Faculty of Medicine

University of Dhaka

Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial.

By
Faruq Ibn Sadeq
Part – II, M.Sc. in Physiotherapy
BHPI, CRP, Savar, Dhaka-1343
Registration No: 2519
Roll No: 111160040
Session: 2017-18

Department of Physiotherapy

Bangladesh Health Professions Institute (BHPI)

December 2020

Faculty of Medicine

University of Dhaka

Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial.

By

Faruq Ibn Sadeq

Part – II, M.Sc. in Physiotherapy

BHPI, CRP, Savar, Dhaka-1343

Registration No: 2519

Roll No: 111160040

Session: 2017-18

Submitted in Partial Fulfillment of the Requirements for the Degree of Master of Science in Physiotherapy

Department of Physiotherapy

Bangladesh Health Professions Institute (BHPI)

December 2020

We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for acceptance of this thesis entitled, "**Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial",** submitted by Faruq Ibn Sadeq for the partial fulfillment of the requirements for the degree of Master of Science in Physiotherapy.

Mohammad Anwar Hossain
Associate Professor and Head of
Physiotherapy Department CRP
Department of Physiotherapy
Bangladesh Health Professions Institute
(BHPI)

Ehsanur Rahman
Associate Professor
Department of Physiotherapy
Bangladesh Health Professions Institute
(BHPI)

Dr. Kamal Ahmed
Associate Professor
IHT, Mohakhali, Dhaka

Asma Islam
Assistant Professor
Department of Physiotherapy
Bangladesh Health Professions Institute
(BHPI)

Date of approval: 16-01-2021

Declaration Form

- This work has not previously been accepted in substance for any degree and isn't concurrently submitted in candidature for any degree.
- This dissertation is being submitted in partial fulfillment of the requirements for the degree of M. Sc in Physiotherapy.
- This dissertation is the result of my own independent work/investigation, except where otherwise stated. Other sources are acknowledged by giving explicit references. A Bibliography is appended.
- I confirm that if anything identified in my work that I have done plagiarism or any form of cheating that will directly awarded me fail and I am subject to disciplinary actions of authority.
- I confirm that the electronic copy is identical to the bound copy of the Thesis.
- In case of dissemination the finding of this project for future publication, research supervisor will highly concern and it will be duly acknowledged as graduate thesis.

(Signature)

Name:

Date:

Acknowledgement

First of all, I am grateful to almighty Allah for allowing me to complete this thesis and then thanks to my parents to support me in all aspect of my life. I would like to express deepest appreciation to my supervisor **Mohammad Anwar Hossain**, Associate Professor and Head of Physiotherapy department, CRP, for his keen supervision without which I could not able to complete this thesis. In addition, my special thanks go to also goes to him for giving me permission for data collection. Besides, I would like to express my heartiest thanks to **Prof Md Obaidul Haque**, Vice Principal of BHPI, **Firoz Ahmed Mamin**, Former Associate Professor& Coordinator, M. Sc. in Physiotherapy program, for giving their valuable opinion throughout the thesis period. I would like to express my thanks to **Ehsanur Rahman**, Associate Professor, BHPI for his careful guidance, support and valuable suggestion in every critical point of my study. I would like to thanks all physiotherapy staff and interns for helping me during data collection and treating patient for this project. I am obliged to all Physiotherapists of Neurology Unit, CRP, Savar, for their cordial support. There are also **MPT students** at the BHPI who have supported me. I would like to express my gratitude to patient with stroke, who gave me their valuable time and provided the information, related to my study and helped me to make my work successful. I am grateful to my thesis data collector for collecting and handed over raw data. I would also like to thank librarians of BHPI as they helped me to find out related books, journals and also access to internet.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATION

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

KG……. Kilogram

sEMG…….surface electromyography

TIS……Trunk Impairment Scale

WHO……..World Health Organizations

Abstract

Background. Stroke causes impairment of trunk musculature in with in addition to limb muscles. After stroke, hemiplegia causes motor paralysis of the limb muscles affects one side of the body but contrary to the trunk muscles which are also impaired on both ipsilateral and contralateral side of body to that of lesion. ***Objective.*** The aim of this study this study is to compare the effectiveness of physio ball trunk rehabilitation exercise with physio bed trunk rehabilitation exercise program for improving trunk control and balance among hemiplegic stroke patients. ***Methods.*** Design of this study was single blind Randomized Clinical Trial. The study was conducted in the CRP (Savar Centre). 34 patients with stroke who met the inclusion criteria were randomly allocated to the control and experimental group (1:1 ratio). Each group got 16 treatment sessions (30min/d for 4 days in 4 constructive weeks). Data was collected by Berg Balance Scale (BBS) and Trunk Impairment Scale (TIS). ***Analysis of data:*** SPSS version 23 was used for data analysis. Inferential statistics- nonparametric statistics such as Mann-Whitney *U* test, Wilcoxon test were used for data was analysis. Besides, effect size index (*d*) was calculated for each of the outcome measures. ***Result.*** After treatment, both the groups showed significant improvement ($p<.05$) but the physio ball exercise group improved more significantly ($p<.05$) than the physio bed exercise group in terms of trunk control and functional balance (sit to stand and transfer). ***Conclusion.*** 30 min Physio ball exercise program was proven to be more effective than physio bed exercise in trunk control and functional balance (sit to stand and transfer) of patients with stroke.

