000	1	0.981	0.001
Level IV	-17.283	7.098	0.000	1	0.981	0.001
Level V	7.811	7.098	0.000	1	0.981	0.001
CFCS						
Level I[R]			7.022	4	0.132	
Level II	-6.844	3.308	4.281	1	***0.043****	0.001
Level III	-5.180	2.242	5.337	1	***0.021****	0.005
Level IV	-12.671	5.337	5.637	1	***0.012****	0.006
Level V	-31.957	1.389	4.875	1	0.994	0.001
EDACS						
Level I[R]			5.186	4	0.269	
Level II	2.818	2.004	1.978	1	0.165	0.743
Level III	9.782	4.631	4.463	1	***0.033****	1.605
Level IV	11.237	5.125	4.808	1	***0.024****	1.548
Level V	28.708	1.544	0.000	1	0.998	0.935
Constant	1.099	0.222	24.441	1	***0.001****	3.000
Goodness of fit	**H-L test**: **x2** = 14.101 p=0.082 **Omnibus test: x2** = 87.870 p<0.001					
R^2 value	**Cox &Snell R^2 =** 0.557					

GMFCS: Gross Motor Function Classification System, MACS: Manual Ability Classification System, CFCS: Communication Function Classification System, EDACS: Eating and Drinking Ability Classification System, * p<0.05, [R] refers to the reference category.

level compared to the children with EDACS Level I, respectively (p=0.033, and p=0.024, respectively). However, age, sex, baseline GMFCS level, and baseline MACS level are not significant predictors of improvement in GMFCS level (p>0.05).

DISCUSSION

The present study aimed to determine the change in the GMFCS, MACS, CFCS, and EDACS levels of children and adolescents with CP and to predict the prognosis of gross motor function level according to the MACS, CFCS, and EDACS over two years. The findings of the present study pointed out that preschool children generally showed greater improvement in GMFCS, MACS, CFCS, and EDACS compared to school-age children. Furthermore, the adolescent period showed no change in all classification systems. Compared to the children with CFCS Level I, children with CFCS Level II, Level III, and Level IV were less likely to improve in GMFCS level. Similarly, children with EDACS Level III and Level IV were less likely to improve in GMFCS level compared to those with Level I. Those with EDACS levels IV and V remained stable for two years in all

age groups.

Various degrees of correlation have been found, ranging from strong to weak, between the levels of GMFCS, MACS, CFCS and EDACS, which are functional classification systems (7,22,23). Only a moderate correlation existed between the CFCS, GMFCS, and MACS (22). Moreover, the prediction of the progression in gross motor function level can be made according to the functional classification systems (6). In the present study, compared to children with CFCS Level I, children with Level II, Level III, and Level IV were found to be less likely to improve at the GMFCS level. Communication skills positively support functional performance and thus might also contribute to the improvement in the GMFCS level (25). In this study, children with EDACS levels III and IV were less likely to improve at the GMFCS level than those with level I. If eating and drinking skills are very good, the development of gross motor function skills is better.

In childhood and adolescence, children also showed stability in EDACS levels IV and V over two years in our study. If eating and drinking skills are poor, this becomes more stable and stabilised after two years. Currently, there is insufficient evidence for longitudinal changes in the eating and drinking skills of children with CP. Sellers et al. evaluated the change in EDACS levels of 97 children with CP at two-year intervals, reporting no change in EDACS levels in 83 children and a level change in 14. Of those fourteen, three showed improvement in EDACS, and ten showed a decline. Considering that these 10 were between the ages of 12 and 19, it reveals a greater decrease in eating and drinking skills in children with CP during adolescence (26), and this statement contradicts our findings. However, in the present study, EDACS levels might have remained stable since all children with CP, especially adolescents had better initial functional levels and continued regular therapy.

Similar to our findings, the previous study reported no alteration in the gross motor function level in school-age children and adolescents with CP over two years (22). Moreover, the GMFCS level remained unchanged for 58.2% of children, the MACS level remained unchanged for 30.3%, and the CFCS level remained unchanged for 39.3% of children with CP under 4 years old. For children under 4 years old with CP, the GMFCS level remains unchanged for 72.3%, the MACS level remains unchanged for 49.1%, and the CFCS level remains unchanged for 55% (6). A recent study concluded that children with CP were more likely to alter their classification level if GMFCS levels were between II and IV, MACS levels were between III and IV, and CFCS levels were between II and V (6). However, the present study included both children with CP and adolescents with CP, and previous reports only reported limited changes in GMFCS levels in adolescent CP (27); therefore, the baseline GMFCS and MACS levels did not predict any change in the present study. On the other hand, it was found that CFCS and EDACS levels could predict gross motor function levels.

Keeratisiroj et al. concluded that positive predictors for ambulation were sitting independently at the age of 2 years and the absence of visual disorder, intellectual disability, and epilepsy (28). The topographical distribution is another factor that plays a role in predicting ambulation in CP. In the present study, topographical distribution, baseline CFCS, and EDACS levels were significant predictors of improvement in GMFCS over two years. In the present study, compared to children with bilateral spastic-type CP, children with unilateral spastic-type CP were less likely to improve on the GMFCS level. In the present study, compared to children with bilateral spastic-type CP, children with unilateral spastic-type CP were less likely to improve on the GMFCS level. In support of our findings, Wu et al. also stated that children with diplegic and hemiplegic CP had better ambulation levels than children with quadriplegic CP (29). However, Schmidt et al. discovered that children with unilateral CP had a lower chance of improving at the GMFCS level than children with other subtypes, and concluded that this was because children with unilateral CP have more stable gross motor function than children with other subtypes (30).

Limitations

To the best of our knowledge, there is only one previous study evaluating the stability of EDACS (31), and it did not evaluate other functional classification systems in addition to the EDACS over

an extended period. The present study has some limitations that should be emphasized. First, the study only included spastic-type CP. Therefore, the findings may not accurately reflect the overall CP population, even though they provide a clearer prediction about the progression of a specific type. Second, there was a long interval between the two evaluations with no intermediate measurements. However, the classification was made by the same therapist in both periods, and this is one of the strengths of our study, because a new evaluator may provide a higher level of function scores than one who has been working with the child for a long time (32). Finally, the present study only used function classification systems as outcome measures and did not evaluate factors such as children's cognitive level, family interest, and motivation.

CONCLUSION

This study found that the topographical distribution of CP, levels of CFCS, and EDACS are significant predictors of the GMFCS level over two years. Knowing the prognosis of function in children with CP might help to establish realistic and achievable goals specific to the children and to develop interventions to improve outcomes for children with different functional levels. Because functional classification systems are the best way to describe children and adolescents with CP, healthcare professionals can use CFCS and EDACS to predict the progression of gross motor function, thereby providing more appropriate interventions and more realistic predictions. There is a need for further studies with a larger sample size, including individuals with CP of all ages and clinical types, and a longer follow-up period.

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