



## Impact of Mental Imagery Training on the Upper Limb Functions and Motor Skills in Children with Cerebral Palsy

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### Keywords

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### Abstract

**Background:** Children with cerebral palsy due to limitations in movement are dependent on others in terms of mobility and self-care. These limitations affect their participation in daily life and its quality.

**Objective:** This study aimed to determine the impact of mental imagery training on the upper limb functions and motor skills in children with cerebral palsy.

**Method:** Twenty children with cerebral palsy were selected from Tavana Rehabilitation Center in Tabriz city using a convenience sampling method and were randomly divided into two groups: mental imagery and control. The subjects of the mental imagery group were trained by mental imagery and subjects of the control group did not receive any training. Lincoln-Oseretsky development scale was used for collecting data from the subjects.

**Results:** The results of the covariance test indicated that mental imagery teaching can cause the improvement of upper limb functions and motor skills in children with cerebral palsy ( $p < 0.05$ ).

**Conclusion:** It can be concluded that mental imagery is considered as an effective strategy to improve motor skills in children with cerebral palsy.

### Introduction

Cerebral palsy is a group of permanent but non-progressive motor disorders that occurs due to a lesion in the growing brain (Lim, Seer, & Wong, 2009). This brain damage occurs in fetal life, at birth, infancy, and childhood (Soleimani & Sourtiji, 2009). The prevalence of cerebral palsy in the world is reported to be 2-3 in a thousand and 2.06 in a thousand in Iran (Hamid Dalvand, Dehghan, Hadian, Feizy, & Hosseini, 2012; Joghataei & Kazem, 1990). And its beginning is in the early days of life but affects the entire range of one's life (Lim et al., 2009). In cerebral palsy,

different musculoskeletal parts can be involved in various forms of involvement; segmentation of cerebral palsy occurs based on muscle tone and involvement of other parts of the brain except pyramid system including Spastic, Dyskinesia, Athetoid, Ataxic, Buffer forum, Hypotonic and integration based on the involvement of different parts which have various types of Monoplegia, Hemiplegia, Diplegia, Quadriplegia (Crockarell Jr & Guyton, 2003); depending on the type of involvement, they experience different motor disorders.

One of the motor disorders in children with cerebral palsy is a limitation on upper limb muscle function, reduction of upper limb joints range of motion such as wrist and elbow, loss of ability to perform fine movements and manipulation skills of hand (Asghari, Ebrahimi Atri, & Hashemi Javaheri, 2011). These disorders are affected by factors like weakness of muscle of organs, sensory impairment, Ataxia, Dyskinesia, Spasticity, failure, and contracture (F, 2009). The public believes that the existence of such a limitation decreases the amount of their life quality and makes them dependent on others in terms of movement and self-care and affects their participation in everyday activities and their quality of life (Asghari et al., 2011; Crockarell Jr & Guyton, 2003; H Dalvand, Dehghan, Fayyaz, Rasafiani, & Hosseini, 2010; Hamid Dalvand et al., 2012; F, 2009; Gregg, Hall, & Nederhof, 2005; Hoover & Wade, 1985; Isozujian, Shojaeddin Sayed, & Bahram, 2016; Joghataei & Kazem, 1990; Lim et al., 2009; McCullagh & Weiss, 2002; Shariat of & Abedi, 2010; Siyadi, 2009; Soleimani & Sourtiji, 2009; Soroush, 2010; Vealey & Greenleaf, 2001). Motor and movement patterns can be changed during the growth period of puberty and/or with therapeutic interventions; though cerebral palsy in children is not completely treated and the motor disability due to it is life-long-specific; in other words, it is incurable.

Psychological interventions have been reported as one of the therapeutic interventions for children with cerebral palsy to decrease the symptoms and complications caused by disability and improve the

function as much as possible (Isozujian et al., 2016). Mental imagery is one of the most accepted psychological techniques (Crockarell Jr & Guyton, 2003). Psychological researchers have presented different definitions of imagery among which we can refer to the mental imagery as the use of senses to recreate or create an experience in mind (Gregg et al., 2005). In the field of sports sciences, mental imagery means to build or voluntarily or involuntarily renew the experience of reviewing memory information which includes pseudo-emotional, pseudo-perceptual and pseudo-sentimental features that have had physiological and psychological effects on the individual and has been done in the absence of external stimuli (Lotfi, Tahmasebi, & Hasanzadeh, 2012). Mental imagery has been proposed as rebuilding a motor (movement) pattern in mind. In many cases, it has been used to increase the motor skills of individuals especially athletes. On one hand, the evaluations conducted over past years have indicated that mental exercises like physical exercises lead to improve individuals' motor skills so that multiple assumptions about the similarity of function between imagination and perception has been developed up to the level of uniformity of physical and mental functions and, on the other hand, have specified that the same nervous mechanisms are activated in the mental exercises which participate in physical exercises, therefore, this issue shows that mental exercises ,like physical ones, cause to learn motor skills (Molk pour, Dadmohar, & Ghamrani, 2015).

