



**EFFECT OF MIRROR
VISUAL FEEDBACK ON
HAND FUNCTIONS IN
CHILDREN WITH
HEMIPARESIS**

تأثير التغذية البصريه المرتدة
بواسطة المرآه على الوظائف
اليديوية عند الاطفال
المصابين بالخزل الشقى
الطولى

ACKNOWLEDGEMENT

"First and foremost, thanks to **ALLAH**, the
beneficent and merciful of all".

I'm deeply grateful to my supervisor, **Prof. Dr. Eman Ibrahim Elhadidy**, for her guidance, patience, and support. I consider myself very fortunate for being able to work with a very considerate and encouraging professor like her.

I would like to express my deep gratitude and faithful thanks to **Prof. Dr. Elham Abd Elghaffar Nawar**, for her creative thinking, valuable suggestions, and instructive guidance throughout the whole work.

Special thanks to **Dr. Hatem Abd Elmohsen Emara**, for his valuable supervision and encouragement to me.

Thanks to children and their parents who
enrolled in this study.

No words would describe the real love, patience, and greatest support for my kind parents, my wife Seham, my pretty kids Ahmed and Norseen, my brother, and my sister.

INTRODUCTION

Hemiparesis is a weakness on one side of the body. It is less severe than hemiplegia (the total paralysis of the arm, leg, and trunk on one side of the body). Thus, the patient can move the impaired side of his body, but with reduced muscular strength (Weiss, 2010).

Children with hemiparesis have limitations in the capacity to use the impaired upper limb and bimanual coordination deficits which impact on daily activities (**Bleyenheuft and Gordon, 2013**).

Mirror therapy is a technique that uses visual feedback about motor performance to improve rehabilitation outcomes (**Franz and Packman, 2004**).

In mirror therapy, patients place a mirror beside the unaffected limb, blocking their view of the affected limb, creating the illusion that both limbs are working normally.

It is believed that by viewing the reflection of the unaffected arm in the mirror that it may act as a substitute for the decreased or absent proprioceptive input (Ramachandran, 1994).

In childhood hemiparesis, the strength of this visual illusion may alleviate what is termed as (learned paralysis), and partly compensate for the lack of experience of age appropriate sensorimotor stimuli that lead to the development of upper extremity skills **(Ramachandran and Altschuler, 2009)**.

Statement of the problem

Is mirror visual feedback effective for improving hand functions and grip strength in children with hemiparesis?

Purpose of the study

The purpose of the study was to determine the efficacy of mirror visual feedback on hand functions and grip strength in children with hemiparesis.

Significance of the study

Upper extremity hemiparesis is a leading cause of functional disability. Approximately two thirds of hemiplegic survivors have residual neurological deficits that persistently impair their functions, specifically dysfunction for upper extremity (Delden et al., 2009).

It has been suggested that mirror visual feedback is an effective therapy as it is a simple, inexpensive, and patient directed treatment that may improve upper extremity functions.

In addition it is enjoyable for the child to do exercises in front of mirror. So, it is easily conducted at home and school. (Yavuzer et al., 2008).

SUBJECTS, MATERIALS, AND METHODS

I- SUBJECTS

This study was carried on forty children with hemiparesis of both sexes, and conducted at the outpatient physical therapy clinic of Qaha central hospital and Tikh central hospital between July 2012 and August 2013.

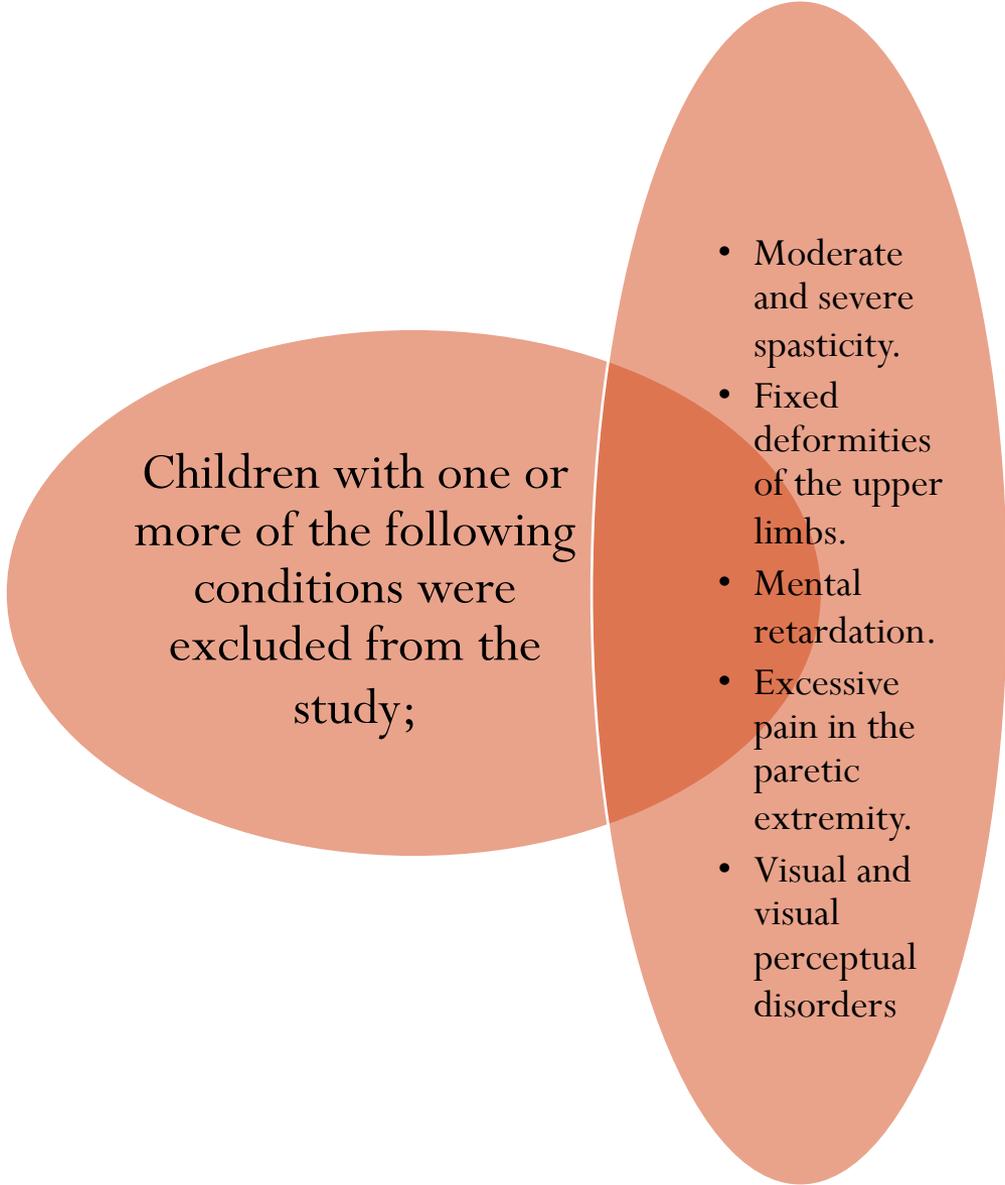
Subjects were selected according to the following inclusive criteria:

Children age ranged from 5 to 7 years.

They had mild hand spasticity according to modified **Ashworth** scale grade 1 and 1+ (**Blackburn, 2001**).

They were able to use their both upper extremities.

They were able to understand and follow verbal commands included in evaluation and training.



Children with one or more of the following conditions were excluded from the study;

- Moderate and severe spasticity.
- Fixed deformities of the upper limbs.
- Mental retardation.
- Excessive pain in the paretic extremity.
- Visual and visual perceptual disorders

Once the children met the mentioned inclusion criteria, they were assigned randomly to one of two groups of equal numbers (study and control) using sealed envelop, each group composed of 20 children.

1- Control group (A):
20 children received physical therapy to improve the gross motor functions and hand functions of the affected upper extremity, for 5 days/week for 4 successive weeks.

2- Study group (B):
20 children received the same physical therapy program given to the control group in addition to mirror visual feedback session for half an hour for the unaffected upper extremity, 5 days/week for 4 successive weeks.

II- INSTRUMENTATION

A- For evaluation

1- Peabody developmental motor scale

Grasping subtest: It measures the child ability to use his hands and fingers.

Object manipulation subtest: This subtest measures the child's movements needed to catch and throw objects.

