EFFECT OF BIOMECHANICAL ANKLE PLATFORM SYSTEM (BAPS) TRAINING FOR IMPROVING BALANCE IN STROKE PATIENTS

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EFFECT OF BIOMECHANICAL ANKLE PLATFORM SYSTEM (BAPS) TRAINING FOR IMPROVING BALANCE IN STROKE PATIENTS.

Submitted by **Md. Abdul Alim**, for the partial fulfillment of the requirements for the degree of Bachelor of Science in Physiotherapy (B. Sc. PT).

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Declaration

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of information of the study, I would be bound to take written consent of my supervisor & Head, Department of Physiotherapy, BHPI.

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Contents

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Acronyms

ADL	Activity of Daily Living
BHPI	Bangladesh Health Professions Institute
CRP	Centre for the Rehabilitation of the Paralysed
BBS	Berg Balance Scale
RCT	Randomized Control Trial
SD	Standard Deviation
PT	Physiotherapy
BAPS	Biomechanical Ankle Platform System
USA	United States of America
WHO	World Health Organization

List of Figures

List of Tables

Page No.

ABSTRACT

Purpose: The purpose of this study was to test the hypothesis "BAPS training with conventional physiotherapy is better than only conventional physiotherapy for improve balance in stroke patients". *Objectives:* To identify the effect of Biomechanical Ankle Platform System (BAPS) training for improving balance in stroke patients. Also to explore the commonly affected age group, affected side, type of stroke and gender group of people who were more affected. *Methodology*: Single blinded; Randomized controlled trial study was used in this study. The data were collected by simple random sampling procedure by using a structural mixed type of questionnaire. 20 stroke patients with balance problem were listed from Neurology outdoor at physiotherapy department of CRP (Savar). After that 10 patients were randomly assigned to BAPS training exercises with conventional physiotherapy group and 10 patients to the only conventional physiotherapy group for this study. Berg Balance Scale (BBS) was used to measure the Balance level of the patients. *Results:* Data was analyzed by using Mann Whitney *"U"* test and Microsoft Mac Excel Worksheet 2011 was used to decorate data according to BBS scale. After observing pre-test and post-test score the significant improvement wasn't found. P-value was > 0.05. Improvements were not statistically significant. But according to mean difference this study has found greater improvement over control group. *Conclusions:* Biomechanical Ankle Platform System training exercises along with conventional therapy are more effective than conventional therapy alone to improve balance of stroke patients.

Keywords: Stroke patient, Balance in stroke patient, BAPS Training, Conventional Physiotherapy.

CHAPTER-I INTRODUCTION

1.1 Background

Bangladesh is the most densely populated developing country in the world. Stroke is the third most common cause of death and adult disability in Bangladesh. Bangladesh's mortality rate due to stroke is 84 in the world based on WHO ranks. And overall prevalence for stroke is 0·30% (Islam et al., 2012).

Stroke is the synonym of cerebrovascular accident (CVA), rapid loss of brain function due to a disturbance of blood supply to the brain. It is the most common cause of death and neurological disability in the world's adult population. Based on World Health Organization (WHO), "Stroke is a rapidly developed clinical sign of focal disturbance of cerebral function of presumed vascular origin and of more than 24-hours duration" (Stokes, 1989). This definition does not include `transient ischemic attacks`. Transient Ischemic Attacks (TIA) are episodes of stroke symptoms that last only temporarily; the standard definition of duration is <24 h, but most TIAs last <1 h. The standard definition of TIA requires that all neurologic signs and symptoms resolve within 24 h regardless of whether there is imaging evidence of new permanent brain injury; stroke has occurred if the neurologic signs and symptoms last for >24 h (Braunwald et al., 2003). It is the most frequent clinical manifestation of diseases of the cerebral blood vessels (Boon et al., 1999). The clinical manifestations of stroke are highly variable because of the complex anatomy of the brain and its vasculature (Boon et al., 1999). A stroke is a brain attack, or a CVA is a sudden death of brain cause by a lack of supply in oxygen to the brain.

According to the WHO, approximately 15 million people suffer a stroke worldwide each year, among them nearly six million die and another five million are left permanently disabled (Eijk et al., 2010). Stroke results in more disability than death.

Cerebrovascular diseases contain most common and devastating disorders: ischemic stroke, hemorrhagic stroke, and cerebrovascular anomalies such as intracranial aneurysms and arteriovenous malformations (AVMs).

There are 2 main types of stroke- Ischemic & Hemorrhagic.

Ischemic stroke or cerebral infarct (80% of strokes) is the effect of a blockage or a reduction of blood flow in artery which delivers brain. It could happen either completely blocks the blood vessel (clot), or buildup of plaque inside the arteries that defeat of blood flow in the narrow vessel often due to cholesterol.

Hemorrhagic stroke is the rupture of an artery with in the brain affecting an intracerebral hemorrhage (15% of strokes) or AVM involving sub arachnoid hemorrhage (5% of strokes) or to the rupture of aneurysm (Braunwald et al., 2003).

Risk factors of stroke can be divided into two factors. They are modifiable and non-modifiable factor. Non- modifiable factors are; age, gender (male > female, except in the very young and very old), race (Afro-Caribbean > Asian > European), heredity, previous vascular event, e.g. myocardial infarction, stroke or peripheral embolism, high fibrinogen and modifiable factors are; high blood pressure, heart disease (atrial fibrillation, heart failure, endocarditis), diabetes mellitus, hyperlipidaemia, smoking, excess alcohol consumption, polycythaemia, oral contraceptives, social deprivation (Boon et al., 1999). The most important modifiable risk factors for stroke are hypertension and atrial fibrillation.

As the affected area of the brain cannot work that might result in hemiparesis or hemiplegia, an inability to understand or formulate speech (aphasia), or hemianopia (Donnan et al., 2008). Hemiparesis is the most common neurological deficit afterward stroke. Hemiparetic stroke patients normally represent balance disorders (Harris et al., 2005). Balance is a complex motor skill that depends on interactions between multiple sensorimotor processes and environmental and functional contexts. Balance or postural stability is the ability to maintain a position and react to a perpetuating force (Roth et al., 2006). Many physiological components of the human body allow us to perform such reactions. Of most importance regarding maintaining balance is proprioception: the ability to sense the position of a joint or body part in motion (Brown, Miller, & Eason, 2006). Several types of sensory receptors located throughout the skin, muscles, joint capsules, and ligaments give the body its ability to recognize both internal and external environmental changes within each joint and ultimately lead to improvements in balance (Riemann & Lephart, 2002). Balance is

essential to all functional activities during sitting and standing (Eser et al., 2008). Proprioception is produced through the simultaneous actions of the vestibular, visual, and sensorimotor systems, each of which plays a significant role in maintaining postural stability. Of most concern in enhancing proprioception are the functions of the sensorimotor system. Encompassing the sensory, motor, and central integration and processing components involved in maintaining joint homeostasis during bodily movements, the sensorimotor system includes the information received through nerve receptors located in ligaments, joint capsules, cartilage, friction, and the bony geometry involved in each joint's structure. Mechanoreceptors are specialized sensory receptors responsible for quantitatively transducing the mechanical events occurring in their host tissues into neural signals (Riemann & Lephart, 2002). Those that are responsible for proprioception are generally located in joint muscles, tendons, ligaments, and capsules while pressure sensitive receptors are located in the fascia and skin (Riemann & Lephart, 2002). Impaired balance is a main reason of locomotors disability afterward stroke (Rode et al., 1997). Moreover, impaired postural control is a main characteristic of the mobility problems in stroke patients that caused by a complex interplay of motor, sensory, and cognitive impairments (Laufer et al., 2000). In hemiplegia patients, the lower extremity of the affected side supports only 25 to 43% of the patient's body weight in standing postures, leading to asymmetric postures. The specific causes of balance disorders in hemi paretic patients after stroke can be various (Chang & Gung, 2000). Balance can be affected in various ways which include joint motion limitation, weakness, altered muscular tone, (Oliviera et al., 2008) sensory deficits, (Bayouk et al., 2006) anomalous postural reactions (Hammer et al., 2008) and cognitive problems, neurological deficits, vestibular deficits, (Tyson & Connell, 2009) loss of sensation, visual defects, proprioceptive defects, co-ordination defecits, loss of attention (Chun et al., 2002). Difficulties in determining individual causes of balance impairment and disability are related to the diverse mechanisms involved. A significant positive correlation between strength or lower-limb control and balance disability was found in studies (Niam et al., 1999). Niam et al. (1999) & Keenan et al. (1984) found a positive relationship between balance disability and sensation (as measured by ankle proprioception). In this study Niam et al. (1999) & Bohannon, (1989) failed to find a relationship between age, sex, or side of stroke and balance disability. The another study has indicated that weakness and sensation have the most impact on balance (De Haart et al., 2004).

The physical management process aims to maximize functional ability and prevent secondary complications to enable the patient to resume all aspects of life in his or her own environment (Braunwald et al., 2003).

As balance problems are common after stroke and treatment of balance continues to be standard of care in stroke rehabilitation (Goljar et al., 2010). The physiotherapist plays a major role in the physical management of stroke using skills acquired during education and professional development, to identify and manage problems of stroke using scientific principles (Carr & Shepherd, 2003).

There are many researches done about improving balance in stroke patients. Most of the work done regarding balance training in stroke subjects has focused on task-oriented activities and training under varied sensory input and found them to be effective.

Studies have also compared the effect of stable and unstable surfaces on balance in stroke subjects and found that balance training on unstable surfaces is more effective in improving static and dynamic balance. There has not been any study till to evaluate the effectiveness of balance training program through BAPS training, which is specific for stroke subjects who have difficulty in standing. The BAPS has been shown to improve lower extremity proprioception, strength and coordination; therefore, with BAPS training, it is possible to increase postural control and balance (Soderberg et al., 1991.The BAPS consists of a reversible platform, five hemispherical attachments, weight rods and weights and a storage rack. One of five differently sized half spheres can be manually attached to the surface of the platform to adjust the maximal tilt angle. The five levels challenge subjects to keep single-leg postural control while maintaining a steady stance or performing various range of motion exercises (Lee et al., 2008).

1.2 Rationale

Bangladesh is the most densely populated developing country in the world. Stroke is the third most common cause of death and adult disability in Bangladesh (Islam et al., 2012). Balance problems are common after stroke and it is challenging to improve balance in stroke patient. The physiotherapists play a major role in the physical management of stroke and manage problems of stroke using scientific principles (Carr & Shepherd, 2003). Many work done regarding balance training in stroke subjects. But there has not been any study till date investigating the effect of BAPS training for improving balance, which is specific for stroke subjects. The purpose of the study was to test the hypothesis "BAPS training with conventional physiotherapy is better than only conventional physiotherapy for improve balance in stroke patients.

BAPS board is more proprioceptive because it has a reversible platform, five hemispherical attachments, weight rods and weights as well as a storage rack. There are five different sizes of half spheres which are manually attached on surface of platform to adjust the maximal tilt angle. The five levels of challenging the subjects to keep single-leg postural control while maintaining a steady stance or performing various range-of-motion exercises with their functional ankle instability (FAI) limb (Lee et al., 2008). BAPS training help to improve balance, which is essential for functional activity. It also may help to improve the balance, proprioception, stretching, strengthening the lower leg and ankle (Soderberg et al., 1991). BAPS improve postural stability by increasing balance, proprioception and strengthen muscle. So, BAPS training exercise could be included as evidence based treatment for stroke patients.

1.3 Hypothesis

BAPS training with conventional physiotherapy is better than only conventional physiotherapy for the improvement of balance in stroke patient.

1.4 Null hypothesis

BAPS training with conventional physiotherapy is no more effective than only conventional physiotherapy for the improvement of balance in stroke patient.

1.5 Objective

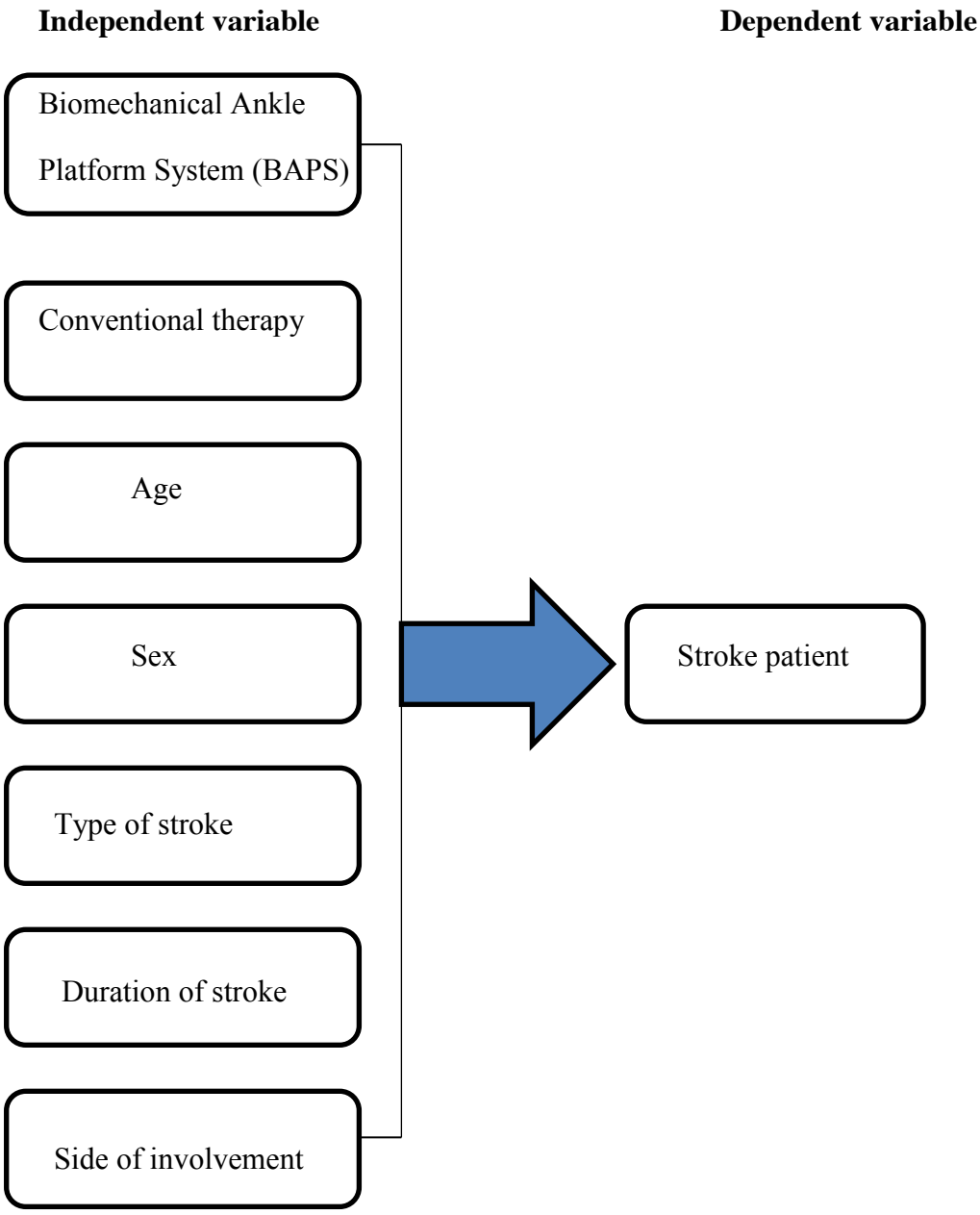
1.5.a General objective

To identify the effect of Biomechanical Ankle Platform System (BAPS) training to improve balance in stroke patients.

