*International Journal of Health Sciences and Research*
*Vol.13; Issue: 11; November 2023*
*Website: www.ijhsr.org*
*Original Research Article* *ISSN: 2249-9571*

# A Comparative Study of Hand Arm Bimanual Intensive Therapy and Neurodevelopmental Therapy on Improving Upper Extremity Function in Children with Spastic Hemiplegia

**Premalatha. E[1], Kannan. D[1], Vishnupriya. R[2], Anantharaj. K[2], Ferdinand. R[3], Sathyapriya[4]**

[1]MPT Student, Professor, [2,3,4]Professors, JKKMMRF College of Physiotherapy The Tamil Nadu Dr. M.G.R Medical University Chennai, Tamil Nadu

Corresponding Author: Premalatha Eswaran

**DOI: https://doi.org/10.52403/ijhsr.20231141**

## ABSTRACT

**AIM:** To examine the efficacy of hand arm bimanual intensive therapy and neurodevelopmental therapy on improving upper extremity functions such as gross manual dexterity and bimanual performance of daily functioning in children with spastic hemiplegia.
**METHOD:** Thirty children with spastic hemiplegia, aged 6 to 12 years, classified in levels II to IV of manual ability classification system, were selected by convenience sampling method based on inclusion criteria. The treatment duration was 6 months. There are divided into three groups, each 10 in a group. Group A assigned to HABIT (n=10, 2hrs-1hr intensive therapy& 1hr home program,5 days/week), Group B assigned to NDT (n=10, 45 mis, 5days/week) and Group C control group customary care. Box and block test for gross manual dexterity and Weefim scale for assessing the independence in activities of daily living are measured.
**RESULT:** Analysis of variance (ANOVA) indicated significant improvement in outcome measures P< 0.01. Children participating in HABIT showed greater improvement in daily functioning compared with neuro developmental therapy and control group.
**CONCLUSION:** The findings suggest that the HABIT training protocol most efficacious for improving upper extremity function in children with spastic hemiplegia.

***Keywords:*** Hand arm bimanual intensive therapy, neurodevelopmental therapy, gross manual dexterity weefim scale, ADL, Box &block test.

## INTRODUCTION:

**Cerebral palsy (CP)** is the most prevalent physical developmental disorder in children. It constitutes a group of enduring movement and posture disorders, resulting in restricted activities. These limitations stem from non-progressive disruptions in the developing fetal or infant brain, leading to permanent developmental impairments. These motor impairments are often accompanied by disturbances in sensation, perception, cognition, communication, behavior, and may also involve epilepsy and secondary musculoskeletal issues. (1) Globally, CP affects approximately 10% of the population, with around 3.8% of India's population being impacted. In India, the estimated incidence of CP is approximately 3 cases per 1000 live births (2). Notably, the prevalence of CP is higher among prematurely born infants or those with low birth weight. **Risk factors for CP** encompass congenital malformations, fetal growth restrictions, multiple gestations, fetal

or neonatal birth asphyxia, untreated maternal hypothyroidism, perinatal stroke, thrombophilia, intraventricular hemorrhage, periventricular leukomalacia, and childhood meningitis. Cerebral Palsy is also clinically classified as spastic hemiplegia, spastic diplegia, spastic quadriplegia, and also in extrapyramidal or dyskinetic forms.

Among these, spastic cerebral palsy is the most prevalent subtype, accounting for approximately 70% of all diagnosed cases. Spastic hemiplegic CP, a subtype of spastic CP, results from damage to the hemisphere of the brain responsible for movement control. It predominantly affects one side of the body, either the right or left. A significant portion, ranging from 70% to 90%, of congenital cases are attributed to spastic hemiplegic cerebral palsy, while the remaining 10% to 30% are acquired cases.

**In instances of spastic hemiplegia,** the upper extremities are more affected than the lower extremities. Symptoms display variability among individual children. More than 80% of children with CP experience impairments in their upper extremities, significantly impacting their daily activities and quality of life. Such impairments arise from damage to the brain's motor cortex and corticospinal pathways. (3) Spasticity, a common complication in CP, interferes with motor functions, hampers development, exploration, and play in children, and may worsen with age.(4) During the early stages, the wrists and hands are the most affected regions of the upper extremities. Abnormal hand postures, such as thumb adduction and limited wrist extension, characterize hand involvement. Increased muscle tone, impaired posture, and function significantly influence daily activities and functional independence. (5) The functional challenges in children with spastic hemiplegic CP are not solely attributed to motor deficits but also to concurrent sensory impairments. Tactile registration, perception, and sensorimotor integration play a pivotal role in tasks such as grasping objects, dexterous manipulation, and daily activities. (6) Approximately 50% of these children manifest more upper extremity disabilities than lower extremity impairments. Deficits in upper extremity activities such as reaching, grasping, and object manipulation result in dependency for daily activities and compromised social interactions. (7) These impairments arise from spasticity, sensory deficits, and reduced strength, which collectively compromise the functional utility of the upper limb. While most children with hemiplegia possess the cognitive capacity for mainstream education, impaired arm function curtails their participation in education, leisure, and future vocations. (8) Although many children with hemiplegic CP are ambulatory, deficiencies in hand function on the affected side remain a significant concern for both caregivers and the children themselves. Consequently, children tend to overuse their unaffected upper extremity, leading to disuse of the hemiparetic upper extremity. (9)

