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Evaluation of Factors Affecting Communication Functions in Children with Cerebral Palsy

Serebral Palsili Çocuklarda İletişim Fonksiyonlarını Etkileyen Faktörlerin Değerlendirilmesi

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ABSTRACT

Objective: Communication disorders are one of the most common dysfunctions observed in cerebral palsy (CP). Our aim in this study was to explore clinical factors and socio-demographic characteristics associated with communication impairments in children with CP.

Material and Methods: One hundred and three CP children were evaluated with Communication Function Classification System (CFCS) for communication skills. Socio-demographic characteristics of the parents and detailed clinical data were collected. Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) were used for the analysis of motor functions. The effect of all obtained data on communication skills was examined.

Results: The rates of the children with the highest and lowest level of CFCS were 21.4% and 23.3%, respectively. The presence of any comorbid disease, dyskinetic/quadriplegic CP subtype, poorer motor functional level, lower education level of the mother and lower rehabilitation intensity were found to be associated with communication impairments ($p<0.05$).

Conclusion: Communication is very important to lead a healthy and happy life in the social environment. This situation becomes more important for individuals with CP who have difficulty in adapting to society due to physical limitations. Therefore, it is very important to thoroughly evaluate the individuals with CP in terms of communication skills, to analyze the risk factors affecting communication and to make the necessary interventions on time to develop these skills.

Key Words: Cerebral palsy, Clasification systems, Communication, Comorbidities

ÖZ

Amaç: İletişim bozuklukları serebral palside (SP) gözlenen en yaygın işlev bozukluklarından biridir. Bu çalışmada amacımız SP'li çocuklarda iletişim bozuklukları ile ilişkili klinik faktörleri ve sosyo-demografik özellikleri araştırmaktır.

Gereç ve Yöntemler: Yüz üç SP'li çocuk iletişim becerileri açısından İletişim Fonksiyonu Sınıflandırma Sistemi (İFSS) ile değerlendirildi. Ebeveynlerin sosyodemografik özellikleri ve ayrıntılı klinik veriler toplandı. Motor fonksiyonların analizi için Kaba Motor Fonksiyon Sınıflandırma Sistemi (KMFSS) ve Manuel Yetenek Sınıflandırma Sistemi (MYSS) kullanıldı. Elde edilen tüm verilerin iletişim becerileri üzerindeki etkisi incelendi.

Bulgular: İFSS düzeyi en yüksek ve en düşük olan çocukların oranı sırasıyla % 21.4 ve % 23.3'dü. Herhangi bir komorbid hastalık, diskinetik / kuadriplejik SP alt tipi, daha zayıf motor fonksiyonel düzey, annenin düşük eğitim düzeyi ve düşük rehabilitasyon yoğunluğu varlığı iletişim bozuklukları ile ilişkili bulunmuştur ($p <0.05$).

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Sonuç: Sosyal ortamda sağlıklı ve mutlu bir yaşam sürmek için iletişim çok önemlidir. Bu durum, fiziksel kısıtlamalar nedeniyle topluma uyum sağlamada güçlük çeken SP'li bireyler için daha önemli hale gelmektedir. Bu nedenle, SP'li bireyleri iletişim becerileri açısından kapsamlı bir şekilde değerlendirmek, iletişimi etkileyen risk faktörlerini analiz etmek ve bu becerileri geliştirmek için zamanında gerekli müdahaleleri yapmak çok önemlidir.

Anahtar Sözcükler: Serebral palsi, Sınıflandırma sistemleri, İletişim, Komorbiditeler

INTRODUCTION

Cerebral palsy (CP) is a group of permanent disorders of the development of movement and posture, causing activity limitations, that are attributed to non-progressive disturbances that occurred in the developing fetal or infant brain. This motor disorder can be accompanied by sensory and cognitive losses, communication, perceptual and behavioral disorders and epilepsy (1). Its prevalence was calculated as 1.2-2.5/1000 (2).