1.5.b Specific objective

To evaluate the effect of Biomechanical Ankle Platform System (BAPS) training for stroke patient during postural instability.

1.6 List of variable



1.7 Operational definition

BAPS

The BAPS board or Biomechanical Ankle Platform System is a circular platform that patient's foot is placed on. Different sizes of balls can be placed on the bottom of the board. This makes the board different heights so patient can do different levels of exercise. As the ball size becomes larger, the amount of ankle movement increases. Weights can also be placed on the BAPS board to help strengthen ankle (Clark & Burden, 2005).

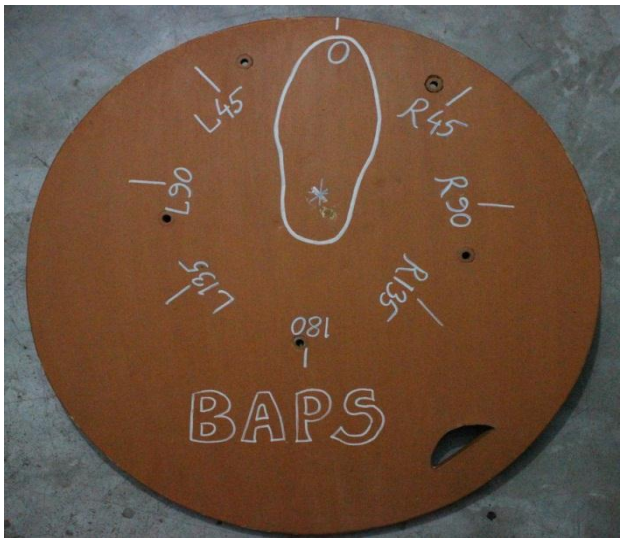


Figure-1: BAPS Board.

BAPS Training

Some systemic programmed exercises performed by BAPS board for improving postural stability and neuromuscular balance along various patients (Lee et al., 2008).

Stroke

A rapidly developed clinical sign of focal disturbance cerebral function and presumed vascular origin and of more than 24 hours duration is called stroke (Stokes, 1989).

Balance

The ability to maintain the body's center of gravity over the base of support (Bonan et al., 2004).

Berg Balance Scale

The BBS is a 14- item scale that quantitatively assesses balance and risk for falls in older community dwelling adults through direct observation of their performance (Geiger et al., 2001).

Conventional physiotherapy

Conventional physiotherapy is a group of selected treatment techniques set by a physiotherapist on the basis of evidence that are widely used around the world for the treatment of specific disease (Kishner & Colby, 2007).

CHAPTER-II LITERATURE REVIEW

Stroke is the most common cause of neurological disability in the adult population. It is responsible for about a quarter of all deaths in the developed countries and account for much disability in the elderly (Rayamajhi et al., 2014). About 75% of stroke affected people have leftover effects, and other effects make it impossible to work. Stroke is one of the major causes of permanent disability with an incidence of approximately 1.75% per year (Herman et al., 1982). Although approximately two thirds of the affected patients are above 65 years, a stroke may occur at all ages, even in very young children (Warlow, 2001). A majority of the survivors from stroke have a combination of sensory, motor, cognitive and emotional impairments leading to restrictions in their capacity to perform basic activities of daily living (ADL) (Hochstenbach et al., 1996).

Impaired balance is the most common after stroke. After stroke, some patients are unable to stand, and others have higher postural sway, asymmetric weight distribution, impaired weight- shifting ability and equilibrium reactions may be delayed or disrupted (Dickstein & Abuluflo, 2000). There is also an increased risk of falling, resulting in high economic costs and social problems (Belgen et al., 2006). Balance can be affected in different ways, which include joint motion limitation, weakness, altered muscular tone, (Oliviera et al., 2008) sensory deficits, (Bayouk et al., 2006) anomalous postural reactions (Hammer et al., 2008) and cognitive problems, neurological deficits, vestibular deficits, (Tyson and Connell, 2009) loss of sensation, visual defects, proprioceptive defects, co-ordination deficits, loss of attention (Chun et al., 2002).

Measuring balance is an important for prescribing the most appropriate therapy, mobility aids, identifying safe and unsafe activities after the stroke and outcome measurement of the patient (Berg et al., 2008). A variety of laboratory approaches to assess balance are proposed, but the functional scales of balance measures are most commonly applied to stroke patients in clinical settings. There are 15 different functional scales measuring balance are developed and used in stroke patients (Berg, at al., 2008). However, only a few are specifically designed for stroke patients. The balance sub scale of the Fugl-Meyer test (FM-B) (Fugl- Meyer, 1975) and the Berg

Balance Scale (BBS) are the most commonly used. Recently, Benaim et al., (1999) adapted items from the FM-B and developed a new scale, the Postural Assessment Scale for Stroke Patients (PASS). The Berg Balance Scale (BBS) is a widely used clinical measure of functional balance. The BBS is a 14- item scale that quantitatively assesses balance and risk for falls in older community- dwelling adults through direct observation of their performance (Berg et al., 2008).

Postural control is important to maintain balance. The important resources for postural control are movement strategies, biomechanical constraints, cognitive processing, perception of the verticality (visual and postural), sensory modalities (somatosensory, visual and vestibular) and the sensory reintegration and reweighting in central nervous system (CNS) which is impaired after a stroke (Oliveira et al., 2008). The physiotherapist plays a major role in the physical management of stroke using skills acquired during education and professional development, to identify and manage problems of stroke using scientific principles (Carr & Shepherd, 2003). Many researchers use many techniques for improving balance in stroke patient. In both strength training and skill development, repetition is an important aspect of practice (Carr & Shepherd, 2003). Repetitive exercise and practice of an action facilitates the contraction of the muscles is necessary to increase muscle strength and train co-ordination of the muscular synergies that move the segmental linkage (Nayak et al., 2009). Restoration of paretic leg muscle functions may determine the standing balance gains in patients with stroke (Geurts et al., 2004).

Improvement of weight bearing symmetry is traditionally regarded as primary goal rehabilitation and associated with better motor functioning in post-acute phase of stroke (Hatton et al., 2010). The possible efficacy of repetitive sit to stand training using biofeedback on dynamic standing balance skills, especially sit to stand transfers is of lower limb strength training on making sit to stand transfer need further support (Cheng et al., 1998). In addition, targeted balance training during visual deprivation may be more effective to improve stance stability under complex sensory conditions than the same training with full vision (Carr & Shepherd, 2003). Stepping and grasping movements of the limbs also appear to play an important functional role in maintaining upright stance (Pyo¨ria et al., 2004). Recovery and improvement of function following a stroke vary much during the first year after the stroke (Pyo¨ria et

al., 2004). Most studies of balance in stroke patients on stairs have not included. Recent study examined the effects of stair exercise on the balance ability of stroke patients (Kim et al., 2009). Aquatic exercise improves motor function, static and dynamic balance in people who suffered stroke (Lee, 2010). Cheng et al. (2001) achieved a significant improvement in sit-to stand performance in hemiplegic stroke patients in the training group with standing biofeedback trainer. Bayouk et al. (2006) showed his study a multisensory training component with the regular exercise program was required to obtain a significant improvement in standing balance of stroke subjects. Their sample size was sixteen and duration of treatment was 8 weeks. Montagna et al. (2014) showed that the Halliwick method improved balance and the mobility domain in Stroke subject. Overall, aquatic exercise improves motor function, static and dynamic balance in people who suffered stroke. Their duration of treatment was 18 individual sessions and their measurement tools was balance berg scale, times up and go test. Katz-Leurer et al. (2006) showed their study cycling exercise programmed achieved better balance and motor abilities immediately after the cycling exercise programme as well as three weeks. In previous studies it was demonstrated that repetitive bilateral training and treadmill walking with and without suspension have a positive influence on walking ability and balance. Goljar et al. (2010) showed that both methods, conventional balance training and training balance in the balance trainer, improved balance in subacute stroke patients. There were no significant differences between the two groups in any of the measured parameters. The results of the study are similar to others, who also showed that different therapeutic approaches improved balance in stroke patients. One-leg standing is important for many daily activities, such as walking (single leg support phase) and climbing stairs, stepping on an escalator or on the sidewalk as well as for reaching things, dressing the lower body, and similar. Ding et al. (2013) showed that study applied the principles of CIMT to lower-limb balance rehabilitation by using a modified off-the-shelf motion gaming system. Our preliminary results from three chronic stroke patients with hemiparesis demonstrated that a virtual reality system with augmented control gains can increase weight bearing on the paretic leg. Compared to a conventional stroke rehabilitation program, one week of training with this modified CIMT rehabilitation improved participants' performance in COP tracking and stance symmetry. The study is a small-sample clinic study, our results suggest that the principles of CIMT therapy may be applied to balance training in stroke survivors with a low-cost, customizable

VR system. In the tracking task a portion of the observed improvement is likely to be contaminated by practice effects. The findings suggest that VR-based rehabilitation may be an effective approach to lower-limb hemiparesis; our performance metrics may only be capturing very specific learning effects. The Wii Fit games require players to coordinate the trunk and leg muscles to swiftly and accurately shift body weight. The Wii training is, thus, very similar to the COP tracking assessment task. Similarly, the augmented control gain forces participants to load their paretic leg during VR training and encourages a more symmetrical stance. Winstein et al. (1989) collected data from two groups of 21 matched hemi paretic adults. One group received a specially designed device, which provided dynamic visual information about relative weight distribution over bilateral limbs. The other group received conventional hospital-assigned physical therapy. Their results revealed that standing balance including center of pressure position, weight distribution and stability were better in those with special augmented feedback training, but loco-motor control performance was not differentially affected by the two therapy modes. Such results suggested that although standing balance and locomotion were highly interrelated, changes in one function might not reflect in changes in the other. Geiger et al. (2001) recruited 13 hemiplegic outpatients; the experimental group (N=7) was trained on NeuroCom Balance Master. Following 4 weeks of intervention, their major findings did not support any beneficial effects in the experimental group although both groups scored higher on functional measurements using Berg Balance Scale and Timed Up & Go Test. Chen et al. (2002) founded dynamic balance function showed significant improvements in patients with visual feedback training when compared with those receiving conventional therapy only. Patients in the trained group also showed significant improvements in the self-care ability at 6 months of follow up. Taly et al. (2009) showed that Balance training by force platform and visual feedback technique leads to significant improvement in the ability to perform activities of daily living as evidenced by improved Barthel Index scores both at the completion of the training and at 3 months follow-up. Januário et al. (2010) suggest that a training programmed using force platform visual biofeedback improves objective measures of bilateral postural stability in patients with hemiplegia and/or ataxia after stroke, even in a chronic phase when significant motor recovery or neurological gains are not expected. It may be important to associate biofeedback balance training to conventional programmes. In this study their sample size was 38 individual stroke patients and their

time duration of training was 15 weeks. The biomechanical ankle platform system (BAPS) is one way in which participants can train/exercise in older to improve balance. The BAPS incorporates an axis of rotation for a insertion of a hemispherical attachment (Mandy & Kelly, 2000). The BAPS has been shown to improve lower extremity proprioception, strength and coordination; therefore, with BAPS training, it is possible to increase postural control and balance (Soderberg et al., 1991). The effectiveness of 4–8 weeks of wobble board training on postural control and perceived stability has been well documented (Clark & Burden, 2005). One study demonstrated that a 10-week BAPS training program significantly improved postural control (Hoffman & Payne, 1995). The 12-week BAPS training program produced significant improvement in ankle proprioception (Lee & Lin 2008). BAPS training is a form of closed-chain exercise, which might induce maximal stimulation of joint, muscle and plantar-surface mechanoreceptors found about the lower limb. During BAPS training, participants in this study had to consciously manipulate their ankle position and keep balance to coordinate the various exercises (Lee & Lin 2008).

CHAPTER-III METHODOLOGY

It was an experimental design that used to evaluate the effect of Biomechanical Ankle System (BAPS) training for improving balance in stroke patients. 20 stroke patients were selected from out patient of neurology unit at physiotherapy department of CRP, Savar and then 10 patients were randomly assigned to Experimental group comprising the treatment of BAPS training with conventional physiotherapy and 10 patients to the control group with conventional physiotherapy only.

3.1 Study design

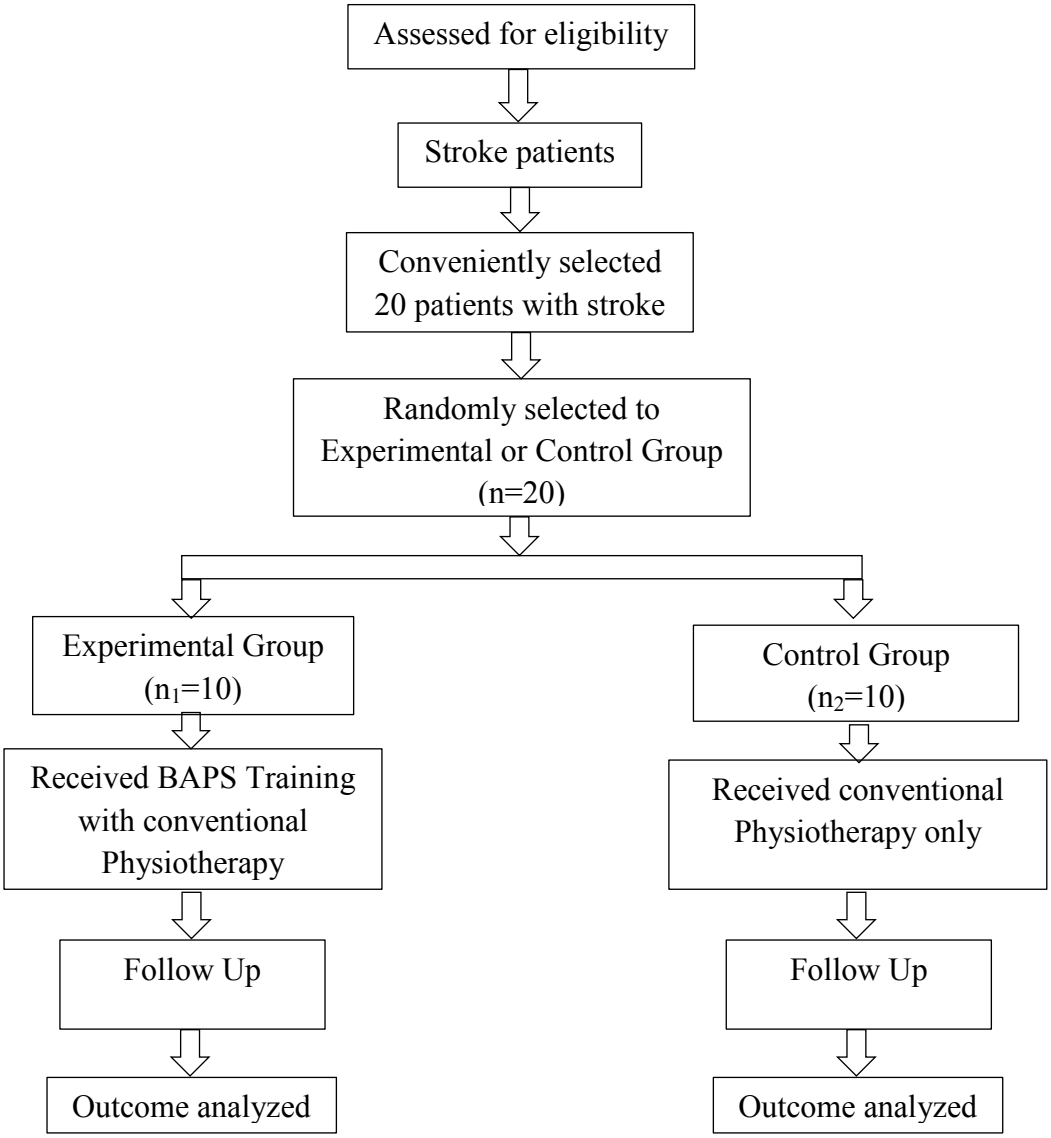
This study was designed based on an experimental quantitative method. According to Depoy & Gitlin (2013) the design could be shown by:

Experimental Group : r O_1 X O_2

Control Group : r O_1 O_2

The study was an experiment between two subject designs. BAPS training with Conventional physiotherapy were applied to the experimental group and only conventional physiotherapy was applied to the control group. Measurement was obtained before starting the intervention (Pretest) and after the 8 session of intervention period (Post-test).