2- A calibrated hand-held dynamometer



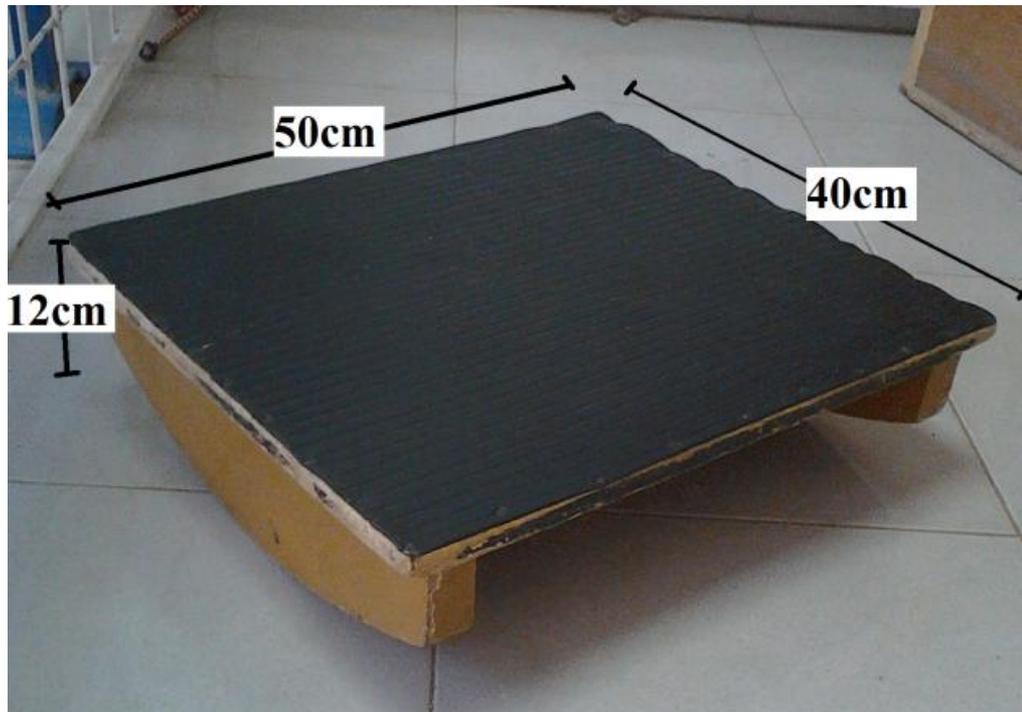
- 1-Adjustable handle. 2-Dual scale read out. 3-Peak-hold needle.
4-Peak-hold knob. 5-Guage needle.

B- For treatment

1- Tools for physical therapy program designed to improve gross motor functions:

a- *A firm exercise mattress*, it's dimensions (120x200cm) with 5cm thickness

b- A wooden balance board



c- Stairs with hand rails



**2-Tools for physical therapy program
designed to improve hand functions:**

a- A table and a sturdy chair



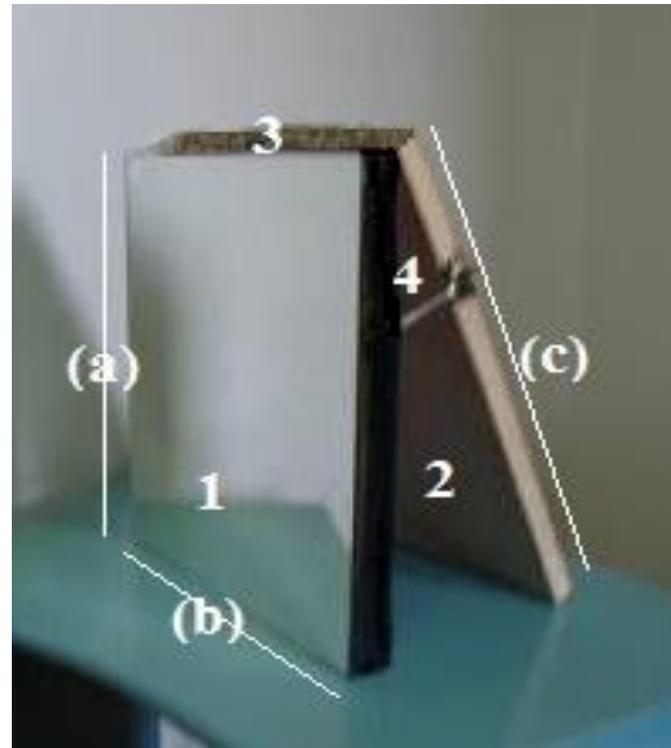
b- Therapy tools



balls, cubes, drawing board, pen, jar, and cards

3- The mirror used in mirror therapy session:

A vertical wooden stand mirror



1: the mirror piece, 2: the wooden piece, 3: the site of hings,
4: the hook, (a): 35cm hight, (b): 35cm width,
and (c): 40cm length.

III- PROCEDURES:

A- For evaluation:

Evaluation of each child in each group was conducted before and after the suggested treatment period (4 successive weeks).

1- Assessment of fine motor skills:

PDMS-2 was used to evaluate the fine motor skills level of children participated in this study using grasping subtest.

Grasping subtest: Item 21 (grasping marker)



Each child was asked to sit on a chair in front of the table. Marker and paper were placed on the table and each child was asked to make a mark, the way of holding the marker was recorded.

Object Manipulation subtest: Item 19 (throwing ball-underhand in an open area)

Each child was asked to throw a tennis ball underhand as far as he/she could. The therapist stood about 12 ft. away from the child after giving him/her the ball to throw at least 10 ft., then the body movements and the distance of ball travelling were recorded.

2- Evaluation of hand grip strength:

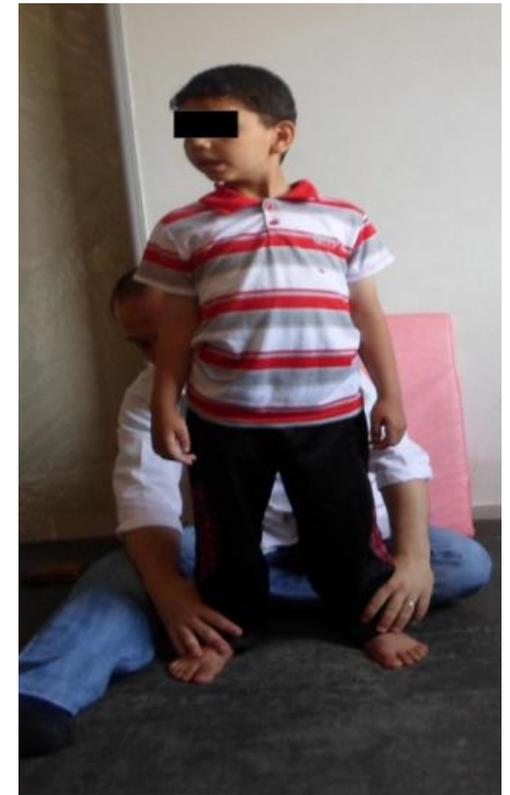
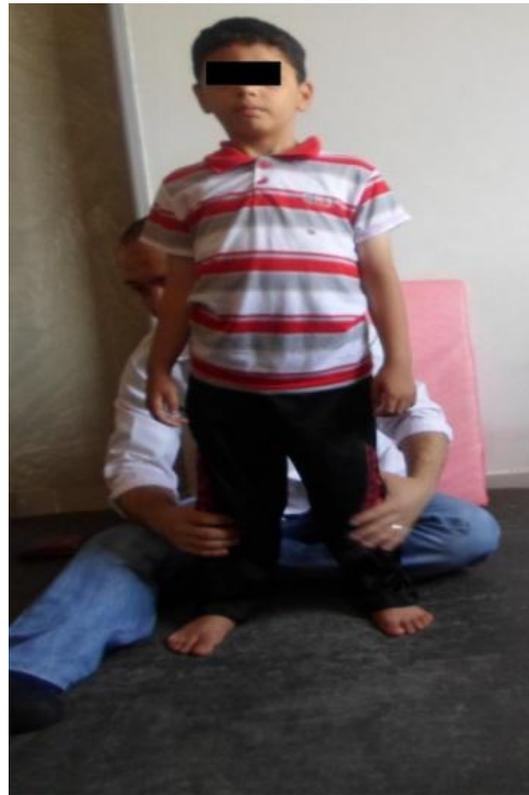
Each child was asked to sit on a chair with back supported. The head was maintained in mid position with trunk erected and fastened to the back of the chair. The hips and knees were flexed 90° with the feet fully supported on the ground in neutral position.