Communication disorders are one of the most common dysfunctions observed in CP, and its prevalence is thought to be between 38% and 55% (3,4). Communication disorders have been shown to have significant negative effects on social and educational participation and overall quality of life (5-7). These communication disorders in CP may be related to motor control of speech, language, sensory and perceptual disorders, cognitive problems, or different combinations of these (8). It is very important to thoroughly understand communication disorders and the factors they interact with in CP children. In this way, early detection of the problem can be achieved, planning targeted interventions such as speech and language therapy can be facilitated, and augmentative and alternative communication (AAC) systems can be encouraged to be used in order to directly intervene and support the level of communication (9,10). Thus, by improving the communication skills of individuals with CP, their quality of life in adulthood can be improved (11).

In the past decade, various classification systems have been developed to help understand the level of communication functions of the individuals and populations with CP (5,12). The Communication Function Classification System (CFCS), developed for use in the children with CP by taking into consideration the concepts of the World Health Organization's International Classification of Functioning, Disability and Health (ICF), takes the lead among these systems (5,13). The CFCS is a verified separation tool that allows clinicians and parents to categorize the communication skills of children.

The aim of this study is to investigate the relationship of communication disorder level that can be observed in CP with clinical characteristics and socio-demographic characteristics of both children and parents.

MATERIAL and METHODS

We collected data from CP patients and their parents who visited our outpatient clinic between November 2019 and March 2020. We accepted childs between ages 4 and 18 whose parents agreed to sign the voluntary consent form. Children with another neurological disease (spinal muscular atrophy, muscular dystrophies/myopathies, myelodysplasia, spinal stenosis/tethered cord, brain tumors etc.) were excluded. The study protocol was approved by the institutional Ethics Committee and declared on Clinical Trials (NCT04149561). The study was conducted in accordance with the ethical principles described by the Declaration of Helsinki.

Cerebral palsy classification

We classified CP subtypes as spastic, ataxic and dyskinetic according to the dominant type of tonus and movement abnormality recommended by the Surveillance of Cerebral Palsy in Europe in 2000 (14). Spastic subtypes were also classified as quadriplegic, hemiplegic and diplegic according to the extremity region involved (15).

Socio-demographic data

The socio-demographic information form prepared for the study was used to obtain detailed socio-demographic data of both the children and their parents. The age, gender, percentile value (according to height and weight), comorbid diseases and rehabilitation intensity of the child were recorded with this form. The percentile values were determined by using national reference values (16). The percentile ranges were divided into 5 levels for ease of statistical calculation. Among the comorbid diseases, the most common comorbidities in cerebral palsy such as; epilepsy, intellectual disability, visual impairment, hearing disorders, orthopedic deformities, genito-urinary system (GUS) disorders (incontinence, dysuria, enuresis, etc.), gastro-intestinal system (GIS) disorders (dysphagia, hypersalivation, gastro-esophageal reflux, chronic constipation, persistent vomiting etc.), respiratory system problems (chronic cough, wheezing, sleep apnea syndrome, aspiration pneumonia, restrictive pulmonary disease, needing respiratory support etc.) and hypothyroidism were questioned. Each neurological rehabilitation session performed and recorded by a physiotherapist was collected. Thus, the total number of neurological rehabilitation sessions the child received was determined. While calculating the rehabilitation intensity, the total number of rehabilitation sessions received by the child was divided by the age and multiplied by 12. Thus, the mean duration of rehabilitation per year was obtained. As for the parents, the data on age, profession, educational level and total monthly income were recorded.

Evaluation of the communication level

The purpose of the CFCS is to classify daily communication performance between I-V levels in the individuals with CP. It focuses on the levels of activity and participation defined in the ICF. All methods of communication performance are taken into account in identifying the CFCS level. These include speaking, mimics, behaviors, eye contact, facial expression and use of AAC systems. AAC systems includes materials and equipment such as hand signs, pictures, communication charts, communication books and speech devices (5,17). The levels vary depending on the familiarity of the communication partner, the child's sending and receiving messages successfully, and the pace of communicative interactions. While the children at Level I function best in terms of communication skills, the children at Level V are at the lowest level (18). Currently, the CFCS has been translated into many different languages worldwide. Its validity and reliability have been evaluated by the studies in these languages, contributing to important scientific information in the literatüre (17, 19-21).