Flowchart of the phases of randomized controlled trial



A flowchart for a randomized controlled trial of a treatment program including conventional physiotherapy with BAPS training for stroke patients.

3.2 Study site

Neurology unit of the Centre for the Rehabilitation of the Paralyzed (CRP), Savar was selected for the study site.

3.3 Study area

The study conducted on Neurology area.

3.4 Study population

Patient with CVA who received physiotherapy intervention from CRP, Savar, Dhaka

3.5 Sampling procedure

Subjects, who met the inclusion criteria, were taken as sample in this study. 20 stroke patients were selected from out patient of neurology unit at physiotherapy department of CRP, Savar and then 10 patients were randomly assigned to experimental group comprising of the treatment of BAPS training with conventional physiotherapy and other 10 patients to control group with conventional physiotherapy only for this study. The study was a single blinded technique. When the samples were collected, the researcher randomly assign the participants into experimental and control group, because it improves internal validity of experimental research. The samples were given numerical number C1, C2, C3 etc. for the control group and E1, E2, E3 etc. for experimental group. Total 20 samples were included in this study, among them 10 patients were selected for the experimental group and rest 10 patients were selected for control group.

3.6 Sample size

20 subjects were randomly selected into two groups where 10 subjects were in control group and 10 subjects were in trial group.

3.7 Inclusion criteria

- ✓ 3-8 months post stroke patient
- ✓ Patient with CVA who is able to stand without support
- ✓ Patient with poor static and dynamic standing balance
- ✓ Age range 45-65 years
- ✓ Male and Female patient with CVA
- ✓ Both ischemic and hemorrhagic stroke
- ✓ Both right and left hemiplegia
- ✓ Able to communicate
- ✓ The participants were those individuals who continued physiotherapy treatment at least 8 sessions.

3.8 Exclusion criteria

- ✓ Medically unstable
- ✓ Pusher syndrome
- ✓ Any deformity, contracture, surgical condition
- ✓ Any spinal deformity
- ✓ Cognitive, visual, hearing problem
- ✓ Any other neurological deficits as multiple sclerosis, Parkinson's disease etc.
- ✓ Any musculoskeletal disorder like osteoarthritis, ligament injury etc.

3.9 Data collection tools

- Record or Data collection form
- Consent Form
- Structured questionnaire. (Both open ended and close ended questionnaire)
- BBS scale (Berg Balance Scale)
- Pen, Pencil, Papers
- Stopwatch
- Weight measurement machine

3.10 Data collection

Data collection procedure was conducted through assessing the patient, initial recording, treatment and final recording. After screening the patient at outdoor department, the patients were assessed by qualified physiotherapist in neurology department of CRP. 20 subjects were chosen for data collection according to the inclusion criteria and randomly allocated in to two groups where one group received only conventional treatment called control group and another group received BAPS training along with conventional treatment called trial group. The researcher divided all participants into two groups and the coded C1, C2, C3, C4, C5, C6, C7, C8, C9, C10 for control group and E1, E2, E3, E4, E5, E6, E7, E8, E9, E10 for experimental group. Data was gathered through a pre-test, intervention and post-test. Data was collected by using a structural mixed type of questionnaire form, which was formatted by the researcher. Pre-test was performed before beginning the treatment and functional outcome was noted. The same procedure was performed to take post-test at the end of 8 session of treatment. The researcher was collected the data both in experimental and control group in front of the qualified physiotherapist and verified by a witness selected by the Head of clinical setting in order to reduce the biasness. At the end of the study, specific test was performed for statistical analysis.

3.11 Measurement

Baseline variables included age, sex, occupation, type of stroke, duration of stroke, Site of hemiplegia, living area, Weight, and balance. Outcome measurements were taken at the baseline and after eight session of treatment in two groups. Measurements were made of by Berg Balance Scale (BBS). The BBS is a 14-item scale that quantitatively assesses balance. The Berg Balance Scale measures a person's ability to perform 14 balance activities: sit and stand unsupported, transfer from a sitting position to standing position and from a standing position to a sitting position, transfer to and from a chair and mat, stand unsupported with eyes closed, stand unsupported with feet together, reach with an outstretched arm, squat and pick up an object from the floor, stand and turn to look over each shoulder, stand and turn 360 degrees toward the right and left, stand and alternately place one foot up on a step, maintain tandem stance, and stand on one lower extremity. The items are scored from 0 to 4, with a score of 0 representing an inability to complete the task and a score of 4 representing independent item achievement. A global score is calculated out of 56 possible points. All the measurements were recorded in double blinding style that is both the participants and data collector were not informed about the patient's grouping.

3.12 Intervention

After randomization subjects were assigned into two groups that are control group and trail group. The entire subjects were given intervention according to their groups. Both the groups received 45 min of physiotherapy per day, 2-3 days a week and 8 sessions for each patient within 4 weeks.

3.12.a Control group

There were 10 subjects in control group. Eight sessions of treatment the control group received a conventional physiotherapy program, which included balance training. The balance training are-

Category	Components	Setting
Balance Training	Sitting to standing	1 set/5 rep
	Standing to sitting	1 set/5 rep
	Standing with eye closed	2 min
	Standing with eye open	2 min
	Standing with feet together	2 min
	Standing with feet apart	2 min
	Reaching forward with outstretched arm	5 min
	Standing with one foot in front	1 set/10 rep
	Staring practice	1 set/10 rep
	Stepping forward, backward and sideways	1 set/10 rep
	Stepping over blocks of various heights	1 set/10 rep
	Ball throwing practice in standing position	2 min
	Walking in rough surface	5 min
	Walking in smooth surface	5 min

Table-1: Balance training program

3.12.b Trial group

There were 10 subjects in trial group. Eight sessions they were received BAPS training in addition with conventional physiotherapy. BAPS training exercises and conventional physiotherapy both were given by clinical physiotherapist.

Exercises for BAPS training

Category	Components	Setting
Exercise	Anterior–posterior cycles	3 sets/10 rep
	Medial–lateral cycles	3 sets/10 rep
	Clockwise rotation	3 sets/10 rep
	Counterclockwise rotation	3 sets/10 rep
	Single-leg stability	3 sets/10 rep

Table-2: BAPS training program

Figure-2: BAPS Training Exercise

3.13 Data analysis

To find out the effect of BAPS training for patients with stroke data were collected. In this study there were two different group where one was control that were received only conventional intervention and another group was trail that was received BAPS training exercise with conventional intervention. There were demographic data that was obtained by questioner and ratio data that was scoring for balance test by BBS scale. The clinical outcome variables were analyzed by intention to treat. The results were expressed by means. Statistical comparison between the groups was made using the *U* test for balance.

3.14 Statistical test

For the significance of the study, a statistical test was carried out. Statistical analysis refers to the well-defined organization and interpretations of the data by systemic and mathematical procure and rules (Deposy & Gittin, 2013). The *U* test was done for the analysis of the balance after 8 session treatment of both control and tail groups. Mann-Whitney *U* test is a non-parametric test that is simply compares the result obtained from the each group to see if they differ significantly. This test can be used with ordinal or interval/ ratio data.

The formula of Mann-Whitney *U* test:

$$U = n_1 n_2 \frac{n_x(n_x + 1)}{2} - T_x$$

n_1 = the number of the subjects in trail group

n_2= the number of the subject in control group.

n_x= the number of the subjects of the group with larger rank total.

T_x= the larger rank total.

3.15 Ethical consideration

Research proposal was submitted for approval to the administrative bodies of ethical committee of CRP. Again before beginning the data collection, researcher was obtained the permission from the concerned authorities ensuring the safety of the participants. In order to eliminate ethical claims, the participants were set free to receive treatment for other purposes as usual. Each participant was informed about the study before beginning and given written consent.

3.16 Informed Consent

The researcher obtained consent to participate from every subject. A signed informed consent form was received from each participant. The participants were informed that they have the right to meet with outdoor doctor if they think that the treatment is not enough to control the condition or if the condition become worsen. The participants were also informed that they were completely free to decline answering any question during the study and were free to withdraw their consent and terminate participation at any time. Withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they would still get the same facilities.

CHAPTER-IV RESULT

Twenty stroke patients were enrolled in the study. 10 in the BAPS training exercise with conventional physiotherapy treatment group (trial group) where 10 in the only conventional physiotherapy treatment group (control group). The balance score of all the subjects of both experimental and control group were measured on BBS scale before and after completing treatment.

Mean age of the participants

20 Stroke patients were included as sample of the study.

Trial group		**Control group**	
Subjects	**Age (Year)**	**Subjects**	**Age (Year)**
T1	60	C1	58
T2	65	C2	60
T3	55	C3	55
T4	51	C4	65
T5	57	C5	50
T6	60	C6	45
T7	55	C7	45
T8	46	C8	65
T9	65	C9	50
T10	60	C10	64
Mean Age	**57.4**	**Mean Age**	**55.7**

Table-3: Mean age of the participants of experimental and control group

Age range involvement

20 stroke patients were included as sample of the study, among them almost 70% (n=14) were 44-54 years and 30% (n=6) were 55-65 years.

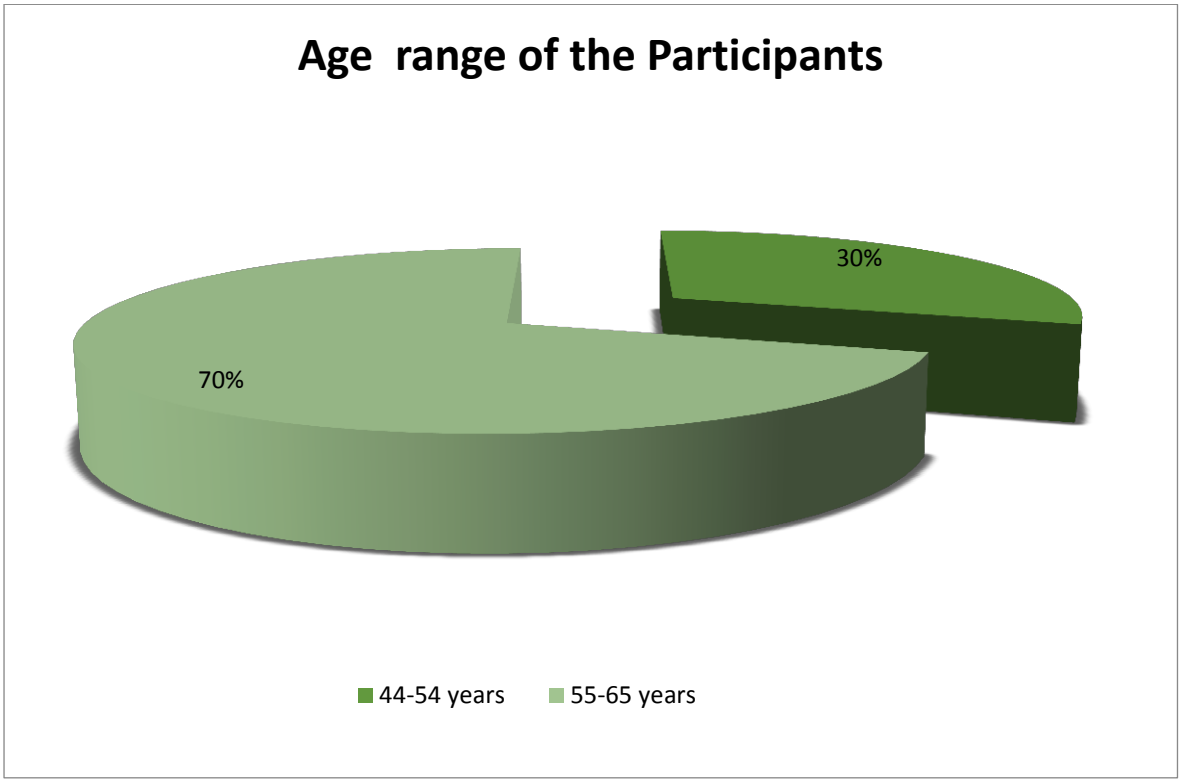


Figure-3: Age range of the participants with percentage

Sex of the participants

There were 20 stroke patients included as a sample of this study, among them 80% (n=16) were male and 20% (n=4) were female. In an epidemiological study in Bangladesh it has been found that 74% are male patients and 26% are female patients (Islam et al., 2012). In this study it was found that male and female ratio 4:1. So male are more affected than female in stroke.