With respect to the treatment of spastic hemiplegic children, the research studies identified that various treatment approaches were used to improve the upper extremity function. However, there is no one single approach is best to another one to treat the upper extremity function.

**Hand Arm Bimanual Intensive Therapy (HABIT**), is one of the approaches developed at Columbia University, represents a novel intervention. This therapy involves practicing tasks with both hands instead of just one, enhancing the coordination and use of both arms in daily functions. (10) HABIT specifically targets upper extremity impairments in congenital hemiplegia. Both unimanual and bimanual intensive therapies have demonstrated efficacy in enhancing hand motor function in children with spastic hemiplegia. Bimanual intensive therapy particularly excels in self-determined goal achievement due to its utilization of both hands (e.g., tying shoes). Moreover, bimanual training

notably enhances bimanual coordination compared to unimanual training. (11)

**Neurodevelopmental Therapy (NDT)** is another approach that employs handling techniques to enhance upper extremity function in children with cerebral palsy. (12,13) NDT, a long-standing and frequently used intervention, aims to improve gross motor function and postural control by facilitating muscle activity through key control points guided by therapists. NDT prioritizes upper body control and the acquisition of hand skills for self-care, academics, leisure activities, and community engagement, ultimately striving for maximal independence. The handling techniques intend to normalize muscle tone, achieve postural alignment throughout the body, and prepare upper and lower extremities for weight-bearing, shifting, and functional activities. .

Therefore, the current study is aimed to investigate the effectiveness of Hand-arm bimanual intensive therapy(habit) and Neurodevelopmental therapy on improving upper extremity function in children with spastic hemiplegia

## METHOD

Children were recruited from outpatient department of J.K.KM MRF college of physiotherapy and Nehru memorial sampoorani ammal differently abled school. There were thirty spastic hemiplegic children with aged 6 to 12 years, classified in levels II to IV of manual ability classification system, were selected by convenience sampling method based on inclusion criteria. The treatment duration was 6 months. There were divided into three groups, each 10 in a group. Group A received Hand arm bimanual intensive therapy (n=10, 2hrs, 5 days/week), Group B received neurodevelopmental therapy (n=10, 45 mis, 5days/week) and Group C control group customary care. The parameters box and block test and selfcare domain in weefim scale were used to assess the patients before and after the intervention program. The exclusion criteria of visual and auditory impairments, recent orthopedic surgery and cognitive impairments.

### INTERVENTION PROCEDURE

### HABIT PROCEDURES:

The principles of HABIT were used to issue bimanual activities, where the most affected upper extremity was initially used as a passive support to the activity and developing successively toward more complex use of affected hand. HABIT is a repetitive task practice using two hands rather than one hand to complete functional activities. The activities were selected for age-appropriate fine motor and gross motor activities that require use of both hands. specific activities were selected by considering the role of the involved limb in the activity (e.g. stabilizer, manipulator, active/ passive assist). Task performance was recorded. The therapist was instructed to avoid urging the child to use his/her involved hand and avoid physically inhibiting use of the non- involvement hand during an activity.

### NDT PROCEDURE:

Neurodevelopmental treatment is an hands on approach.it is used for children with disorders of function and movement or postural control. The key elements in NDT are preparation, facilitation, inhibition and functional activities. The therapist assist the child to move using the key points of control such as head and shoulder. The level of touch provided during handling are direct and contoured, shaped to the child's body. Depth of touch varies depending upon the type of sensory input required to elicit an active movement. Light touch is best used when the demonstrates greater degree of independent motor control and deep touch provides increased support and direction. Compression and traction provide sensory data sensory data through both the touch and proprioceptive systems modifying tonal properties, alignment and muscle activation.