According to Bandura, one's viewpoint of his/her efficiency affects an individual's imagery in association with mental structures and his/her imagination of the future (Shariat of & Abedi, 2010). In a study on the accuracy of the service of tennis players, they found that imagery made the service more accurate than a control group who had not performed any imagery. Thus, they indicated that imagery before the competition can make a stronger movement. Due to the series of studies conducted in this regard and effective role of mental practice from different clinical points of view, the importance and necessity of evaluating and applying this method in children with cerebral palsy are considered and mentioned along with physical exercise (F, 2009). Hence, they recommended that mental imagery exercises can save costs, facilities, time, space, manpower, etc. and on the other hand, increase the motivation and sense of responsibility to participate in therapeutic programs to improve the rehabilitation program. Despite many advantages of these exercises, their application has been more proposed in the field of sports activities and the existing researches have been addressed to investigate the effect of these types of exercises on cognitive and motor activities. The role of this phenomenon needs more research and evaluation McCullagh and Weiss (2002). The current study aims to respond to this hypothesis that whether this mental imagery teaching has an impact on the function of upper limbs and motor skills in children with cerebral palsy or not.

## Method

The current research is semi-experimental and its statistical population includes children with cerebral palsy from Tavana Rehabilitation Center for physical-motor handicapped in Tabriz with the age range of 5 to 14 years old among which 20 children were selected using convenience sampling method and considering entry criteria including being afflicted with cerebral palsy, volunteer participating at training sessions, the age range of 5 to 14 years old, not having any other disease such as mental retardation, Hydrocephalus, Microcephaly or other diseases and being under rehabilitation treatments (occupational therapy, physiotherapy, speech therapy, psychology). The parents of children with cerebral palsy gave consents and then the subjects were divided into two groups of mental imagery (10 persons) and control (10 persons). The subjects of the mental imagery group were trained in two sessions per week for 20 minutes but the subjects of the control group did not receive any training and education. At the beginning of the mental imagery training, they told children that mental imagery is the work of great heroes and athletes to motivate them and draw attention to cooperation. Then, the subjects watched a movie about performing motor skills in upper limbs and their ability for visualizing or imaging and mental exercise was evaluated. Some of the children were excluded from the research due to their absence in 3 sessions of educational programs or parental dissatisfaction. Lincoln-Oseretsky development scale was used before and after training in both groups to collect data related

to the upper limb function and motor skills of the subjects. Descriptive statistics (dispersion index, standard deviation, mean central tendency index) and analysis of covariance tests were used to test hypotheses to analyze the information statistically.

### Results

Evaluating the groups studied in this research by descriptive statistic indicated that the variable means and standard deviation of fine motor skills in mental imagery group was equal to 44.13, 5.54, 53 and 5.80 in pretest and posttest, respectively. The variable means and standard deviation of gross motor skills in the mental imagery group were equal to 3.75, 1.28 and 6.50, 1.60 in pretest and

posttest, respectively. In this group, the variable means and standard deviation of the upper limb were equal to 57 and 4.43 in pretest and 74.12 and 6.46 in the posttest. The variable means and standard deviation of fine motor skills for the control group was 38.57, 5.12 in pretest and 40.57, 4.68 in the posttest. The values of the variable mean and standard deviation of gross motor skills for the control group in pretest and posttest were equal to 3.71, 1.11 and 4, 1.11, respectively. The variable means and standard deviation of the upper limb in this group was 51.42 and 4.79 in pretest and 52.28 and 5.21 in the posttest (Table 1).

**Table 1. Description of the variables in the studied groups.**

Group	Variable	Pretest M(SD)	Posttest M(SD)
Imagery	Fine motor skill	44.13(5.54)	53.00(5.80)
	Gross motor skill	3.75(1.28)	6.50(1.60)
	Upper limb	57.00(6.43)	74.12(6.46)
Control	Fine motor skill	38.57(5.12)	40.57(4.68)
	Gross motor skill	3.71(1.11)	4.00(0.81)
	Upper limb	51.42(4.79)	52.28(5.21)

The results of the one-variable analysis of covariance on the indexes of the research in Table 2 indicated that by controlling the pretest effects:

- The mental imagery method has a significant increase in the upper limb function of the children because the value of calculated F (58.29) at the level of  $P < 0.05$  is significant.
- The mental imagery method has a significant increase in fine motor function because the value of calculated F (66.06) at the level of  $P < 0.05$  is significant.

