



# PERCEPTUAL & MOTOR DUAL TASKING ON HEMIPLEGICS-A STUDY

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## **ABSTRACT:**

### **Introduction**

Stroke causing Hemiplegia, limits mobility over a long period of time by causing physical & functional disorder which results in difficulty in daily living tasks. The patients are limited both at their home and community. Stroke patients exhibit inefficient walking because of decreased dynamic balance ability, as well as decreased musculoskeletal function. Also, the relationship between cognition and motor control after neurological damage has significant implications for understanding the recovery. Dual tasking means carrying out two or more tasks at the same time. As most activities that take place in the everyday life occur as two or more tasks, such simulation was attempted by this study for hemiplegics.

### **Aim of the study**

To find out whether dual task training positively influence recovery for Hemiplegic patients

### **Objectives of study**

- ✚ To identify & select hemiplegic patients, at fifth stage of recovery based on Brunnstrom stage of recovery.
- ✚ To, identify their perceptual & motor problems.
- ✚ To apply selected Dual task training with hopscotch and other motor perceptual tasks for a period of time
- ✚ To analyse the effect of these dual task with FAB, CASP scores & statistical correlations
- ✚ To relate whether dual task training positively influence recovery for Hemiplegic patients

## Method of study

The study was conducted on those hemiplegic patients willing to learn movement through a new method of perceptual, motor task, in & around (50 km) of Chidambaram. As suitable to study objectives, patients were attended by house visit & some patients were selected from outpatient services of Occupational Therapy service at GCMC&H.

In this study, **Hopscotch** game is DEvised, with specific purpose of TRAINING Hemiplegics as suitable to the study requirements. Therapist need to pay attention to whether patient is losing balance and falling out of the figure. Stepping on wrong design other than therapist mentioned, & landing outside of the square or using two feet in a one-foot square are focused as mistakes. With these simple rules, game was created flexible to hemiplegic recovery.

## RESULTS

It is seen from study, that majority of the patients involved are in the age group of 35, male group. The Fullerton advanced balanced scale and Cognitive assessment scale used for assessment show significant changes before & after training with modified Hopscotch.

## Discussion

This study, perceptual & motor dual tasking on hemiplegics was done on patients with hemiplegia illness, of age 30 to 55 years. The data regarding participants were collected from medical records department of the hospital. The study sample was taken using both FAB and CASP scale with informed consent of the patients. Most of the patients were willing for the activity were daily wages workers. The least willing of the patients were the person leading a sedentary life. Pre & Post therapy comparison of scores shows that the male participants have improvement in their balance.

## Conclusion

Dual tasking, though implemented in daily living task unconsciously, like walking and carrying a bag, texting or making a phone call while walking, as well the ability to perform such activities is affected after stroke. For better occupational performance, hemiplegics has to be involved in dual task training sessions by OT's as relevant for ADL. In this project, Hopscotch game is DEvised, with specific purpose of TRAINING Hemiplegics as suitable to the study requirements. Therapist need to pay attention, while patient is playing the game. The Pre & post therapy analysis conducted with valid assessment tools shows dual task training positively influence recovery for hemiplegic clients.

Keywords: Hemiplegia, Dual-tasking, Hopscotch, FAB, CASP.

## INTRODUCTION

Stroke causing Hemiplegia, limits mobility over a long period of time by causing physical & functional disorder which results in difficulty for daily living tasks. Loss of balance is one of the most important functional disorder of patients with hemiplegia. Stroke patients exhibit inefficient walking; one of the factor is decreased dynamic balance. The relationship between cognition and motor control after neurological damage has significant implications for understanding recovery of motor function. Because movements cannot be performed without intent, cognitive processing is crucial for motor control.

Dual-tasking means carrying out another task while engaged on one task. The training in the dual-tasking situation can show the positive results with, the cerebral blood flow in the brain. It was attempted in this study on Hemiplegic patients, whether such dual-tasking can positively influence any recovery for Hemiplegic patients.