The first 3 levels of the CFCS, from the strongest to the weaker, classify the children with a certain level of communication skills. The last 2 levels define the children with very limited communication skills. For this reason, we created two groups in some of our analyses and compared the children at the first 3 levels with the children at the last 2 levels in order to correctly perform the statistical analyses.

Evaluation of motor function

The Gross Motor Function Classification System (GMFCS) and Manual Ability Classification System (MACS) were used to evaluate the motor functional capacity of the child (15,22). Both of these functional classifications provide insight into disease severity and patient needs in CP. While the GMFCS focuses on general mobility and ambulation, the MACS defines the level of bimanual skills. Both functional classifications objectively divide the children into five non-overlapping skill levels from the most capable ones (level I) to the least capable ones (level V).

All functional classification levels were determined by the same two raters (O.K. and N.Y.B.) in agreement with a common decision in order to avoid any differences between the raters. In the event of a conflict between the two raters, a third clinician (O.V.Y.) resolved the conflict.

Statistical Analysis

Statistical analysis was performed by using SPSS Statistics software, version 20.0 (SPSS, Inc., Chicago, IL). Continuous variables were expressed as mean ± standard deviation, and categorical variables were expressed as number and percentage. Pearson's chi-square test and Fiscer exact test was used for categorical values. In the groups with significant difference, subgroups were compared with chi-square test by correction of Bonferroni. Pearson correlation coefficients were used for correlation analysis. P value less than or equal to 0.05 was considered statistically significant.

RESULTS

Of 103 CP children included in the study, 56.3% were boys (n=58) and 42.7% were girls (n=45). The mean age was 66.6 ± 40.3 months. While 65% of all children were at the first 3 communication levels indicating better communication skills, 35% were at the last 2 communication levels expressing the status of being very limited in terms of communication. Although the number of the boys at the first 3 levels seemed higher, there was no statistical significance. No significant effect of the percentile values calculated according to both

Table I: Socio-demographic and clinical data of children with CP and their effects on communication level

Socio-demographic and clinical data of children	Communication Level		
	CFCS Level I,II,III n (%)	CFCS Level IV,V n (%)	p
Gender			
Boy	40 (38.8)	18 (17.5)	
Girl	27 (26.2)	18 (17.5)	0.407*
Percentile height (Ph)			
Ph ≤ 10	34 (33.0)	14 (13.6)	
10 < Ph ≤25	10 (9.7)	5 (4.9)	
25 < Ph ≤50	11 (10.7)	6 (5.8)	
50 < Ph ≤75	6 (5.8)	6 (5.8)	
Ph >75	6 (5.8)	5 (4.9)	0.653*
Percentile weight (Pw)			
Pw ≤ 10	27 (26.2)	19 (18.4)	
10 < Pw ≤25	13 (12.6)	4 (3.9)	
25 < Pw ≤50	10 (9.7)	5 (4.9)	
50 < Pw ≤75	7 (6.8)	2 (1.9)	
Pw >75	10 (9.7)	6 (5.8)	0.645*
Comorbidity			
Yes	39 (37.9)	34 (33.0)	
No	28 (27.2)	2 (1.9)	0.000*
Surgery History			
Yes	29 (28.2)	20 (19.4)	
No	38 (36.9)	16 (15.5)	0.163*
CP subtype			
Spastic	63 (61.2)	25 (24.3)	
Ataxic	2 (1.9)	2 (1.9)	
Dyskinetic	2 (1.9)	9 (8.7)	0.002*
Spasticity subtype			
Hemiplegic			
Diplegic	24 (27.3)	0 (0.0)	
Quadriplegic	18 (20.5)	8 (9.1)	
No spasticity	21 (23.9)	17 (19.3)	0.001*