Then each child was asked to hold the handle of the dynamometer and squeeze it by his maximum power as much as possible, then release. Three trials were allowed and the mean of the trials was recorded.

B-For treatment:

i- The physical therapy program to improve the gross motor functions was applied for one hour for both groups as follows:

1- Standing with support.



2- Standing on balance board.



3- Kneeling.



4- Half-kneeling.



5- Quadriped exercise.



6- Ascending/descending stairs.



ii- The physical therapy program to improve fine motor functions (hand functions) of the affected upper limb was applied for one hour for both groups as follow:

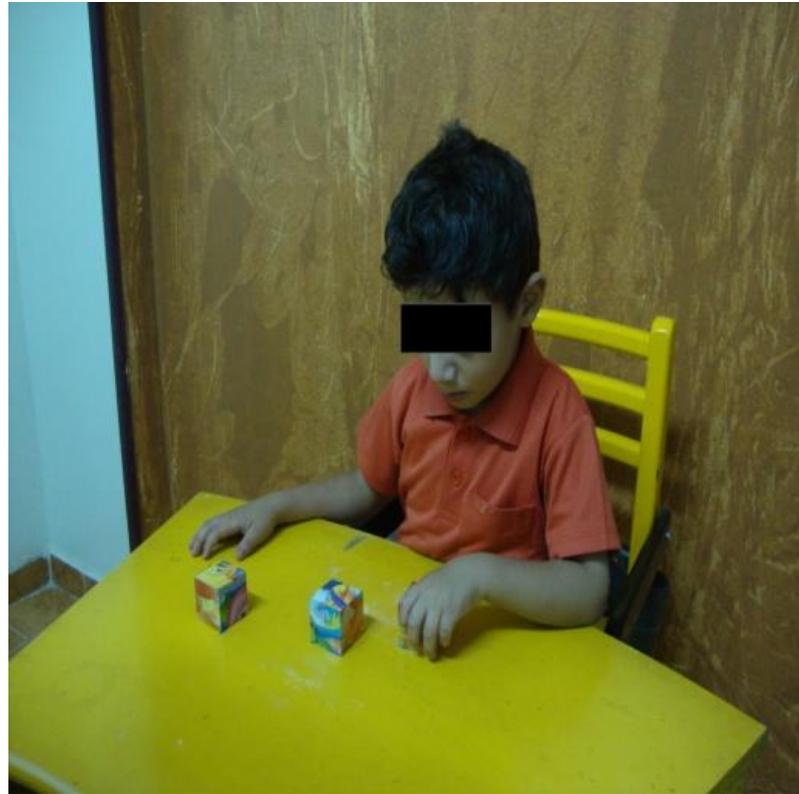
Turning cards



Building a tower with cubes



Transferring cubes from one place to another



Reaching to mouth (eating lollipop)



Squeezing a ball (with a small sponge ball)



Transferring cubes from hand to the other (bilateral hand use)

Opening and closing a jar (bilateral hand use)



Hands clapping (bilateral hand use)



Ball activities: catching ball (with large ball for bilateral hand use)



Ball activities: throwing ball (with large ball for bilateral hand use)



iii- The mirror visual feedback therapy to improve hand functions of the affected upper extremity by exercising the other hand of the unaffected upper extremity, it was applied for thirty minutes for study group (B) as follows:



Tasks performed using mirror therapy included the following;

Transferring cubes from one place to another place





Squeezing a ball (sponge ball)