## Etiology:

1. Vascular - Cerebral haemorrhage , Stroke , Diabetic Neuropathy.
2. Infective - Encephalitis, Meningitis , Brain abscess.
3. Neoplastic - Glioma – meningioma
4. Traumatic - Cerebral lacerations , Subdural Hematoma . Rare cause of hemiplegia is due to local anaesthesia injections given intra arterially rapidly , instead of given in a nerve branch .
5. Congenital- Cerebral palsy
6. Disseminated - Multiple Sclerosis
7. Psychological - Parasomnia (Nocturnal hemiplegia)

## Main causes for hemiplegia

- **Brain Injury:** Traumatic brain injury on one side of the brain can give rise to hemiplegia on the other side of the body. Brain injury can occur from road accidents, falls, violence, as well as other causes. The types of brain injuries that can occur include cerebral lacerations, subdural/epidural hematoma, and compression fractures in the vertebral column.
- **Stroke:** Hemiplegia can occur as a result of stroke, which is technically termed as cerebrovascular accident (CVA). Other causes include Transient Ischemic Attack (TIA), commonly known as mini-strokes.
- **Aneurysms and Haemorrhage:** The development of a brain aneurism (weakening and bulge of the arterial wall) can be fatal, especially if it bursts. Moreover, brain haemorrhage can be equally devastating. Both these conditions can cause hemiplegia. Haemorrhage can also occur in new born. This type of haemorrhage is termed intra ventricular haemorrhage (IVH).
- **Infections:** Brain infections such as meningitis and encephalitis are very serious and if untreated, can result in hemiplegia, among other complications. Other causes include brain abscess and spinal epidural abscess.

Symptoms of hemiplegia range from one person to another and are dependent on the severity of the condition. Hemiplegia affects either left or the right side of the body. If the left side of the brain is injured, paralysis occurs on the right side of the body, while injury on the right side of the brain causes symptoms on the left side of the body.

- ✚ Impaired motor skills & muscle fatigue
- ✚ Difficulty grasping or holding on to objects
- ✚ Weakness of muscles or stiffness on one side of the body or muscle spasticity
- ✚ Impaired coordination, Poor balance & Difficulty walking

Treatment of hemiplegia involves a multi-pronged approach. Medicines to treat symptoms such as, Librium can be administered to relax the patient. Other drugs are used to treat recurrent seizures following brain injury. Antibiotics are used to treat any brain infections. Blood thinners such as warfarin or heparin can be administered to clear any blood clots and prevent strokes.

## Rehabilitation of the Patient

The role of physical therapists and occupational therapists is vital for regaining functionality of the hemiplegic patient. Treatment aims at improving sensation and motor abilities, to help patient perform the daily activities, make them independent as much as possible.

**Physical Therapy:** Exercises carried out under the supervision can appreciably improve muscle strength, muscle coordination as well as increase the mobility. Assistive devices like walkers, prosthetics and orthotics such as braces, slings, and splints can help with spasticity and gait. For immobile patients, wheelchairs are used to enable mobility.

**Neuromuscular electrical stimulation:** This uses high-intensity electrical stimulation to maintain size and functionality of the muscles. Importantly, this can appreciably decrease spasticity and increase the awareness of existence of the limbs.

**Occupational Therapy:** The main goal of occupational therapy is to instill a sense of independence in order to carry out everyday tasks like dressing, eating, brushing teeth and grooming. Occupational therapists help to increase the functional ability of the affected hand and increase strength of the muscles of the shoulder and back.

### **BRUNNSTROM APPROACH**

Signe Brunnstrom, a Swedish physical therapist developed this approach in the 1960s. Her work on hemiplegia was based on various traditional neurophysiological theories of motor control. She tried various trial & error method on motor and verbal reactions to each procedure. Brunnstrom approach is a widely used movement therapy approach, highly focuses synergic pattern of spastic muscles on the recovery of stroke patients through various stages. Although patients proceed through Brunnstrom's stages of recovery for upper extremity & Hand, a particular patient may stop at any stage. Hence, each movement is demonstrated on the unaffected side of the patient and asked to perform voluntarily at the affected extremity.

Basics for the principles of movement strategy are as follows

- In normal motor development, reflexes become modified into purposeful movements and thus recovery in stroke appears to result development in reverse as reflexes are used to facilitate and learn purposeful movements. Brunnstrom believed that no reasonable training method should be left untried and stated "It may well be that a subcortical motion synergy which can be elicited on a reflex basis may serve as a wedge by means of which limited amount of willed movement can be learned"
- Proprioceptive and exteroceptive stimuli can be used to provoke desired motion or tonal changes
- Recovery of voluntary movement in post stroke proceeds in sequence from mass patterns to discrete movements voluntarily. The stereotyped movements are called limb synergies.
- Repetition is a must of learned movements.
- Practice in context of ADL's enhances learning

### **Principles of Movement therapy: -**

- Treatment progresses in a developmental sequence from reflexes to voluntary to functional movements. When no motion exists, movement can be facilitated using reflexes, associated reactions, proprioceptive /exteroceptive stimuli to develop muscle tension.
- The patient is asked to hold (isometric) response if voluntary effort is done. If possible, he is asked for an eccentric (controlled lengthening) followed by concentric (controlled shortening) contraction.
- Even if a partial movement is possible, reversal of movement is stressed within each session.
- Facilitation techniques are dropped as soon as the patient shows voluntary control. Responses to exteroceptive stimuli are least stereotyped thus tactile stimuli is last to be eliminated. No primitive reflexes are used beyond stage 3.
- Emphasis is more on voluntary movement and similar ADLs are encouraged to perform.
- Correct movement, once elicited, should be repeated and practiced.

