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"Exploring the Efficacy of Plinth Trunk Exercise and Physio Ball on Functional Balance and Trunk Control among Stroke Patients"

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"EXPLORING THE EFFICACY OF PLINTH TRUNK EXERCISE AND PHYSIO BALL ON FUNCTIONAL BALANCE AND TRUNK CONTROL AMONG STROKE PATIENTS"

Submitted by Md. Golam Nobi, for the partial fulfillment of the requirements for the degree of Master of Science in Physiotherapy.

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List of Abbreviation

BOS : Base of Support

BBS : Berg Balance Scale

BHPI : Bangladesh Health Professions Institute

BMI : Body mass index

BMRC : Bangladesh Medical & Research Council

CRP : Centre for the Rehabilitation of the Paralysed

DM : Diabetes Mellitus

DALYs : Disability Adjusted Life Years

HTN : Hypertension

IHD : Ischemic Heart Disease

IRB : Institutional Review Board

sEMG : surface electromyography

TIS : Trunk Impairment Scale

WHO : World Health Organizations

ABSTRACT

Background: A stroke not only affects the leg muscles but also the muscles in the trunk and the abdominal wall. After a stroke, hemiplegia causes motor paralysis of the limb muscles, which only affects one side of the body, in contrast to the trunk muscles, which are impaired on both the ipsilateral and contralateral sides of the body to the side of the body that was affected by the lesion. **Objective:** To evaluating the effects of physio ball and plinth trunk exercise for trunk control and functional balance in patients with stroke. **Methods:** The design of this investigation was a randomised control trial with assessor blinded. Neurology and Stroke Rehab Unit of CRP was the location where the study was carried out (Savar Centre). Both the control group and the experimental group each had 30 patients with stroke who matched the inclusion criteria. These patients were randomly assigned (1:1 ratio) in these groups. Each group received a total of twelve therapy sessions, each lasting forty-five minutes and taking place over the course of three weeks. **Analysis of data*:*** SPSS version 25 was used for data analysis. Inferential statistics- nonparametric statistics such as Mann-Whitney U test, Wilcoxon test were used for data was analysis. **Results:** After treatment, both the groups showed significant improvement ($p<0.05$) but the plinth trunk exercise on physio ball exercise group improved more significantly ($p<0.05$) than the standard physiotherapy exercise group in terms of trunk control and functional balance (sit to stand and transfer). **Conclusion:** Plinth trunk exercise on physio ball program was proven to be more effective with standard physiotherapy treatment in trunk control and functional balance (sit to stand and transfer) of patients with stroke.

Key Words: Stroke, Physio Ball, Plinth Trunk Exercise, Trunk Control and Functional Balance.

CHAPTER – I INTRODUCTION

1.1 Background

According to a bulletin published by the World Health Organization (WHO), strokes and other cerebrovascular accidents are the second major cause of mortality and the third leading cause of disability throughout the entire world (WHO) (Johnson et al., 2016). Out of the 15 million people who suffer from cerebrovascular stroke each year across the globe, approximately 5 million are left permanently incapacitated (El-Helow et al., 2015). A stroke is the result of the rapid death of some brain cells as a result of a lack of oxygen caused by a reduction or loss of blood flow to the brain as a result of a blockage or rupture in an artery that supplies blood to the brain. Strokes are also a primary cause of dementia and depression (Owolabi et al., 2015). There are various risk factors for stroke, both those that can be changed and those that cannot be changed. A high cholesterol level, diabetes, being a smoker, having atrial fibrillation, and not getting enough exercise were some of the primary risk factors they had (Jin, 2014).

According to the findings of a survey study that was carried out in 2009 by Johnston et al., the prevalence of strokes was approximately 70% across the globe, with stroke-related deaths and disability adjusted life years (DALYs) ranging from approximately 87% to be observed in low and middle income countries (Johnston et al., 2009). Over the past four decades, the incidence of stroke has more than doubled in poor and middle income nations, while the incidence of stroke has decreased by 42 percent in high income countries during these same decades (Feigin et al., 2014). Islam et al. (2016) revealed that in Bangladesh, the stroke prevalence rate is 0.30% overall, and it is the third biggest cause of death in the country. The American Stroke Association (2016) estimates that Stroke is approximately the fifth largest cause of mortality in the United States. It is also the primary cause of disability for a longer period of time and the major cause of disability that can be prevented. In the United Kingdom, it is regarded as one of the most significant health problems, despite the fact that it is approximately the third most leading cause of mortality on a global scale (Parmer, Sumaria & Hashi, 2011).

Early and typical indicators of strokes include a change in facial appearance, weakness on one side of the body along with altered sensation, and difficulty speaking (Jin, 2014). The symptoms of a stroke can vary widely depending not just on the magnitude of the lesion but also where it occurs in the brain. The most characteristic sign of a stroke is

hemiparesis or hemiplegia, which can range from weakening to complete paralysis of the side of the body that is opposite to the side where the supratentorial lesion is located (Rai et al., 2014). In addition to the muscles in the limbs, those who have suffered a stroke often have problems with their trunk muscles as well. In the condition known as hemiplegia, motor paralysis of the limb muscles is limited to one side of the body, in contrast to the trunk muscles, which experience weakness on both the ipsilateral and contralateral sides of the body, depending on which side of the body is affected by the lesion (Tsuji et al., 2013).

Trunk muscles play a crucial role in the control of the trunk in addition to supporting our bodies in antigravity positions like sitting and standing, stabilizing proximal body parts during voluntary limb movements, adjusting weight shifts, and performing selective movements of the trunk that maintain the base of support during static and dynamic postural adjustments (Davis, 2016; Ryerson & Levit, 2017; Edwards, 2015). A stable trunk is a crucial component for maintaining balance and making use of one's extremities when doing daily functional activities. Stroke patients have been shown in multiple studies to have deficiencies in the strength of their trunk muscles as well as impaired control of their trunk. The pyramidal and extra pyramidal tracts of the nervous system are responsible for a number of functions, including coordination of movement patterns, balance, and trunk control and stability. These functions are disrupted after a stroke, which results in a reduction in mobility (Karatas et al., 2004).

The Bobath principle is a neurodevelopmental concept that stresses how the regulation of movement progresses from the proximal to the distal parts of the body. This is one of the ideas that underlies neurodevelopment (Davis, 2013). Because the trunk is the centre critical point of the body, proximal trunk control is a necessity for controlling the movement of distal limbs, maintaining balance, and engaging in functional activities (Karthikbabu et al., 2011). When it comes to the prediction of functional outcome following stroke therapy, the performance of the trunk muscles is a crucial determinant. In stroke survivors, a poor recovery of trunk muscular function produces severe impairment and a decline in the performance of activities of daily living, leading to a lower overall quality of life (Fujiwara et al., 2012). In chronic stroke patients, selected motions of both the upper and lower trunk were reported to be impaired by a study that used a scale called the Trunk Impairment Scale (TIS) (Verheyden et al., 2015).

1.2 Rationale

One of the leading causes of death and disability worldwide is stroke. Following a stroke, the trunk's movements are altered and decreased, making it difficult to maintain bodily balance and get the pelvis and trunk back to moving normally. There are numerous research-based discoveries that highlight the significance of trunk function following stroke. Numerous research have shown the benefits of various post-stroke therapy modalities, including neurophysiologic, motor learning, limb muscle strengthening activities, etc. However, the performance of the lower or upper extremities is the focus of the majority of investigations.

As a result, compared to limb rehabilitation, recovery of the trunk and balance is a relatively underutilized aspect of stroke rehabilitation. For post-stroke patients who want to regain their balance and improve their gait, a trunk rehabilitation exercise through balance training is also a crucial element. The goals of balance training are to improve gait after stroke, retrain postural control, and establish efficient, targeted techniques for performing functional tasks in a variety of shifting environmental circumstances. Therefore, balance retraining is a crucial part of a thorough physical rehabilitation program. However, there isn't much data to back up the benefits of balance training and trunk rehabilitation. The goal of this protocol was to ascertain the impact of balancing training and trunk therapy on the recovery of balance and trunk control in post-stroke patients. Additionally, it aids in the establishment of proper guidelines, ideas, and instruction regarding certain protocols of a trunk rehabilitation exercise program to enhance trunk control, balance, and lessen impairment for stroke patients.

1.3 Study Objective

1.3.1 General objective

To evaluate the effects of physio ball and plinth trunk exercise for trunk control and functional balance in patients with stroke.

1.3.2 Specific objectives

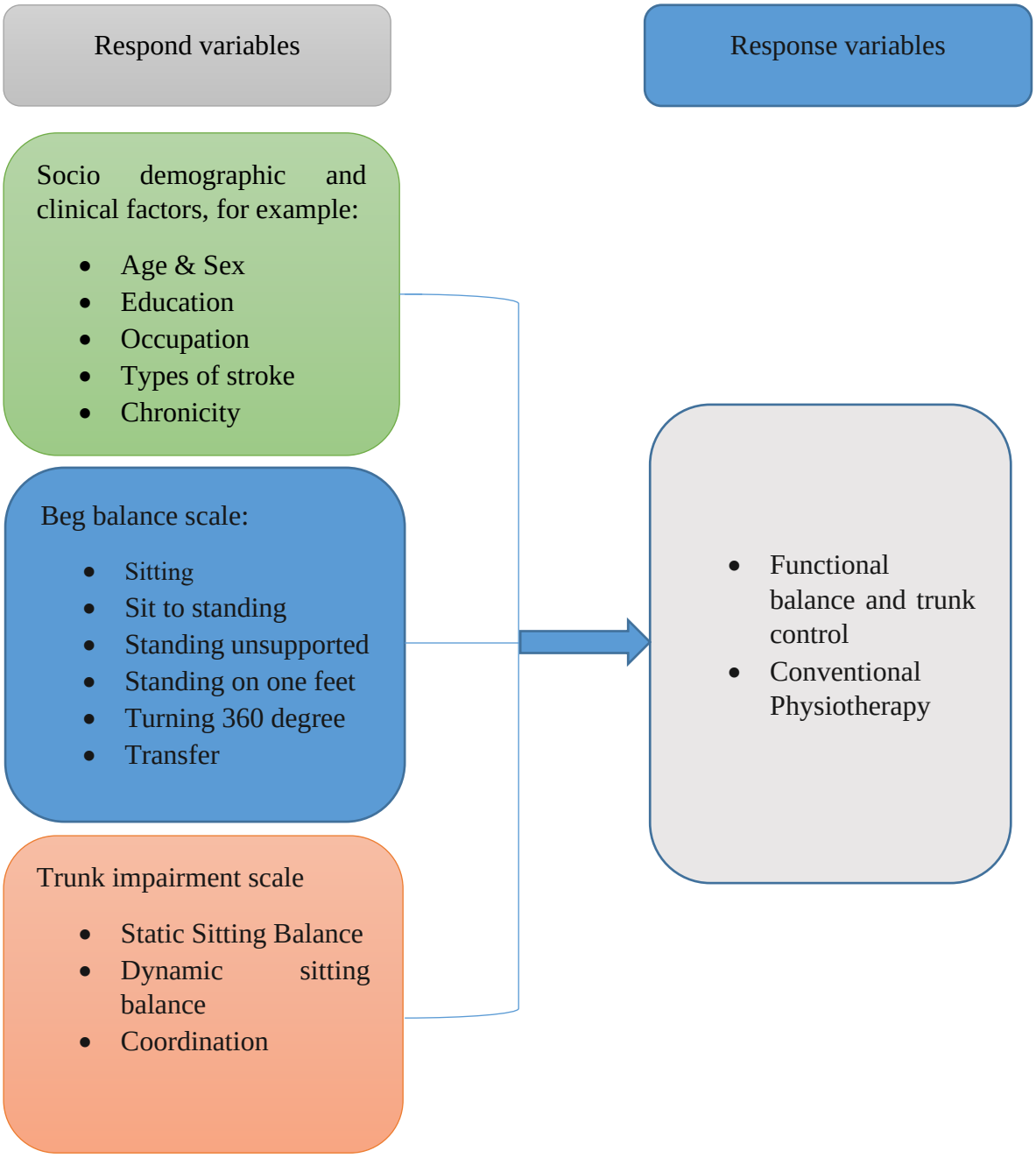
1. To find out the socio-demographic characteristics of the stroke patients.
2. To observe the effectiveness of physio ball and plinth trunk exercise with usual therapy in comparison with usual therapy alone to improve balance for patients with stroke.
3. To identify the effectiveness physio ball and plinth trunk with usual therapy in comparison with usual therapy alone to improve trunk control for the patients with stroke.

1.4 Hypothesis

Null Hypothesis (Ho): $\mu 1 - \mu 2 = 0$ or $\mu 1 = \mu 2$; where $\mu 1$= mean of the physio ball and plinth trunk exercise with usual therapy for trunk control and functional balance group (experimental group) and $\mu 2$= mean of the usual therapy for trunk control and functional balance group (control group) with initial and final mean difference is same. So, the physio ball and plinth trunk exercise with usual therapy is not more effective for trunk control and functional balance than usual therapy alone for stroke patients.