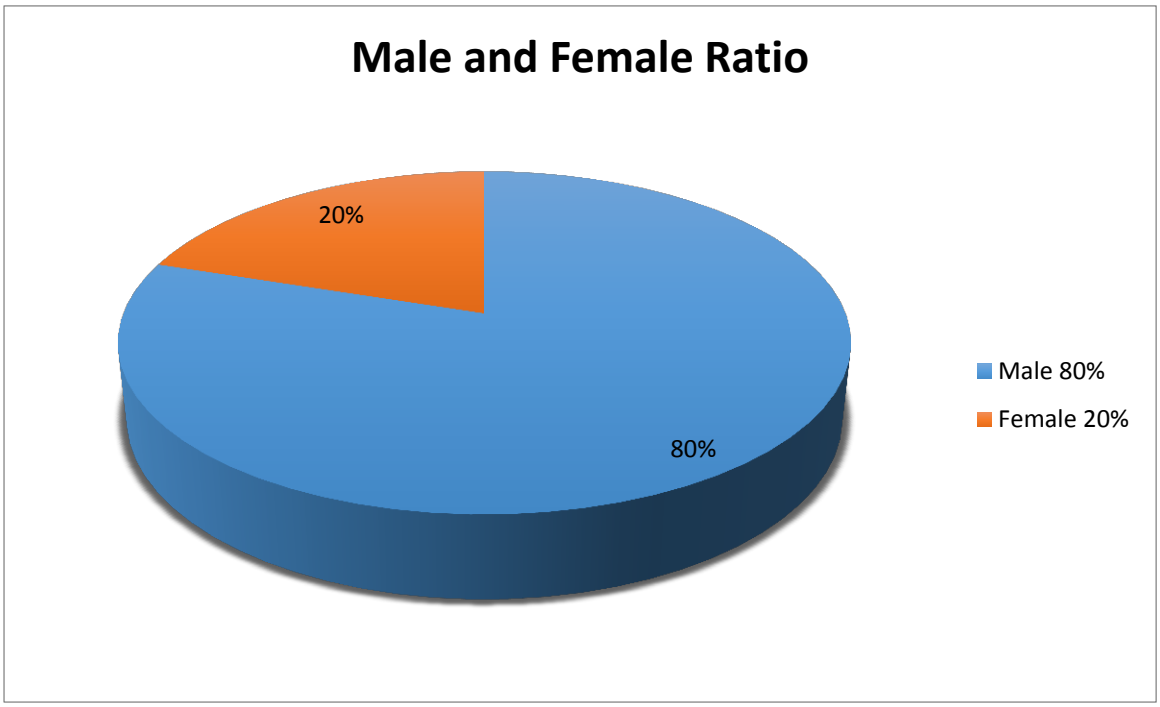


Figure-4: Involvement of the sex

Mean weight of the participants

20 Stroke patients were included as sample of the study.

Experimental group		Control group	
Subjects	**Weight (kg)**	**Subjects**	**Weight (kg)**
E1	60	C1	72
E2	62	C2	50
E3	62	C3	75
E4	72	C4	45
E5	58	C5	62
E6	62	C6	65
E7	85	C7	53
E8	70	C8	62
E9	51	C9	45
E10	59	C10	58
Mean Weight	**64.1**	**Mean Weight**	**58.7**

Table-4: Mean weight of the participants of experimental and control group

Weight range of the participants

There were 20 stroke patients appointed as a sample of this study, among them stroke patients have been classified based on their weight ranges 44-54, 55-65, and 66-76 kg and participants 45% (n=9), 30% (n=6) and 25% (n=5) respectively.

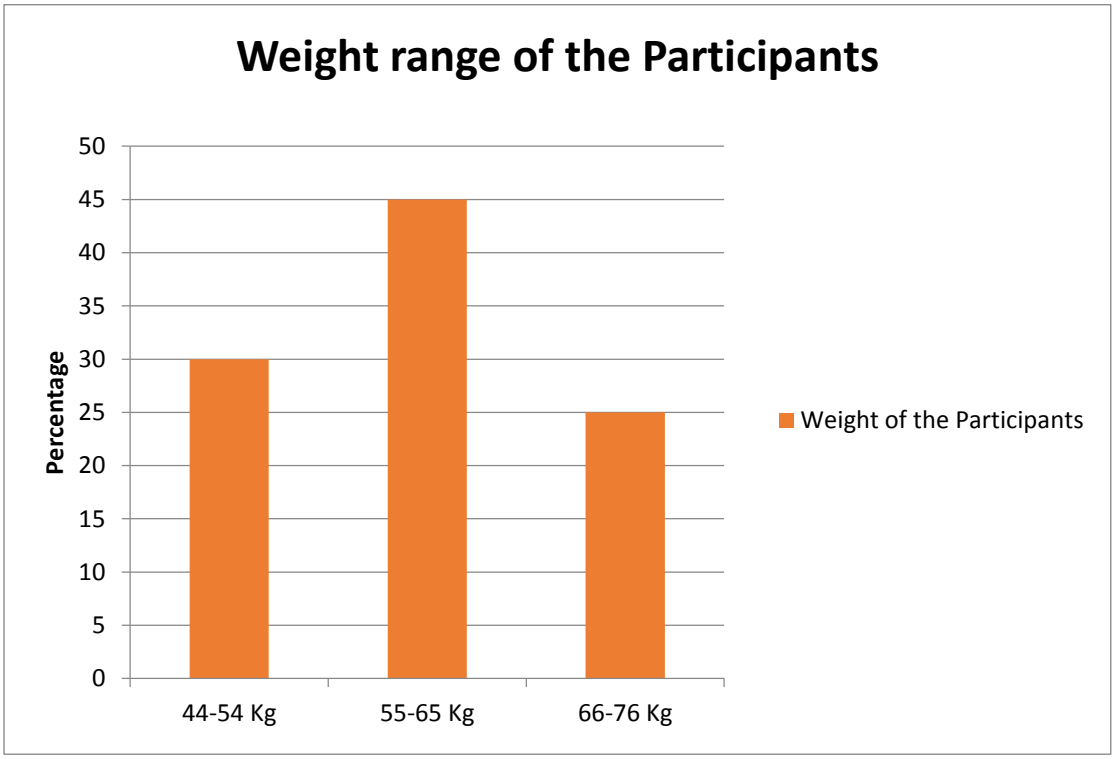


Figure-5: Weight range of the participants

Educational level of the participants

Among the 20 stroke participants, 10% (n=2) participants were illiterate, 25% (n=5) participants were primary passed, 15% (n=3) participants were secondary, 30% (n=6) participants were S.S.C passed, 5% (n=1) participants were completed H.S.C level, 5% (n=1) participants were graduate and 10% (n=2) participants were postgraduate holder.

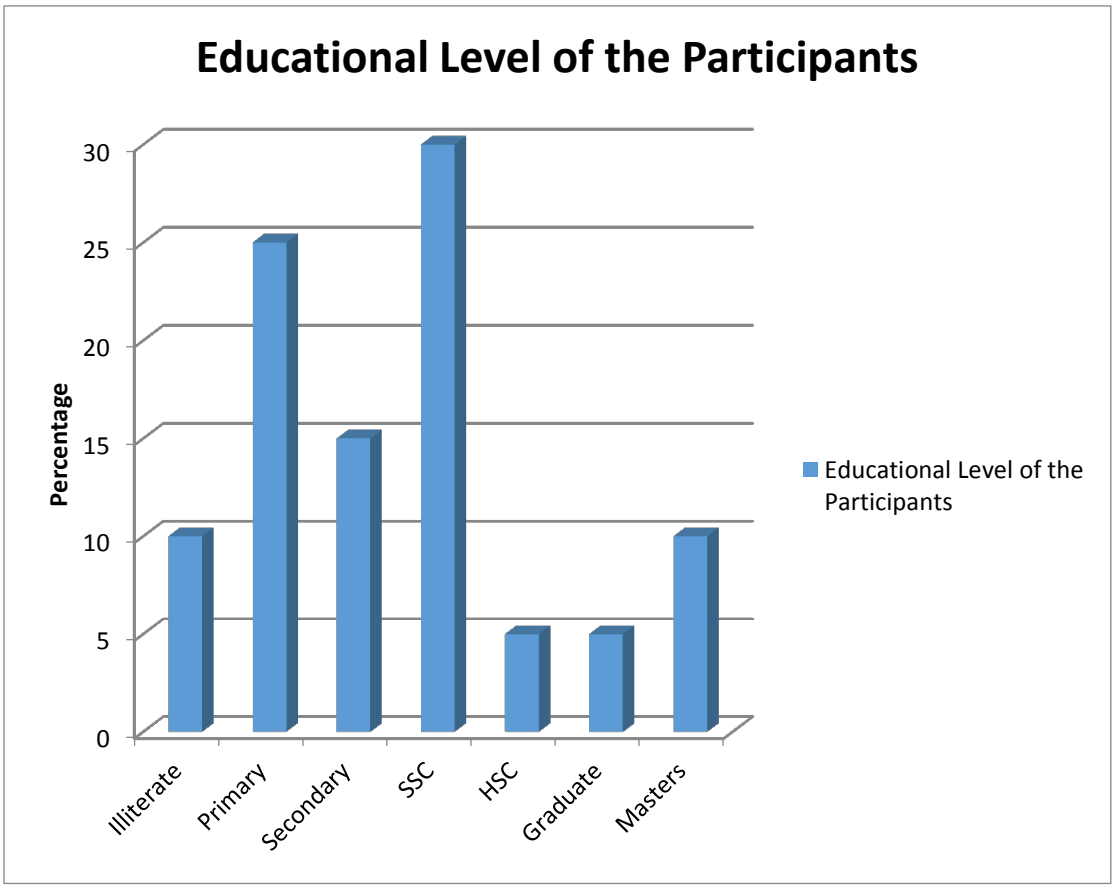


Figure-6: Educational level of the participants

Family Type of the participants

20 stroke patients were included as sample of the study, among them 45% (n=9) were nuclear family and 55% (n=11) were extended family.

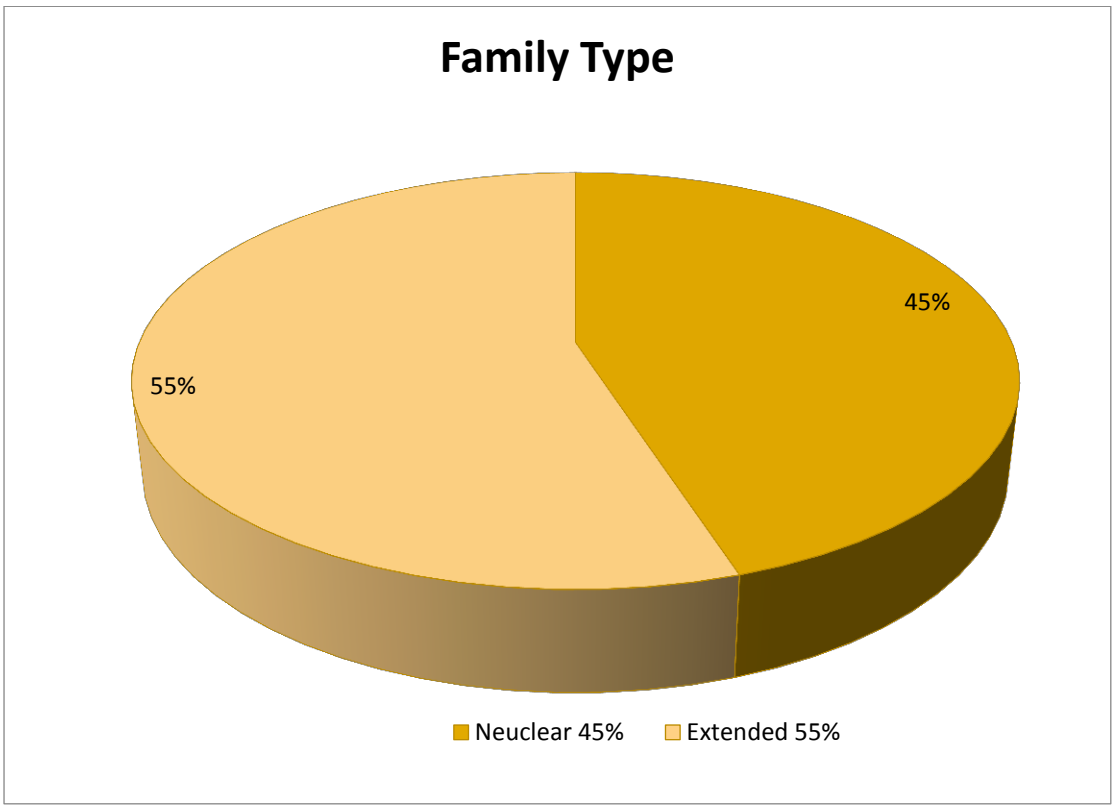


Figure-7: Family Type of the participants

Occupation

This study was conducted on 20 stroke patients. Among them 20% (n=4) were farmer, 20% (n=4) were service holder, 30% (n=6) were businessmen, 20% (n=4) were housewives, 10% (n=2) were others.

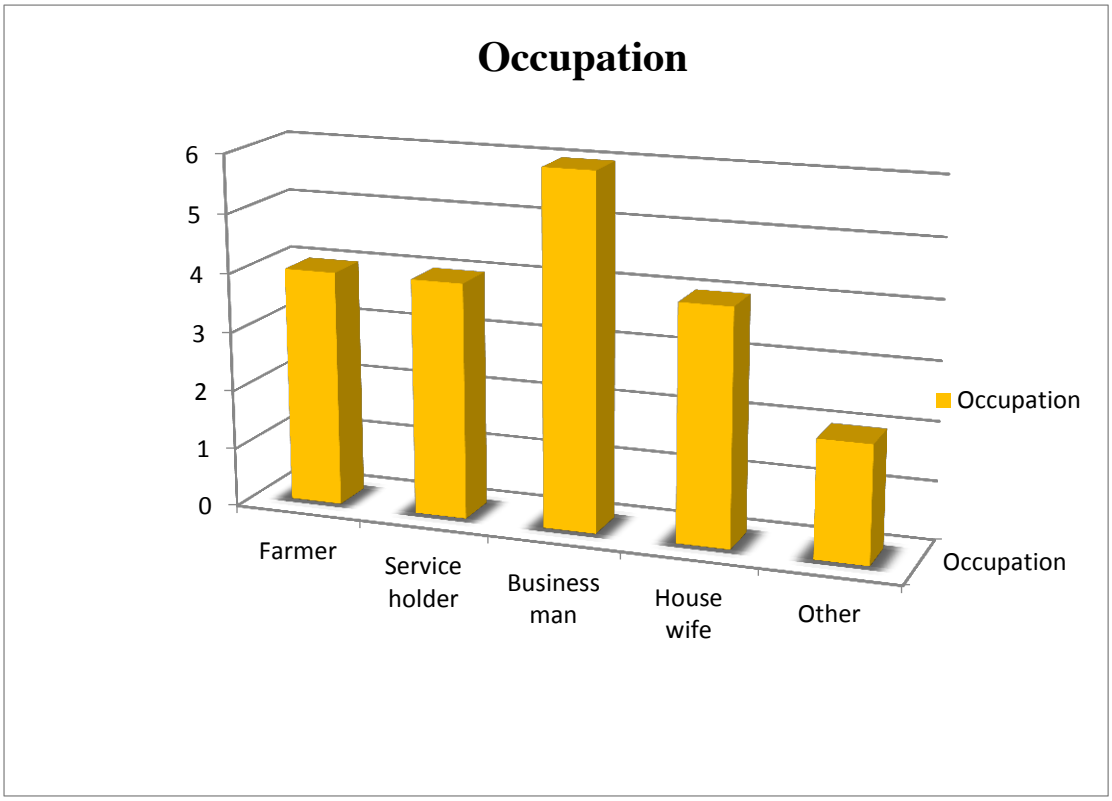


Figure-8: Presentence of occupation of the participants

Living area

The study was conducted on 20 stroke patients. Among them 60% (n=12) were rural area, 40%(n=8) were urban area.