**Associated reactions** are involuntary movement or patterned reflexive tonal increase in those muscles that are expected to be in contrast to cause movement. These reactions are seen in affected extremities when other unaffected extremities are resisted or effort is made in affected extremity. These are evaluated to determine which facilitation method can be used.

Associated reactions seen in stroke patients are as follows:-

1. Flexor Synergy
2. Extensor Synergy
3. Raimeste's Phenomenon (Resistance to Hip abduction or adduction of non-involved extremity causes same motion in involved leg)
4. Resistance to flexion of non-involved leg causes extension of the involved extremity and resistance to extension of non-involved side causes flexion of involved extremity.
5. Resisted grasp of non-involved hand causes grasp reaction in the involved hand.
6. Flexor movement or tone may be elicited in involved arm when the patient attempts to flex the leg are resisted. This reaction is called homolateral synkinesis.
7. Souque's Phenomenon - Increased tone of involved arm above horizontal evokes an extension and abduction of fingers.

**Balance** is diminished in people with hemiplegia. Postural sway for patients with hemiplegia can be twice that of their age-matched peers. Symmetry of weight bearing is also impaired following stroke, with patients bearing as much as 61% to 80% of their body weight through their nonparetic lower extremity. In addition, hemiplegia can cause a reduction in patients' limits of stability, which is defined as the maximal distance that an individual can shift their weight in any direction without loss of balance.

With stroke, balance impairments and decreased ankle proprioception are positively correlated. Abnormal interactions between the three sensory systems involved in balance could be the source of abnormal postural reactions. In situations of sensory conflict, a patient with stroke can inappropriately depend on one particular system over another. Laboratory measurements of sensory organization demonstrate that patients with chronic stroke perform worse in conditions of altered somatosensory information and visual deprivation or inaccurate visual input. Excessive reliance on visual input may be a learned compensatory response that occurs over time. Relying on a single system can lead to inappropriate adaptations and, hence, balance disturbances. Furthermore, sensory integration and reweighting can be impaired in patients with stroke, emphasizing visual input even when it provides inaccurate information.

The most important biomechanical constraint to balance is the quality & size of the Base of Support. In hemiparetic patients, weakness and impaired muscle control, decreased range of motion, and pain can lead to changes in the Base of Support. The centre of pressure (CP) can be displaced anteriorly in the paretic leg because of antero posterior muscle imbalance in the ankle joint (equinus foot). A positive correlation exists between balance impairments and decreased lower-limb strength. In addition, poor trunk control negatively influences overall balance. A subset of patients with stroke who have balance problems are distinguished by resistance to support weight on their nonparetic side, a phenomenon historically referred to as "pushing" or "pusher syndrome".

## **DUAL TASKING IN HEMIPLEGIA USING THE CAPACITY THEORY**

The ability to execute two tasks at the same time is necessary and commonly used by human beings in the performance of various activities of daily living. This capability represents an evolutionary advantage, since it allows the individual to perform various activities concurrently, with lower neural activation, using less than with doing the same tasks separately. The loss that one - or both - suffers is called dual task interference. It can be expressed in the gait as a decrease in the speed, in the length of the stride, and in the cadence and as an increase in the time of double support. Among the three theoretical models available to explain the dual task interference, capacity theory - or theory of sharing resources (the capacity model), is more suitable. The dual task can be motor, cognitive, or motor-cognitive. A rehabilitation strategy

increasingly used is the dual task training, which seeks to facilitate, by means of conducting concurrent functional activities, the allocation of attention resources, thus decreasing the dual task interference.

In daily living, walking and balancing are performed while executing simultaneous tasks. For example, frequently encountered scenarios include conversing, carrying a bag, texting or making a phone call while walking. Researchers have explored the effects of gait on dual-task training, involving Motor Dual-Task Training (MDTT) and Cognitive Dual-Task Training (CDTT), in chronic stroke patients at risk of falling. Pang et al indicated that a CDTT intervention had encouraging results for improving mobility and potentially preventing falls.