## STASTISTICS

Groups were compared at pre and post assessment using t tests. The post assessment values of three groups were compared by using of one-way ANOVA. Games -howell multiple comparison test used for difference between groups.

**Comparison of mean posttest level WEE FIM score of Control, HABIT and NDT groups**
**(One Way ANOVA)**

| S. No. | Group | N | Mean | SD | F value | P value |
|---|---|---|---|---|---|---|
| 1 | Control | 10 | 38.10 | 1.853 | 91.500 | 0.000** |
| 2 | HABIT | 10 | 49.50 | 2.121 | | |
| 3 | NDT | 10 | 42.40 | 1.713 | | |

** - Significant at 1% level * - Significant at 5% level

**Result:**

In the above table, the p value 0.000 is less than 0.01 and is highly significant at 1% level and hence we can conclude that there is high significant difference between the mean post test scores of Controls, HABIT and NDT group in WEE FIM domain.

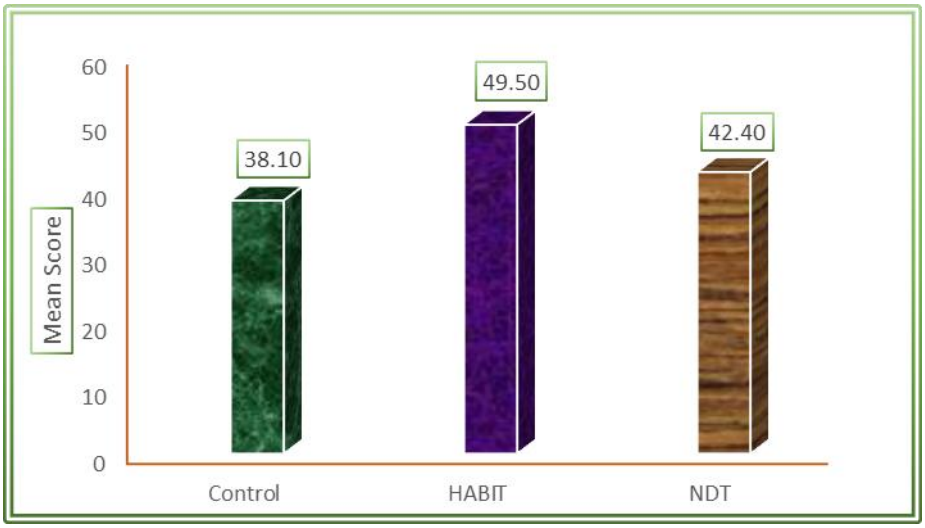
**Games – Howell multiple comparison test**

| S. No | Group (I) | Group (J) | Mean difference (I - J) | Std. Error | P value |
|---|---|---|---|---|---|
| 1 | Control | HABIT | -11.400 | 0.891 | 0.000** |
| | | NDT | -4.300 | 0.798 | 0.000** |
| 2 | HABIT | NDT | 7.100 | 0.862 | 0.000** |
| | | Control | 11.400 | 0.891 | 0.000** |
| 3 | NDT | HABIT | -7.100 | 0.862 | 0.000** |
| | | Control | 4.300 | 0.798 | 0.000** |

** - Significant at 1% level * - Significant at 5% level

In the above table, all the p values are highly significant at 1% level and hence we can say that the mean differences between post test level scores of three groups “Control, HABIT and NDT” are highly significant and hence we can say that there is high significant difference between the mean posttest WEE FIM scores.

Also, the mean of HABIT group is significantly higher than NDT and control groups and NDT group is significantly higher than Control group.




**Comparison of mean posttest level BBT score of Control, HABIT and NDT groups**
**(One Way ANOVA)**

| S. No. | Group | N | Mean | SD | F value | P value |
|---|---|---|---|---|---|---|
| 1 | Control | 10 | 35.10 | 4.012 | 9.952 | 0.001** |
| 2 | HABIT | 10 | 43.50 | 5.191 | | |
| 3 | NDT | 10 | 39.00 | 3.197 | | |

**** - Significant at 1% level** *** - Significant at 5% level**

## RESULT

In the above table, the p value 0.001 is less than 0.01 and is highly significant at 1% level and hence we can conclude that there is high significant difference between the mean post test scores of Controls, HABIT and NDT group in BBT domain.