=Chi-square test.* ***Subgroup analysis for CP subtype:*** *spastic/dyskinetic=0.000, spastic/ataxic=0.354, dyskinetic/ataxic=0.516.* ***Subgroup analysis for spasticity subtype:*** *hemiplegic/quadriplegic=0.000, hemiplegic/diplegic=0.004, diplegic/quadriplegic=0.261.* ***CP:*** *Cerebral palsy;* ***CFCS:*** *Communication Function Classification System*

Table II: Socio-demographic data of parents and their effects on communication levels.

Socio-demographic data of parents	Communication Level		
	CFCS Level I,II,III n (%)	CFCS Level IV,V n (%)	p
Working status (mother)			
Working	13 (12.6)	9 (8.7)	
Not working	54 (52.4)	27 (26.2)	0.615*
Level of education (Mother)			
Primary school	13 (12.6)	20 (19.4)	
Middle School	8 (7.8)	5 (4.9)	
High school	25 (24.3)	8 (7.8)	
University	21 (20.4)	3 (2.9)	0.001*
Level of education (Father)			
Primary school	15 (14.6)	7 (6.8)	
Middle School	7 (6.8)	10 (9.7)	
High school	20 (19.4)	11 (10.7)	
University	25 (24.3)	8 (7.8)	0.110*
Monthly income (USD)			
0-300	6 (5.8)	6 (5.8)	
300-600	40 (38.8)	18 (17.5)	
600-900	6 (5.8)	6 (5.8)	
900+	15 (14.6)	6 (5.8)	0.368*

=Chi-square test.* ***Subgroup analysis for Level of education (Mother):*** *primary/middle=0.175, primary/high=0.001, primary/university=0.000, middle/high=0.469, middle/university=0.100, high/university=0.326.* ***CFCS:*** *Communication Function Classification System,* ***USD:*** *United States dollar*

Table III: Distribution of children in classification systems according to their levels.

LEVEL	Classification System n (%)		
	CFCS	GMFCS	MACS
I	22 (21.4)	25 (24.3)	28 (27.2)
II	25 (24.3)	16 (15.5)	32 (31.1)
III	20 (19.4)	14 (13.6)	15 (14.6)
IV	12 (11.7)	18 (17.5)	12 (11.7)
V	24 (23.3)	30 (29.1)	16 (15.5)

CFCS:*Communication Function Classification System,* ***GMFCS:*** *Gross Motor Function Classification System,* ***MACS:*** *Manual Ability Classification System*

height and weight was observed on the communication levels. The communication levels of the children with at least one comorbidity were significantly lower than those without (p<0.001). While the children at the first 3 communication levels had a partially balanced distribution in terms of having comorbidity, comorbidity was present in almost all children with lower communication levels. There was no significant difference between the communication levels in terms of ortopedical surgical history (tendon lengthening and transfers, osteotomies, arthrodesis, fusion procedures for scoliosis etc.). When CP subtypes were compared, a significant difference was observed between the CFCS levels (p=0.002). In the

Table IV: Distribution of comorbid diseases and their relationship with communication level.

Comorbid diseases	Communication Level		p
	CFCS Level I,II,III n (%)	CFCS Level IV,V n (%)	
Epilepsy			
Yes	22 (21.4)	22 (21.4)	
No	45 (43.7)	14 (13.6)	0.006*
Visual impairment			
Yes	19 (18.4)	17 (16.5)	
No	48 (46.6)	19 (18.4)	0.034*
Orthopedic deformity			
Yes	18 (17.5)	9 (8.7)	
No	49 (47.6)	27 (26.2)	0.837*
Intellectual disability			
Yes	1 (1.0)	13 (12.6)	
No	66 (64.1)	23 (22.3)	0.000[f]
Hearing impairment			
Yes	1 (1.0)	10 (9.7)	
No	66 (64.1)	26 (25.2)	0.000[f]
GUS pathology			
Yes	2 (1.9)	7 (6.8)	
No	65 (63.1)	29 (28.2)	0.003[f]
GIS pathology			
Yes	4 (3.9)	1 (1.0)	
No	63 (61.2)	35 (34.0)	0.654[f]
Hypothyroidism			
Yes	2 (1.9)	2 (1.9)	
No	65 (63.1)	34 (33.0)	0.610[f]
RS pathology			
Yes	1 (1.0)	3 (2.9)	
No	66 (64.1)	33 (32.0)	0.043[f]

