



Original Article

How Intensity of Impairment and Dose of Occupational Therapy Services Impact the Outcome in Cerebral Palsy?

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ABSTRACT

Background: The present study aimed to evaluate the impact of the number of occupational therapy sessions, using the neurodevelopmental technique, (NDT) on gross motor function and other moving outcomes in children with cerebral palsy (CP).

Methods: The present cross sectional study evaluated all patients who referred to the occupational therapy service centers in the private sector and welfare organizations in Shiraz, Iran in 2015. The studied patients were children of both genders affected by spastic CP. A total of 59 individuals met the inclusion criteria and were entered in the study. A researcher-made questionnaire including 66 questions of gross motor function measure (GMFM) was used. This questionnaire measured the gross motor function in 5 dimensions including lying down, and rolling, sitting, crawling and kneeling, standing and walking, running and jumping. A negative binomial regression model with logarithmic function was applied in STATA 11 software.

Results: 59.3% of the patients were boys. According to our results, 38.3%, 33.3% and 38.3% were affected by spastic diplegia, spastic hemiplegia and spastic quadriplegia respectively. Children at level one of gross motor function had 1.3 times higher achievement, compared to the individuals in other levels ($P=0.003$) and the subjects who participated in more than five sessions per week had 1.04 more achievement than the others ($P=0.001$).

Conclusion: The results of this study showed that the more common occupational therapy sessions the children participated in, the more successful the gross motor function of children affected by level 1 CP of gross motor function classification was. Further investigations are required to assess other motor levels.

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Introduction

Cerebral palsy (CP) in children is characterized by motor lesions leading to a limitation in activities and social participation. These neuromuscular and musculoskeletal lesions include spasticity, dystonia,

short stature, disturbed growth of the bones, weak balance, disturbance in the voluntary control of the muscles, and muscular weakness [1]. All the mentioned disorders may both determine and be affected by the lesion intensity and the level of gross motor function of the patient.

Various studies reported the intensity of spasticity to be correlated with motor function and gross motor score [2, 3]. However, weakness is not known as a major sign of CP. As a result, programs for improving and increasing

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muscular strength have not been approved due to the resultant elevation in spasticity. On the other hand, the enhancement of muscular strength and resistance is recommended for raising the perseverance of children with CP [4].

Common rehabilitation treatments are currently based on the traditional treatments to reduce the positive signs, such as spasticity and shortness, in addition to the improvement of the negative signs, including increasing muscular strength. The principle of most of these treatments is neurodevelopmental treatment (NDT) techniques.

Today, functional base treatment is more emphasized than symptoms reduction focus therapy, in rehabilitation of children with cerebral palsy. Therefore, in recent years, the gross motor function classification system and manual activity classification system indices have been utilized for predicting gross motor outcomes and classifying the function of manual movements, respectively. These two indices categorize the gross and fine motor function in five levels. Level one represents the best motor function and level five demonstrates the minimum motor function resulting in the highest dependence of the person on others and assisting tools [5].

There is some evidence on the subject of traditional approaches such as conductive education technique and neurodevelopmental therapy. This evidence showed that NDT and other kinds of sensory motor techniques could be effective in improving the gross motor function of children with cerebral palsy [6-8].

It has been shown in the literature that diverse factors can play a role in the success rate of children achieving therapeutic aims. The type of CP, the experience of the therapist, beliefs of parents and therapist towards treatment, amount of received treatment and rehabilitation, and etiology can all influence the outcome of treatment. In order to determine the results and achievements of rehabilitation, great attention is needed. Therefore, all the mentioned factors should be taken into consideration to describe the best care pathway for the patient.

With this background in mind, the current study aimed to evaluate the relationship of achieving gross movements in CP children with gross motor function level, the number of routine treatment sessions (therapeutic dose), and the aforementioned factors. To conclude, it is determined whether the treatment sessions can affect the initial level of motor function in the patient and motor outcomes.

Generalized linear models, especially Poisson or negative binomial regressions are used for modeling the quantitative dependent variables, such as the number of blood donations and quitting addiction timeline [9]. One of the assumptions for Poisson regression is the equal mean and variance of the dependent variable. However, more often than not, the distribution of the data is higher than the mean, which is known as variability occurring due to the high inhomogeneity of the results. An approach for eliminating variability is to apply negative binomial regression as a substitute for the Poisson regression

model. This model considers a separate parameter for variance making the estimation of parameters more accurate [10, 11].