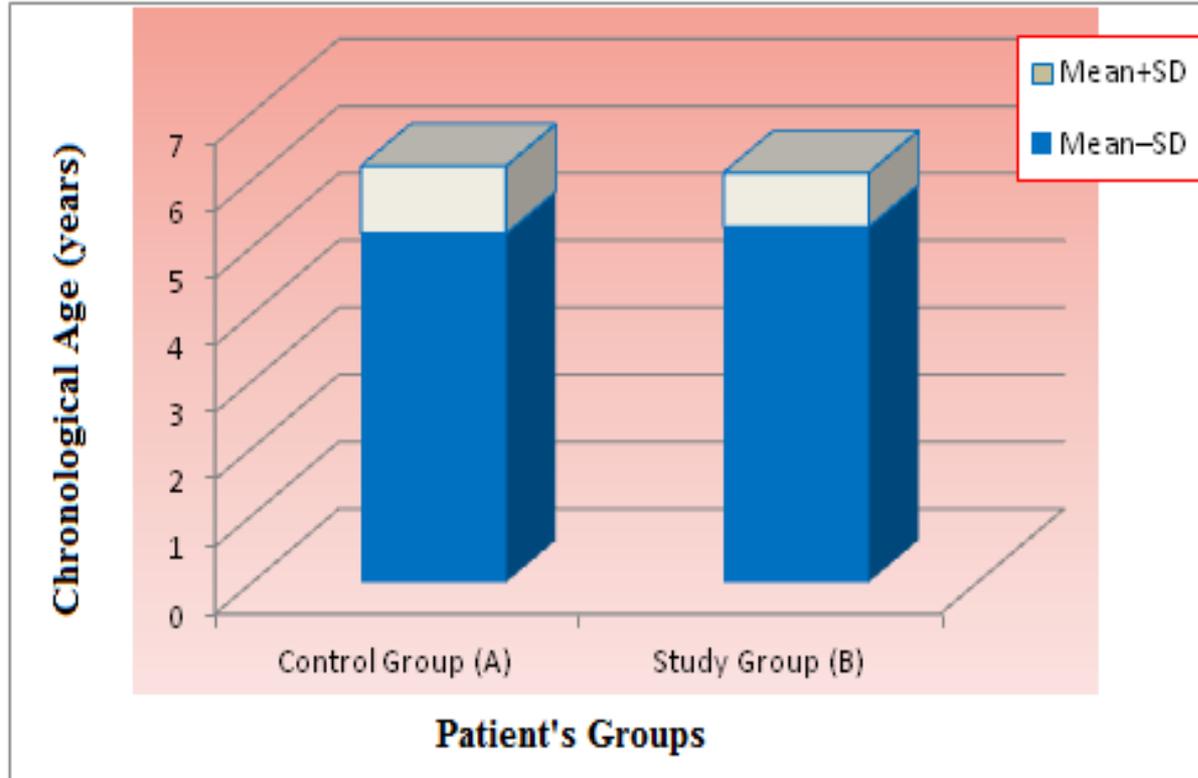
Drawing a circle





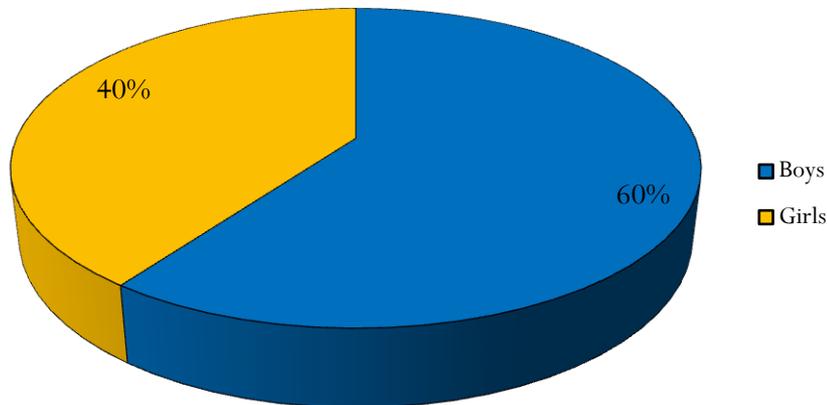
RESULTS

*I- General characteristics
of the subjects*

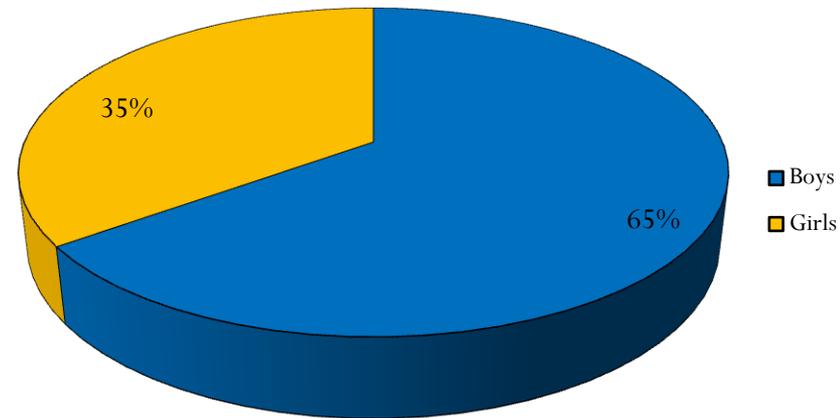


a. The Chronological Age (years) in the two groups

**Gender
Control Group (A)**

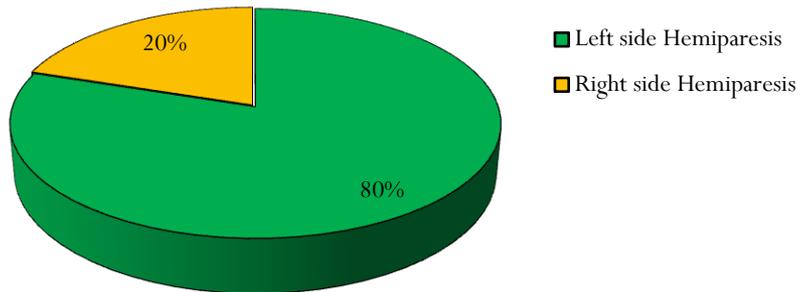


**Gender
Study Group (B)**

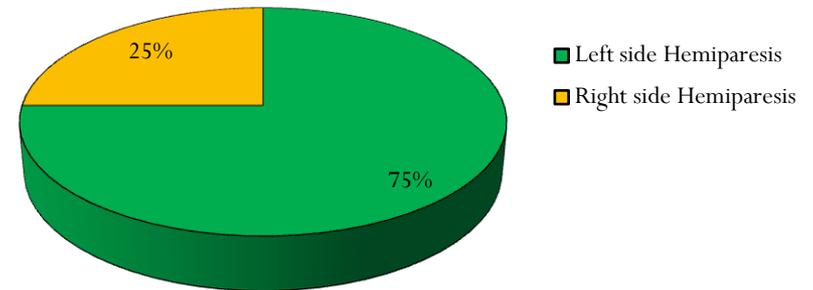


b. The Gender distribution in the two groups

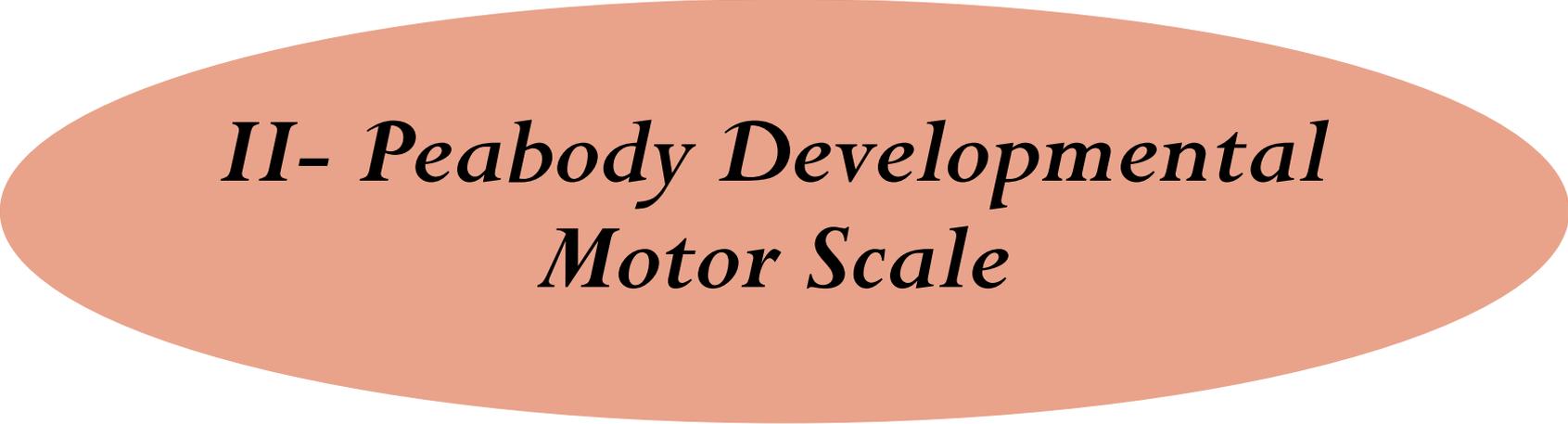
**Dominance Affection
Control Group (A)**