p: *Probability values,* ****:*** *Chi-square test,* ***f:*** *Fisher's Exact test,* ***GUS:*** *Genitourinary system,* ***GIS:*** *Gastrointestinal system,* ***RS:*** *Respiratory system*

subgroup analisis, the children with dyskinetic CP were found to have a significantly lower communication level compared to the children with spastic CP (p=0.000). When evaluated in terms of spasticity subtype, a significant difference was observed between the CFCS levels (p=0.001). In the subgroup analisis, the communication level of hemiplegic children was significantly higher than quadriplegic and diplegic children (p<0.01). In terms of rehabilitation intensity, there was a weak negative correlation with communication level (r=-0.265). Demographic data on the children and their effects on the communication levels are given in detail in Table I.

Regarding the parents, the mean ages of the mothers and fathers were 34.7±6.1 and 37.7±6.2 years, respectively. No statistical relationship was observed between the CFCS levels and parental age. Also, there was no significant relationship with the working status of the mother. The educational level of the mother had a statistically significant effect on the CFCS levels (p=0.001), and this difference was due to the fact that the communication level of the children of primary school graduate mothers was lower than that of the children of high school and university graduate mothers (primary school/high school; p=0.001 and primary school/university; p<0.001). When the fathers educational level was examined, no significant difference was observed between the CFCS levels. When examined in terms of monthly income, there was no significant difference between the communication levels according to the income level of the family. Demographic data on the parents and their effects on the communication levels are given in detail in Table II.

When the distribution of the CFCS, GMFCS and MACS levels was examined, the rates of the children with the highest level of functionality were 21.4%, 24.3% and 27.2%, while the rates of the children with the lowest level of functionality were 23.3%, 29.1% and 15.5%, respectively. The distribution of the children by levels is given in Table III. When the correlation between the classification systems was examined, there was a moderate positive correlation between the CFCS and both the GMCFS (r=0.640) and MACS (r=0.693) (p<0.001).

When comorbidities were evaluated, epilepsy (42.7%) was the most common comorbidity. The presence of epilepsy, visual impairment, intellectual disability, hearing impairment, GUS pathology and respiratory system pathology were found to be statistically significantly associated with low communication skills. Detailed data of comorbidities are given in Table IV.

DISCUSSION

We observed that many factors related to both children and parents may affect the communication level. There is only one study in the literature evaluating the children between 2-18 age in this respect, and the results have revealed that the girls have higher communication levels, unlike our study. The reason for this is explained by the fact that the problem of speech delay is more common in the boys compared to the girls (23). From this perspective, our inclusion of children aged 4 and over in our study may have led to this difference. We found that the children with dyskinetic CP had the lowest and the children with spastic CP had the highest communication levels. Similarly, Himmelman et al. (24) showed that the children with dyskinetic CP had the lowest communication levels. In a recent study, the children were ranked from the best to the worst according to their communication functions as ataxic, spastic, hypotonic and dyskinetic, and this was explained by the fact that the children with ataxic CP were exposed to cerebellar influences rather than cerebro-cortical influences. In the same study, when the communication functions of the children with spastic CP were compared according to the extremity involvement, hemiplegic children were observed to be in the best condition, followed by diplegic and quadriplegic children, respectively. It was mentioned that this reflected the size of the area of involvement in the cerebral cortex and the rate of involvement might be associated with communication losses (23). Spastic diplegia or spastic hemiplegia were found to be less associated with communication disorder compared to other subtypes in a study (25). Speech disorder leading to significant communication limitations, was found to be more common in dyskinetic and tetraplegic patients compared to diplegic patients in another study (26). In this respect, our results are consistent with the literature.