Rafiei et al. used various distributions, including Gaussian, inverse Gaussian, Poisson, negative binomial, gamma, zero-truncated Poisson, in addition to the mass function and logarithmic negative binomial to analyze the duration of hospitalization of mothers after delivery. These authors concluded that the negative binomial and zero-truncated negative binomial models were the most suitable models for modeling the duration of hospitalization for this group of people [12]. Nasserian et al. in 2016 investigated the relationship of repeated stenosis in patients in Iran under angioplasty with demographic characteristics and clinical factors using negative binomial regression [13]. Ardles et al. in 2018 evaluated the relationship between hospitalization and air pollution using the negative binomial regression model. They demonstrated that this modeling method was better than other methods, compared to the previous studies [10].

In the present study, the negative binomial regression model was used in the current study for modeling and determining the number of routine treatment sessions (therapeutic dose) and the factors that affect gross movement achievement based on gross motor function level in children with CP.

Methods

The present cross sectional study evaluated all patients who referred to the occupational therapy service centers in the private sector and welfare organizations in Shiraz, Iran in 2015. This work is part of an approved proposal numbered 92-6696, from the Shiraz University of Medical Sciences Research Council with the following ethic code number: IR.SUMS.REC.1392.S6696. The samples were selected through the census method. The studied patients included children of both genders affected by spastic CP in all levels of GMFCS, aged 0 to 7 years. Children with uncontrolled seizures, who did not receive regular therapy sessions; with long gaps between therapy, were excluded. Some of these children were referred to these centers before the initiation of this study. Consequently, a primary evaluation of detailed growth stages was performed at the beginning. A total of 59 individuals met the inclusion criteria and were entered in the study.

Data collection instruments utilized in our study was a researcher-made questionnaire including two parts: demographic characteristics as the first part and 66 questions of the gross motor function measure (GMFM) as the second. In the current study, success in all the moving stages was evaluated every time with Yes/No responses. As a result, the number of motor alterations of each child was obtained during the six months of the study process. The mentioned questionnaire has been validated in Iran and the validity aspects have been confirmed [14]. This questionnaire measures the gross motor function in 5 dimensions including lying down

and rolling, sitting, crawling and kneeling, standing and walking, running and jumping. Originally each item consisted of four scores including 0 (inability to start action), 1 (ability to start action and to perform 10% of the activity), 2 (ability to perform 10% to <100% of the activity) and 3 (ability to perform activity completely) [15]. In the present study we decided to use all items in the questionnaire for evaluation of each child's achievement and their progress to a higher level of motor function during 6 months of therapy by giving nominal answers: Yes and No.

To analyze the data, a negative binomial regression model with logarithmic function was applied in the present study for modeling the quantitative dependent variable since the variance of dependent variable was clearly higher than the corresponding mean. In order to choose more related independent variables, the relationship of all variables to the number of gross movements function was first assessed using Mann-Whitney and Kruskal-Wallis tests. The primary independent variables with a significant level less than 0.1 that did not have high linearity with other variables were applied in a negative binomial model as the independent variables as the independent variables. All the analyses were made using STATA software version 11 and the significant level was considered as 0.05.

Results

Based on our findings, 59 children with CP disorder who were referred to four private and welfare organization centers in Shiraz, south of Iran indicated that all the patients were diagnosed at an age of less than two years old. It was seen that 59.3% of the patients were boys. According to our results, 38.3% (60.9% boys and 39.1% girls), 33.3% (71.4% boys and 28.6% girls), and 38.3% (52.2% boys and 47.8% girls) were affected by spastic diplegia, spastic hemiplegia, and spastic quadriplegia, respectively. Table 1 represents the descriptive data and the results of the Mann-Whitney test and Kruskal-Wallis test regarding the factors related to achieving gross movements. As is shown in table 1, we categorized the gross motor achievement into six columns according to the number of milestones in GMFM the child reached. The number of achievements in gross motor skills

was not significantly different in the different groups of age of diagnosis and the age when occupational therapy sessions started. But GMFCS and dose of therapy brought about some differences.

Table 2 represents the results of negative binomial model and the factors that have significant effects on achieving gross movements. The findings revealed that level one of gross motor function was significantly correlated

Table 1: Descriptive Attributes of children with CP problem in the present study

Attribute	N (%)	The number of motor achievements						P value*
		0	1	2	3	4	5≤	
Age of diagnosis								0.760
0-1 years	48 (81.4)	14	8	2	5	1	18	
1-2 years	11 (18.6)	4	0	0	3	1	3	
Child age when starting occupational therapy services								0.181
0-2 years	31 (52.5)	6	3	1	4	2	15	
2-5 years	13 (22.0)	4	4	1	1	0	3	
5-7 years	15 (25.5)	6	1	0	3	0	5	
Number of sessions per week								0.003
more than 5 sessions	31 (52.5)	7	3	0	4	1	16	
5 and less than 5 sessions	24 (40.7)	11	4	2	4	1	2	
GMFCS								0.001
Grade 1	13 (22.0)	1	0	0	3	0	9	
Grade 2	13 (22.0)	2	3	1	2	0	5	
Grade 3	17 (28.8)	9	3	0	2	1	2	
Grade 4	10 (16.9)	6	1	0	1	1	1	
Grade 5	0	
Missing	6 (10.3)	1	2	1	1	0	1	