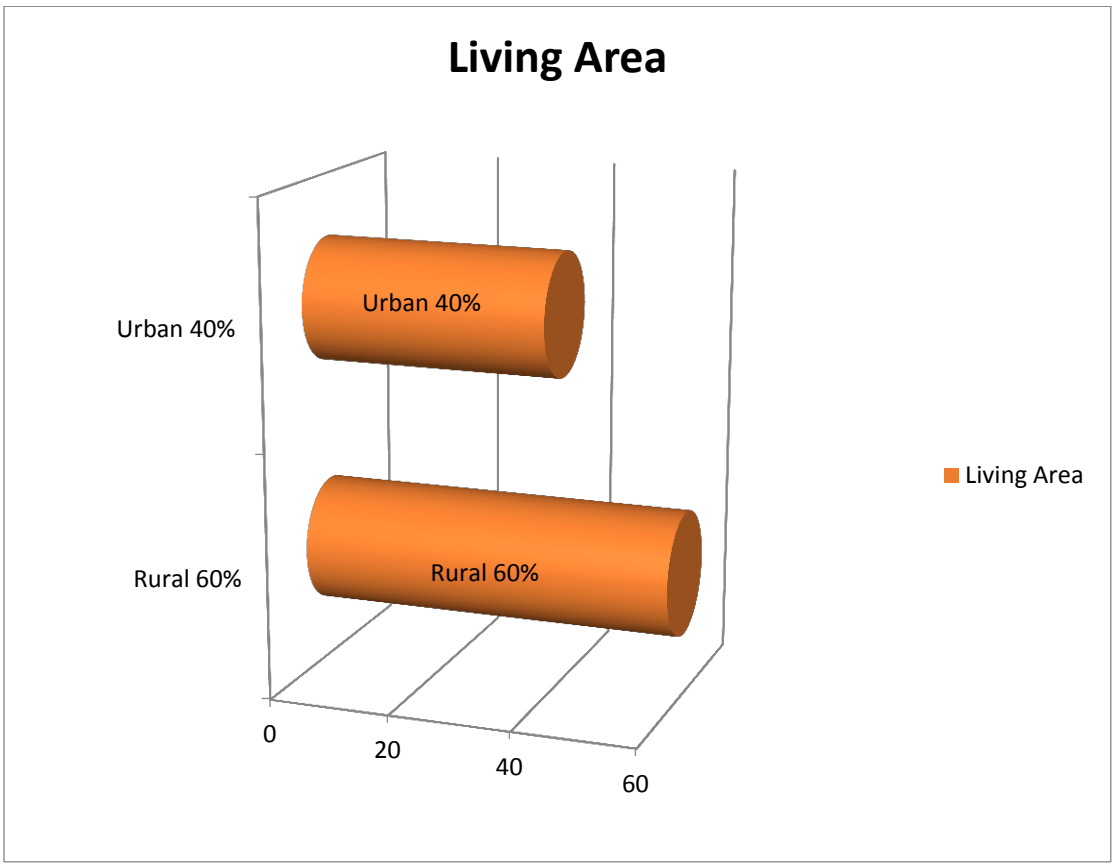


Figure-9: Presentence of Living area of the participants

Type of Stroke

20 stroke patients were included as sample of the study, among them 80% (n=16) were Ischemic and 20% (n=4) were Hemorrhagic. In an epidemiological study in Bangladesh the majority (61·18%) suffered from an Ischemic and others had intracerebral haemorrhage (29·40%), subarachnoid haemorrhage (8·24%), or aneurysm (1·18%) (Islam et al., 2012). In this study it was found that Ischemic and Hemorrhagic stroke ratio was 4:1.

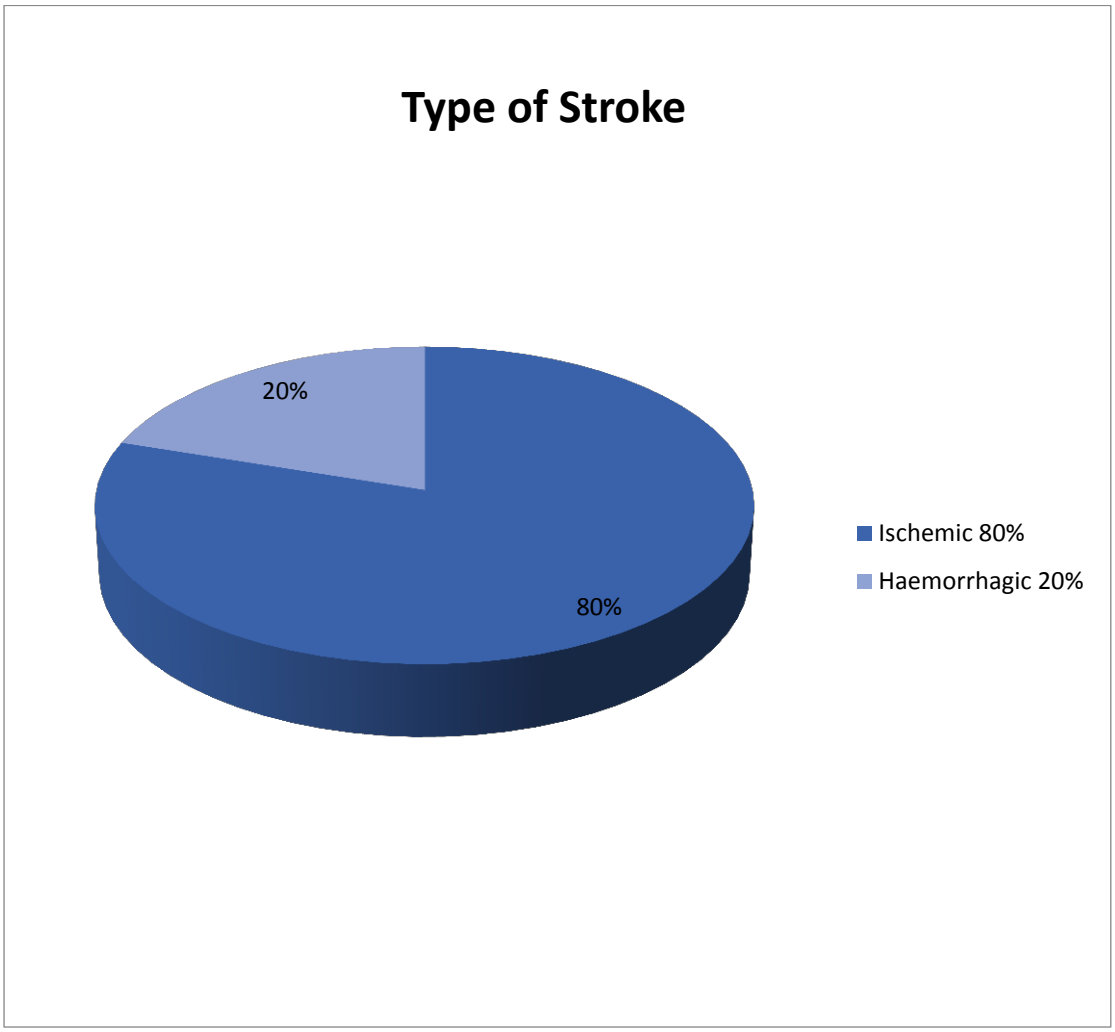


Figure-10: Presentence of Type of Stroke

Duration of Stroke

20 stroke patients were included as sample of the study, among them 3-4 months post stroke were 11 participants, 5-6 months post stroke were 6 participants and 7-8 months post stroke were 3 participants.

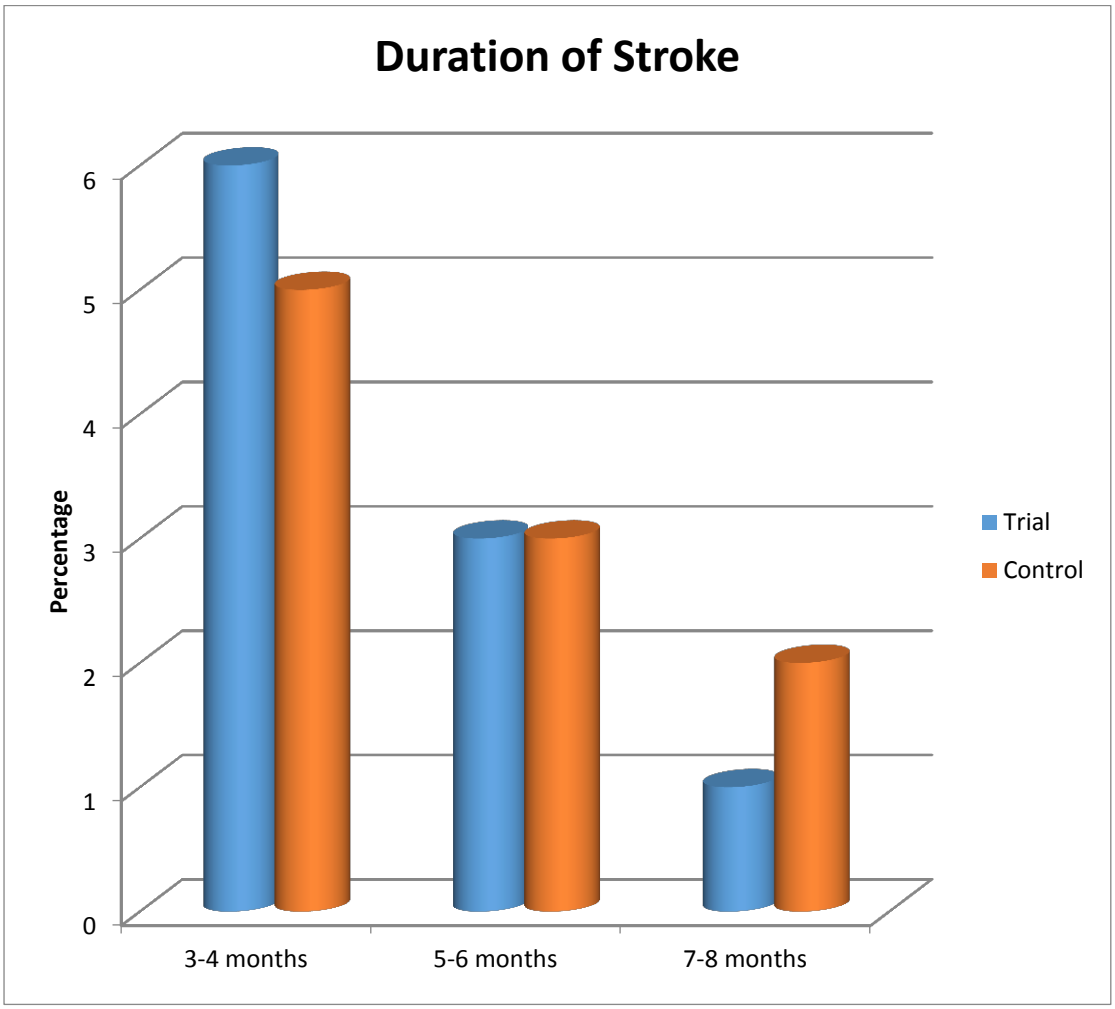


Figure-11: Duration of Stroke

Affected side of the participants

20 stroke patients were included as sample of the study, among them 80% (n=16) were right site and 20% (n=4) were left site affected.

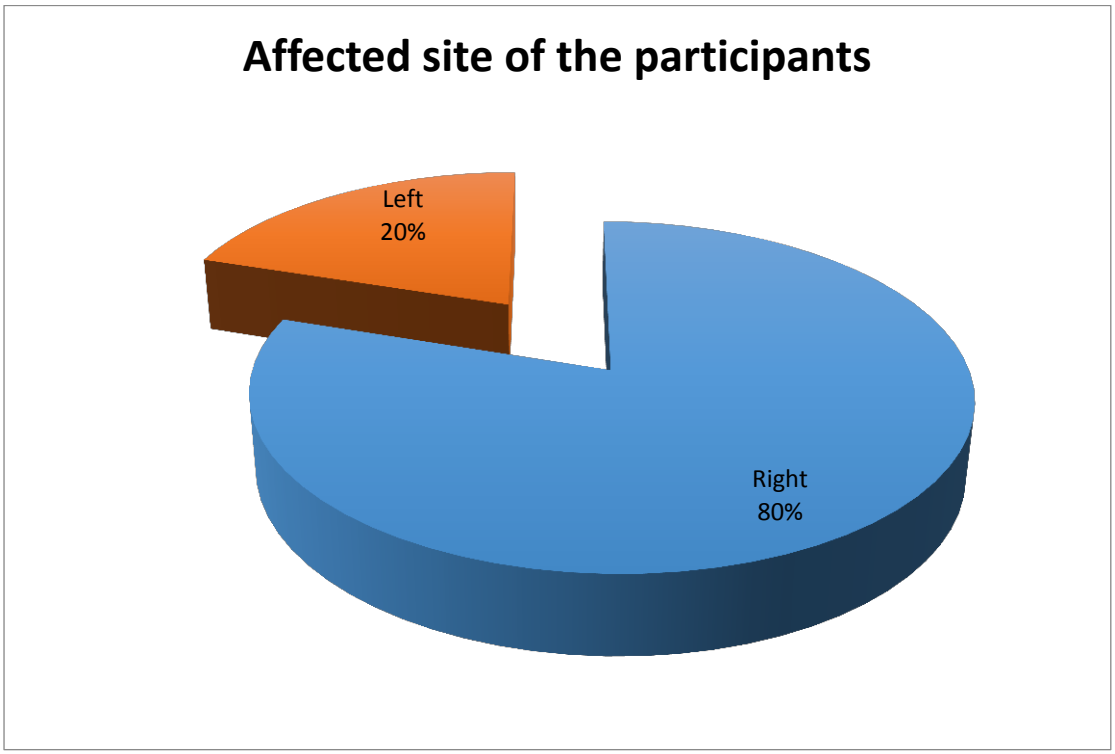


Figure-12: Affected side of the participants

Affected Leg

There were 20 stroke patients included as sample of the study, among them n=12 were affected dominant leg and n=8 were affected non-dominant leg.