Alternative Hypothesis (Ha): $\mu 1 - \mu 2 \neq 0$ or $\mu 1 > \mu 2$; where $\mu 1$= mean of the physio ball and plinth trunk exercise with usual therapy for trunk control and functional balance group (experimental group) and $\mu 2$= mean of the usual therapy for trunk control and functional balance group (control group) with initial and final mean difference is not same. So, the physio ball and plinth trunk exercise with usual therapy is more effective for trunk control and functional balance than usual therapy alone for stroke patients.

1.5 List of variables



1.6 Operational definitions

Stroke

A stroke occurs due to blockage of blood flow or any rapture in blood vessels that carries oxygen and nutrients to the brain leads to death of brain cells. After stroke most of patients represents several clinical features which lasting more than 24 hours like spasticity, loss of balance, paralysis or weakness of one side of the body which includes arm, leg and trunk muscles also. Unlike arm and leg muscles trunk muscles also paralysed or become weak on both sides. This factors leads to disability and decrease functional independence to perform daily living activities. Currently, in Bangladesh it considers one of the legend cause death and disability. After stroke functional recovery of is one of the challenges for clinician, researcher.

Physio Ball Trunk Exercise

Physio ball trunk exercise program is one of the specialized exercise regimens for stroke rehabilitation where some systemic exercise program targeted for the trunk muscles performed by the patient under physiotherapist guidance over unstable surface such as physio ball is called physio ball trunk exercise.

Plinth Trunk Exercise

Plith trunk exercise program is one of the specialized exercise regimens for stroke rehabilitation where some systemic exercise program targeted for the trunk muscles performed by the patient under physiotherapist guidance over the stable surface such as physio bed or treatment table is called physio bed trunk exercise.

Trunk control

Trunk control refers to the body's ability to conduct certain trunk motions, maintain an upright posture and/or position, and make adjustments in response to weight changes or transfers. During static and dynamic postural modifications, this capacity aids in keeping the center of mass within the base of support (BOS).

Balance

In order to attain a goal that calls for an upright posture, balance is defined as a complicated process that includes the receiving and integration of sensory inputs, as well as the planning and execution of motions.

CHAPTER-II LITERATURE REVIEW

Stroke is a widespread neurological illness that is getting worse every day. There are numerous factors that contribute to this issue, as well as numerous solutions available. Stroke patients experience a variety of challenges, including issues with hand function, balance, gait, and movement. Stroke is a term used to describe a common neurological condition where a clinical symptom of focused disturbance develops suddenly as a result of a vascular event and lasts for more than 24 hours (Gayer & Gomes, 2009). Today, stroke is the most common known cause of impairment in daily activities (ADLs), and its prevalence is rising globally (Hsieh, Sheu, Hsueh, & Wang, 2002).

The "Dreaded- D's," which are the second most prevalent cause of dementia, the fourth greatest cause of death, and the leading cause of persistent disability in the United States (U.S.), are all brought on by stroke, a relatively common illness. Stroke seems to affect more people worldwide than it does in the US, yet overall numbers are quite erratic and frequently unreliable. Nearly 7 million persons in the US, or about 3% of the adult population, have experienced a stroke (Roger et al., 2011).

Around 600,000 primary (first-time) strokes occur annually in the US, compared to roughly 800,000 secondary (recurrent) strokes. Approximately 87 percent of these strokes are ischemic infarctions, with primary hemorrhages coming in at 10 percent and subarachnoid hemorrhages at 3 percent. Worldwide estimates place the percentage of strokes caused by major hemorrhages between 10 and 25 percent. Persons of Asian, African, and Latin American descent experience primary hemorrhages more commonly than persons of European descent. Furthermore, while major hemorrhage accounts for 10 to 17 percent of strokes in Western countries, it can account for up to 25 percent of strokes in Asian countries (Ariesen et al., 2003). Age-related stroke incidence rises quickly, doubling every ten years after age 55 (Chong & Sacco, 2005). Stroke incidence ranges from 30 to 120 per 100,000 persons aged 35 to 44 and from 670 to 970 per 100,000 adults aged 65 to 74 each year. Children do get strokes, although they are far less common than in adults (about 1 to 2.5 per 100,000 per year), and between 50 to 75 percent of children's strokes are caused by bleeding. The most likely time for a pediatric stroke to occur is between the ages of 2 and 5 years, and the most prevalent cause is sickle cell disease (Ohene-Frempong et al., 1998).

Incidence rates of stroke in affluent countries have somewhat decreased or plateaued during the past ten years, possibly because of improved treatment of vascular risk factors. For instance, the number of hospital-based stroke diagnoses decreased overall in the U.S. from 680,607 to 609,359 between 1997 and 2006, and the age-adjusted hospital-based stroke diagnosis rate per 100,000 people significantly decreased in a linear pattern from 282.7 to 210.4 for men (26%) and from 240.5 to 184.7 for women (23%). Men saw a considerably higher average rate of decline in hospital-based stroke diagnostic rates than women (-8.7 vs. -7.5 per 100,000 people). These rates are anticipated to climb considerably again during the next 40 years because of increasing population aging, particularly in Western nations (Ovbiagele, 2011). The World Health Organization (WHO) defines a stroke as "a clinical syndrome consisting of rapidly evolving clinical signs of focal (or global, in the case of coma) disturbance of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than a vascular origin." According to Sym and Kim (2015), there are numerous reasons why stroke patients struggle with upper extremity tasks, lower extremity tasks, balance issues, postural issues, and gait issues, among others. Stroke patients suffered from spasticity, weakness, loss of equilibrium and righting reactions, commonly representing asymmetrical posture of the trunk resulting lose their ability to perform postural adjustment and maintain postural alignment. Loss of trunk control is commonly observed in patients who have had stroke which may lead to dysfunction in upper and lower limb control (Zakaria, Rashad & Mohammed, 2010).

According to Chen, Wang, Wang, and Wong (2017), stroke is a condition that impairs sensory and motor abilities by producing irreversible brain damage as a result of cerebral vascular issues. As a result, neurological abnormalities that affect movement control, balance control for maintaining posture, and selective muscle activation appear to be complicated (Rinalduzzi et al., 2015). By altering the center of gravity at the base of the surface, balance is continuously maintained. The ocular, vestibular, and somatosensory systems—all of which are supported by the central nervous system—provide the sensory input used to make this adjustment (Dunsky, 2019). However, depending on the location of the stroke lesion in stroke patients, various systems are affected (Chen, Wang, Wang, & Wong, 2017), according to research by Zandvliet, Meskers, Kwakkel, and van Wegen (2018), these results have been linked to decreased ability to control one's balance, limitations on one's capacity to perform activities of

daily living (ADL), loss of range of motion, an imbalanced standing posture, and excessive weight bearing on the unaffected side. Normal balance depends on the ability of healthy people to maintain adequate weight distribution and to adjust their weight in accordance with their needs. But people who have had strokes typically exhibit diminished capacity to shift weight to the paretic side of the body when sitting or standing (Cabanas-Valdés, Cuchi, & Bagur-Calafat, 2013), higher postural sway, and poorer dynamic stability.

According to Jung, Cho, and In (2016), sitting balance is a predictor of functional recovery, and the trunk muscles' contribution to balance maintenance is crucial given that the center of mass is lowered compared to standing. According to research by Karthikbabu, Chakrapani, Ganesan, Ellajosyula, & Solomon (2018), the activation of the trunk muscles during a reaching task in stroke patients is highly linked with both balance and trunk control. Exercises involving pelvic tilt or bridging, weight-shifting, and trunk stability utilizing the arms and legs may be employed as training techniques to enhance balance while sitting (Song, & Heo, 2015). The ability to control the alignment of the trunk is necessary to counteract the center of mass change during weight-shifting exercises (Huang, Lee, Lin, Tsai, & Liao, 2014), and the trunk muscles contract to counteract postural sway during shoulder or hip flexion exercise in the sitting position (Helbostad, Sturnieks, Menant, Delbaere, Lord, & Pijnappels, 2010).

As it stabilizes the pelvis and the spinal column, trunk control appears to be particularly crucial for balance. The trunk's muscles play a role in keeping the body balanced and in control. Numerous investigations have documented post-stroke weakness in the bilateral trunk rotator muscles as well as the trunk flexor and extensor muscles. Additionally, a number of authors have emphasized the significance of evaluating trunk function in order to forecast the functional state of stroke patients following discharge (Cabanas-Vald'esa, Caritat, & Bagur-Calafat, 2013). Exercises that target trunk control specifically are crucial for stroke patients' effective rehabilitation. Through a targeted exercise program for trunk rehabilitation, one can finally increase selective mobility by strengthening the muscles in the trunk. According to Moreno-Segura, Martn-San Agustin, Garca-Bafalluy, and Escriche-Escuder (2002), this result aids patients in learning basic daily life skills. Trunk control in stroke patients is associated with measures of balance, gait, and functional capacity, according to a cross-sectional study

by Verheyden et al. (2011). Additionally, early after a stroke, extra trunk rehabilitation activities enhanced upright balance and ambulation, according to one randomized control experiment. The training of one component has a transfer impact on the other component since the two components are interconnected (Saeys et al., 2008).

According to Boukadida, Piotte, Dehail, and Nadeau (2015), teaching stroke patients to be aware of their trunk position improved weight symmetry. Propioceptive neuromuscular facilitation-based resisted anterior elevation and posterior depression of pelvic motions for lower trunk muscles improved walking in early phase stroke patients, according to El-Basatiny, & Abdel-Aziem (2015).

In comparison to other balance trainings on different support surfaces, balancing training on different support surfaces (affected side: stable surface, non-affected side: unstable surface) may permit a higher favorable effect on balance and walking capacity in stroke patients (Kong, Bang & Shin, 2015). The internal oblique and transversus abdominis muscles, as well as balance skills, were enhanced by the unstable surface trunk stabilization exercise (Yoo, Jeong & Lee, 2014).

Exercise on the unstable support surface had a far greater impact on improving balance and the size of the trunk muscles' cross-sectional area than exercise on the stable support surface (Bae, Lee, Kim, Jung, & Kim, 2016). In patients with hemiparetic stroke, trunk exercises on an unstable surface increase trunk muscle activation, postural control, and walking speed (Jung, Cho & In, 2016).

The effectiveness of adding trunk exercises to traditional therapy on functional outcomes is assessed by meta-analysis. According to the study's findings, there is "moderate evidence" that particular trunk exercises added to typical early stroke rehabilitation greatly enhance post-stroke standing balance and mobility. (Sorinola, Powis, & White, 2014). Patients with subacute stroke who added trunk exercises to their routine physiotherapy performed better in trunk lateral flexion (Verheyden et al., 2009). Early after stroke, truncal exercises showed promise for improving balance and mobility, according to a randomized controlled experiment (Saeys et al. 2008). Recent research found that adding additional trunk exercises to a regular exercise routine had a substantial impact on early stage stroke patients' balance, functional status, and ability to walk (Haruyama, Kawakami, & Otsuka, 2017). Using a different pre-post design, it

was discovered that the aquatic and land-based trunk exercise program significantly increased walking speed and cycle, stance phase and stride length of the affected side, and the symmetry index of the stance phase among stroke patients (Abouzeid, 2012).

The internal oblique and transversus abdominis muscles, as well as balance capacity, were found to be improved by unstable surface trunk stabilization exercise (Yoo, Jeong & Lee, 2014). Trunk exercises performed on a physio ball resulted better trunk rotator control compared to similar exercises performed on a plinth but also have additional effects for the stepping balance performance in subjects with acute-stroke (Karthikbabu et al., 2011). Verheyden et al. (2009) demonstrated that 10 hours of additional task-specific trunk exercises performed on the physio plinth along with regular physiotherapy had a beneficial effect on the selective movement control of the lateral flexion in patients with subacute stroke. A pre-post design trial showed that administration of trunk rehabilitation in chronic stroke patients improved their balance performance and gait parameters (Karthikbabu et al., 2011).
Another pre-post test design study concluded that trunk stability exercise using proprioceptive neuromuscular facilitation with changes in chair heights have significant changes in gait velocity, cadence, and stride length were observed on the affected side (Park & Moon, 2016).

Around 80% of deaths from NCDs take place in low- and middle-income nations (LMICs). Stroke is clearly one of the leading causes of mortality and disability worldwide among NCDs. With 10.3 million new cases every year, 6.5 million fatalities, and around 26 million survivors with some impairment, stroke wreaks havoc on life (Feigin et al., 2015). Over a period of three decades, the incidence of stroke in LMICs rose from 56/100,000 to 117/100,000 person-years. South-East Asian nations are reported to account for more than half of all yearly NCD mortality. The Global Burden of Illness study's epidemiological findings for many LMICs may not accurately reflect the burden of disease because of the inadequate disease reporting or death registration systems in LMICs (Feigin et al., 2014).