### **Fullerton advanced balance scale (FAB)**

The Fullerton Test is mainly intended to identify persons at increased risk to experience fall-related injuries due to sensory impairments. The test uses both dynamic and static balance under different situations in older adults. The FAB scale is a 10-item balance scale with a 5-point ordinal scale (0–4) for each item and a maximum score of 40 points (higher values indicate better performance).

### **Cognitive assessment scale for stroke (CASP)**

The CASP is a clinical scale specifically designed for post-stroke especially for those, aphasia or hemispatial neglect may interfere with the results. It is one of the oldest & Brief Neuropsychological Screening test, which is very rapid (5–10 min). CASP has good psychometric properties for screening cognitive impairment in the post-stroke. The CASP includes nine items evaluating a total of 6 cognitive functions: language, praxis, short-term memory, temporal orientation, spatial/visuo-construction neglect and executive functions. Each function is quoted on 6 points; the maximum total score is 36 points. The results from the CASP administration can be presented either as a profile for a qualitative analysis of the impairments, or as a global score.

## **REVIEW OF LITERATURE**

- ❖ Hui-xian Yu, Zhao-Xia Wang, Chang-bin Liu, Pei Dai –Jan 2021 Patients with hemiplegic gait are at a risk of falling because of poor balance. The theory of cognitive-motor networks paved the way for a new field of research. However, the mechanism of the relationship of cognition with gait or posture control networks is unclear because of the dynamic characteristics of walking and changing postures. To explore differences in the balance function and fall risk between patients with and without cognitive impairment after stroke, we utilized the Berg balance scale, Timed “Up and Go” test, and 10 m walking test. Patients were divided into two groups: the observation group (16 patients, female 6 and male 10), comprising patients with cognitive impairment after stroke, and the control group (16 patients, female 7 and male 9), comprising patients without cognitive impairment after stroke. We found that patients with cognitive impairment had worse balance function and a higher risk of falls. They needed a longer time to turn around or sit down. Our findings indicated that posture control in turning around and sitting down required more cognitive resources in daily life.
- ❖ Numpung Khumsapsiri, Akkradate Siriphorn - mar 2017 objective of this study was to investigate the reliability of the FAB. The FAB is a balance measure that comprehensively addressed the multiple dimensions of balance. Ten individuals with stroke were recruited by the investigator. The inclusion criteria were as following: persons with hemiparesis who was diagnosed with their first stroke (ischemic or haemorrhagic); aged between 30-75 years old. The exclusion criteria were, if they could not follow the command and could not finish the test. All data were analysed using SPSS software, version 17.0. The minimal detectable change at the 95% confidence interval. The result indicated that the FAB provided good reliability

❖ Gye Yeop Kim , Mi Ran Han , Hong Gyun Lee - Jan 2014

To determine the effect of dual-task training with cognitive tasks, walking ability after stroke. Twenty patients diagnosed with stroke participated in this study. All participants were receiving a traditional rehabilitation program 5 days a week. Dual-task and single-task training were additionally performed for 4 weeks, 3 days a week. 10-Meter Walk Test and Figure-of-8 Walk Test were used to measure cognitive and walking abilities. They evaluated 3 times (before and after training and at the 2-week follow-up) & concluded dual tasking is effective.

## METHODOLOGY

### Aim of the study

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The study was conducted on those hemiplegic patients willing to learn movement through a new method of perceptual, motor task, in & around (50 km) of Chidambaram. As suitable to study objectives, patients were attended by house visit & some patients were selected from outpatient services of Occupational Therapy service at GCMC&H.

**Study design** Experimental study

### Selection criteria

#### Inclusion criteria

- Hemiplegics in the 5th stage of recovery.
- Both male and female participants of age 30 to 55 years

#### Exclusion criteria

- Comorbid neurological & Orthopaedic problem

## PROCEDURE ADAPTED TO PLAY MODIFIED HOPSCOTCH



1. With instruction from project supervisor, a modified Hopscotch court with 8 ×8 squares was prepared, as unique for the study participants (given above)
2. One player (HP client) goes at a time.
3. Starting in front of foot shaped squares (square 1)
4. From square 1 according to Therapist instruction on shapes, patient bends down and touches the square with hand and progress along the other area.
5. Instruction will be like “Hop one leg on a single square with star shape” (one foot only)
6. After reaching the end, instruction to turn around & continue will be given
7. The shapes represented like circle , triangle , square , parallelogram & foot & hand prints are also given training to perceive at different sessions, to do the above steps.