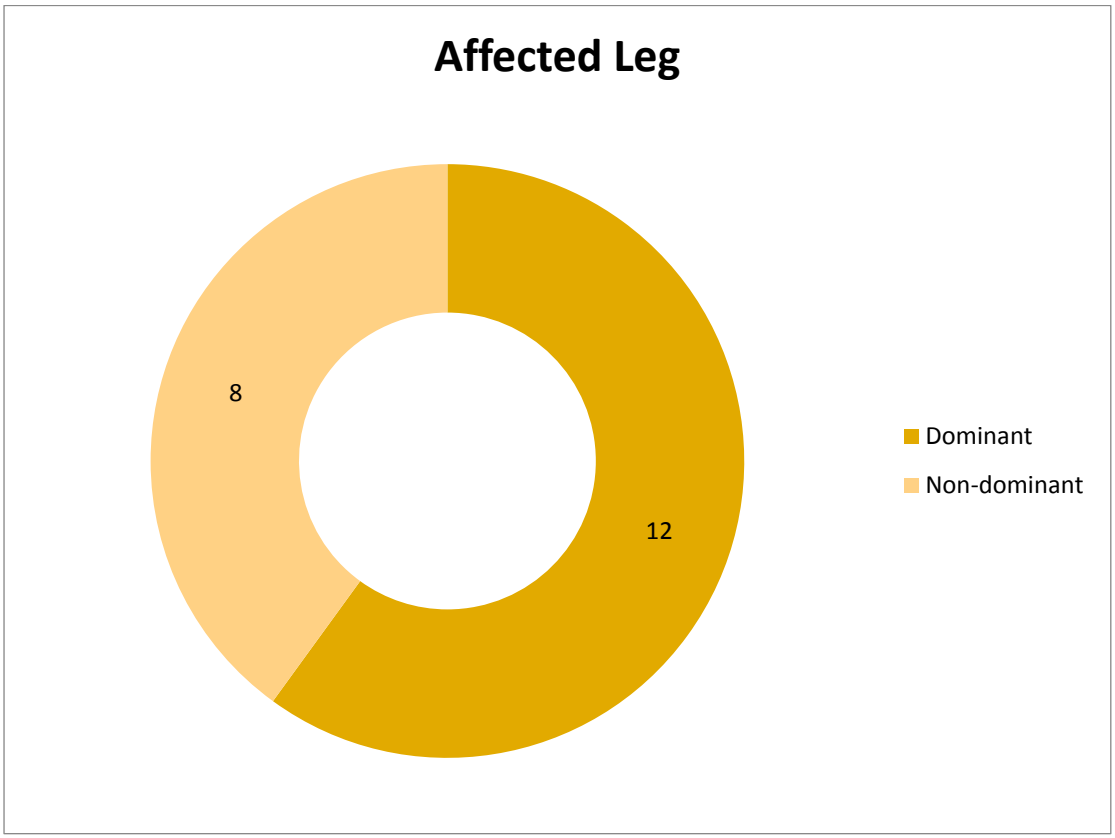


Figure-13: Affected Leg

Number of Physiotherapy Sessions

20 stroke patients were included as sample of the study, among them (n=5) were 1-3 sessions, (n=5) were 4-6 sessions, (n=4) were 7-9 sessions, (n=6) were 10-12 sessions received Physiotherapy treatment.

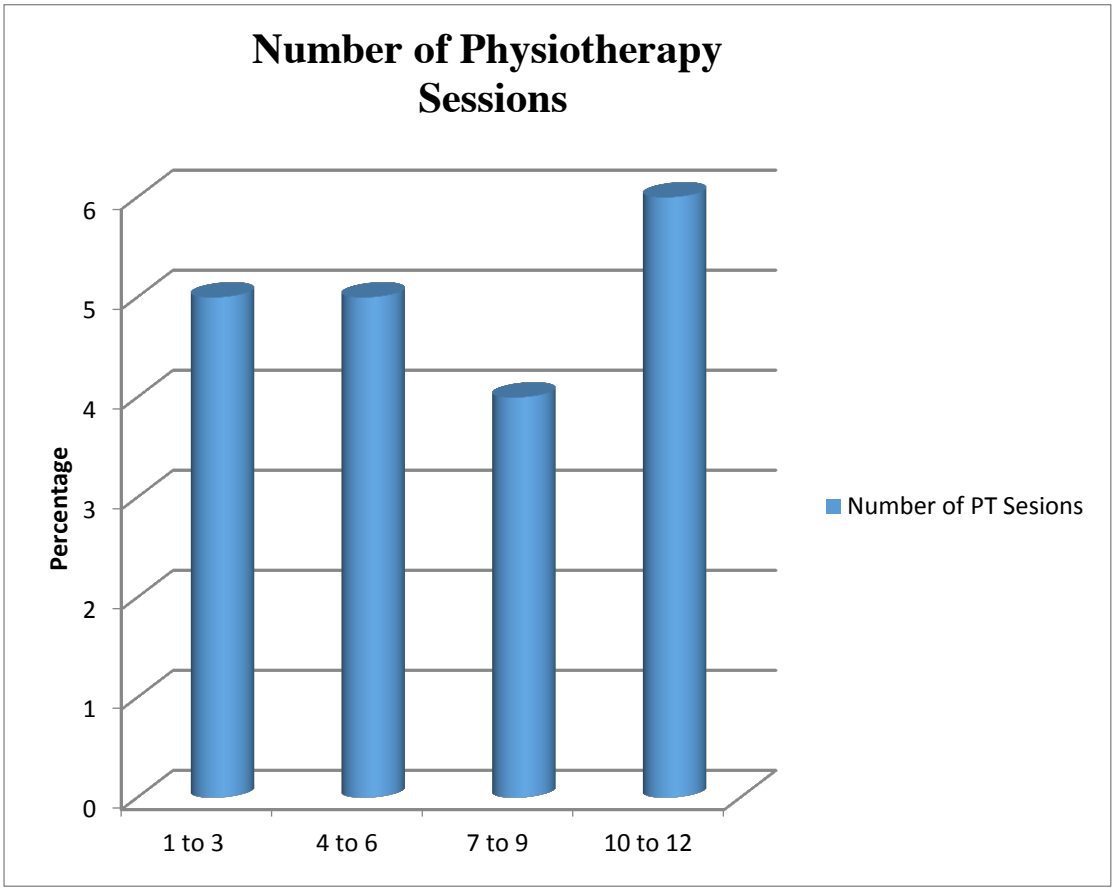


Figure-14: Number of Physiotherapy Sessions

Total score of the participants in BBS scale (Pre Test)

Experimental group		Control group	
Subjects	**Scale Ranking**	**Subjects**	**Scale Ranking**
E1	33	C1	36
E2	29	C2	19
E3	15	C3	20
E4	37	C4	35
E5	37	C5	27
E6	41	C6	33
E7	36	C7	25
E8	40	C8	29
E9	18	C9	37
E10	36	C10	34
Total Score	**322**	**Total Score**	**295**
Mean Score	**32.2**	**Mean Score**	**29.5**

Table-5: Score of the participants in BBS scale (Pre Test)

Total score of the participants in BBS scale (Post- Test)

Experimental group			Control group		
Subjects	**Scale Ranking**	**Rank**	**Subjects**	**Scale Ranking**	**Rank**
E1	42	17.5	C1	37	12
E2	33	6.5	C2	21	1.5
E3	25	3	C3	21	1.5
E4	40	16	C4	35	8
E5	37	12	C5	30	6
E6	42	17.5	C6	36	9.5
E7	38	14	C7	27	4
E8	43	19	C8	33	6.5
E9	29	5	C9	37	12
E10	39	15	C10	36	9.5
Total	**368**		**Total**	**313**	
Mean Score	**36.8**	**125.5**	**Mean Score**	**31.3**	**70.5**

Table-6: Score of the participants in BBS scale (Post- Test)

We Know,

The formula of Mann-Whitney U test: $U = n_1\, n_{2+} \frac{n_x(n_x+1)}{2} - T_x$

$$=10\times 10 + \frac{10(10+1)}{2} - 125.5$$

$$=100+55- 125.5$$

$$=29.5$$

n_1 = the number of the subjects in trail group

n_2= the number of the subject in control group.

n_x= the number of the subjects of the group with larger rank total.

T_x= the larger rank total.

SITTING TO STANDING

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during sitting to standing.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	4	C1	3	3
E2	3	3	C2	2	3
E3	2	3	C3	1	2
E4	2	3	C4	3	3
E5	3	3	C5	3	3
E6	3	3	C6	4	4
E7	3	3	C7	2	2
E8	3	4	C8	3	4
E9	2	3	C9	4	4
E10	3	4	C10	3	3
Total	**27**	**33**	**Total**	**28**	**31**
Mean Score	**2.7**	**3.3**	**Mean Score**	**2.8**	**3.1**

Table-7: Balance Score during sitting to standing

STANDING UNSUPPORTED

The functional outcome is different between pre-test and post-test scores.

To evaluate the Balance during Standing unsupported.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	4	4	C1	4	4
E2	4	4	C2	4	4
E3	3	4	C3	3	3
E4	4	4	C4	4	4
E5	4	4	C5	4	4
E6	4	4	C6	4	4
E7	4	4	C7	4	4
E8	4	4	C8	4	4
E9	3	4	C9	4	4
E10	4	4	C10	4	4
Total	**38**	**40**	**Total**	**39**	**39**
Mean Score	**3.8**	**4.0**	**Score Mean**	**3.9**	**3.9**

Table-8: Balance Score during standing unsupported

STANDING TO SITTING

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during Standing to Sitting.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	3	C1	3	3
E2	3	3	C2	2	2
E3	2	2	C3	1	1
E4	3	3	C4	4	4
E5	3	3	C5	3	3
E6	3	3	C6	3	3
E7	3	3	C7	2	2
E8	4	4	C8	3	3
E9	2	3	C9	4	4
E10	4	4	C10	3	3
Total Score	**30**	**30**	**Total Score**	**28**	**28**
Mean Score	**3.0**	**3.0**	**Mean Score**	**2.8**	**2.8**

Table-9: Balance Score during standing to sitting

TRANSFERS

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during Transfers.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	3	C1	3	3
E2	3	3	C2	2	2
E3	1	2	C3	1	1
E4	3	4	C4	4	4
E5	3	3	C5	3	3
E6	3	3	C6	3	3
E7	3	3	C7	3	4
E8	4	4	C8	3	4
E9	2	2	C9	4	4
E10	4	4	C10	3	3
Total Score	**29**	**31**	**Total Score**	**29**	**31**
Mean Score	**2.9**	**3.1**	**Mean Score**	**2.9**	**3.1**

Table-10: Balance score during transfers

STANDING UNSUPPORTED WITH EYES CLOSED

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during standing unsupported with eyes closed.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	4	4	C1	3	3
E2	2	3	C2	1	2
E3	1	2	C3	3	3
E4	4	4	C4	3	3
E5	4	4	C5	4	4
E6	3	3	C6	3	3
E7	3	3	C7	4	4
E8	4	4	C8	3	3
E9	2	2	C9	4	4
E10	3	3	C10	3	3
Mean Score	**3.0**	**3.2**	**Mean Score**	**3.1**	**3.2**

Table-11: Balance score during sanding unsupported with eyes closed

STANDING UNSUPPORTED WITH FEET TOGETHER

The functional outcome is different between pre-test and post-test scores.

To evaluate the Balance during sanding unsupported with feet together.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	3	C1	2	3
E2	1	2	C2	0	0
E3	0	0	C3	3	1
E4	3	3	C4	3	0
E5	3	3	C5	0	1
E6	3	3	C6	2	3
E7	3	3	C7	0	3
E8	3	4	C8	1	1
E9	0	2	C9	1	1
E10	3	3	C10	2	2
Mean Score	**2.2**	**2.6**	**Mean Score**	**1.4**	**1.5**

Table-12: Balance Score during sanding unsupported with feet together

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during reaching forward with outstretched arm while standing.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	3	C1	3	3
E2	1	1	C2	2	2
E3	2	2	C3	2	3
E4	3	3	C4	2	2
E5	3	3	C5	2	2
E6	3	3	C6	2	2
E7	2	4	C7	2	2
E8	2	3	C8	2	3
E9	1	2	C9	2	2
E10	3	3	C10	2	3
Mean Score	**2.3**	**2.7**	**Mean Score**	**2.1**	**2.4**

Table-13: Balance Score during reaching forward with outstretched arm while standing

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

The functional outcome is different between pre-test and post-test scores.

To evaluate the Balance during pick up objective from floor a standing position.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	1	4	C1	3	3
E2	3	3	C2	1	1
E3	0	3	C3	0	0
E4	2	3	C4	2	2
E5	2	2	C5	0	0
E6	3	3	C6	2	2
E7	3	3	C7	0	0
E8	3	3	C8	1	2
E9	0	1	C9	2	2
E10	3	3	C10	2	2
Mean Score	**2.0**	**2.8**	**Mean Score**	**1.3**	**1.4**

Table-14: Balance Score during pick up objective from floor a standing position

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during turn to look behind over left and right shoulders while standing.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	4	C1	4	4
E2	3	3	C2	2	2
E3	2	3	C3	3	3
E4	3	4	C4	4	4
E5	3	3	C5	3	4
E6	4	4	C6	4	4
E7	4	4	C7	3	3
E8	4	4	C8	3	3
E9	3	3	C9	4	4
E10	3	3	C10	3	4
Mean Score	**3.2**	**3.5**	**Mean Score**	**3.3**	**3.5**

Table-15: Balance Score during turning to look behind over left and right shoulders while standing

TURN 360 DEGREES

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during turn 360 degrees.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	1	2	C1	2	0
E2	1	1	C2	0	0
E3	0	0	C3	0	1
E4	2	2	C4	1	1
E5	2	2	C5	0	1
E6	4	4	C6	2	2
E7	2	2	C7	0	0
E8	2	3	C8	1	1
E9	0	2	C9	2	2
E10	1	2	C10	2	2
Mean Score	**1.5**	**2.0**	**Mean Score**	**1.0**	**1.0**

Table-16: Balance Score during turn 360 degrees

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

The functional outcome is different between pre-test and post-test scores.

To evaluate the Balance during place alternate foot on step or stool while standing unsupported.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	3	3	C1	3	3
E2	2	3	C2	1	1
E3	1	2	C3	1	1
E4	3	3	C4	1	1
E5	3	3	C5	2	2
E6	3	3	C6	2	2
E7	2	3	C7	2	3
E8	2	3	C8	2	2
E9	1	2	C9	2	2
E10	2	2	C10	2	2
Mean Score	**2.2**	**2.7**	**Mean Score**	**1.8**	**1.9**

Table- 17: Balance Score during place alternate foot on step or stool while standing unsupported

STANDING UNSUPPORTED ONE FOOT IN FRONT

The functional outcome is different between pre-test and post-test scores.

To evaluate the Balance during standing unsupported one in front.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	2	4	C1	3	3
E2	3	4	C2	2	2
E3	1	2	C3	2	2
E4	4	4	C4	3	3
E5	3	3	C5	3	3
E6	4	4	C6	3	4
E7	3	3	C7	3	3
E8	3	3	C8	3	3
E9	2	3	C9	3	3
E10	2	3	C10	3	3
Mean Score	**2.7**	**3.3**	**Mean Score**	**2.8**	**2.9**

Table-18: Balance Score during standing unsupported one in front

STANDING ON ONE LEG

The functional outcome is different between pre-test and post-test scores.

To evaluate the balance during standing on one leg.