### Games – Howell multiple comparison test

| S. No | Group (I) | Group (J) | Mean difference (I - J) | Std. Error | P value |
|---|---|---|---|---|---|
| 1 | Control | HABIT | -8.400 | 2.075 | 0.002** |
| | | NDT | -3.900 | 1.622 | 0.068 |
| 2 | HABIT | NDT | 4.500 | 1.928 | 0.082 |
| | | Control | 8.400 | 2.075 | 0.002** |
| 3 | NDT | HABIT | -4.500 | 1.928 | 0.082 |
| | | Control | 3.900 | 1.622 | 0.068 |

**** - Significant at 1% level** *** - Significant at 5% level**

In the above table, mean difference between Control and HABIT group is highly significant and the posttest level mean BBT score of HABIT group is higher than the mean BBT score of Control group.

While the p value of mean difference of “Control and NDT groups” and “HABIT and NDT” groups are not significant and therefore we can say that there is no significant difference between “Control and NDT groups” as well as “HABIT and NDT” group.


## DISCUSSION

The purpose of the study was to compare the hand arm bimanual intensive therapy and neurodevelopmental therapy to the spastic hemiplegic child to improve the upper extremity function. The weefim scale and box &block test was taken as the parameter to measure the effectiveness of hand arm bimanual intensive therapy and neurodevelopmental therapy in spastic hemiplegic child. The study sample comprised of 30 subjects and divided into 3 groups. Each group had 10 children and the age of the child was above 6 years. In the

group of 30 subjects, 10 were treated with hand arm bimanual intensive therapy and 10 were neurodevelopmental therapy and 10 control group.

Surkar, swatim; hoffman et al 2018 reported a study in changes in the prefrontal cortical activation following hand arm bimanual intensive therapy in children with hemiplegic cerebral palsy. The result of this study showed HABIT technique improves the pre frontal cortical involvement in the action of planning the upper extremity functions in the children with hemiplegic cerebral palsy. (13)

Gormley ME et al 2001, who reported that the bimanual intensive therapy is differ from conventional physical and occupational therapy in atleast two ways. 1) the intensity of bimanual training is too far and giving sufficient opportunity for practice using the motor learning principles. 2) the bimanual approach encouraging the involved hand in any manner as the child want to use and in particularly focus on how the hand and arm are performing at the end of movement. (14)

The significant difference in weefim scores between the HABIT and NDT may be attributed to the effect of hand arm bimanual intensive therapy which allowed the study group receive simultaneously proprioceptive and visual feedback from the unaffected arm (e.g of rolling balls against the table) that they didn't receive during the unilateral training in which only the affected arm is used in the control group. This explanation was reported by Stephen et al.

Stephen et al 2005 was gave the explanation to this that when practicing bimanually, the patient can use the unaffected extremity that have neurologically intake afferent and efferent signals as when looking and feeling movement within the unaffected extremity, this will help to promote similar movements by the affected extremity. (15)

**COMPARISON OF WEEFIM SELFCARE DOMAIN POST TEST SCORE OF CONTROL, HABIT, NDT GROUPS:**

In using one way ANOVA, the mean post-test values of control, HABIT and NDT groups are 38.10, 49.50 and 42.40. the f ratio was 91.500, p value is 0.000 and is less than 0.01 at 1% level. There are high significant differences between the mean of post test scores of control, HABIT and NDT groups in weefim selfcare domain.

The Games-Howell multiple comparison test shows the mean difference between groups. The mean difference between CONTROL and HABIT was -11.400 and CONTROL and NDT was -4.300. The mean difference between HABIT and NDT was -7.100 and HABIT and CONTROL was 11.400. The mean difference between NDT and HABIT was -7.100 and NDT and CONTROL was 4.300. The result of games-howell test, the mean of HABIT group is significantly higher than the NDT and control groups and NDT group is significantly higher than control group.

**COMPARISON OF BBT POST TEST SCORE OF CONTROL, HABIT, NDT GROUPS:**

In using one way ANOVA, the mean post-test values of control, HABIT and NDT groups are 35.10, 43.50 and 39.00. the f ratio was 9.952, p value is 0.001 and is less than 0.01 at 1% level. There is high significant differences between the mean of post test scores of control, HABIT and NDT groups in BBT.

The Games-Howell multiple comparison test shows the mean difference between groups. The mean difference between CONTROL and HABIT was -8.400 and CONTROL and NDT was -3.900. The mean difference between HABIT and NDT was 4.500 and HABIT and CONTROL was 8.400. The mean difference between NDT and HABIT was –4.500 and NDT and CONTROL was 3.900.

The mean difference between control and HABIT group is highly significant and the post-test level of BBT mean score pf HABIT is higher than the BBT mean score of control group. While the p value of mean difference of "Control and NDT groups"

and "HABIT and NDT" groups are not significant and therefore we can say that there is no significant difference between "Control and NDT groups" as well as "HABIT and NDT" groups.