### Data analysis

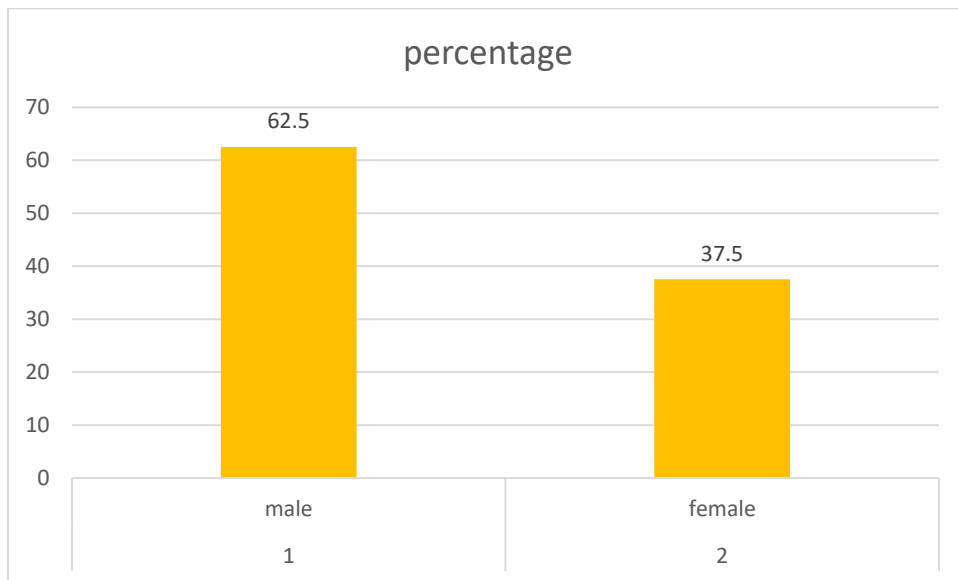
#### Distribution sample according to Age

S.NO	AGE	PARTICIPANTS	PERCENTAGE
1	30	10	25
2	35	13	32.5
3	45	9	22.5
4	55	8	20
	<b>TOTAL</b>	40	100

It is seen from the table that 25% of respondent are of Age 30. 32.5% of them belong to age 35. 22.5% of the respondent patients are in the age of 45, 20 % percentage of the respondent are in the age of 55. Therefore the majority of the patients involved are in the age group of 35.



### Distribution of samples by gender



62.5 percent participants are male, 37.5 percent participants are females

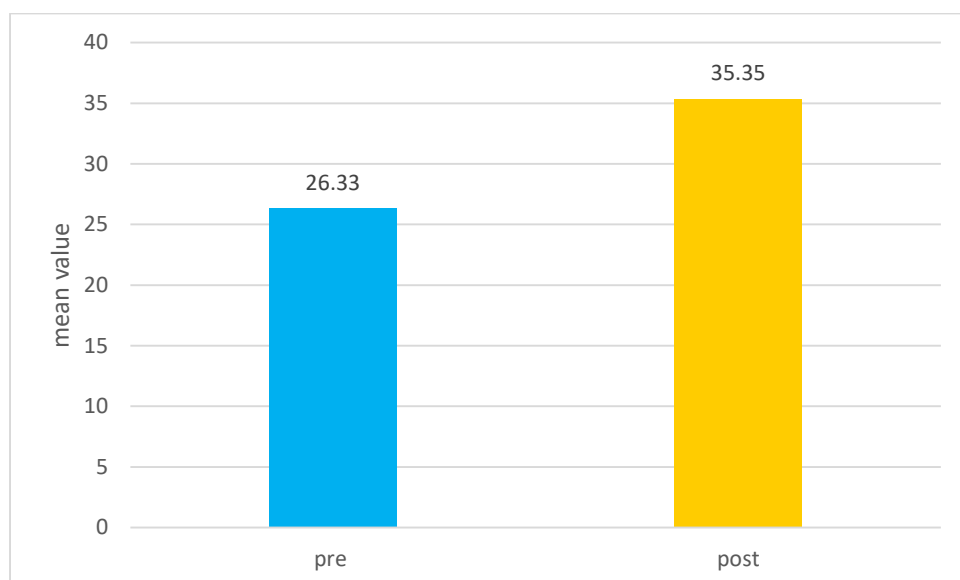
### TABLE showing T TEST OF FAB SCALE IN PRE AND POST VALUE