We found that the rehabilitation intensity had a weak but positive effect on the communication levels. No data is available in the literature on this subject; however, the positive benefits of the rehabilitation process in terms of speaking, choosing and using AAC systems and enhancing social interaction are likely to have an impact.

The possible relationship between the parental age and communication skills was studied in a single study. The communication functions of the child were shown to progress as the age of the mother increased in this study. This was associated with increased experience of the mother in childcare (23). However, we did not find any correlation in this respect. In the same study, the communication functions of the children with CP were examined according to the educational level of the mothers, and the children of mothers with high school or lower educational level were observed to have better communication skills. The reason for this is explained by the fact that the mothers with higher educational level had a higher rate of being employed, and this group spent less time with their children. Similarly, the communication levels of the children of unemployed mothers were evaluated as higher in this study (23). Our results are almost entirely opposite to this study. The lowest communication levels were observed in the children of primary school graduate mothers, and the levels were significantly lower compared to the children of high school and university graduate mothers. Our view is that a mother with a high level of education can contribute more consciously and actively to the communication level of the child and better participate in the rehabilitation process.

We observed a moderate correlation between the CFCS and GMFCS and MACS. The compatibility of the three classification systems with one another was evaluated in many previous studies, and findings similar to our results were reported in these studies (27,28). Our findings also support that it would be appropriate to use these three functional classification systems together in order to better determine the profile of the children with CP regarding motor and communication skills.

When comorbidities were evaluated, epilepsy (42.7%) was the most common. The presence of epilepsy, visual impairment, intellectual disability, hearing impairment, GUS pathology and respiratory system pathology were found to be statistically significantly associated with low communication skills. Zhang et al. examined the relationship of communication disorder with comorbidity and found it significantly associated with visual and auditory sensory impairment (25). Similar relationships have been found in other studies examining visual and hearing impairments (4,29). Previous studies have shown that epilepsy is significantly associated with communication disorders (3,4). Our results support this. It is a well-documented finding that intellectual disability is strongly associated with communication skills (24). This highlights the importance of considering the communication function in educational settings, when evaluating intelligence and/or planning post-school engagements, and has been reported in previous intelligence assessment studies for the children with CP (30). There is no previous study examining the relationship between GUS disorders and communication capacity. In our study, 4 of 9 children with GUS pathology were dyskinetic, while the remaining 5 were spastic quadriplegic patients. In other words, the rate of having GUS disorder was significantly higher in the children with more severe CP, which may be the main reason for communication disorders observed in these children. Respiratory system disorders mostly described the children in need of respiratory support, and low communication level was an expected finding in these children.

The most important limitation in our study is that we evaluated children in our own clinical setting. Therefore, the time allocated for evaluation can be considered relatively limited. In addition, children may feel shy to communicate in a foreign environment. Thus, communication level measurements may have been determined differently from the child's own living space. The diagnosis of intellectual disability was determined based on clinical observation, parents' anamnesis, and the child's previous pediatric neurology examination data. No additional intelligence assessment test was applied. This is another limitation of our study. In future studies, these limitations can be overcome by evaluating children in their own living environment and applying appropriate intelligence assessment methods.

Communication is of great importance for being able to exist and take place in a community and is socially indispensable. The person has to communicate in order to live a healthy and happy life in the social environment and to meet the spiritual and physical needs. The individuals with CP experience serious problems in terms of communication skills as well as many physical capacity deficits that they have to struggle with. Focusing only on motor functional capacity may be a negative factor for these individuals to gain full independence. Therefore, it is very important to thoroughly evaluate the individuals with CP in terms of communication skills, to analyze the risk factors affecting communication and to make the necessary interventions on time to develop these skills.

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