**Dominance Affection
Study Group (B)**

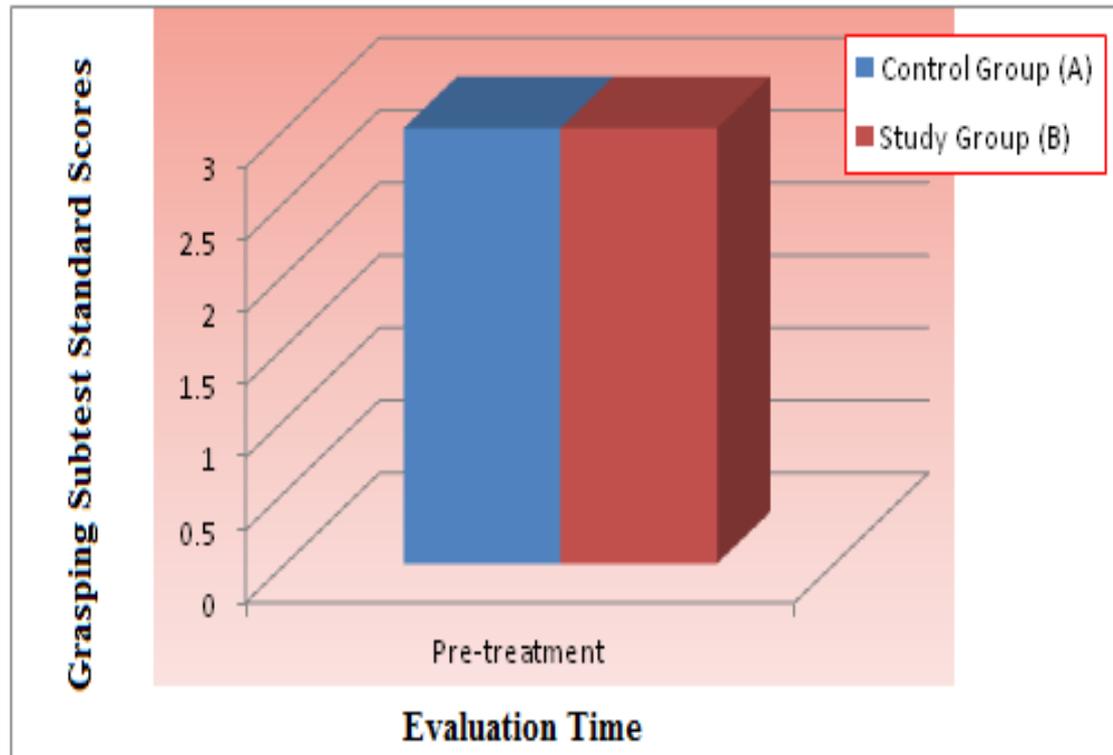


**c. The Dominance Affection distribution
in the two groups**

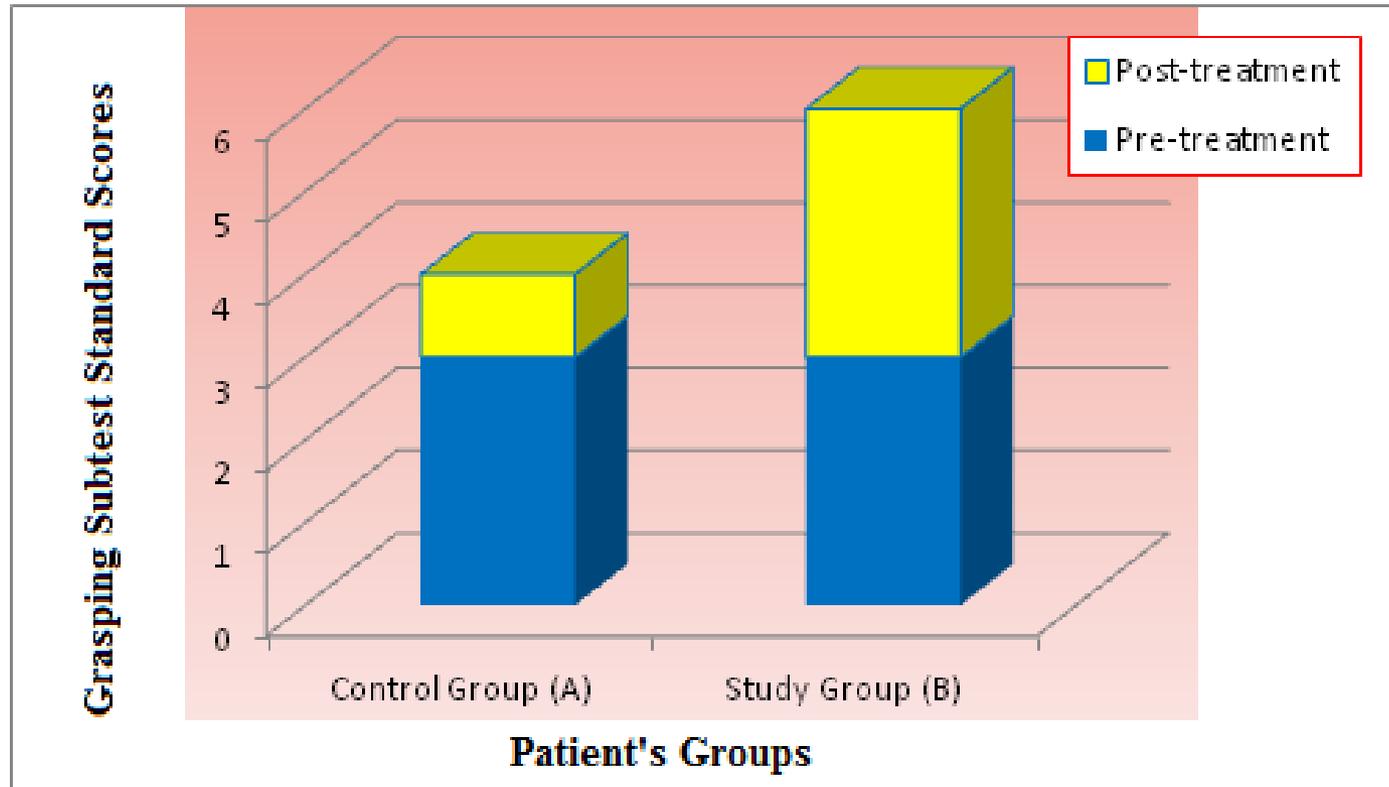


***II- Peabody Developmental
Motor Scale***

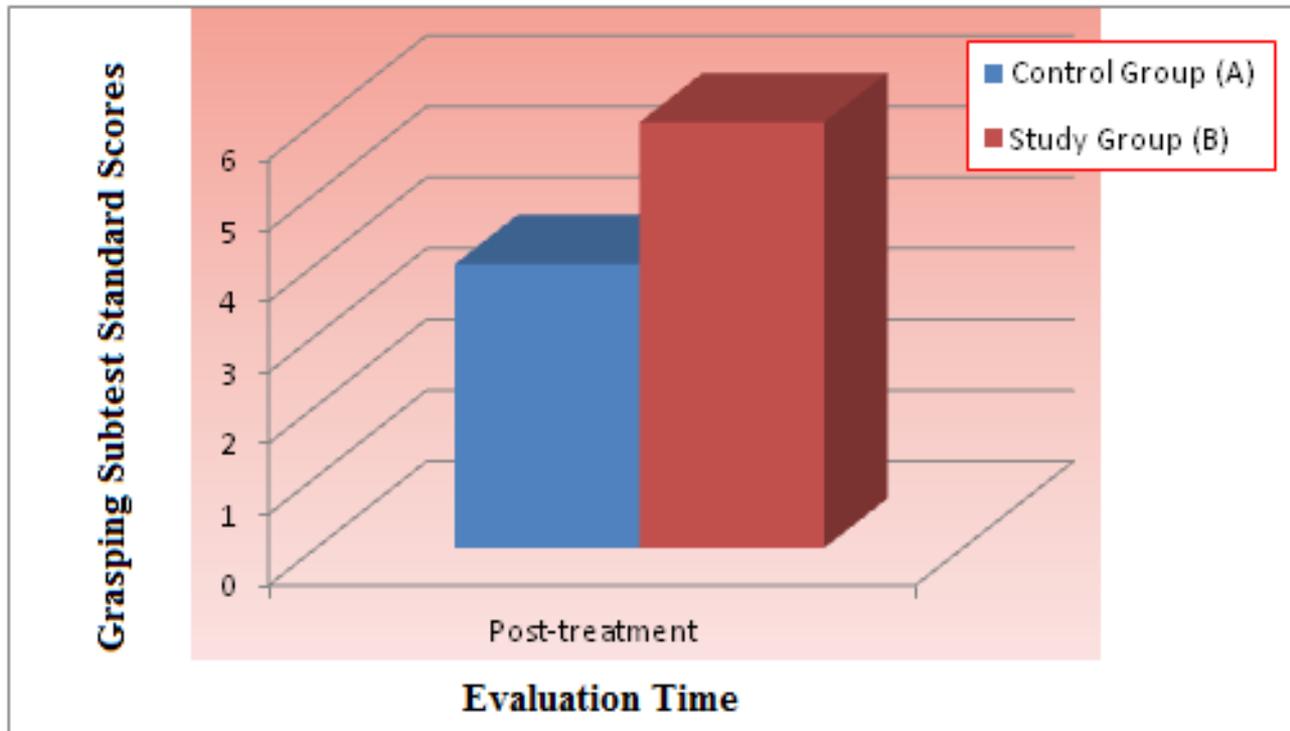
1- Grasping subtest standard scores



i. Comparing the pre-treatment values of grasping subtest standard scores between groups:



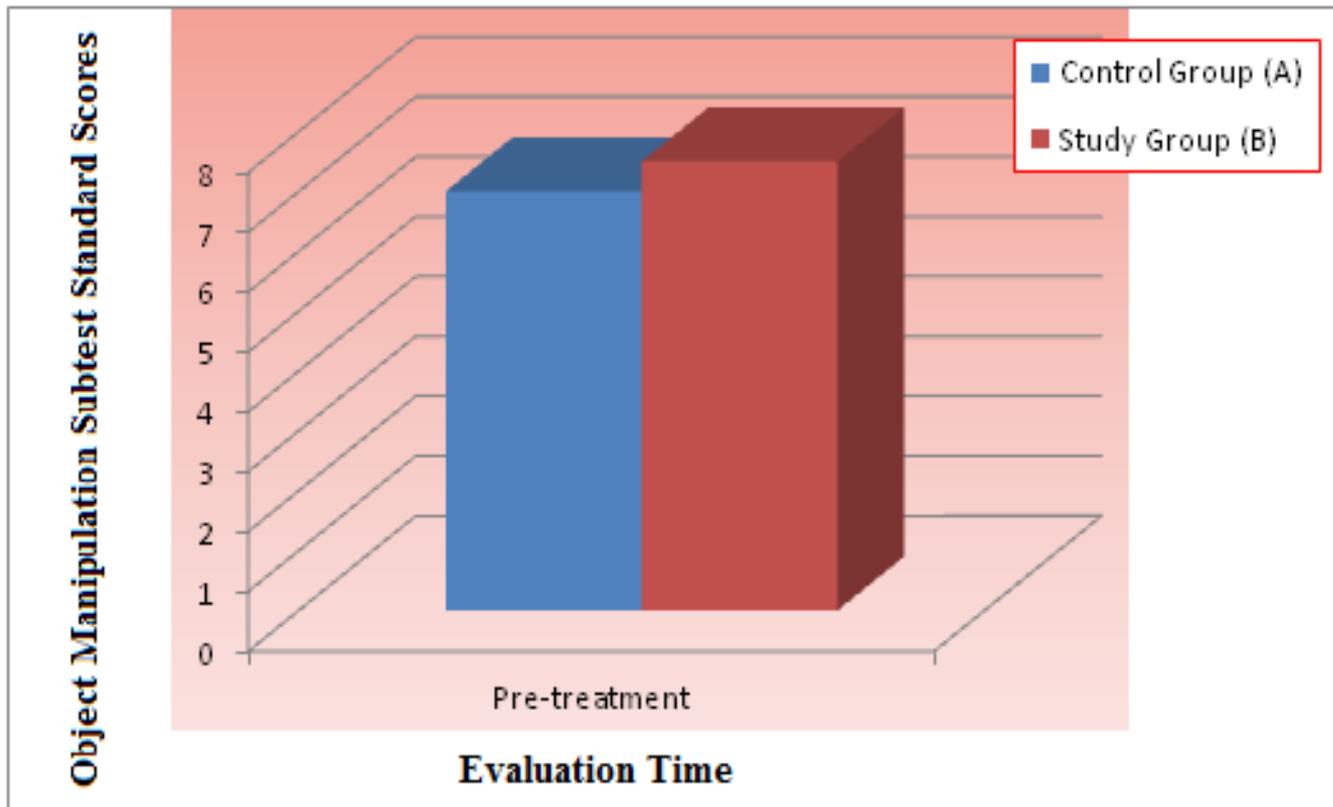
ii. Comparing pre and post-treatment values of grasping subtest standard scores within the control group (A) and the study group (B)