With this rapid economic change, non-communicable illnesses are now more prevalent in Bangladesh than infectious ones. Over the past three decades, due to epidemiological change, NCDs have steadily replaced infectious and parasitic illnesses as the leading cause of death. The few data that are available indicate that about 51 percent of deaths

in Bangladesh are thought to be caused by NCDs. The ninth-highest age-standardized death rate attributable to chronic diseases, particularly diabetes and cardiovascular disease, is found in Bangladesh (Bleich et al., 2011).

A stroke can have devastating effects that result in 5 million deaths and lifelong disability each year. The stroke fact sheet from 2012 now projects 84–262/100,000 cases in rural regions and 334–424/100,000 cases in urban areas. Due to the high incidence of poorly managed hypertension, hemorrhagic stroke is more common in Asian nations than it is globally. Hemorrhagic stroke is thought to account for about 10% of all stroke cases in the western population and 17.7%–32% of all strokes in India (Kasper et al., 2015).

CHAPTER-III METHODOLOGY

3.1 Study design

The study was a quantitative evaluation of assessor blinded randomized control trial research design with baseline assessment, post-treatment assessment, two group comparison. Classic experimental research finding out the causal relationship between independent and dependent variables and infer the findings for generalization (Stangor, & Walinga, 2019). In fact, the study was an experiment between different subject designs. Physio ball trunk rehabilitation exercise along with conventional physiotherapy applied to the treatment group and physio bed trunk rehabilitation exercise along with conventional physiotherapy techniques applied to the control group. It was a single blinded study where the assessors were blinded. A pretest before intervention and posttest after 12 sessions of intervention was administered with each subject of both groups to compare the functional improvement effects on trunk control and balance before and after the treatment.

3.2 Study site

The study was conducted from outpatient, neurology and stroke rehabilitation physiotherapy unit of the center for rehabilitation of the paralysed (CRP), Savar, and Dhaka 1343.

Consort flow chart

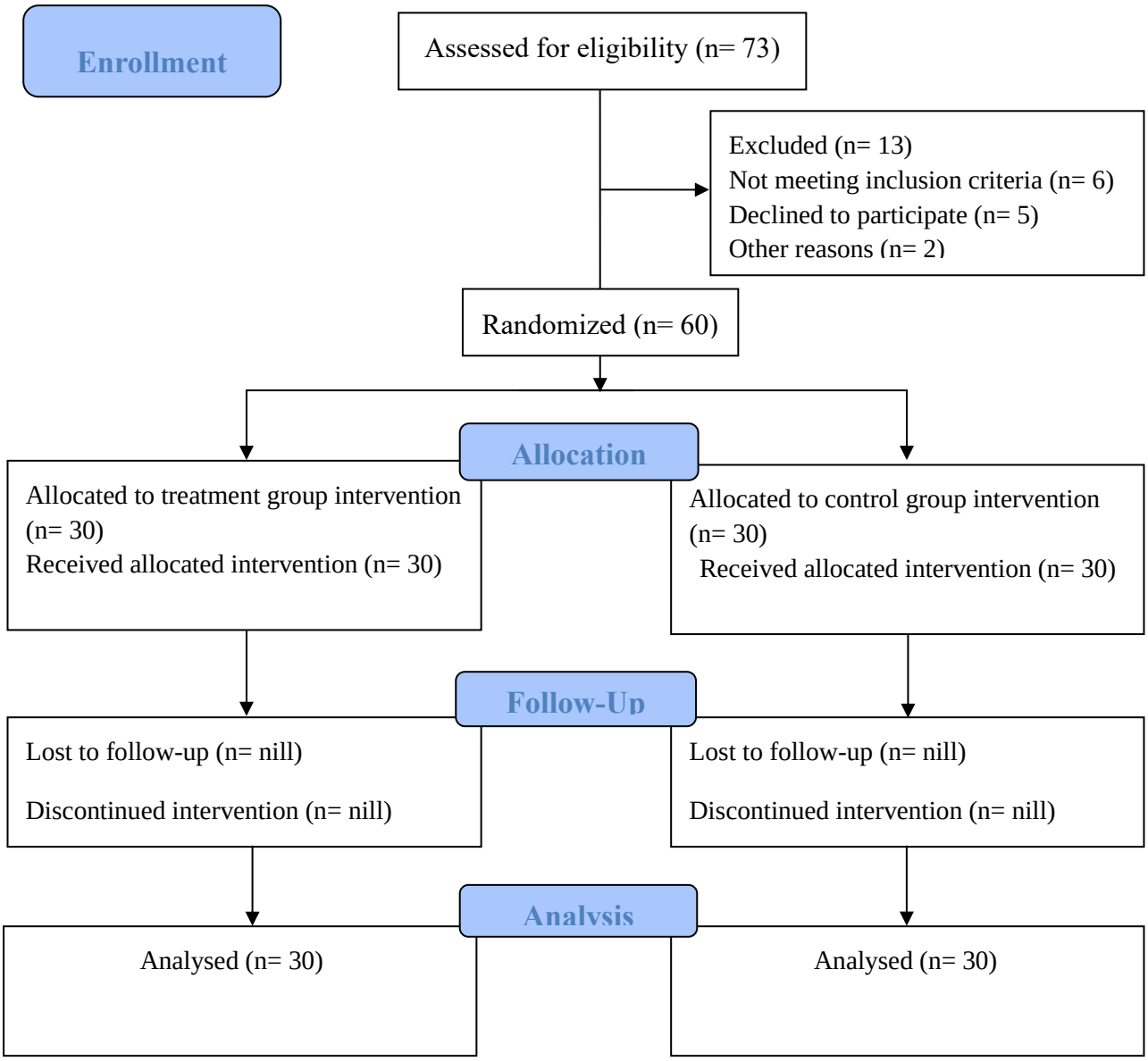


Figure 01: Consort flow chart of the phases of Randomized Control Trial

3.4 Study Population

The study population who was diagnosed as stroke patients who received treatment in the Neurology and Stroke Rehabilitation Unit of CRP.

3.5 Sampling technique

Computerized Random sampling technique was used in this study. A single blinded (assessor) randomized controlled trial with pre-measurements and post-measurements was conducted. Participants were measured by a blinded assessor once before randomization and intervention and again once 3 weeks after randomization and getting intervention. The assessor were responsible for conducting the baseline assessments had checked that each participant meets the inclusion criteria and had collected demographic information including date of birth, sex, duration of stroke, type of stroke and classification of stroke. A secure random allocation schedule had been generated prior to commencement of the trial by an independent person. The randomisation schedule had blocked (1:1) to ensure equal numbers of Participants are randomised to the treatment and control group. A participant had entered into the trial when baseline details are logged and the allocation was provided

3.6 Sample size

A power analysis to determine sample size with 1.14% prevalence of stroke in Bangladesh (Mondal et al., 2021) where a 5% type – I error (α), 80% power (1 – type II error/β) and a clinically acceptable margin, δ = 0.1, then according to Zhong (2009),

$$N = 2 \times \left(\frac{Z_{1-\alpha}+Z_{1-\beta}}{\delta}\right)^2 \times p \times (1-p)$$

$$= 29.66 \approx 30$$

Here,
$1 - \alpha = 0.95$
$1 - \beta = 0.80$
$Z\ (0.95) = 1.96$
$Z\ (0.90) = 1.65$

So, researcher considered 30 participants for each group.

3.7 Eligibility Criteria

3.7.1 Inclusion criteria

- Diagnosed with stroke according to the World Health Organization (WHO) definition (Demaerschalk et al., 2016).
- Both Male and female will be included (deRooij et al., 2019).
- Age ranges between 35 to 70 years.
- Patient able to sit: Could be able to sit independently with their feet touching the ground for 30 seconds on a stable surface (Karthikbabu et al., 2011).
- Suffering from both acute and chronic stroke: Duration of stroke from within 1 month up to above duration stroke cases was included (Karthikbabu et al., 2011).

3.7.2 Exclusion criteria

- Medically unstable patients, unstable cardiac disease (Kim, Jung & Lee, 2017).
- Patient who had cognitive problem
- Recurrent stroke history, neurological disease affecting balance other than stroke, musculoskeletal disorders affecting motor performance
- Participants who were unwilling to participate.

3.8 Data Collection

The researcher had taken data by using a close ended questionnaire, with face to face interview and assessing the patient, initial recording treatment and final recording. The patients were assessed and treated by a qualified Physiotherapist in the meantime the assessor had taken the pre-test data. The pre-test data were taken before starting intervention balance related information was measured by Berg balance scale (BBS); level of trunk impairment was measured by Trunk impairment scale (TIS). The researcher had given a verbal and practical training session about the treatment protocol towards 4 qualified physiotherapists before giving treatment to the patients.

The total 3 weeks (4 days per week) treatment session was provided to each participant. After completing the 3 weeks of trunk and balance rehabilitation exercise the post-test data were taken. Both pre-test and post-test data were collected by using a written questionnaire from which was formulated by the researcher. The questionnaire was formulated in both Bangla and English for better understanding.

3.9 Measurement Tools

The interviewer was asked from the structured questionnaire which was designed to collect information on related. However, the questionnaire was comprised of socio demographic characteristics and background information like- name, sex, age, educational qualification, height, weight etc, and medical information like stroke types, duration, affected side, dominant side affected etc. Next section included items on balance related information by Berg balance scale (BBS). Final section included items on trunk impairments related information by Trunk Impairment Scale.

Berg Balance Scale (BBS)

The Berg balance scale is used to objectively determine a patient's ability (or inability) to safely balance during a series of predetermined tasks. It is a 14 item list with each item consisting of a five-point ordinal scale ranging from 0 to 4, with 0 indicating the lowest level of function and 4 the highest level of function and takes approximately 20 minutes to complete. It does not include the assessment of gait. Test retest and interobserver reliability for the BBS total score Intraclass correlations (ICC) was 0.97 and 0.98, respectively (Downs, Marquez & Chiarelli, 2013).

Trunk Impairment Scale (TIS)

The Trunk Impairment Scale (TIS) is a tool to measure motor impairment of the trunk after stroke. The TIS evaluates static and dynamic sitting balance as well as coordination of trunk movement. The TIS has sufficient reliability, internal consistency and validity for use in clinical practice and stroke research. Test retest and inter observer reliability for the TIS total score Intra class correlations (ICC) was 0.96 and 0.99, respectively (Verheyden et al., 2005).

3.10 Treatment regime

Five physiotherapists who were expert in treatment of neurological patient were involved in treatment of patients. All the physiotherapists have the experience of more than two years in the aspect of neurological physiotherapy. Among them, three were male and two were female physiotherapist. An in-service training was arranged to share the information with practical demonstration regarding physio ball and physio bed

trunk rehabilitation exercise including patient position, dose, rest interval and repetition of task with conventional physiotherapy.

The experimental group performed task-specific trunk exercises on an unstable surface (physio ball) and also on a stable surface (plinth) in addition to usual physiotherapy while control group received only usual therapy. Both the groups had undergone for 45 minutes of functional balance and trunk exercises in a day, four days a week for three weeks (Karthikbabu et al., 2011).

Control group

All the patients included in the study underwent regular acute-phase physiotherapy treatment, such as tone facilitation and a range of movement exercises for the hemiplegic side. In addition, both the groups received 1 hour of trunk exercises a day, four days a week for three weeks. All the patients received exercises consisting of task-specific movements of the upper and lower part of the trunk both in the supine and sitting positions. The supine exercises involved the pelvic bridge, the unilateral bridge, the flexion rotation of the upper and lower trunk.

Sitting exercises included selective flexion extension of the lower trunk; lateral flexion of the upper and lower trunk; rotation of the upper and the lower trunk; weight shifts; forward and lateral reach.

All the treatment sessions were delivered by research physiotherapists. The trunk exercises were initiated with moderate assistance and progressed to a state of no assistance. The number of repetitions and intensity of the exercise were determined by the physiotherapists based on the patient's performance. The exercises were performed with adequate rest periods in between.

The intensity of the exercises was increased by introducing one or several of the following changes: (1) reducing the base of support; (2) increasing the lever arm; (3) advancing the balance limits; or (4) increasing the hold time. The control group performed task-specific trunk exercises on a stable surface (i.e. the plinth), while the experimental group performed them on an unstable support (i.e. the physio ball).

Experimental group intervention

The supine exercises were as follows: the pelvic bridge was performed by placing both the patient's legs on a physio ball and asking him or her to lift the pelvis off the support surface. Initially the ball was kept beneath the knees and advanced to the lower leg. The exercise intensity was further increased by flexing the uninvolved upper limb. The unilateral pelvic bridge was performed by lifting the uninvolved leg off the ball while maintaining the pelvic bridge position. Upper trunk rotation was executed by having the patient rest his or her trunk on the ball with knee flexed at 90 degrees and the feet flat on the support surface. The patient was asked to perform a task-specific reach-out for an object kept above the hip by a flexion rotation of the upper trunk. Lower trunk rotation was performed by placing the both the patient's legs on the ball and asking him or her to move the ball to both the left and the right by rotating the pelvis. Initially the ball was placed beneath the knees, and then advanced towards the ankles. The flexion rotation of the lower trunk was achieved by bringing the ball diagonally towards the shoulder while holding the ball in between the knees.