Experimental group			**Control group**		
Subjects	**Pre Test**	**Post-Test**	**Subjects**	**Pre Test**	**Post-Test**
E1	0	1	C1	0	1
E2	0	0	C2	0	0
E3	0	0	C3	0	0
E4	0	0	C4	1	1
E5	1	1	C5	0	0
E6	1	2	C6	0	0
E7	1	2	C7	0	0
E8	1	1	C8	0	0
E9	0	0	C9	1	1
E10	1	1	C10	2	2
Total Score	**05**	**08**	**Total Score**	**04**	**05**
Mean Score	**0.5**	**0.8**	**Mean Score**	**0.4**	**0.5**

Table-19: Balance Score during standing on one leg

Variables in the study statistically significance at the following level of significance

No	Variables	Observed 'U' value	Critical value of U at p≤ 0.05 is	Significance (Value ≤ 27)
1	SITTING TO STANDING	43	27	Not significant
2	STANDING UNSUPPORTED	45	27	Not significant
3	STANDING TO SITTING	41.5	27	Not significant
4	TRANSFERS	47	27	Not significant
5	STANDING UNSUPPORTED WITH EYES CLOSED	49	27	Not significant
6	STANDING UNSUPPORTED WITH FEET TOGETHER	54	27	Not significant
7	REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING	36	27	Not significant
8	PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION	43.5	27	Not significant
9	TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING	47.5	27	Not significant
10	TURN 360 DEGREES	66	27	Not significant
11	PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED	20.5	27	Significant
12	STANDING UNSUPPORTED ONE FOOT IN FRONT	33.5	27	Not significant
13	STANDING ON ONE LEG	121	27	Not significant

Table-20: Level of significance in different variables

Mean difference between different variables

No	Variables	Mean difference between Pre Test and Post-Test		Improvement between experimental and control group
		Experimental group	Control group	
1	SITTING TO STANDING	0.6	0.3	Experimental more than control group
2	STANDING UNSUPPORTED	0.2	0	Experimental more than control group
3	STANDING TO SITTING	0	0	Equal
4	TRANSFERS	0.2	0.2	Equal
5	STANDING UNSUPPORTED WITH EYES CLOSED	0.2	0.1	Experimental more than control group
6	STANDING UNSUPPORTED WITH FEET TOGETHER	0.4	0.1	Experimental more than control group
7	REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING	0.4	0.3	Experimental more than control group
8	PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION	0.8	0.1	Experimental more than control group
9	TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS	0.3	0.2	Experimental more than control group
10	TURN 360 DEGREES	0.5	0	Experimental more than control group
11	PLACE ALTERNATE FOOT ON STEP OR STOOL	0.5	0.1	Experimental more than control group
12	STANDING ONE FOOT IN FRONT	0.4	0.1	Experimental more than control group
13	STANDING ON ONE LEG	0.3	0.1	Experimental more than control group

Table-21: Mean difference between different variables

CHAPTER-V DISCUSSION

The purpose of this study was to test the hypothesis "BAPS training with conventional physiotherapy is better than only conventional physiotherapy for improving balance in stroke patients. In this study, 20 stroke patients were randomly assigned as experimental group and the others as in control group. Among these patients, the experimental group received BAPS training with conventional physiotherapy and rest of the 10 patients included in the control group who received only conventional physiotherapy. Both the groups attended the 8 sessions of treatment at the outpatient neurology unit physiotherapy department of CRP, Savar in order to identify the improvement. The functional outcome was measured by using structural mixed type of questionnaire and the Berg Balance Scale (BBS) through different functional activity.

Age is a factor that provokes the test result. In this study, it was found that among the participants the age distribution of 70% (n=14) was between 44-54 years, 30% (n=6) was between 55-65 years. The mean age for experimental group was 57.4 years and control group was 55.7 years where Islam et al., (2012) reported that 0·20%, 0·30%, 0·20%, 1·00%, and 1·00% for the age groups 40–49 years, 50–59 years, 60–69 years, 70–79 years, and 80 years and above respectively.

In this study it was found that, among the stroke patients about 80% were male and 20% were female, where all the female participants were housewife. In an epidemiological study in Bangladesh showed that 74% were male patients and 26% were female patients (Islam et al., 2012). So male are more affected than female in stroke.

About 80% of patients who were affected at the right side where 20% affected by left side. So the right side became more affected than the left. In this study it was also found that about 60% patients have dominant leg involvement and 40% patients have non-dominant leg involvement.

It has been found that 45% (n=9) were between 44-54 kg, 30% (n=6) were between 55-65 kg and 30% (n=5) were between 55-65 kg and the mean weight for the experimental group was 64.1 kg and for the control group was 58.7 kg.

The study also showed that the stroke was Ischemic type in 80% of the participants where haemorrhagic type in 20%. In an epidemiological study it was found that the majority (61·18%) suffered from an Ischemic and others had intra-cerebral haemorrhage (29·40%), subarachnoid haemorrhage (8·24%), or aneurysm (1·18%) (Islam et al., 2012). In this study it was found that Ischemic and Hemorrhagic stroke ratio was 4:1.

20 patients with stroke were included as sample of the study, among them almost 60% (n=12) lived in rural and 40% (n=8) lived in urban.

The mean difference indicate that balance more improved in Experimental group than the Control group. Pre-test mean difference was 2.7 and post-test mean difference was 5.5.

Statistically the study was analysed by Mann Whitney *U* test where the *U* value was 29.5. The critical value of *U* at $p \leq 0.05$ was 27. Therefore the result was not significant at $p \leq 0.05$ at two-tailed hypothesis. Most of the variables indicated that the result was not significant, although some variables indicated significant result. So, the overall result was not statistically significant.

5.1 Limitations

The main limitation of this study was its short duration. The study was conducted with 20 Stroke patients with balance problem, which was a small number of samples in both groups and was not sufficient enough for the study to generalize the wider population of this condition. It was limited by the fact daily activities of the subject were not monitored, which could have influenced. Researcher only explored the effect of BAPS training after 8 sessions, so the long-term effect of treatment was not explored in this study. The research was carried out in CRP, Savar such a small environment, so it was difficult to keep confidential the aims of the study for blinding procedure. Therefore, single blinding method was used in this study. There was no available research done in this area in Bangladesh and worldwide. So, relevant information about with BAPS Training for Bangladesh was very limited in this study.

CHAPTER-VI CONCLUSION AND RECOMENDATION

6.1 Conclusion

The result of this experimental study have identified the effectiveness of conventional physiotherapy with BAPS training are better treatment than the conventional physiotherapy alone for improving balance among stroke patient. Participants of the conventional physiotherapy with BAPS training showed no statistical significant value but a small separate comprises improvement than those in the only conventional physiotherapy group, which indicate that the conventional physiotherapy with BAPS training can be an effective therapeutic approach for stroke patients with balance problem.

BAPS training exercise is used along with conventional physiotherapy that aims to improve balance and proprioception for stroke patients and may also a cost effective treatment. So it may become helpful for stroke patients those who have balance problem.

6.2 Recommendations

The aim of the study was to find out the effectiveness of BAPS Training among the stroke patient those have balance problem. However, the study had some limitations. Some steps were identified that might be taken for the better accomplishment for further study. The main recommendations would be as follow:

- ✓ The duration of the study was short, so in future wider time would be taken for conducting the study.
- ✓ Investigator use only 20 participants as the sample of this study, in future the sample size would be more.
- ✓ Double blinding procedure.
- ✓ A specific protocol should be included that in which stage patient will be able to start this exercises in the home.
- ✓ Sample should collect from different hospital, clinic, institute and organization in different district of Bangladesh to generalize the result.
- ✓ In this study BAPS training applied in repetition in future it will be applied in duration.

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APPENDIX-1

মৌখিক সম্মতিপত্র

আসসালামু আলাইকুম \নমস্কার, আমি মোঃ আব্দুল আলিম, ঢাকা বিশ্ববিদ্যালয়ের মেডিসিন অনুষদের অধীনে বাংলাদেশ হেল্থ প্রফেশন ইনস্টিটিউট (বিএইচপিআই) এর বিএসসি ইন ফিজিওথেরাপি বিভাগের ৪র্থ বর্ষের শিক্ষার্থী। আমার ব্যাচেলর ডিগ্রী স্মপন্ন করার জন্য, আমাকে একটি গবেষণা করতে হবে এবং এটা আমার অধ্যয়নের একটি অংশ। অংশগ্রহণকারীদের নিম্নলিখিত পড়ার পর গবেষণায় অংশগ্রহণের জন্য অনুরোধ করা হয়।

আমার গবেষণা শিরোনাম "স্ট্রোক রোগীদের ভারসাম্য বৃদ্ধিতে বি.এ.পি.এস ট্রেনিং এর কার্যকারীতা।" এই পরীক্ষামূলক গবেষণার মাধ্যমে আমি একটি অনুমান পরীক্ষা করবো য়ে, স্ট্রোক রোগীদের ক্ষেত্রে শুধুমাত্র প্রচলিত থেরাপি অপেক্ষা প্রচলিত থেরাপির সাথে বি.এ.পি.এস ট্রেনিং বেশী কার্যকরি হবে।আমার গবেষণার উদ্দেশ্য হল এই থেরাপির আগে ও পরে ভারসাম্যের হ্রাস ও বৃদ্ধি পরিমাপ করা।আমি যদি এই গবেষণাটি সফলভাবে সম্পূর্ণ করতে পারি তাহলে যেসব স্ট্রোক রোগীরা ভারসাম্য জনিত সমস্যায় ভুগছেন তারা উপকৃত হবেন এবং এটি একটি গবেষণামূলক প্রমান।গবেষণাটি সম্পাদনের জন্য, আমার তথ্য সংগ্রহ করা প্রযোজন হবে।গবেষণার ক্ষেত্র বিবেচনা করে আপনার মধ্যে প্রযোজনীয় বৈশিষ্ট্য লক্ষ্য করা গেছে।এজন্য, আপনি আমার গবেষণার একজন সম্মানিত অংশগ্রহণকারী হতে পারেন এবং আমি আপনাকে আমার গবেষণায় অংশগ্রহণের জন্য অনুরোধ জানাচ্ছি।আপনার নিয়মিত থেরাপির সময় আমি আপনার সাথে কয়েকবার দেখা করব।যে চিকিত্সা পদ্ধতি প্রয়োগ করা হবে তা আপনার জন্য ব্যাথামুক্ত এবং নিরাপদ।আমি আপনাকে অবগত করছি যে, এটি একটি সম্পূর্ণ প্রাতিষ্ঠানিক গবেষণা এবং এটি অন্য কোন উদ্দেশ্যে ব্যবহার হবে না।আমি আপনাকে আরও নিশ্চিত করছি যে আপনার সব তথ্য গোপন রাখা হবে।আপনার অংশগ্রহণ হবে ইচ্ছাকৃত।এই গবেষণা থেকে আপনি যে কোন মুহূর্তে সম্মতি প্রত্যাহার করতে পারেন কিংবা অংশগ্রহণ থেকে বিরত থাকতে পারেন।আপনার যদি এই গবেষণা সম্পর্কে এবং অংশগ্রহণকারী হিসাবে আপনার অধিকার সম্পর্কে কোন জিজ্ঞাসা থাকে তবে আপনি আমার সাথে যোগাযোগ করতে

পারেন।শুরু করার পূর্বে আপনার কি কোন প্রশ্ন আছে?আমি কি আপনার সাক্ষাত্কার গ্রহণের সম্মতি পেয়েছি? হ্যা..... না.....

প্রশ্নকর্তার স্বাক্ষরঃ

আমি .....এই সম্মতিপত্রটি পড়েছি এবং বুঝেছি।আমি সেচ্ছায় এই গবেষণায় অন্তর্ভুক্ত হচ্ছি।

অংশগ্রহণকারীর স্বাক্ষরঃ.....

সাক্ষীর স্বাক্ষরঃ.....

CONSENT FORM

Assalamu-alaikum / Namaskar, I am Md. Abdul Alim, 4th year B.Sc. (Hon's) in Physiotherapy student of Bangladesh Health Professions Institute (BHPI) under Medicine faculty of University of Dhaka. To obtain my Bachelor degree, I shall have to conduct a research and it is a part of my study. The participants are requested to participate in the study after reading the following.

My research title is "Effect of BAPS training for improving balance in stroke patients." Through this experimental research I will test the hypothesis "BAPS training with conventional physiotherapy is better than only conventional physiotherapy for the treatment of stroke patients." The objective of my study is to identify the effect of BAPS training for improving balance in stroke patients. If I can complete this study successfully, patient may get the benefits who have been suffering from balance problem and it will be an evidence based treatment.

To fulfill my research project, I need to collect data. Considering the area of my research, which criteria is necessary for my research is present of you. So, you can be a respected participant of my research and I would like to request you as a subject of my study. I want to meet you a few couple of session, during your regular therapy. The exercises that will be given are pain free and safe for you.

I would like to inform you that this is a purely academic study and will not be used for any other purpose. I assure that all data will be kept confidential. Your participation will be voluntary. You may have the right to withdraw consent and discontinue participation at any time of the experiment. You also have the right to answer a particular question that you don't like.

If you have any query about the study or right as a participant, you may contact with me.

Do you have any questions before I start?

So may I have your consent to proceed with the interview?

Yes …… No……

Signature of the Interviewer……

I……..have read and understand the contents of the form. I agree to participate in the research without any force.

Signature of the participant ……

Signature of the witness……

APPENDIX-2

Title: Effect of BAPS training for improving balance in stroke patients.

Questionnaire (English)

SECTION-1: Subjective Information

This questionnaire is developed to assessment of static and dynamic balance of the patient with stroke and this section will be filled by physiotherapist using a black ball pen.

Code no:

Patient ID: Date of test:

1. Socio demographic information:

1.1 Patient's name:

1.2 Age: .....years

1.3 Sex: (Tick ☑ which is appropriate)

a) Male
b) Female

1.4 Address:

Village/House no- Upazilla-

Post office- District-

Mobile no-

1.5 What is your marital status? (Tick ☑ which is appropriate)

a) Married b) Unmarried

c) Widow d) Divorced

1.6 Weight: ..... Kg

1.7 Dominant leg: (Tick ☑which is appropriate)

a) Rt
b) Lt

1.8 Site of hemiplegia

a) Rt

b) Lt

1.9 Occupation: (Tick ☑ which is appropriate)

a) Farmer b) Service holder c) Day labourer d) Garments/ Factory worker

e) Driver f) Rickshaw puller g) Businessman h) Unemployed

i) Teacher j) Housewife k) Other.....

1.10 Type of stroke: (Tick ☑ which is appropriate)

a) Ischemic

b) Haemorrhagic

1.11 Date of incidence of stroke: DD/MM/YY.....

1.12 Do you have any assistant? (Tick ☑ which is appropriate)

a) Yes

b) No

1.13 Living area: (Tick ☑ which is appropriate)

a) Rural

b) Urban

c) Hill tracks

1.14 What is your educational level? (Tick ☑ which is appropriate)

a) Illiterate b) Primary c) S.S.C

d) H.S.C e) Graduate f) Masters and above

1.15 Family type: (Tick ☑ which is appropriate)

a) Nuclear family

b) Extended family

1.16 How long you have received physiotherapy treatment?

a) 1-2 session
b) 3-4 session
c) 5-6 session
d) 7-8 session
e) > 8 session

SECTION-2: Assessment of balance

This questionnaire is designed for stroke patients for assessment of static and dynamic balance. The Berg Balance Scale (or BBS) is a widely used clinical test of a person's static and dynamic balance abilities, named after Katherine Berg, one of the developers (Berg et al., 1989). The BBS is a 14-item scale that quantitatively assesses balance. The items are scored from 0 to 4, with a score of 0 representing an inability to complete the task and a score of 4 representing independent item achievement. A global score is calculated out of 56 possible points. This section of questionnaire will be filled by the physiotherapist using a pencil.