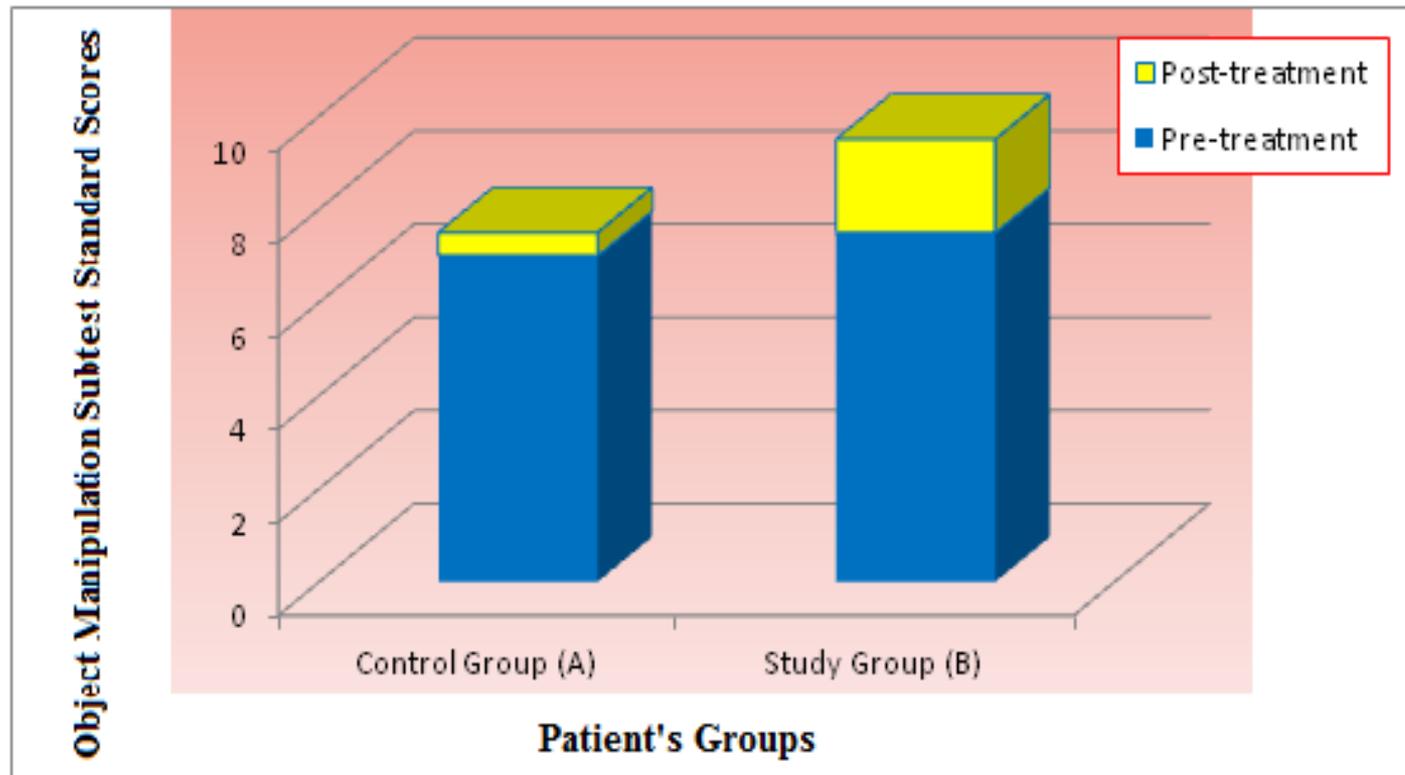
iii. Comparing the post-treatment values of grasping subtest standard scores between groups



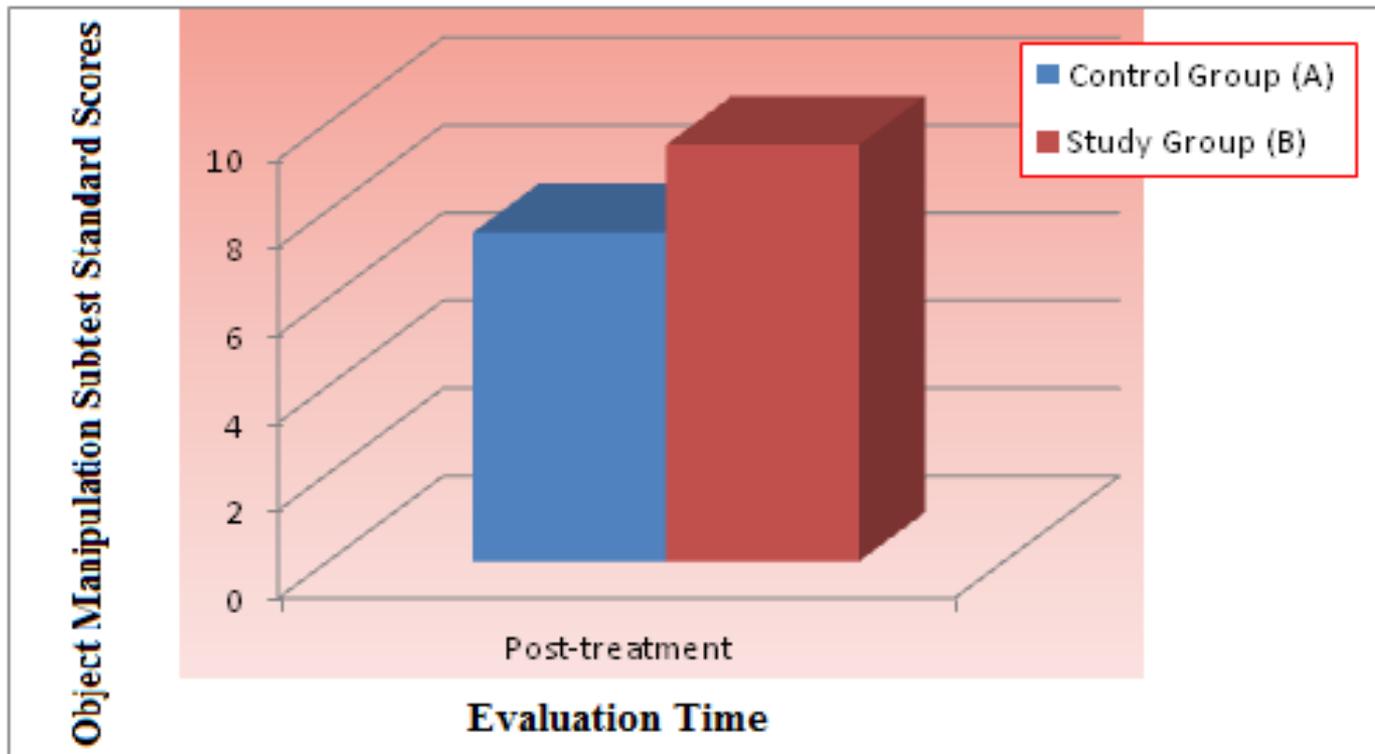
2- Object Manipulation subtest standard scores



i. Comparing the pre-treatment values of object manipulation subtest standard scores between groups