Based on the statistically and interpretation the result of the study showed that there was significantly improving the upper extremity function in children with spastic hemiplegic cerebral palsy. Therefore, the present study was rejected the null hypothesis and accepting the alternate hypothesis.

By analysing the mean and standard deviation values of the result showed the subjects who receives hand arm bimanual intensive therapy is found to be more effective in children with spastic hemiplegia than the other techniques of group B group C.

## CONCLUSION

The study was conducted to compare the effect of hand arm bimanual intensive therapy and neurodevelopmental therapy on improving upper extremity function in spastic hemiplegic children. It shows that there was improvement in selfcare activities such as eating, grooming, bating under the weefim scale and gross dexterity improvements in box and block test in the hand arm bimanual intensive treatment group than the neurodevelopmental therapy and control group.

The study showed that high intensity of hand arm bimanual training (HABIT) continuously directed to the upper extremity during a short period of time was more effective than a neurodevelopmental therapy and conservative treatment and neurodevelopmental therapy is also effective than the conservative management.

### Limitation And Recommendation

The study was conducted in short duration of treatment time.

The study was conducted in small size samples.

A similar study can be done with larger samples and long duration of treatment time.

The study can be conducted with other outcome measures.

The study can be conducted with other neurological conditions who have upper extremity problems.

The study can be done similar age groups.

### *Declaration by Authors*

**Ethical Approval:** Approved

**Acknowledgement:** We are thankful close to all candidates who were given more support engaged in this study.

**Source of Funding:** None

**Conflict of Interest:** The authors declare no conflict of interest.

## REFERENCE

1. Peter rosenbaun, nigel panteth, alan Leviton a reported "the definition and classification of cerebral palsy" April 2006.
2. NICE publishes guidelines on diagnosing and managing cerebral palsy in young people BMJ 2017:356; j462.
3. Cerebral palsy spastic hemiplegia (n.d) genetic and rare disease information center(GARD)NCATs, program/providing information about rare or genetic disease .
4. Tardieu G, tardieu C. et.al1987;219:63-9 cerebral palsy mechanical evaluation and conservative correction of limb joint contracture.
5. Basu AP, Pearse J, Kelly s, et.al-2014; early intervention to improve hand function in hemiplegic cerebral palsy.
6. Audl ML, Boyd RN, Moseley GL et.al 2012 ;93(4). Impact of tactile dysfunction on upper limb motor performance in children with unilateral cerebral palsy, archeives of physical medicine and rehabilitation.
7. Jaspers E,desloovere k, bruyninckx H et.al 2009, review of quantitative measurement of upper limb movements in hemiplegic cerebral palsy gait posture.
8. Anita Choudhary, sheffali gulati et.al 2013, efficacy of modified constraint induced movement therapy in improving upper limb function in children with hemiplegic cerebral palsy- a randomized controlled trail.
9. Virtual reality based intervention for enhancing upper extremity function in children with hemiplegic cerebral palsy –

literature review, chanan goyal,Vishnu Vardhan et.al 2022.
10. Teachers' college (TC) Columbia university, New York, USA.
11. Hsing- ching kuo et.al 2015, the effect of intensive bimanual training with and without tactile training on tactile function in children with unilateral spastic cerebral palsy: a pilot study.
12. Law M, Russell D, Pollock N, et.al1997; a comparison of intensive neurodevelopmental therapy plus casting and a regular occupational therapy program for children with cerebral palsy.
13. Surkar SM, Hoffman RM, Willett S, Flegle J, Harbourne R, Kurz MJ. Hand-Arm Bimanual Intensive Therapy Improves Prefrontal Cortex Activation in Children With Hemiplegic Cerebral Palsy. Pediatr Phys Ther. 2018 Apr;30(2):93-100. doi: 10.1097/PEP.0000000000000486.
14. Gormley ME Jr. Treatment of neuromuscular and musculoskeletal problems in cerebral palsy. Pediatr Rehabil. 2001 Jan-Mar;4(1):5-16. doi: 10.1080/13638490151068393.
15. Stephen J, Page, Levine P. biomechanics archives; bilateral training aids rehabilitation progression. Dev med child neurology 2005; 44 :25-33.

How to cite this article: Premalatha. E, Kannan. D, Vishnupriya. R, Anantharaj. K, Ferdinand. R, Sathyapriya. A comparative study of hand arm bimanual intensive therapy and neurodevelopmental therapy on improving upper extremity function in children with spastic hemiplegia. *Int J Health Sci Res.* 2023; 13(11):334-341. DOI: *10.52403/ijhsr.20231141*

******