*Mann-Whitney test and Kruskal-Wallis test

Table 2: The coefficients and standard error values of attributes in negative binomial regression for number of gross motor achievements of children with CP problem

Variables	Coefficients (SE)		95% CI	P value
	Upper	Lower		
GMFCS				
Grade 1	1.30 (0.44)	0.43	2.17	0.003
Grade 2	0.33 (0.46)	-0.57	1.23	0.473
Grade 3	-0.51 (0.47)	-1.43	0.41	0.276
Grade 4	-	-	-	-
Number of sessions per week				
more than 5 sessions	1.04 (0.31)	0.43	1.66	0.001
5 and less than 5 sessions	-	-	-	-

Chi-Square=34.0, P=0.000, ^bLevel 1 is the highest level

with the number of gross movement achievements. In other words, a child at level one of gross motor function attained 1.3 times higher achievement, compared to the individuals at other levels (CI 95%: 0.43-2.17, $P=0.003$).

In addition, the number of treatment sessions (therapeutic dose) had a significant correlation with the number of achievements in gross movements. It was shown that the subjects who participated in more than five sessions per week attained 1.04 more achievement in goals than the others (CI 95%: 0.43-1.66, $P=0.001$). It should be noted that according to the likelihood ratio test, the model had a good fit on this data (Chi-Square=34.0, $P=0.000$). All the details are reported in Table 2.

Discussion

According to family centered approach, the literature concerning occupational therapy states that for achieving more efficient outcomes in terms of functional improvement of children with motor and developmental problems, treatment is required to be guided towards 24-hour potential of children at home. Subsequently, the home becomes a treatment environment [16, 17]. One of the reasons for this recommendation is to engage parents and family members in treatment leading to reduced economic pressure on the government, health system, and family. In addition, more practice helps the child to learn better [18]. Furthermore, based on this hypothesis, it is acceptable that the more treatment sessions the child receives, the better the results.

The current investigation confirms the latter point and indicated that children who received more than five sessions per week had higher movement success (Table 2). It is noteworthy that these achievements were significant only in level one of gross motor classification. In other words, children with gross motor function level one achieved more success with more training sessions per.

This result may be related to the fact that individuals in lower motor function levels require a longer time for more success and also a six-month follow-up is not a sufficient time for reaching motor success. In addition, children of lower motor levels may have gained higher quality at the same level but they did not succeed in reaching an upper level.

As was observed in the progress curve of gross movements in past related studies, the expected rate of enhancement is different in distinct motor function levels. For instance, it is expected, based on the progress curves for level five that the child reaches 20% of the skills in the GMFM questionnaire. However, approximately 80% of the skills could be expected to be reached in children in level one [5].

Most of the studies that used obligatory limitation treatment regarding hemiplegia rehabilitation were performed on children of gross and fine movement level one to three. It could be concluded that longer treatments in more sessions could exert remarkable effects only in children of motor levels one to three [19]. The higher rates of moving success following more rehabilitation sessions have not been confirmed in age under one year,

which is the time for receiving real-time interventions and the brain is more responsive to neuroplasticity [20]. The latter point is consistent with the results of the current study concerning the lack of impact on the age of receiving services (Table 1).

Therefore, the application of this valuable evidence is of high importance in designing common occupational therapies. It seems that occupational therapists should pay more attention to GMFCS level of cerebral palsy children to decrease the burden and load of costs and time in families caring for such children.

As a result, regardless of the background factors, the recommendation for increasing occupational therapy sessions is not beneficial for all children and motor function level should be taken into consideration. In other words, the focused NDTs cannot result in favorable outcomes in all gross motor function levels and combination with other techniques, namely Botox injections and surgery is needed for obtaining the most efficient results [21]. And consequently, less economic, emotional, and psychological pressure is imposed on families in long-term treatment courses. In addition, one of the reasons for the tendency towards home-based rehabilitation might be the training and engagement of the parents, in addition to using the existing potentials.

Evidence showed that GMFCS level is the most powerful predicting factor for motor improvement but, we suggest that some contributing factors such as taking drugs, past medical history; Hyperbilirubinemia, birth status; and the family social economic status need to be considered for future work.

Conclusion

Results indicated that the use of some criteria such as GMFCS to determine the load and intensity of therapy is important. More intensive therapy, according to the number of sessions per week, is not effective for improving the gross motor function of children with cerebral palsy at the GMFCS levels 3 to 5. However intensive sessions could be more appropriate in gross motor function improvement of children at the GMFCS level 1 or 2.

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