The sitting exercises were as follows: The patient was seated on the physio ball with hips and knee bent at 90 degrees and the feet kept flat on the support surface. The patient performed all the task-specific dynamic exercises while balancing in a sitting posture on the ball. Selective flexion extension of the lower trunk was performed by ante-flexion and retro-flexion of the lower part of the trunk. Upper trunk lateral flexion was executed by initiating movement from the shoulder girdle so as to bring the elbow towards the ball. Lower trunk lateral flexion was achieved by initiating movement from the pelvic girdle so as to lift the pelvis off the ball and bring it towards the ribcage. Upper trunk rotation was performed by moving each shoulder forwards and backwards. Lower trunk rotation was performed by moving each knee forwards and backwards. Weight shifting was executed by letting the ball roll forward until it touched the back of the legs, thereby allowing the lower spine to curve, followed by rolling the ball backward as far as possible and allowing the lower spine to arch. A forward reach was performed by asking the patient to reach a fixed point at shoulder height by forward flexing the trunk at the hips. Furthermore, progression was made by a forward diagonal reach at shoulder height. A lateral reach was performed by asking the patient to reach out for a fixed point at shoulder height so as to elongate the trunk on the weight-bearing side and shorten the trunk on the non-weight-bearing side.

3.11 Data Analysis

In order to ensure that the research have some values, the meaning of collected data has to be presented in ways that other research workers can understand. In other words, the researcher had to make sense of the results. As the result comes from an experiment in this research, data analysis was done with statistical analysis. Statistical analysis was performed by using descriptive statistics for demographic data and inferential statistics for group differences of functional balance improvement and improvement of trunk control of the participants through Statistical Package for the Social Science (SPSS) version 25.

3.12 Statistical test

The between group analysis of functional balance, improvement level of trunk control of the participants was analyzed by Mann-Whitney U-test. The within group analysis of functional balance improvement and improvement of trunk control of the participants was done by Wilcoxon singed rank test.

Parametric test was used to do analyzed interval/ ratio data and non-parametric test used to analyze the nominal/ordinal data. Also normality of data was checked. Normality of data was tested by Kolmogorov-Smirnov test. As the value of Kolmogorov-Smirnov test is less than .05, which indicate that the data distribution is not normal. The Kolmogorov-Smirnov test was used to determine normal distribution of the Berg balance and trunk impairment scale data. The results of this test indicated that the data for Berg balance and trunk impairment scale was not normally distributed and hence non-parametric statistics were used for the analysis of data. Within group analysis was done by Wilcoxon signed ranked test and between group analysis was done by Mann-Whitney U test.

Mann-Whitney U test is a non-parametric test that is simply compares the result obtained from each group to see if they differ significantly. This test can only be used with ordinal or interval/ ratio data.

The formula of Mann-Whitney U test:

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

Here,

n_1 = number of subjects from experimental group.

n_2 = number of subjects from control group.

T_x = the larger rank total.

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

Wilcoxon sign-ranked test is used when two groups of matched subjects, one group represent one condition and the other group represent other condition; to see if there is significant deference within the groups.

The formula of Wilcoxon sign-ranked test:

$$Z = \frac{W_s - \frac{n(n+1)}{4}}{\sqrt{\frac{n(n+1)(2n+1)}{24}}}$$

Here,

n = number of pairs where differences is not 0

W_s = smallest of absolute values of the sum

The statistical approach to determining sample size was the power calculation. Statistical power is a measure of how likely the study was to produce a statistically significant result for a difference between groups of a given magnitude (Serdar, Cihan, Yücel, & Serdar, 2021).

3. 13 Level of Significance

To find out the significance of the study, the "p" value was calculated. The p values refer to the probability of the results for experimental study. The word probability refers to the accuracy of the findings. The level of significant was set at 95% ($p<0.05$). A p value is called level of significance for an experiment and a p value of <0.05 was accepted as significant result for health service research. If the p value is equal or

smaller than the significant level, the results are said to be significant (De Poy and Gitlin, 2013).

3.14 Quality control and assurance

Blinding of Patients: Allocation of patient to experimental and control group by using computarised allocation system.

Homogeneity: Both groups are homogenous regarding inclusion criteria and sociodemographic factors.

Pilot trial: Researcher conducted a short pilot trial (7 days with 2 patients) before conducting the study for checking feasibility of the protocol and outcome measures.

Questionnaire: The format of the questionnaire was purely structural, thus it enabled a definitive answer. The questionnaire was developed according to the literature search. Follow the international accepted questionnaire and peer reviewed for reliable questionnaire.

Selection bias: The investigator tried to avoid selection bias through randomization and strictly maintained inclusion and exclusion criteria.

3.15 Ethical consideration

This experimental study includes clients, physiotherapists, other staff members and resources for better outcome. All participants‟ information was kept confidential. The participants had the right to withdraw from treatment anytime.

Ethical issues were followed as described by World Health Organization (WHO) and Bangladesh Medical and Research council (BMRC). At first to conduct study, the formal research project proposal was submitted to Bangladesh Health Professions Institute Institutional Review Board (IRB) (CRP/BHPI/IRB/10/2022/663). After got permission for data collection data were obtained from Savar, branches of CRP. This trial is also registered with the Clinical trial registry – India (CTRI/2022/11/047265). All data and assessment files were stored in strict secure and maintained confidentiality.

CHAPTER-IV RESULTS

After randomization between, targeted 60 patients were assigned to treatment group (n=30) and control group (n=30) (Figure 01). There was no drop out among both groups during post assessment. The dropout rate is very lower then hypothesized.

Table 1: Baseline characteristics of the patients

Characteristics		Experimental group	Control group	p value
Age (Mean±SD)		48.97±10.036	51.73±12.935	0.363[a]
Gender % (n)	Male	76.7 (23)	83.3 (25)	0.847[b]
	Female	23.3 (7)	16.7 (5)	
Education % (n)	Illiterate	26.7 (8)	3.3 (1)	0.385[b]
	Primary	26.7 (8)	36.7 (11)	
	Secondary school certificate (SSC)	23.3 (7)	26.7 (8)	
	Higher secondary certificate (HSC)	20.0 (6)	26.7 (8)	
	Bachelor	3.3 (1)	6.7 (2)	
Stroke type % (n)	Ischemic	73.3 (22)	86.7 (26)	0.935[b]
	Hemorrhagic	26.7 (8)	13.3 (4)	
Affected body side % (n)	Right Side	43.3 (13)	46.7 (14)	0.431[b]
	Left Side	56.7 (17)	53.3 (16)	
Dominant Side Affected % (n)	Yes	63.3 (19)	60.0 (18)	0.279[b]
	No	36.7 (11)	40.0 (12)	
Chronicity % (n)	Acute	40.0 (12)	66.7 (20)	0.429
	Chronic	60.0 (18)	33.3 (10)	

Outcome Measures	**Berg balance scale (BBS)** (Mean±SD)	20.93±6.698	21.47±4.569	0.091[a]
	Trunk impairment scale (TIS) (Mean±SD)	10.50±2.203	11.83±2.588	0.100[a]

(a, Mann Whitney U test; b, Chi-square test)

At baseline characteristics (Table 1) there is no statistically significant difference (p>.05) between the experimental group and control group on the assessed demographic characters (age, sex, education) and participants stroke characteristics (onset of stroke, affected side, dominant side).

Table 1 described that mean age of experimental group was 48.97±10.036 and control group was 51.73±12.935. Besides, in experimental group among 30 participants, 76.7% (n=23) were male and 23.3% (n=7) participants were female. While 83.3% (n=25) participants were male, and 16.7% (n=5) participants were female in control group. In chi-square test both group showed there is no significant (p>0.05) difference in their gender (Table 1).

On the other hand, in experimental group among 30 participants, 73.3% (n=22) had ischemic stroke and 26.7% (n=8) participants had hemorrhagic stroke. While 86.7% (n=26) participants had ischemic stroke and 13.3% (n=4) participants had hemorrhagic stroke in control group. In chi-square test both group showed there is no significant (p>0.05) difference in stroke type (Table 1). In Table 1, it was found that before treatment, both group has no significant (p>0.05) difference in affected body side (experimental group: right side 43.3% (n=13) and left side 56.7% (n=17); control group right side 46.7% (n=14) and left side 53.3% (n=16). Above table 1 also showed that both groups have no statistically significant difference (p>0.05) in dominant side affected category after stroke (Experimental group: 63.3% (n=19) and control group: 60.0% (n=18)). Besides, before intervention in chi-square test both groups have no significant difference (p>0.05) at onset of stroke characteristics. In experimental group among 30 participants; 40.0% (n=12) were in acute stage of stroke and 60.0% (n=18) participants were in chronic stage of stroke. While in control group, among 30

participants; 66.7% (n=20) participants were in acute stage and 33.3% (n=10) participants were in chronic stage.

In terms of before treatment evaluation or baseline assessment (Table 1), Mann-Whitney U test revealed that there is no statistically significant difference (p>0.05) between both groups in terms of outcome measures: Trunk Impairment Scale (p=0.100) and Berg Balance Scale (p=0.091).

Berg Balance Scale

Table 2: Between group comparisons of Post treatment Berg Balance Scale (BBS) Score among the participants (Mann-Whitney U Test)

BBS	Experimental group		Control group		z value	p value
	Pre-test Mean	Post test Mean	Pre-test Mean	Post test Mean		
	20.93±6.698	42.00±6.119	21.47±4.569	38.30±6.665	2.007	0.045*

(* Significant at 95% Confidence level)

This study found that for post treatment Berg balance scale score, Mann-Whitney U test in between group gives Z = 2.007 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.045 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means plinth trunk exercise combined with physio ball on functional balance and trunk control is more effective than standard physiotherapy among stroke patients.

Table 3: Within group Comparison among outcome measures of BBS (Wilcoxon signed- ranked test)

BBS	Experimental group		Control group	
	Z	p	Z	p
	4.791	0.001*	4.682	0.001*

(* Significant at 95% Confidence level)

By examining the final test statistics through Wilcoxon signed- ranked test, it was discovered that for n = 30 in experimental group, Wilcoxon test gives Z = 4.791 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.001 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means plinth trunk exercise combined with physio ball on functional balance and trunk control is showed statistically significant change among stroke patients. And in case of control group, by examining the final test statistics through Wilcoxon signed- ranked test, it was discovered that for n = 30 Wilcoxon test gives Z = 4.682 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.001 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means standard physiotherapy is showed statistically significant change among stroke patients.

Trunk Impairment Scale (TIS)

Table 4: Between group comparisons of Post treatment Trunk Impairment Scale (TIS) Score among the participants (Mann-Whitney U Test)

TIS	Experimental group		Control group		z value	p value
	Pre-test Mean	Post test Mean	Pre-test Mean	Post test Mean		
	10.50±2.203	19.00±1.883	11.83±2.588	17.43±2.300	2.997	0.003*

(* Significant at 95% Confidence level)

This study found that for post treatment Trunk Impairment Scale score, Mann-Whitney U test in between group gives Z = 2.997 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.003 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means plinth trunk exercise combined with physio ball on functional balance and trunk control is more effective than standard physiotherapy among stroke patients.

Table 5: Within group Comparison among outcome measures of TIS (Wilcoxon signed- ranked test)

TIS	Experimental group		Control group	
	Z	p	Z	p
	4.802	0.001*	4.793	0.001*

(* Significant at 95% Confidence level)

By examining the final test statistics through Wilcoxon signed- ranked test, it was discovered that for n = 30 in experimental group, Wilcoxon test gives Z = 4.802 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.001 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means plinth trunk exercise combined with physio ball on functional balance and trunk control is showed statistically significant change among stroke patients. And in case of control group, by examining the final test statistics through Wilcoxon signed- ranked test, it was discovered that for n = 30 Wilcoxon test gives Z = 4.793 which is greater than 1.96, the critical value Z for 95% Confidence level and p value is 0.001 which is less than 0.05. So, the null hypothesis is rejected and alternative hypothesis is accepted at 5% level of significance which means standard physiotherapy is showed statistically significant change among stroke patients.

CHAPTER-V DISCUSSION

The aim of the study was to examine whether task-specific trunk exercises performed on the physio bed and physio ball are more beneficial than standard physiotherapy exercises performed on the stroke patients. The study results showed that trunk exercises performed on the physio ball and physiotherapy bed are more effective than standard physiotherapy for improving trunk controlled and the coordination, which measured by Trunk Impairment Scale, respectively. Furthermore, the experimental (physio ball) group showed greater improvement in functional balance (sit to stand and transfer skill), particularly with trunk rehabilitation. The overall effect size observed in the study is in favor of the experimental group. To the best of our knowledge, this study is the first of its kind using a physio ball, the dynamic treatment instrument for trunk rehabilitation in patients with acute and chronic stroke in Bangladesh. The treatment techniques incorporated in our study were based on the task-specific system and ecological motor control theory. Task-specific trunk exercises practiced in a challenging environmental field (i.e. a stable as against an unstable surface) provided a gradual biomechanical demand on the trunk muscles. The trunk control improvement was quite impressive in our study, suggesting better trunk muscle activity due to destabilizing forces while exercises were performed on the physio ball.