The

GROUP	N	MEAN	STANDRAD DEVIATION	STANDRAD ERROR MEAN	T-VALUE	PROBALITY VALUE
Pre therapy	40	26.33	1.15	0.19	2.3581	1.729
Post therapy	40	35.35	2.13	0.46		

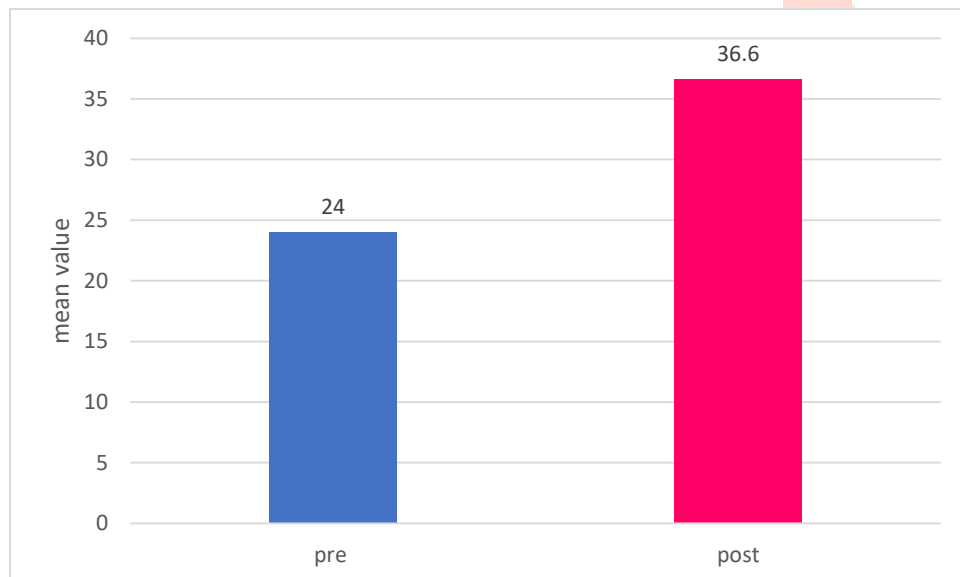
calculated t value 2.3581.and the probability value is 1.729 at 0.01 level of significance shows, there is significant difference between the pre and post test for Fullerton advanced balance scale.

The following Bar diagram shows mean value plots for pre & post therapy



#### MEAN SAMPLE T TEST OF [CASP- SCALE]

GROUP	N	MEAN	STANDRAD DEVATION	STANDRAD ERROR MEAN	T-VALUE	PROBALITY VALUE
PRE	40	24.0	1.99	0.316	0.2165	1.72913
POST	40	36.6	1.35	0.213		



From the above, table & bar diagram, pre test the calculated t value 0.2165 and the probability value is 1.72913 at significance 0.01, concludes that there is significant difference because of therapy by CASP-SCALE.

## RESULTS

It is seen from the table that 25% of respondent are the age of 30, 32.5% of them are the age of 35, 22.5% of the respondent patients are in the age of 45, 20 % percentage of the respondent are in the age of 55. Therefore the majority of the patients are involved are in the age group of 35. The majority of the sample belong to the age group of 35. The majority of the population are male group about 62.5% are selected around 50 km radius of Chidambaram and RMMC, and 37.5% are females. The Fullerton advanced balanced scale FAB scale and the Cognitive assessment scale for hemiplegics show significant increase in balance in male then female.

## Discussion

The study is an revivification for stroke patients with problem in their perceptual and motor activity (balance), through occupational therapy activities which was given to clients through home visits and institutional participation. The data were collected form MRD medical records department with proper permission. The study sampling was taken using both FAB and CASP scale with informed consent of the patients. Most of the patients were willing for the activity were daily wages workers. The least willing of the patients were the person leading a sedentary life. Pre & Post therapy assessment shows that the male participants have improvement in their balance.

## Conclusion

Dual tasking, though implemented in daily living task unconsciously, like walking and carrying a bag, texting or making a phone call while walking, as well the ability to perform such activities is affected after stroke. For better occupational performance, hemiplegics has to be involved in dual task training sessions by OT's as relevant for ADL. In this project, Hopscotch game is DEVISED, with specific purpose of TRAINING Hemiplegics as suitable to the study requirements. Therapist need to pay attention, while patient is playing the game. The Pre & post therapy analysis conducted with valid assessment tools shows dual task training positively influence recovery for hemiplegic clients.

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