The mental imagery method has a significant increase in gross motor function in children with cerebral palsy because the value of calculated F (40.50) at the level of  $P < 0.05$  is significant.

**Table 2. Covariance analysis of the effects of mental imagery method on upper limb functions.**

Index/variation resources	Sum of squares	Mean of squares	Degree of freedom	F	Significance level	Eta-squared
Group	306.85	306.85	1	58.29	0.001	0.82
Error	22.21	2.20	11	-	-	-
Total	55265	-	14	-	-	-

**Table3. Covariance analysis of the effects of mental imagery method on the fine motor functions.**

Index/variation resources	Sum of squares	Mean of squares	Degree of freedom	F	Significance level	Eta-squared
Group	144.23	144.23	1	66.06	0.001	0.84
Error	26.19	2.18	11	-	-	-
Total	34362	-	14	-	-	-

**Table4. Covariance analysis of the effects of mental imagery method on the gross motor functions.**

Index/variation resources	Sum of squares	Mean of squares	Degree of freedom	F	Significance level	Eta-squared
Group	23.14	23.14	1	40.52	0.001	0.77
Error	6.13	0.55	11	-	-	-
Total	436	-	14	-	-	-

## Discussion and Conclusion

This research aimed to determine the effect of mental imagery on upper limb functions and motor skills in children with cerebral palsy in the age range of 5 to 14 years old. The results indicated that mental imagery teaching improves the function of upper limbs and fine and gross motor skills in children with cerebral palsy. Though motor handicap and disabilities caused by cerebral palsy cannot be treated, some of its complications and outcomes can be cured. For example, movement patterns of individuals suffering from cerebral palsy can change during the growth period of puberty and/or with therapeutic interventions. Given that, according to many researchers childhood is the best age for improving the condition of children with cerebral palsy (Lotfi et al., 2012), hence, it seems that increasing physical activities in children with cerebral palsy can be

helpful to decrease the symptoms and complications caused by their further disability using methods such as (Ghasempour, Hosseini, & Mohammadzadeh, 2015) mental imagery from the beginning of childhood. Mental imagery is a technique that has been widely used for increasing the function of physical skills and also modifying physiological behaviors (Ghasempour et al., 2015). In this method, based on the theory of Miguel and McCullough, benchmarking and modeling can facilitate the acquisition of skill and can help to create the motor pattern in the learning process (Lotfi et al., 2012; Yorks, Ketaleh, & Safiri, 2010). Our results were consistent with previous researches (Asghari et al., 2011). Crajé et al (2010) reported a relation between compromised motor planning and impaired motor imagery in young adults with CP. In this regard, Gharib et al. (Gharib & al, 2010) to examine the relationship between upper limb function and life quality in children

with cerebral palsy indicated that there is a significant relationship between the components of upper limb function and all components of life quality using stratified random sampling method; they also found that having a high level of upper limb function is synonymous with taking advantage of the higher quality of life level and its different areas.

Children with cerebral palsy and pervasive motor disorders are a group with many problems both in the field of motor skill and in the field of sensory, perceptual and cognitive, communicative and behavioral skills. The improvement of the motor skills of the upper limb is considered as one of the main components in therapeutic interventions for these children. Meanwhile, mental imagery leads to create a cognitive image from the skill by providing information which can adjust the motion generation used as the accuracy criteria of movement to find the error in performing the skill (Lotfi et al., 2012; Yorks et al., 2010). Also, in motor learning science, it is said that memory process, especially the processes of selecting answers which is one of the important variables of motor learning and performance, is completely dependent on

encoding and recovery operation that can do better mental organizing on the subjects about movement through creating an association background and effective communication between task elements (Lotfi et al., 2012). Therefore, the mental imagery method can be considered as a learning strategy and beyond that is a base for many children and adolescent therapeutic interventions

to acquire new skills including motor skills. The literature on training intervention highlights the successful involvement of motor imagery training for the recovery of motor deficits.

Considering the effectiveness of mental imagery teaching for improving motor skills and upper limb function in children with cerebral palsy, it can be concluded that the application of this method (mental imagery teaching) in childhood and accessibility of interventions for children and adolescent have positive results. Due to the ease of implementation and applicability of the mental imagery teaching program, coaches of rehabilitation centers and preschools, in addition to parents of children with cerebral palsy, can implement this intervention program easily; they can practically take effective steps towards the teaching of motor skills required by children with the cerebral palsy disorder in the educational and social environment. We focused on mental imagery training in CP, however, future studies should address these strategies in big sample sizes and combination with motor planning intervention.

#### **Limitation and delimitation**

The limitations of this research are the lack of simultaneous examination of possible intermediary variables and low sample size.

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