The effect size index (0.6) observed in the total Trunk Impairment Scale supports for trunk exercises performed on the physio ball indicated an appreciable improvement and 1shows statistically significant outcome in comparison to physio bed exercise program. In 2016, a study by Park et al. shows that plinth trunk and physio ball exercise has greater effect on improving trunk controlled and balance after stroke and Physio ball is commonly used among healthy subjects in performing trunk exercises with greater treatment effect (2.23). Findings of this study match with the current study, where study result shows that physio ball exercise program improve trunk rehabilitation and functional balance, particularly in sit to stand and transfer skill among participants after stroke. In terms of treatment effect current study shows higher treatment effect (.06) of physio-ball exercise in trunk control. The study by Van de Port, Kwakkel, Schepers, & Lindeman, (2006) with the largest treatment effect (2.86), physio ball intervention had statistically significant ($p<0.05$) improvement in trunk rehabilitation.

Current study finding also shows physio ball exercise has significant improvement ($p<0.05$) in trunk rehabilitation. Another study by Cabanas-Valdes et al. (2013) showed physio ball exercise improve trunk control and functional balance after stroke in Trunk Impairment Scale (TIS) and Berg Balance Scale (BBS). This study also revealed physio ball exercise has greater impact than bed exercise on stroke rehabilitation. This systematic reviews finding match with current study finding of improvement of trunk control, however in term of functional balance current study shows statistical significant improvement in sit to stand and transfer skill. Though, in term of mean rank changes physio ball exercise shows higher changes in mean rank in ever aspect of Berg Balance Scale. In 2019, a study by Van Criekinge et al. investigate that trunk rehabilitation using unstable support surfaces like physio ball is effective than to stable support surfaces (physio bed), on static and dynamic sitting balance after stroke. This study finding favors the result of current study. The current study revealed physio ball exercise has statically significant ($p<0.05$) in static and dynamic siting balance.

A study on electromyography analysis observed that the anticipatory postural adjustment of trunk muscles activity is impaired in patients with stroke (Dickstein, Shefi, Marcovitz, & Villa, 2004). Furthermore, there was a reduced recruitment of high threshold motor units of trunk muscles after stroke (Shinde, & Ganvir, 2014). These are, in fact, essential for reactive postural adjustments during external perturbation (Ko et al., 2016). The possible reason for better trunk control improvement in the physio ball exercise group (current study) may be that the movement of the physio ball beneath the patients provides a postural perturbation in a gravitational field to which the trunk muscles respond reactively in order to maintain the desired postural stability. In addition, A study by Yoo et al. in 2014 reveled that physio ball is unstable device presently permeates the fitness and rehabilitation environment. Especially, physio ball exercise for trunk increases the need for force output from trunk muscles to provide adequate stability and balance. Another study by Verheyden et al. (2009) found that 10 hours of additional trunk exercises along with regular physiotherapy improved the lateral flexion of trunk in patients with subacute stroke. In current study it was observed that median changes pre-test 11 to 20 in post-test and that indicate trunk recovery score median increase 74% to 87% due to physio ball treatment in comparison between the two interventions (trunk exercises on the physio ball vs. those on the physio bed), which may be compared with the observed mean changes 30% to 55% in experimental group

(trunk exercise on physio ball exercise as against regular physiotherapy) in the study done by Verheyden et al. (2005). Although the change score between the groups was slightly lower in current study than indicated by earlier trunk research, a greater improvement was observed in physio ball group (i.e. those who performed trunk exercises on the physio ball) than the improvement (3.47) observed in the experimental group (i.e. those who performed trunk exercises on the plinth) of the study undertaken by Verheyden et al. (2009). Besides, in 2011 a study by Karthikbabu et al. shows that within group and between group comparison of physio ball exercise shows higher statistically significant improvement in TIS. In a contrast, current study also shows similar result in terms physio ball exercise. In present study, subscale of TIS static sitting balance, dynamic sitting balance and coordination shows significant improvement and thus also supported by Karthik et al. (2011) findings.

Karthikbabu et al. (2011) also reported that the trunk exercise using a physio-ball was improved with a 41% improvement in the TIS dynamic category, compared to using a plinth among acute stroke patients. Current study showed 40% improvement in TIS dynamic category. Which means current study showed almost similar outcome in case of dynamic sitting balance category to the findings of Karthikbabu et al. (2011). Therefore, present study favor above mentioned study in terms of trunk exercise regime performed on the physio ball. Furthermore, the better weight shift ability towards the hemiplegic side is essential for coordination of the trunk, particularly for the lower trunk rotation (An & Park, 2017). Clinical observation also suggests that the rotation of the lower part of the trunk is more difficult for stroke patients and thus impact on balance. A study by Jung et al. (2014) found that training the patient in the awareness of trunk position could improve weight symmetry in sitting after the early phase of the stroke as well as balance. The probable reason for the significant trunk rotation improvement may be the improved weight shift ability with the physio ball training. Furthermore, the trunk training performed on the plinth involves the same exercises as physio ball training, but the inadequacy of plinth training acting on coordination would only be due to lack of postural perturbation. Another finding of this current study was that trunk exercises performed on the physio ball had a carryover small effect (0.2) in improving functional balance. However, physio ball exercise has greater mean rank changes within group pre-test to post test (22 to 40) score of BBS. In a contrast, between group comparison physio ball exercise only shows statistical significant ($p<0.05$)

improvement of participants sit to stand and transfer ability of participants in comparison to physio bed exercise group while rest of the subsection did not reveal any statistically significant difference in comparison to physio bed treatment group. However, physio ball exercise group has higher mean rank (18) than physio bed exercise group (mean rank 16). A study by Kilinc et al. (2016) showed that physio ball exercise improves trunk control and functional balance of stroke patients in comparison with traditional physiotherapy trunk control exercise group. Kilinc et al. (2016) also showed that physio ball exercise group has statistically significant ($p<.05$) improvement in subcategory of BBS and TIS scale.

This finding shows similarity with current study in terms of TIS. However, in terms of BBS scale there is dissimilarity found in subcategory of BBS scale except sit to stand and transfer ability. In addition, Karthikbabu et al. (2011) shows physio ball exercise has greater effect size (2.1) than plinth trunk-controlled exercise effect size (.1) in BBS scale, whether current study shows smaller effect (.2) of physio ball exercise in BBS score. However, in present study, within group comparison both physio bed group and physio ball showed improvement in BBS after treatment and physio bed exercise group has lower mean score than physio bed exercise. Physio ball exercise also showed higher mean rank changes in between group comparison. In 2017 An and Park also found that Trunk training exercises, performed with unstable surface like physio ball, could be a good rehabilitation strategy for improving sit to stand and transfer ability in BBS scale after stroke. Their finding approves current study result of improving functional balance (sit to stand and transfer ability) after physio ball exercises. Moreover, there is strong evidence in the stroke literatures that trunk performance is an important predictor of functional outcomes for balance, coordination and trunk control (Verheyden et al., 2009). As a result, the trunk exercise on physio ball could have more intensive effects of treatment than the general physio bed exercise since it consists of unsupported surface training specialized by the individuals needs (An & Park, 2017). In this present study, the effectiveness of the physio ball exercise was detected as applicable treatment continuum for improving functional balance, and trunk control of the participants.

CHAPTER-VI LIMITATIONS

The study finding warrant caution when interpreting and generalizing the observed trunk control and functional balance improvement in both acute and chronic stroke patients.

First, the study had a limited number of stroke patients recruited from a single geographical location. Therefore, future multicentre trials with a larger number of patients are needed to confirm our study results.

Second, there was a lack of follow-up of patients to find out if improvement was carried over.

Third, the functional status of the patients was not assessed following intervention. Future studies should assess the long-term effects of trunk rehabilitation on the level of falls self-efficacy and of re-integration into the community of patients with stroke.

Fourth, researcher has taken help from one assessor for data collection purpose, it may vary result. Data was collected from one clinical setting CRP Savar, it can influence the result. Sometimes treatment sessions were interrupted due to public holiday mistaken in appointment schedule may interrupt the result.

Chapter-VII CONCLUSION & RECOMMENDATION

7.1 Conclusions

Post stroke subjects present with difficulties of reduced functional mobility and balance. Trunk impairment is common among stroke subjects which hinder the performance of upper and lower limb. In post-stroke rehabilitation limbs are provided much attention than the trunk. Trunk function has been identified as an important early predictor of functional outcome after stroke. However, trunk-controlled exercise is neglected than other areas of stroke rehabilitation and fewer researches had been found regarding trunk rehabilitation. Trunk function is one of the vital components of the post stroke balance, mobility and functional rehabilitation protocol. It helped in improving balance, mobility and functional outcome of patients with stroke. It encouraged the patients to willing participate in the treatment session and dramatically outcome can be observed through postural change. Physio ball is commonly used among healthy subjects in performing trunk exercises to improve trunk control and functional balance. Besides effects of trunk exercises performed on physio ball helps in trunk muscle activation, functional balance, postural control, and gait speed in stroke patients. The result of the present study has shown that the effectiveness of physio ball exercises for trunk rehabilitation is superior to the physiotherapy bed exercise. Considering the final assessment, the all the variable of trunk controlled and balanced has been improved in both groups, but physio ball group shows higher improvement. From this study it may conclude that both physio bed exercise group and physio ball exercise group have improvement after intervention in TIS and BBS scale. However, Physio ball exercise showed higher improvement in trunk performance and functional balance among the subjects with stroke.

7.2 Recommendation

Some further steps that might be taken for future research. A double blinded randomized clinical trial is recommended with large sample size. And the researcher recommended the following things will cover future research. Regarding this area functional outcome and gait analysis tools should be included. Follow up session should be involved in future studies. Although this study presumed better trunk muscle activity with selective trunk muscle training on a physio ball, it was not studied using surface electromyography (sEMG). Analyzing the efficacy of a similar rehabilitation program on trunk muscle activity by means of sEMG may be the choice for future research.

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Appendix – A

Institutional Review Board (IRB) Letter

বাংলাদেশ হেল্‌থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)
Bangladesh Health Professions Institute (BHPI)
(The Academic Institute of CRP)

Ref: CRP/BHPI/IRB/10/2022/663

Date: 25/10/2022

To
Md. Golam Nobi
M.Sc. in Physiotherapy
Session 2020-2021, DU Reg No. 553
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal **"Exploring the efficacy of plinth trunk and physio ball exercise on functional balance and trunk control among stroke survivors in Bangladesh"** by ethics committee.

Dear Md. Golam Nobi,
Congratulations.
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with yourself, as the principal investigator. The Following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Questioner (English and Bengali version)
3	Information sheet & consent form

The purpose of the study is to form a series of recommended physiotherapy interventions by ensuring the current and available evidence for the upper limb rehabilitation of stroke survivors. Should there any interpretation, typo, spelling, and grammatical mistake in the title, it is the responsibility of investigator. Since the study involve questionnaire that may take 25 to 30 minutes and have no likelihood of any harm to the participants. Data collector will receive informed consents from all participants; the members of the Ethics committee approved the study to be conducted in the presented form at the meeting held at 09.00 AM on 24th September 2022 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring during the study, any revision in the protocol and ask to be provided a copy of the final report. This Ethics committee is working accordance to Nuremberg Code 1947, World Medical Association Declaration of Helsinki, 1964 - 2013 and other applicable regulation.