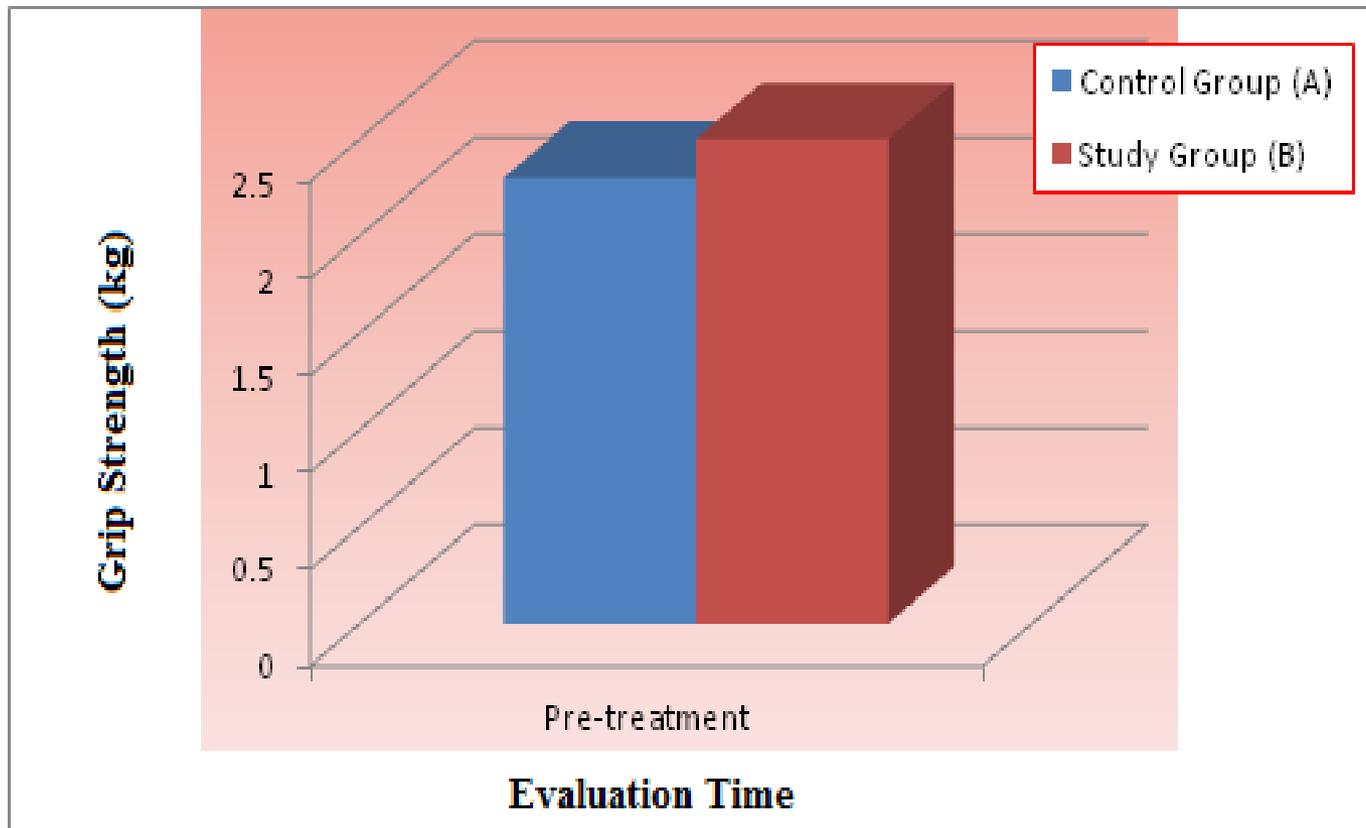
ii. Comparing pre and post-treatment values of object manipulation subtest standard scores within control group (A) and study group (B)



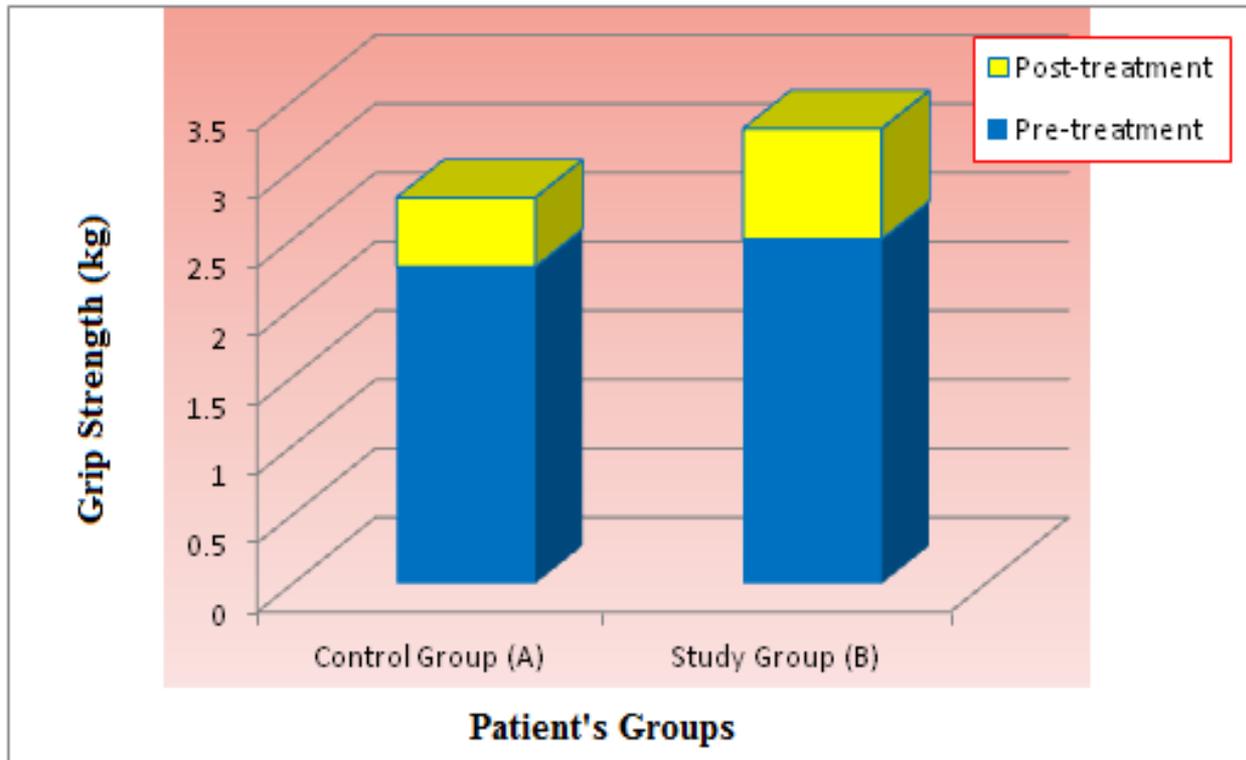
iii. Comparing the post-treatment values of object manipulation subtest standard scores between groups



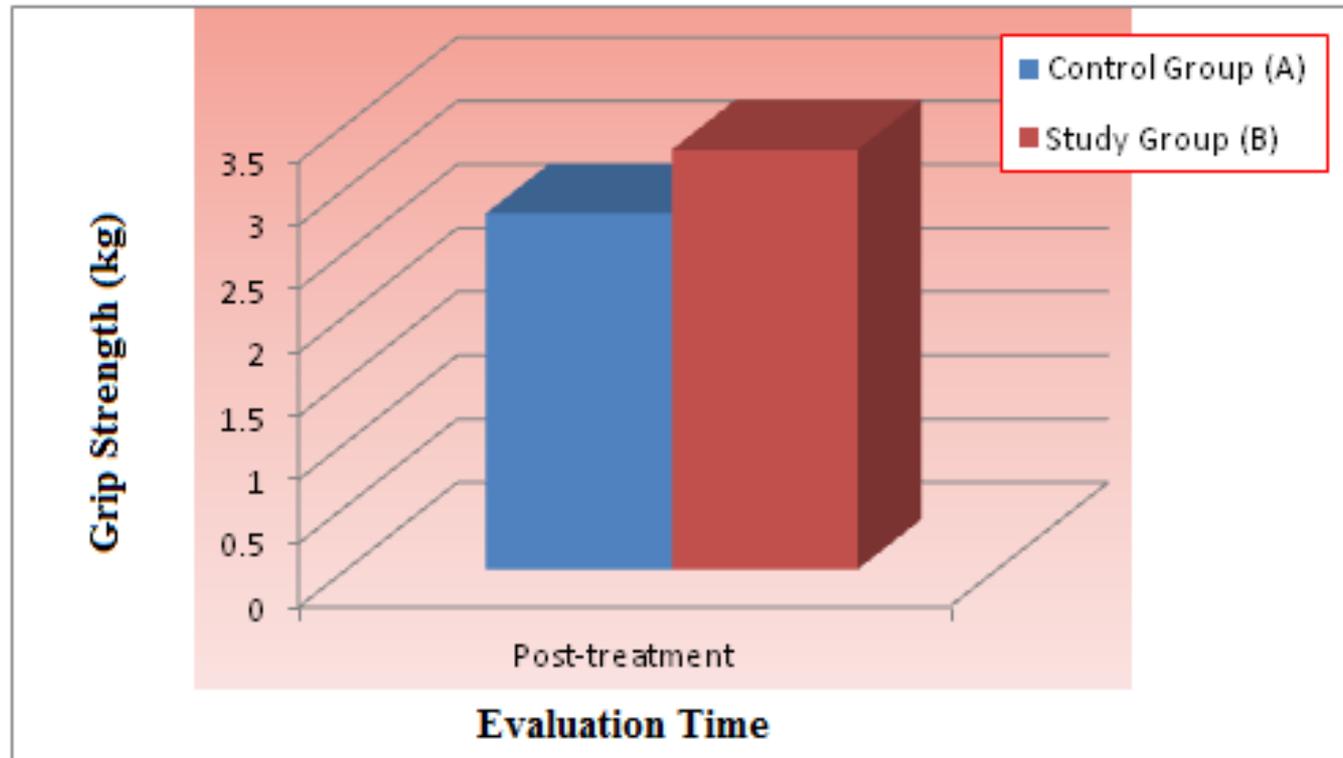
III- Grip strength by a calibrated hand-held dynamometer