(Tick ☑ the point, which is able to perform patient)

2.1 SITTING TO STANDING

INSTRUCTIONS: Please stand up. Try not to use your hand for support.

a) 4 able to stand without using hands and stabilize independently
b) 3 able to stand independently using hands
c) 2 able to stand using hands after several tries
d) 1 needs minimal aid to stand or stabilize
e) 0 needs moderate or maximal assist to stand

2.2 STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on

a) 4 able to stand safely for 2 minutes
b) 3 able to stand 2 minutes with supervision
c) 2 able to stand 30 seconds unsupported
d) 1 needs several tries to stand 30 seconds unsupported
e) 0 unable to stand 30 seconds unsupported

2.3 STANDING TO SITTING

INSTRUCTIONS: Please sit down

a) 4 sits safely with minimal use of hands
b) 3 controls descent by using hands
c) 2 uses back of legs against chair to control descent
d) 1 sits independently but has uncontrolled descent
e) 0 needs assist to sit

2.4 TRANSFERS

INSTRUCTIONS: Arrange chair for pivot transfer. Ask subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use a bed and a chair.

a) 4 able to transfer safely with minor use of hands
b) 3 able to transfer safely definite need of hands
c) 2 able to transfer with verbal cuing and/or supervision
d) 1 needs one person to assist
e) 0 needs two people to assist or supervise to be safe

2.5 STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS: Please close your eyes and stand still for 10 seconds.

a) 4 able to stand 10 seconds safely
b) 3 able to stand 10 seconds with supervision
c) 2 able to stand 3 seconds
d) 1 unable to keep eyes closed 3 seconds but stays safely
e) 0 needs help to keep from falling

2.6 STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS: Place your feet together and stand without holding on.

a) 4 able to place feet together independently and stand 1 minute safely
b) 3 able to place feet together independently and stand 1 minute with supervision
c) 2 able to place feet together independently but unable to hold for 30 seconds
d) 1 needs help to attain position but able to stand 15 seconds feet together
e) 0 needs help to attain position and unable to hold for 15 seconds

2.7 REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS: Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. (Ask subject to use both arms when reaching to avoid rotation of the trunk.)

a) 4 can reach forward confidently 25 cm (10 inches)
b) 3 can reach forward 12 cm (5 inches)
c) 2 can reach forward 5 cm (2 inches)
d) 1 reaches forward but needs supervision
e) 0 loses balance while trying/requires external support

2.8 PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS: Pick up the shoe/slipper, which is place in front of your feet.

a) 4 able to pick up slipper safely and easily
b) 3 able to pick up slipper but needs supervision
c) 2 unable to pick up but reaches 2-5 cm from slipper and keeps balance independently
d) 1 unable to pick up and needs supervision while trying
e) 0 unable to try/needs assist to keep from losing balance or falling

2.9 TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

INSTRUCTIONS: Turn to look directly behind you over toward the left shoulder. Repeat to the right. Examiner may pick an object to look at directly behind the subject to encourage a better twist turn.

a) 4 looks behind from both sides and weight shifts well
b) 3 looks behind one side only other side shows less weight shift
c) 2 turns sideways only but maintains balance
d) 1 needs supervision when turning
e) 0 needs assist to keep from losing balance or falling

2.10 TURN 360 DEGREES

INSTRUCTIONS: Turn completely around in a full circle. Pause. Then turn a full circle in the other direction.

a) 4 able to turn 360 degrees safely in 4 seconds or less
b) 3 able to turn 360 degrees safely one side only 4 seconds or less
c) 2 able to turn 360 degrees safely but slowly
d) 1 needs close supervision or verbal cuing
e) 0 needs assistance while turning

2.11 PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS: Place each foot alternately on the step/stool. Continue until each foot has touch the step/stool four times

a) 4 able to stand independently and safely and complete 8 steps in 20 seconds
b) 3 able to stand independently and complete 8 steps in > 20 seconds
c) 2 able to complete 4 steps without aid with supervision
d) 1 able to complete > 2 steps needs minimal assist
e) 0 needs assistance to keep from falling/unable to try

2.12 STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS: Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. (To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width.)

a) 4 able to place foot tandem independently and hold 30 seconds
b) 3 able to place foot ahead independently and hold 30 seconds
c) 2 able to take small step independently and hold 30 seconds
d) 1 needs help to step but can hold 15 seconds
e) 0 loses balance while stepping or standing

2.13 STANDING ON ONE LEG

INSTRUCTIONS: Stand on one leg as long as you can without holding on.

a) 4 able to lift leg independently and hold > 10 seconds
b) 3 able to lift leg independently and hold 5-10 seconds
c) 2 able to lift leg independently and hold ≥ 3 seconds
d) 1 tries to lift leg unable to hold 3 seconds but remains standing independently
e) 0 unable to try of needs assist to prevent fall

Total Score:

Date: …….. Signature of Examiner……..

APPENDIX-3: Calculating of *U* test

Sitting to Standing

Experimental group			Control group		
Subjects	**BBS Score**	**Rank**	**Subjects**	**BBS Score**	**Rank**
E1	4	17.5	C1	3	8.5
E2	3	8.5	C2	3	8.5
E3	3	8.5	C3	2	1.5
E4	3	8.5	C4	3	8.5
E5	3	8.5	C5	3	8.5
E6	3	8.5	C6	4	17.5
E7	3	8.5	C7	2	1.5
E8	4	17.5	C8	4	17.5
E9	3	8.5	C9	4	17.5
E10	4	17.5	C10	3	8.5
Total Score	**33**	**112**	**Total Score**	**31**	**98**

Table-1: Balance Score during Sitting to Standing

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=112, the larger rank total.

Now 'U' formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 112$$

$$= 100+55-112$$

$$= 43$$

STANDING UNSUPPORTED

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	4	11	C1	4	11
E2	4	11	C2	4	11
E3	4	11	C3	3	1
E4	4	11	C4	4	11
E5	4	11	C5	4	11
E6	4	11	C6	4	11
E7	4	11	C7	4	11
E8	4	11	C8	4	11
E9	4	11	C9	4	11
E10	4	11	C10	4	11
Total Score	**40**	**110**	**Total Score**	**39**	**100**

Table-2: Balance Score during standing unsupported

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=110, the larger rank total.

Now 'U' formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 110$$

$$= 100+55-110$$

$$= 45$$

STANDING TO SITTING

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	3	10.5	C1	3	10.5
E2	3	10.5	C2	2	3
E3	2	3	C3	1	1
E4	3	10.5	C4	4	18.5
E5	3	10.5	C5	3	10.5
E6	3	10.5	C6	3	10.5
E7	3	10.5	C7	2	3
E8	4	18.5	C8	3	10.5
E9	3	10.5	C9	4	18.5
E10	4	18.5	C10	3	10.5
Total Score	**30**	**113.5**	**Total Score**	**28**	**96.5**

Table- 3: Balance Score during standing to sitting

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=113.5, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 113.5$$

$$= 100+55-113.5$$

$$= 41.5$$

TRANSFERS

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	3	9	C1	3	9
E2	3	9	C2	2	3
E3	2	3	C3	1	1
E4	4	17	C4	4	17
E5	3	9	C5	3	9
E6	3	9	C6	3	9
E7	3	9	C7	4	17
E8	4	17	C8	4	17
E9	2	3	C9	4	17
E10	4	17	C10	3	9
Total Score	**31**	**102**	**Total Score**	**31**	**108**

Table- 4: Balance Score during transfers

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=108, the larger rank total.

Now *'U'* formula

$$U = n_1 n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 108$$

$$= 100+55-108$$

$$= 47$$

STANDING UNSUPPORTED WITH EYES CLOSED

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	4	17	C1	3	8.5
E2	3	8.5	C2	2	2
E3	2	2	C3	3	8.5
E4	4	17	C4	3	8.5
E5	4	17	C5	4	17
E6	3	8.5	C6	3	8.5
E7	3	8.5	C7	4	17
E8	4	17	C8	3	8.5
E9	2	2	C9	4	17
E10	3	8.5	C10	3	8.5
Total Score	**32**	**106**	**Total Score**	**32**	**104**

Table- 5: Balance Score during sanding unsupported with eyes closed

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=106, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 106$$

$$= 100+55-106$$

$$= 49$$

STANDING UNSUPPORTED WITH FEET TOGETHER

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	3	12	C1	3	12
E2	2	6	C2	0	0
E3	0	0	C3	1	2.5
E4	3	12	C4	0	0
E5	3	12	C5	1	2.5
E6	3	12	C6	3	12
E7	3	12	C7	3	12
E8	4	17	C8	1	2.5
E9	2	6	C9	1	2.5
E10	3	12	C10	2	6
Total Score	**26**	**101**	**Total Score**	**15**	**52**

Table-6: Balance Score during sanding unsupported with feet together

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=101, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 101$$

$$= 100+55-101$$

$$= 54$$

REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	3	14.5	C1	3	14.5
E2	1	1	C2	2	5.5
E3	2	5.5	C3	3	14.5
E4	3	14.5	C4	2	5.5
E5	3	14.5	C5	2	5.5
E6	3	14.5	C6	2	5.5
E7	4	20	C7	2	5.5
E8	3	14.5	C8	3	14.5
E9	2	5.5	C9	2	5.5
E10	3	14.5	C10	3	14.5
Total Score	**27**	**119**	**Total Score**	**24**	**91**

Table-7: Balance Score during reaching forward with outstretched arm while standing

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=119, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 119$$

$$= 100+55-119$$

$$= 36$$

PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	4	17	C1	3	12.5
E2	3	12.5	C2	1	1.5
E3	3	12.5	C3	0	0
E4	3	12.5	C4	2	5.5
E5	2	5.5	C5	0	0
E6	3	12.5	C6	2	5.5
E7	3	12.5	C7	0	0
E8	3	12.5	C8	2	5.5
E9	1	1.5	C9	2	5.5
E10	3	12.5	C10	2	5.5
Total Score	**28**	**111.5**	**Total Score**	**14**	**41.5**

Table-8: Balance Score during pick up objective from floor a standing position

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=111.5, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 111.5$$

$$= 100+55-111.5$$

$$= 43.5$$

TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	4	15	C1	4	15
E2	3	5.5	C2	2	1
E3	3	5.5	C3	3	5.5
E4	4	15	C4	4	15
E5	3	5.5	C5	4	15
E6	4	15	C6	4	15
E7	4	15	C7	3	5.5
E8	4	15	C8	3	5.5
E9	3	5.5	C9	4	15
E10	3	5.5	C10	4	15
Total Score	**35**	**102.5**	**Total Score**	**35**	**107.5**

Table-9: Balance Score during turning to look behind over left and right shoulders while standing

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=107.5, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x+1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 107.5$$

$$= 100+55-107.5$$

$$= 47.5$$

TURN 360 DEGREES

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	2	9.5	C1	0	0
E2	1	3	C2	0	0
E3	0	0	C3	1	3
E4	2	9.5	C4	1	3
E5	2	9.5	C5	1	3
E6	4	15	C6	2	9.5
E7	2	9.5	C7	0	0
E8	3	14	C8	1	3
E9	2	9.5	C9	2	9.5
E10	2	9.5	C10	2	9.5
Total Score	**20**	**89**	**Total Score**	**10**	**40.5**

Table-10: Balance Score during turn 360 degrees

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=89, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 89$$

$$= 100+55-89$$

$$= 66$$

PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	3	16	C1	3	16
E2	3	16	C2	1	2
E3	2	7.5	C3	1	2
E4	3	16	C4	1	2
E5	3	16	C5	2	7.5
E6	3	16	C6	2	16
E7	3	16	C7	3	16
E8	3	16	C8	2	7.5
E9	2	7.5	C9	2	7.5
E10	2	7.5	C10	2	7.5
Total Score	**27**	**134.5**	**Total Score**	**19**	**84**

Table- 11: Balance Score during place alternate foot on step or stool while standing unsupported

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=134.5, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 134.5$$

$$= 100+55-134.5$$

$$= 20.5$$

STANDING UNSUPPORTED ONE FOOT IN FRONT

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	4	18	C1	3	9.5
E2	4	18	C2	2	2
E3	2	2	C3	2	2
E4	4	18	C4	3	9.5
E5	3	9.5	C5	3	9.5
E6	4	18	C6	4	18
E7	3	9.5	C7	3	9.5
E8	3	9.5	C8	3	9.5
E9	3	9.5	C9	3	9.5
E10	3	9.5	C10	3	9.5
Total Score	**33**	**121.5**	**Total Score**	**29**	**88.5**

Table-18: Balance Score during standing unsupported one in front

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=121.5, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 121.5$$

$$= 100+55-121.5$$

$$= 33.5$$

STANDING ON ONE LEG

Experimental group			Control group		
Subjects	**BBS score**	**Rank**	**Subjects**	**BBS score**	**Rank**
E1	1	4	C1	1	4
E2	0	0	C2	0	0
E3	0	0	C3	0	0
E4	0	0	C4	1	4
E5	1	4	C5	0	0
E6	2	9	C6	0	0
E7	2	9	C7	0	0
E8	1	4	C8	0	0
E9	0	0	C9	1	4
E10	1	4	C10	2	9
Total Score	**08**	**34**	**Total Score**	**05**	**21**

Table-19: Balance Score during standing on one leg

Where,

n_1 =10, the number of the trail group. n_2=10, the number of the control group.

n_x=10, the number of the group with larger rank total. T_x=34, the larger rank total.

Now *'U'* formula

$$U = n_1\, n_{2+} \frac{n_x(n_x + 1)}{2} - T_x$$

$$= 10\times 10 + \frac{10(10+1)}{2} - 34$$

$$= 100+55-34$$

$$= 121$$

March 07, 2015

Head
Department of Physiotherapy
Centre for the Rehabilitation of the Paralysed (CRP)
CRP-Chapain, Savar, Dhaka-1343

Through: Head, Department of Physiotherapy, BHPI

Subject: Seeking permission to collect data to conduct my research project on "Effect of biomechanical ankle platform system (BAPS) training for improving balance in stroke patients".

Dear Sir,

With due respect and humble submission to state that I am Md. Abdul Alim, a student of 4th Professional B.Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). As per approval of ethical review committee of BHPI, I have been conducting a research project on "Effect of biomechanical ankle platform system (BAPS) training for improving balance in stroke patients". Mr. Nasirul Islam, Associate Professor of BHPI has been supervising me in order to accomplish this study. However, conducting this research project is partial of the requirement for the degree of B.Sc. in Physiotherapy. I want to collect necessary data from the patients attending at neurology outpatient department of CRP Savar. Therefore I need to obtain your kind written permission to initiate data collection from the targeted patients. I would like to assure that ethical principles would be followed as per guidelines of my institution/department.

I therefore, pray and hope that you would be kind enough to grant my application and permit me to collect required data to accomplish my research objectives.

Yours faithfully,

Md. Abdul Alim, 07.03.2015

Md. Abdul Alim
4th Professional B.Sc. in Physiotherapy
Session: 2009-2010
Bangladesh Health Professions Institute (BHPI)
(An academic institution of CRP)
CRP-Chapain, Savar, Dhaka-1343.

Forwarded 07/03/2015

Forwarded for Approving 09/03/15

Giving permission for data Collection please contact with my colleague Ms. Rumana, Lect & Clinical PT as a counterpart. 09/03/15