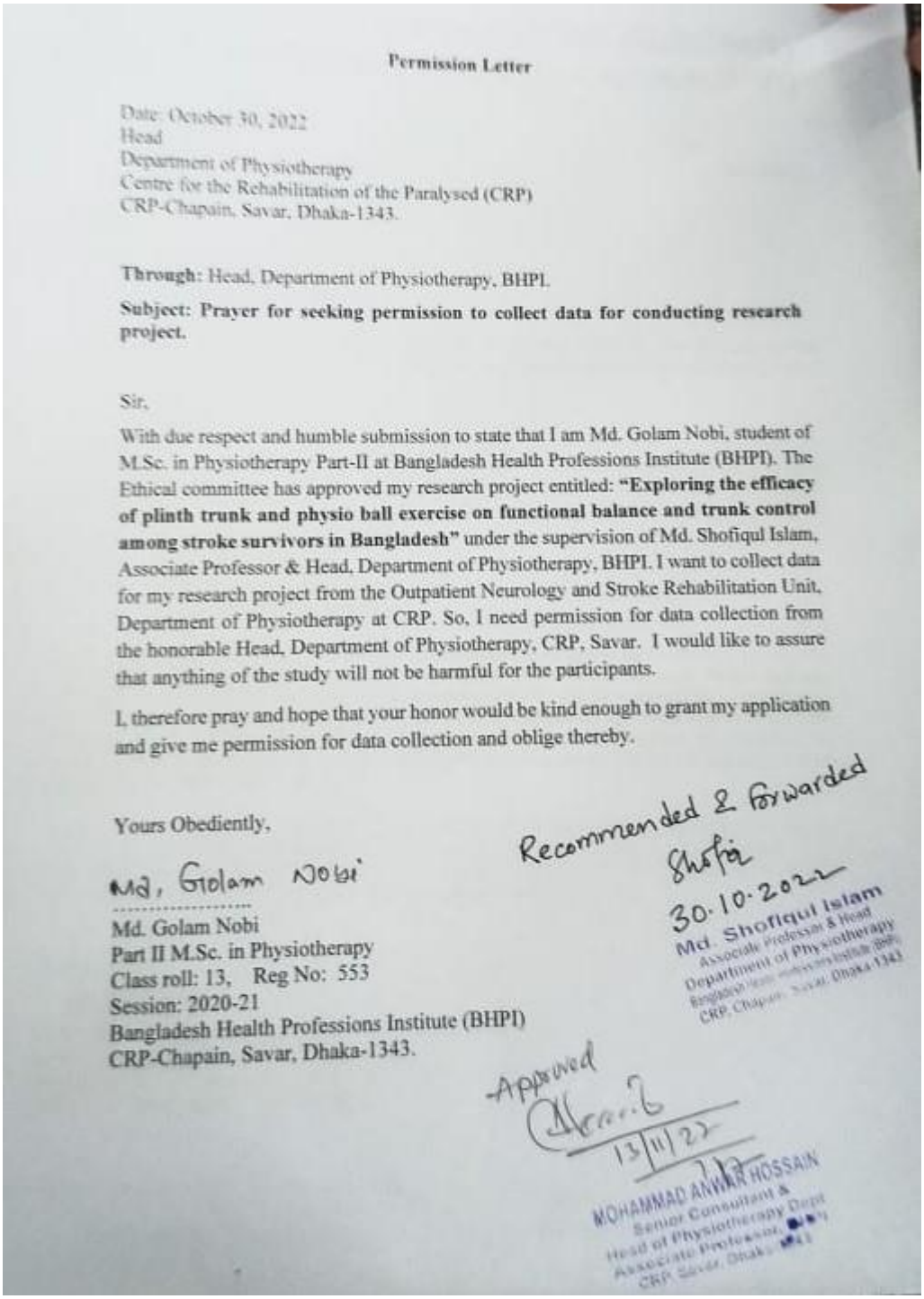
Best regards,

Muhammad Millat Hossain
Associate Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404
E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd, www.crp-bangladesh.org

Appendix- B

Application for Data collection



Permission Letter

Date: October 30, 2022
Head
Department of Physiotherapy
Centre for the Rehabilitation of the Paralysed (CRP)
CRP-Chapain, Savar, Dhaka-1343.

Through: Head, Department of Physiotherapy, BHPI.

Subject: Prayer for seeking permission to collect data for conducting research project.

Sir,

With due respect and humble submission to state that I am Md. Golam Nobi, student of M.Sc. in Physiotherapy Part-II at Bangladesh Health Professions Institute (BHPI). The Ethical committee has approved my research project entitled: **"Exploring the efficacy of plinth trunk and physio ball exercise on functional balance and trunk control among stroke survivors in Bangladesh"** under the supervision of Md. Shofiqul Islam, Associate Professor & Head, Department of Physiotherapy, BHPI. I want to collect data for my research project from the Outpatient Neurology and Stroke Rehabilitation Unit, Department of Physiotherapy at CRP. So, I need permission for data collection from the honorable Head, Department of Physiotherapy, CRP, Savar. I would like to assure that anything of the study will not be harmful for the participants.

I, therefore pray and hope that your honor would be kind enough to grant my application and give me permission for data collection and oblige thereby.

Yours Obediently,

Md. Golam Nobi

Md. Golam Nobi
Part II M.Sc. in Physiotherapy
Class roll: 13, Reg No: 553
Session: 2020-21
Bangladesh Health Professions Institute (BHPI)
CRP-Chapain, Savar, Dhaka-1343.

Recommended & forwarded
Shofiq
30.10.2022
Md. Shofiqul Islam
Associate Professor & Head
Department of Physiotherapy
Bangladesh Health Professions Institute (BHPI)
CRP, Chapain, Savar, Dhaka-1343

Approved
13/11/22
MOHAMMAD ANWAR HOSSAIN
Senior Consultant &
Head of Physiotherapy Dept
Associate Professor
CRP, Savar, Dhaka

Appendix- C

অনুমতিপত্র (বাংলা)

(অংশগ্রহণকারীকে পড়ে শোনাতে হবে)

আসসালামু আলাইকুম,

আমি মোঃ গোলাম নবী, আমি **"স্ট্রোক রোগীদের ট্রাঙ্কের ভারসাম্য উন্নত করতে গতানুগতিক ফিজিওথেরাপির সাথে ফিজিও বল এবং প্লিন্থ ট্রাঙ্ক অনুশীলনের কার্যকারিতা"** এই শিরোনামে এম এস সি ইন ফিজিওথেরাপি প্রোগ্রামের এর জন্য একটি গবেষণা করছি। এই গবেষণার মাধ্যমে আমি স্ট্রোক রোগীদের ট্রাঙ্কের ভারসাম্য উন্নত করতে গতানুগতিক ফিজিওথেরাপির সাথে ফিজিও বল এবং প্লিন্থ ট্রাঙ্ক অনুশীলনের কার্যকারিতা দেখতে চাই। এখন আমি আপনাকে ব্যক্তিগত তথ্য, চাকুরীর বিস্তারিত তথ্য এবং যদি কোন ব্যধি থাকে তবে সে বিষয় সম্পর্কে কিছু প্রশ্ন করতে চাই। এতে মোটামুটি ১৫ – ২০ মিনিট লাগবে।

আমি আপনাকে অবহিত করতে চাই যে, এটি একটি সম্পূর্ণ একাডেমিক গবেষণা এবং অন্য কোন উদ্দেশ্যের জন্য এটি ব্যবহার করা হবে না । আপনার প্রদত্ত সমস্ত তথ্য গোপন থাকবে এবং কোন রিপোর্ট বা প্রকাশনার ক্ষেত্রে এর উৎস গোপন থাকবে ।

এই গবেষণায় আপনার অংশগ্রহণ স্বেচ্ছাধীন এবং আপনি কোন নেতিবাচক প্রশ্ন ছাড়াই যে কোন সময় এই গবেষণা থেকে নিজেকে প্রত্তাহার করে নিতে পারবেন । আপনার অধিকার আছে কোন প্রশ্নের উত্তর না দেয়ার বা আপনার পছন্দ মত বা ইচ্ছেমত উত্তর দেয়ার।

যদি আপনার এই গবেষণা সম্পর্কে অথবা অংশগ্রহণকারী হিসেবে কিছু জানার থাকে তবে, আপনি আমার সাথে অথবা আমার গবেষণা অধীক্ষক, মোঃ সফিকুল ইসলাম, সহোযোগী অধ্যাপক এবং বিভাগীয় প্রধান, ফিজিওথেরাপি বিভাগ, বাংলাদেশ হেলথ প্রফেসন্স ইন্সটিটিউট (বিএইচপিআই) এর সাথে যোগাযোগ করতে পারেন।

শুরু করার আগে কি আপনার কোন প্রশ্ন আছে?

হ্যাঁ	না

আমি কি আপনার অনুমতি সাপেক্ষে সাক্ষাৎকার শুরু করতে পারি?

হ্যাঁ	না

অংশগ্রহণকারীর সাক্ষর ও তারিখঃ _____

সাক্ষাৎকার গ্রহণকারীর সাক্ষর ও তারিখঃ _____

ফিজিওথেরাপিষ্টের সাক্ষর ও তারিখঃ _____

CONSENT STATEMENT

Assalamualaikum,

I am Md. Golam Nobi conducting this thesis for the fulfillment of my M.Sc. in Physiotherapy entitled "**Exploring the efficacy of plinth trunk exercise and physio ball on functional balance and trunk control among stroke survivors in Bangladesh**"**.** By this I would like to find out the effect of plinth trunk exercise on functional balance and trunk control for stroke patients. Now I need to ask some information regarding sociodemographic, balance and trunk impairment related question. This will take approximately 20-30 minutes.

I would like to inform you that this is a purely academic study and will not be used for any other purpose. Your participation in the research will have no impact on your present or future treatment in this area. All information provided by you will be treated as confidential and in the event of any report or publication it will be ensured that the source of information remains anonymous.

Your participation in this study is voluntary and you may withdraw yourself at any time during this study without any negative consequences. You also have the right not to answer a particular question that you don't like or do not want to answer during interview.

If you have any query about the study or your right as a participant, you may contact with me and/or my research supervisor, Md. Shofiqul Islam, Associate Professor & Head, Department of Physiotherapy, BHPI, CRP, Savar, Dhaka.

Do you have any questions before I start?

Yes	No

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

Yes	No

Signature and date of the Participant _____

Signature and date of the Interviewer _____

Signature and date of the Physiotherapist _____

Appendix- D

প্রশ্নপত্র (বাংলা)

সেকশন-১ ব্যক্তিগত তথ্য

রোগীর আইডিঃ

পরীক্ষণের তারিখঃ

নামঃ

বর্তমান ঠিকানাঃ

ফোন নাম্বারঃ

সেকশন-২ সামাজিক-জনসংখ্যাগত এবং রোগ বিষয়ক তথ্যাবলি

দয়া করে সঠিক উত্তরে টিক (√) চিহ্ন দিনঃ

নং	প্রশ্ন	অংশগ্রহণকারীদের প্রতিক্রিয়া	নং	প্রশ্ন	অংশগ্রহণকারীদের প্রতিক্রিয়া
১.১	বয়স (বছর)		**১.৮**	প্রথম স্ট্রোক	○ হ্যাঁ ○ না
১.২	লিঙ্গ	○ পুরুষ ○ মহিলা	**১.৯**	স্ট্রোকের ধরণ	○ ইস্কেমিক ○ রক্তক্ষরণজনিত
১.৩	ওজন (কেজি)		**১.১০**	আক্রান্ত শরীরের অংশ	○ ডান পাশ ○ বাম পাশ
১.৪	বৈবাহিক অবস্থা	○ বিবাহিত ○ অবিবাহিত ○ তালাকপ্রাপ্ত ○ বিধবা	**১.১১**	ডমিন্যান্ট পাশ আক্রান্ত	○ হ্যাঁ ○ না
১.৫	শিক্ষাগত অবস্থা	○ নিরক্ষর ○ প্রাথমিক শিক্ষা ○ মাধ্যমিক ○ উচ্চ মাধ্যমিক ○ স্নাতক	**১.১২**	অতীতে গ্রহন করা চিকিৎসা	○ উচ্চরক্তচাপ ○ ডাইবেটিস ○ হৃদরোগ ○ অন্যান্য

		○ স্নাতকোত্তর অথবা তার উপড়ে ○ অন্যান্যঃ			
১.৬	বসবাসরত এলাকা	○ গ্রামীণ এলাকা ○ শহর ○ পার্বত্য এলাকা	**১.১৩**	একিউট বা দীর্ঘস্থায়ী স্ট্রোক	
১.৭	পেশা				