i. Comparing the pre-treatment values of grip strength (kg) between groups



ii. Comparing pre and post-treatment values of grip strength (kg) within control group (A) and study group (B)



iii. Comparing the post-treatment values of grip strength (kg) between groups

IV- Comparing the percentage of improvement of all measured variables in the two groups

Variable	Percentage of Improvement %	
	Control Group (A)	Study Group (B)
Grasping subtest standard scores	20.96 %	37.87 %
Object Manipulation subtest standard scores	12.5 %	23 %
Grip strength in kilograms	14.28 %	16.67 %

DISCUSSION

The pre-treatment results in the current study showed a lowered values of all measuring variables (grasping subtest, object manipulation subtest, and grip strength) in the two groups.

These decline in the measuring variables may be clarified by **Gormley (2001)**, who attributed it to musculoskeletal and neuromuscular problems found in children with hemiparesis as spasticity, muscle weakness, incoordination, and defective motor control that interfere with motor function.

The post-treatment results showed an improvement in the two groups in all measured variables after the suggested period of treatment, but there was a higher improvement in favor of the study group measured variables.

The improvement of hand functions in the study group children may be due to the combined effect of mirror therapy and physical therapy exercises.

The impact of the visual stimulus (mirror visual feedback [MVF]) on the patient's brain is thought to cause cortical reorganization, therefore enhancing motor recovery of the paretic limbs (Deconinck et al., 2014).

This improvement of motor functions in the current study may be explained by **Parsons et al. (1998)** and **Garry et al. (2005)**. They stated that observation of mirrored distal movements enhanced the corticospinal excitability similar to actual movement execution

Dohle et al. (2008), reported that the application of mirror therapy in the early phase after stroke resulted in functionally relevant improvements in motor, sensory, and attentional domains.

Watching stimulation in a mirror can lead to a referral of sensation to the other hand and stimulate awareness for the affected side. The increased awareness of the paretic limb may stimulate new decrease learnt non-use or even learning (Gordon et al., 2006)

Garry et al. (2005), examined the effect of transcranial magnetic stimulation during mirror illusions in healthy subjects and showed increased of primary motor cortex of the hand behind the mirror.

In Conclusion

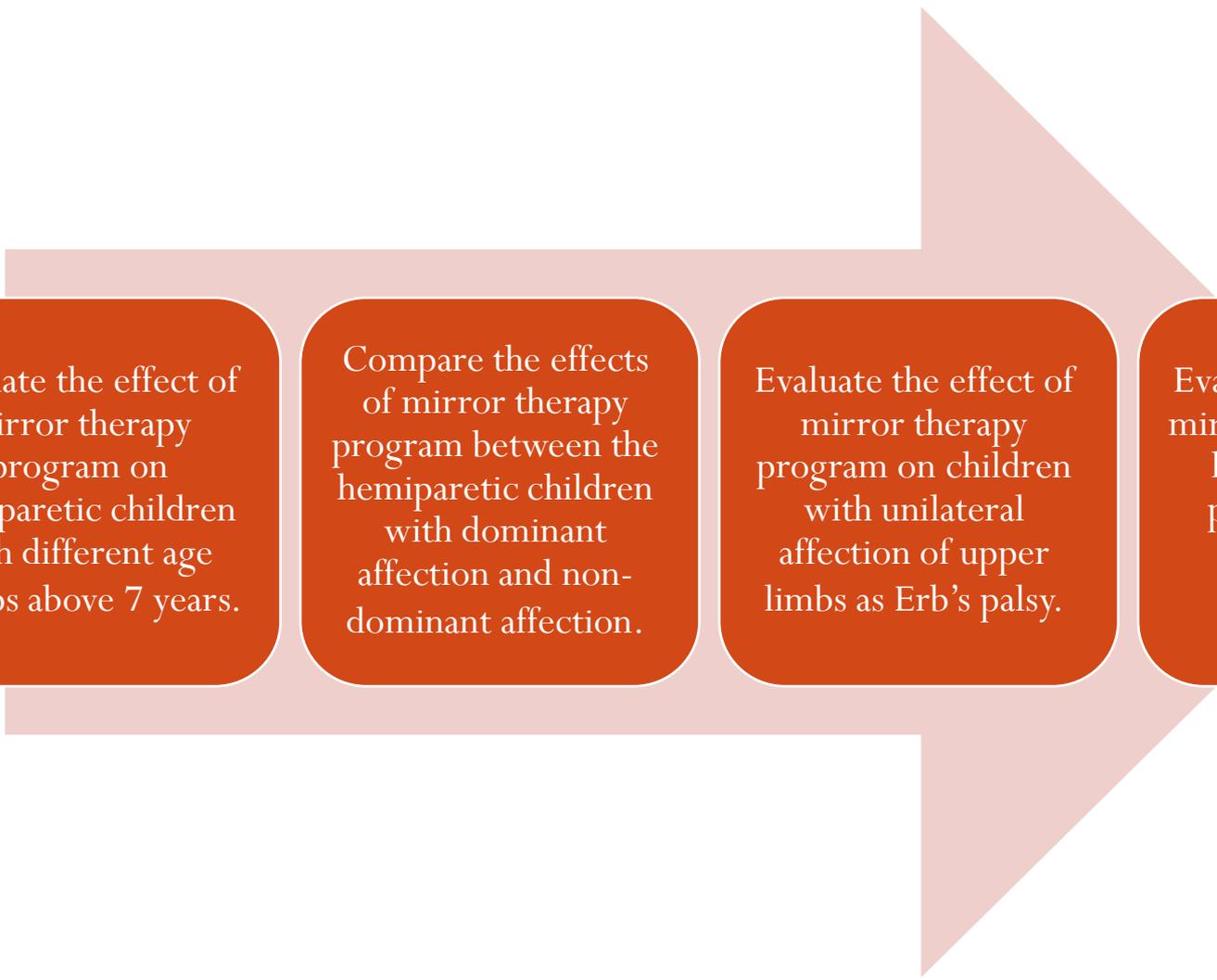
From the obtained results of the current study, it can be concluded that the mirror therapy is an effective additional tool to the rehabilitation program for children with hemiparesis, to gain more hand strength, improve hand functions, and in conclusion prevent from hemineglect, improve ADL capacity, and improve the functional and health outcome of these children.

RECOMMENDATIONS

According to the results of this work, the following recommendations are suggested

Use of mirror therapy as a training routine combined with physical therapy program for children with hemiparesis.

Use different strategies of mirror therapy for improving hand functions in children with hemiparesis.



Evaluate the effect of mirror therapy program on hemiparetic children with different age groups above 7 years.

Compare the effects of mirror therapy program between the hemiparetic children with dominant affection and non-dominant affection.

Evaluate the effect of mirror therapy program on children with unilateral affection of upper limbs as Erb's palsy.

Evaluate the effect of mirror therapy with a larger sample of patients to allow more statistical findings.

THANK YOU