সেকশন-৩ ভারসাম্য মূল্যায়ন

নং	টেস্ট	প্রি টেস্ট	পোস্ট টেস্ট
৩.১	**বসা থেকে দাঁড়ানোঃ** *(অনুগ্রহপূর্বক দাঁড়ান। চেষ্টা করুন সাহায্যের জন্য আপনার হাত ব্যবহার না করতে।)* (৪) হাতের সাহায্য ছাড়া দাড়াতে পারে এবং ভারসাম্য রক্ষা করতে পারে। (৩) হাতের সাহায্য নিয়ে নিজে নিজে দাড়াতে পারে। (২) হাতের সাহায্য নিয়ে কয়েকবার চেষ্টার পর দাড়াতে পারে। (১) দাড়াতে অথবা ভারসাম্য রক্ষা করতে নুন্যতম সহযোগিতা লাগে। (০) দাঁড়াতে মোটোমুটি অথবা সম্পুর্ন সহযোগিতা লাগে।		
৩.২	**অবলম্বন ছাড়া দাঁড়ানোঃ** *(অনুগ্রহপূর্বক কোন কিছুর সাহায্য ছাড়া ২ মিনিট দাঁড়ান)* (৪) নিরাপদভাবে ২ মিনিট দাঁড়াতে পারে। (৩) পর্যবেক্ষণসহ ২ মিনিট দাঁড়াতে পারে। (২) অবলম্বন ছাড়া ৩০ সে. দাঁড়াতে পারে। (১) কয়েকবার চেষ্টার পর অবলম্বন ছাড়া ৩০ সে. দাঁড়াতে পারে। (০) অবলম্বন ছাড়া ৩০ সে. দাঁড়াতে পারে না।		
৩.৩	**পিঠে অবলম্বন ছাড়া কিন্তু মেঝে অথবা টুল দিয়ে পায়ে অবলম্বনের সাহায্যে বসাঃ** *(অনুগ্রহপূর্বক হাত ভাঁজ করে ২ মিনিট বসুন)* (৪) নিরাপদভাবে ২ মিনিট বসতে পারে (৩) পর্যবেক্ষণসহ ২ মিনিট বসতে পারে (২) ৩০ সে. বসতে পারে। (১) ১০ সে. বসতে পারে। (০) অবলম্বন ছাড়া ১০ সে. বসতে পারেনা।		
৩.৪	**দাঁড়ানো থেকে বসাঃ** *(অনুগ্রহপূর্বক বসুন)* (৪) নুন্যতম হাতের সাহায্য দ্বারা নিরাপদে বসতে পারে (৩) হাতের সাহায্য দ্বারা বসতে পারে (২) ভারসাম্য রক্ষার জন্য চেয়ারের বিরুদ্ধে পা ব্যাবহার করে (১) নিজে নিজে ভারসাম্মহিনভাবে বসতে পারে (০) বসতে সাহায্যকারীর প্রয়োজন হয়		

নং	টেস্ট	প্রি টেস্ট	পোস্ট টেস্ট
৩.৫	**স্থানান্তরঃ** *(অনুগ্রহপূর্বক হাতে ভর দিএ চেয়ারের একদিকে এবং ভর ছাড়া অন্যদিকে স্থানান্তর হতে চেষ্টা করুন)* (৪) নুন্যতম হাতের সাহায্য দ্বারা নিরাপদে স্থানান্তর হতে পারে। (৩) হাতের সাহায্য দ্বারা নিরাপদে স্থানান্তর হতে পারে। (২) মৌখিক নির্দেশনা অথবা পর্যবেক্ষণ মাধ্যমে স্থানান্তর হতে পারে। (১) একজন সাহায্যকারীর প্রয়োজন হয়। (০) দুইজন সাহায্যকারীর প্রয়োজন হয়।		
৩.৬	**অবলম্বন ছাড়া চোখ বন্ধ অবস্থায় দাঁড়ানো। নির্দেশনাঃ** *(অনুগ্রহপূর্বক চোখ বন্ধ করুন এবং ১০ সে. দাঁড়ান)* (৪) ১০ সে. নিরাপদে দাঁড়াতে পারে। (৩) পর্যবেক্ষণের মাধ্যমে ১০ সে নিরাপদে দাঁড়াতে পারে। (২) ৩ সে. দাঁড়াতে পারে। (১) ৩ সে. চোখ বন্ধ রাখতে পারেনা কিন্তু দাঁড়াতে পারে। (০) পড়ে যাওয়া রোধ করতে সাহায্যের প্রয়োজন।		
৩.৭	**দুই পা একত্র করে অবলম্বনহীনভাবে দাঁড়ানঃ** *(অনুগ্রহপূর্বক দুই পা একত্র করুন এবং কোন সাহায্য ছাড়া দাঁড়ান)* (৪) দুই পা একত্র করে স্বাধীনভাবে ১ মি. দাঁড়াতে পারে। (৩) পর্যবেক্ষণসহ দুই পা একত্র করে স্বাধীনভাবে ১ মি. দাঁড়াতে পারে। (২) দুই পা একত্র করে দাঁড়াতে পারে তবে ৩০ সে. এর কম। (১) দাঁড়াতে সাহায্যের প্রয়োজন হয় কিন্তু ১৫ সে. পা একত্র রাখতে পারে। (০) দাঁড়াতে সাহায্যের প্রয়োজন হয় এবং ১৫ সে. পা একত্র রাখতে পারেনা।		

নং.	টেস্ট	প্রি টেস্ট	পোস্ট টেস্ট
৩.৮	**দাঁড়ানো অবস্থায় দুইহাত উঁচু করে সামনের দিকে ঝুঁকাঃ** *(দুই হাত ৯০ ডিগ্রি উঁচু করুন। আঙ্গুল টানটান করুন, যতটা সম্ভব সামনে ঝুঁকুন)* (৪) সঠিকভাবে ২৫ সেমি. সামনে যেতে পারে। (৩) সঠিকভাবে ১২ সেমি. সামনে যেতে পারে। (২) সঠিকভাবে ৫ সেমি. সামনে যেতে পারে। (১) সামনে যেতে পারে কিন্তু পর্যবেক্ষণের প্রয়োজন হয়। (০) ভারসাম্য হারিয়ে ফেলে অথবা অন্যের সহায়তা লাগে।।		
৩.৯	**দাঁড়ানো অবস্থায় মেঝে থেকে কোন বস্তু তোলাঃ** *(মেঝেতে আপনার পায়ের সামনে রাখা জুতাটি তুলুন)* (৪) সহজে এবং নিরাপদে জুতাটি তুলতে পারে। (৩) জুতা তুলতে পারে কিন্তু পর্যবেক্ষণ প্রয়োজন হয়। (২) জুতার ২-৫ সেমি. পর্যন্ত যেতে পারে কিন্তু তুলতে পারেনা তবে ভারসাম্য রক্ষা করতে পারে। (১) জুতা তুলতে পারেনা এবং চেষ্টার সময় পর্যবেক্ষণ প্রয়োজন হয়। (০) চেষ্টা করতে পারেনা অথবা ভারসাম্য রক্ষার জন্য সাহায্যকারী প্রয়োজন হয়।		
৩.১০	**দাঁড়ানো অবস্থায় ডান এবং বাম কাঁধ দিয়ে পিছনে তাকানোঃ** *(আপনার বাম কাঁধ বরাবর পিছনে ঘুরুন। একইভাবে ডান দিকে ঘুরুন)* (৪) দুই দিকেই ঘুরতে পারে এবং সমানভাবে ভর দেয়। (৩) শুধুমাত্র একদিকে ঘুরতে পারে এবং অন্যদিকে কম ভর দেয়। (২) শুধুমাত্র পাশে তাকাতে পারে, তবে ভারসাম্য রক্ষা করতে পারে। (১) ঘুরার সময় পর্যবেক্ষণ প্রয়োজন। (০) ভারসাম্য রক্ষার জন্য সাহায্যকারী প্রয়োজন হয়।		

নং.	টেস্ট	প্রি টেস্ট	পোস্ট টেস্ট
৩.১১	**৩৬০ ডিগ্রি ঘুরুনঃ** *(ঘুরে একটি বৃত্ত সম্পন্ন করুন।থামুন এবং অপরদিকে আবার একটি বৃত্ত সম্পন্ন করুন)* (৪) ৪ সে. অথবা তার কম সময়ে ৩৬০ নিরাপদে ঘুরতে পারে। (৩) ৪ সে. অথবা তার কম সময়ে একদিকে নিরাপদে ৩৬০ ডিগ্রি ঘুরতে পারে। (২) ৩৬০ ঘুরতে পারে তবে সময় বেশি লাগে। (১) পর্যবেক্ষণ অথবা মৌখিক নির্দেশনা প্রয়োজন। (০) ঘুরার সময় সাহায্যকারী প্রয়োজন।		
৩.১২	**অবলম্বন ছাড়া দাঁড়ানোর সময় এক পা সামনে দিন অথবা টুলের উপর রাখুনঃ** *(বিপরীতভাবে এক পা টুলে এবং অন্যপা মেঝেতে রাখুন। এভাবে চারবার করুন।)* (৪) নিজে নিজে নিরাপদে দাঁড়াতে পারে এবং ২০ সে. এ ৮ টি ধাপ দিতে পারে। (৩) নিজে নিজে নিরাপদে দাঁড়াতে পারে এবং ২০ সে. এ ৮ টের কম ধাপ দিতে পারে। ২- ৪ টি ধাপ দিতে পারে সাহায্য ছাড়া তবে পর্যবেক্ষণ প্রয়োজন। (১) ২ টির কন ধাপ দিতে পারে এবং নুন্যতম সাহায্য লাগে। (০) ভারসাম্য রক্ষার জন্য সাহায্যকারী প্রয়োজন হয় অথবা করতে পারেনা।		
৩.১৩	**অবলম্বন ছাড়া এক পা সামনে দিয়ে দাঁড়ানঃ** *(এক পায়ের সামনে আরেক পা দিয়ে দাঁড়ান। যদি না পারেন তবে দুই পায়ের দূরত্ব বাড়িয়ে দাঁড়ান)* (৪) ৩০ সে. নিজে নিজে এক পা সামনে দিয়ে নিরাপদে দাঁড়াতে পারে। (৩) ৩০ সে. নিজে নিজে এক পা সামনে দিয়ে দাঁড়াতে পারে। (২) ছোট ধাপ দিয়ে নিজে নিজে ৩০ সে. দাঁড়াতে পারে। (১) ধাপ দিতে সাহায্য লাগে কিন্তু ১৫ সে. থাকতে পারে। (০) ধাপ দেয়া অথবা দাঁড়ানোর সময় ভারসাম্য হারিয়ে ফেলে।		

নং.	টেস্ট	প্রি টেস্ট	পোস্ট টেস্ট
৩.১৪	**এক পায়ে দাঁড়ানোঃ** *(অবলম্বন ছাড়া যতক্ষণ সম্ভব এক পায়ে দাঁড়ান)* (৪) নিজে নিজে পা তুলতে পারে এবং ১০ সে. এর বেশি সময় থাকতে পারে। (৩) নিজে নিজে পা তুলতে পারে এবং ৫-১০ সে. থাকতে পারে। (২) নিজে নিজে পা তুলতে পারে ৩ সে. বা কম থাকতে পারে। (১) পা তুলতে চেষ্টা করে কিন্তু ৩ সে. রাখতে পারেনা তবে নিজে নিজে দাঁড়াতে পারে। (০) চেষ্টা করতে পারেনা এবং পড়ে যাওয়া রোধে সাহায্যের প্রয়জন।		
	মোট নম্বর		

সেকশন-৪ ট্রাঙ্ক ইম্পেয়ারমেন্ট মূল্যায়ন

বসার স্থিতিশীল ভারসাম্য				
নং.	কাজের বিবরণ	নম্বরের বিবরণ	নম্বর	
			প্রি টেস্ট	পোস্ট টেস্ট
৪.১	১০ সে. এর জন্য বসুন *(যদি ০ হয়, তাহলে পুরো স্কেল ০ হবে)*	পড়ে যায় বা হাতের সাহায্য প্রয়োজন	০	০
		১০ সে. এর জন্য করতে পাড়ে	২	২
৪.২	চিকিৎসক দুর্বল পায়ের উপর ভাল পা নিয়ে যাবে, এভাবে ১০ সে. থাকতে হবে	পড়ে যায় বা হাতের সাহায্য প্রয়োজন	০	০
		১০ সে. এর জন্য করতে পাড়ে	২	২
৪.৩	রোগী দুর্বল পায়ের উপর ভাল পা নিয়ে যাবে	পড়ে যায়	০	০
		হাতের সাহায্য প্রয়োজন	১	১
		ট্রাঙ্ক ১০ সে. সরে যায়, নির্দেশনা প্রয়োজন হয়	২	২
		কোন সমস্যা ছাড়াই করতে	৩	৩

		পাড়ে		
নম্বর			**/৭**	**/৭**

বসার গতিশীল ভারসাম্য				
৪.৪	ডান কুনুই দিয়ে সিট স্পর্শ করুন এবং আগের অবস্থায় ফিরে আসুন *(০ হলে ৪.৫ + ৪.৬ ও ০ হবে)*	সিট পর্যন্ত যেতে পাড়ে না, পড়ে যায় অথবা হাতের সাহায্য নেয়	০	০
		কোন সাহায্য ছাড়াই সিট স্পর্শ করে	**১**	**১**
৪.৫	পুনরায় ৪.৪ নং কাজটি করুন, ট্রাঙ্ক এর নড়াচড়া পর্যবেক্ষণ করুন *(০ হলে ৪.৬ ও ০ হবে)*	ট্রাঙ্ক এর নরাচরা হয় না	০	০
		ট্রাঙ্ক এর নরাচরা হয়	**১**	**১**
৪.৬	পুনরায় ৪.৪ নং কাজটি করুন *(সাহায্য ছাড়া অথবা সাহায্য নিয়ে)*	সাহায্য নিয়ে (হাত, কোমর, হাঁটু, পা)	০	০
		সাহায্য ছাড়া করতে পাড়ে	**১**	**১**
৪.৭	বাম কুনুই দিয়ে সিট স্পর্শ করুন এবং আগের অবস্থায় ফিরে আসুন *(০ হলে ৪.৮ + ৪.৯ ও ০ হবে)*	সিট পর্যন্ত যেতে পাড়ে না, পড়ে যায় অথবা হাতের সাহায্য নেয়	০	০
		কোন সাহায্য ছাড়াই সিট স্পর্শ করে	**১**	**১**
৪.৮	পুনরায় ৪.৭ নং কাজটি করুন, ট্রাঙ্ক এর নড়াচড়া পর্যবেক্ষণ করুন *(০ হলে ৪.৯ ও ০ হবে)*	ট্রাঙ্ক এর নরাচরা হয় না	০	০
		ট্রাঙ্ক এর নরাচরা হয়	**১**	**১**
৪.৯	পুনরায় ৪.৭ নং কাজটি করুন (সাহায্য ছাড়া অথবা সাহায্য নিয়ে)	সাহায্য নিয়ে (হাত, কোমর, হাঁটু, পা)	০	০
		সাহায্য ছাড়া করতে পাড়ে	**১**	**১**
৪.১০	ডান পাশের কোমর উঁচু করুন এবং আগের অবস্থায় ফেরত যান *(০ হলে ৪.১১ ও ০ হবে)*	ট্রাঙ্ক এর নরাচরা হয় না	০	০
		ট্রাঙ্ক এর নরাচরা হয়	**১**	**১**
৪.১১	পুনরায় ৪.১০ নং কাজটি করুন	সাহায্য নিয়ে (হাত, কোমর, হাঁটু, পা)	০	০

	(সাহায্য ছাড়া অথবা সাহায্য নিয়ে)	সাহায্য ছাড়া করতে পাড়ে	১	১
৪.১২	বাম পাশের কোমর উঁচু করুন এবং আগের অবস্থায় ফেরত যান *(০ হলে ৪.১৩ ও ০ হবে)*	ট্রাঙ্ক এর নরাচরা হয় না	০	০
		ট্রাঙ্ক এর নরাচরা হয়	১	১
৪.১৩	পুনরায় ৪.১২ নং কাজটি করুন *(সাহায্য ছাড়া অথবা সাহায্য নিয়ে)*	সাহায্য নিয়ে (হাত, কোমর, হাঁটু, পা)	০	০
		সাহায্য ছাড়া করতে পাড়ে	১	১
নম্বর			**/১০**	**/১০**
সমন্বয়				
৪.১৪	৬ বার কাঁধ ঘুরান *(০ হলে ৪.১৫ ও ০ হবে)*	৩ বার ঘুরাতে পারছে না	০	০
		অপ্রতিসম ঘূর্ণন	১	১
		প্রতিসম ঘূর্ণন	০	০
৪.১৫	৬ সে. এর মধ্যে পুনরায় ৩.১৫ করুন	অপ্রতিসম ঘূর্ণন	০	০
		প্রতিসম ঘূর্ণন	১	১
৪.১৬	৬ বার কোমর ঘুরান, হাঁটু কে সামনের দিকে নিন *(০ হইলে ৪.১৭ ও ০ হবে)*	৩ বার ঘুরাতে পারছে না	০	০
		অপ্রতিসম ঘূর্ণন	১	১
		প্রতিসম ঘূর্ণন	২	২
৪.১৭	৬ সে. এর মধ্যে পুনরায় ৩.১৬ করুন	অপ্রতিসম ঘূর্ণন	০	০
		প্রতিসম ঘূর্ণন	১	১
নম্বর			**/৬**	**/৬**
মোট ট্রাঙ্ক ইম্পেয়ারমেন্ট স্কেল নম্বর			**/২৩**	**/২৩**
			তারিখ.....	তারিখ.....

Questionnaire (English)

Code Number:

SECTION-1: Personal Details

Name:

Present Address:

Permanent Address:

Contact Number:

SECTION-2: Socio Demographic Information

Patient ID:

Date of test:

Please give tick (√) mark at the best correct answer:

No.	Questions	Response of the participant	No.	Questions	Response of the participant
2.1	Age (in year)		**2.8**	First time stroke	○ Yes ○ No
2.2	Sex	○ Male ○ Female	**2.9**	Type of stroke	○ Ischemic ○ Hemorrhagic
			2.10	Affected Body Part	○ Right side ○ Left side
2.4	Marital status	○ Married ○ Unmarried ○ Divorced ○ Widow	**2.11**	Dominant side affected	○ Yes ○ No
2.5	Educational status	○ Illiterate ○ Primary ○ Secondary school certificate (SSC)	**2.12**	Past medical history	○ HTN ○ DM ○ Heart Disease ○ Others

		○ Higher secondary certificate (HSC) ○ Bachelor ○ Masters or above ○ Other:			
2.6	Living area	○ Rural ○ Urban ○ Hill tracks	**2.13**	Acute or chronic stroke	
2.7	Occupation				

SECTION-3: Assessment of balance

No.	Test	Pre test	Post test
3.1	**SITTING TO STANDING:** *(Please stand up. Try not to use your hand for support)* (4) able to stand without using hands and stabilize independently (3) able to stand independently using hands (2) able to stand using hands after several tries (1) needs minimal aid to stand or stabilize (0) needs moderate or maximal assist to stand		
3.2	**STANDING UNSUPPORTED:** *(Please stand for two minutes without holding on)* (4) able to stand safely for 2 minutes (3) able to stand 2 minutes with supervision (2) able to stand 30 seconds unsupported (1) needs several tries to stand 30 seconds unsupported (0) unable to stand 30 seconds unsupported		
3.3	**SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL: (***Please sit with arms folded for 2 minutes)*		

	(4) able to sit safely and securely for 2 minutes (3) able to sit 2 minutes under supervision (2) able to sit 30 seconds (1) able to sit 10 seconds (0) unable to sit without support 10 seconds		
3.4	**STANDING TO SITTING:** *(Please sit down)* (4) sits safely with minimal use of hands (3) controls descent by using hands (2) uses back of legs against chair to control descent (1) sits independently but has uncontrolled descent (0) needs assist to sit		

No.	Test	Pre test	Post test
3.5	**TRANSFERS:** *(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)* (4) able to transfer safely with minor use of hands (3) able to transfer safely definite need of hands (2) able to transfer with verbal cuing and/or supervision (1) needs one person to assist (0) needs two people to assist or supervise to be safe		
3.6	**STANDING UNSUPPORTED WITH EYES CLOSED:** *(Please close your eyes and stand still for 10 seconds)* (4) able to stand 10 seconds safely (3) able to stand 10 seconds with supervision (2) able to stand 3 seconds (1) unable to keep eyes closed 3 seconds but stays safely (0) needs help to keep from falling		
3.7	**STANDING UNSUPPORTED WITH FEET TOGETHER:** *(Place your feet together and stand without holding on)* (4) able to place feet together independently and stand 1 minute safely		

	(3) able to place feet together independently and stand 1 minute with supervision (2) able to place feet together independently but unable to hold for 30 seconds (1) needs help to attain position but able to stand 15 seconds feet together (0) needs help to attain position and unable to hold for 15 seconds		

No.	Test	Pre test	Post test
3.8	**REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING:** *(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)* (4) can reach forward confidently 25 cm (10 inches) (3) can reach forward 12 cm (5 inches) (2) can reach forward 5 cm (2 inches) (1) reaches forward but needs supervision (0) loses balance while trying/requires external support		
3.9	**PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION:** *(Pick up the shoe/slipper, which is place in front of your feet)* (4) able to pick up slipper safely and easily (3) able to pick up slipper but needs supervision (2) unable to pick up but reaches 2-5 cm from slipper and keeps balance independently (1) unable to pick up and needs supervision while trying (0) unable to try/needs assist to keep from losing balance or falling		
3.10	**TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING:** *(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.)* (4) looks behind from both sides and weight shifts well (3) looks behind one side only other side shows less weight shift (2) turns sideways only but maintains balance		

	(1) needs supervision when turning (0) needs assist to keep from losing balance or falling		
No.	**Test**	**Pre test**	**Post test**
3.11	**TURN 360 DEGREES:** *(Turn completely around in a full circle. Pause. Then turn a full circle in the other direction)* (4) able to turn 360 degrees safely in 4 seconds or less (3) able to turn 360 degrees safely one side only 4 seconds or less (2) able to turn 360 degrees safely but slowly (1) needs close supervision or verbal cuing (0) needs assistance while turning		
3.12	**PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED:** *(Place each foot alternately on the step/stool. Continue until each foot has touch the step/stool four times)* (4) able to stand independently and safely and complete 8 steps in 20 seconds (3) able to stand independently and complete 8 steps in > 20 seconds (2) able to complete 4 steps without aid with supervision (1) able to complete > 2 steps need minimal assist (0) needs assistance to keep from falling / unable to try		
3.13	**STANDING UNSUPPORTED ONE FOOT IN FRONT:** *(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) (4) able to place foot tandem independently and hold 30 seconds (3) able to place foot ahead independently and hold 30 seconds (2) able to take small step independently and hold 30 seconds (1) needs help to step but can hold 15 seconds (0) loses balance while stepping or standing		

No.	Test	Pre test	Post test
3.14	**2.14 STANDING ON ONE LEG:** *(Stand on one leg as long as you can without holding on)* (4) able to lift leg independently and hold > 10 seconds (3) able to lift leg independently and hold 5-10 seconds (2) able to lift leg independently and hold ≥ 3 seconds (1) tries to lift leg unable to hold 3 seconds but remains standing independently (0) unable to try of needs assist to prevent fall		
	Total Score		
		Date……	**Date……**

SECTION-4: Assessment of the Trunk Impairment

Static Sitting Balance				
Item	**Task Description**	**Score Description**	**Score**	
			Pre test	**Post test**
4.1	Keep starting position for 10s *(if 0, total TIS scale is 0)*	Falls or needs arm support	0	0
		Maintains position for 10 s	2	2
4.2	Therapist crosses strongest leg over weakest leg, keep position for 10 s	Falls or needs arm support	0	0
		Maintains position for 10 s	2	2
4.3	Patient crosses strongest leg over weakest leg	Falls	0	0
		Needs arm support	1	1
		Displaces trunk 10 cm or assists with arm	2	2
		Moves without trunk or arm compensation	3	3
Sub Total			**/7**	**/7**

Dynamic Sitting Balance				
4.4	Touch seat with right elbow, return to starting position *(If 0, items 4.5+4.6 are also 0)*	Does not reach seat, falls, or uses arm	0	0
		Touches seat without help	1	1
4.5	Repeat item 4.4, evaluate trunk movement *(If 0, item 4.6 is also 0)*	No appropriate trunk movement	0	0
		Appropriate trunk movement (shortening right side, lengthening left side)	1	1
4.6	Repeat item 4.4	Compensation used (arm, hip,	0	0

	(compensation strategies used or not)	knee, foot)		
		No compensation strategy used	1	1
4.7	Touch seat with left elbow, return to starting position *(If 0, items 4.8+4.9 are also 0)*	Does not reach seat, falls, or uses arm	0	0
		Touches seat without help	1	1
4.8	Repeat item 4.7, evaluate trunk movement *(If 0, item 4.9 is also 0)*	No appropriate trunk movement	0	0
		Appropriate trunk movement (shortening left side, lengthening right side	1	1
4.9	Repeat item 4.7 *(compensation strategies used or not)*	Compensation used (arm, hip, knee, foot)	0	0
		No compensatory strategy used	1	1
4.10	Lift right side of pelvis from seat, return to starting position. *(If 0, item 4.11 is also 0)*	No appropriate trunk movement	0	0
		Appropriate trunk movement (shortening right side, lengthening left side)	1	1
4.11	Repeat item 4.10 *(compensation strategies used or not)*	Compensation used (arm, hip, knee, foot	0	0
		No compensation strategy used	1	1
4.12	Lift left side of pelvis from seat, return to starting position. *(If 0, item 4.13 is also 0)*	No appropriate trunk movement	0	0
		Appropriate trunk movement (shortening left side, lengthening right side)	1	1
4.13	Repeat item 4.12 *(compensation strategies used or not)*	Compensation used (arm, hip, knee, foot)	0	0
		No compensation strategy used	1	1
Sub Total			**/10**	**/10**

Coordination				
4.14	Rotate shoulder girdle 6 times, move each shoulder 3 times forward. *(If 0, item 4.15 of also)*	Does not move right side 3 times	0	0
		Asymmetric rotation	1	1
		Symmetric rotation	2	2
4.15	Repeat item 4.14, perform within 6s	Asymmetric rotation	0	0
		Symmetric rotation	1	1
4.16	Rotate pelvis girdle 6 times, move each knee 3 times forward. *(If 0, item 4.17 is also 0)*	Does not move right side 3 times	0	0
		Asymmetric rotation	1	1
		Symmetric rotation	2	2
4.17	Repeat item 4.16, perform within 6s	Asymmetric rotation	0	0
		Symmetric rotation	1	1
Sub Total			**/6**	**/6**
Total Trunk Impairment Scale			**/23**	**/23**
			Date……..	**Date……..**

Date: ..... Signature of Examiner.....