Key Words: Stroke, Physio Ball Trunk Exercice and Physio Bed Trunk Exercice, Trunk Control, Balance.

CHAPTER I: INTRODUCTION

1.1 Background

Stroke or cerebrovascular accidents are the second leading cause of death and the third leading cause of disability throughout the World according to a bulletin of World Health Organization (WHO) (Johnson et al., 2016). Around 5 million people are permanently disabled out of 15 million people throughout the world suffered from cerebrovascular stroke each year (El-Helow et al., 2015). Stroke, is the consequence of the sudden death of some brain cells due to lack of oxygen due to reduced or loss of the blood flow to the brain by blockage or rupture of an artery to thebrain, which is also a leading cause of dementia and depression (Owolabi et al., 2015). There are so many modifiable and non-modifiable factors risk factors of stroke. Among them major risk factors included high cholesterol, diabetes, smoking, atrial fibrillation and lack of physical activity (Jin, 2014).

A survey study conducted at 2009 by Johnston et al. found that globally, prevalence of strokes ranged about 70% with stroke related deaths and disability adjusted life years [DALYs] ranged about 87% observed in low and middle income countries (Johnston et al., 2009). Incidence of stroke in the low and middle income countries has more than doubled over the last four decades but during these decades stroke incidence has declined by 42% in high income countries (Feigin et al., 2014). Islam et al. (2016) found that the overall prevalence rate of stroke is 0.30% and the third leading cause of death in Bangladesh. According to American Stroke Association (2016), it is the approximately fifth leading cause of death. It is also the leading cause of longer period disability as well as preventable cause of disability. It is the

approximately 3rd most leading cause of death globally where as in UK it is considered as one of the most important health problem. Mortality rate ranged around 23% of post stroke patients within 30 days whereas 60-70% from the remaining dies within 3 years. Among the post stroke survivals those have to prolong stayed in hospital, reduced quality of life due to extended time disability which also leads to secondary reason of disability and impairment in UK. This factor causes a big compromise in the economic sector (Parmer, Sumaria & Hashi, 2011).

The early and common signs of strokes include deviation of face, weakness affecting one side of the body with altered sensation and difficulties in speech (Jin, 2014). The effects of stroke are variable depending on location of the lesion as well as the size. The most typical symptom of stroke is hemiparesis or hemiplegia, which ranges from weakness to full paralysis of the body opposite to the side of the supratentorial lesion (Rai et al., 2014). There is also impairment of trunk musculature in stroke patients with in addition to limb muscles. In hemiplegia in which motor paralysis of the limb muscles affects one side of the body but contrary to the trunk muscles which are also impaired on both ipsilateral and contralateral side of body to that of lesion (Tsuji et al., 2003).

Trunk muscles play an important role during trunk control through the support of our bodies in antigravity postures such as sitting, standing and in the stabilization of proximal body parts during voluntary limb movements, adjust weight shifts and perform selective movements of the trunk that maintains the base of support during static and dynamic postural adjustments (Davis, 1990; Ryerson & Levit, 1997; Edwards, 1996). To perform daily functional activities good trunk stability is essential part for balance and extremity use. Several studies have identified deficits of trunk

muscle strength and poor trunk control in stroke patients. Functions of the pyramidal and extra pyramidal tracts of the nervous system includes trunk control and stability, coordination of movement patterns and balance which are disrupted after stroke reduce mobility (Karatas et al., 2004).

Davis (2003) states that one of the neurodevelopmental principles which known as Bobath principle emphasizes the control of movement proceeds from the proximal to the distal part of the body. The trunk being the central key point of the body, proximal trunk control is a prerequisite for distal limb movement control, balance and functional activities (Karthikbabu et al., 2011). Prediction of functional outcome during stroke rehabilitation trunk muscle performance acts as an important factor. Poor recovery of trunk muscle performance causes severe disability and reduction in the activities of daily living performance among the stroke survivals (Fujiwara et al., 2001). A study using Trunk Impairment Scale (TIS) also found that selective movements of the upper and the lower trunk are impaired in chronic stroke (Verheyden et al., 2005).

Several studies reported the patients with chronic stroke showed weakness of trunk flexor-extensor and bilateral trunk rotator muscles by means of isokinetic dynamometer muscle strength testing , when compared to that of age matched healthy controls (Tanaka, Hachisuka & Ogata, 1998). A study on electromyography analysis observed that the anticipatory postural adjustment of trunk muscles activity is impaired in patients with stroke (Dickstein et al., 2004). A cross sectional study by Verheyden et al. (2006) demonstrated that measures of balance, gait and functional ability status in patients with stoke strongly influence trunk control ability. Trunk

control has also been identified as an important early predictor of functional outcome after stroke (Hsieh et al., 2002).

Most literature concerning rehabilitation after stroke focuses on the hemiplegic upper and lower limbs while the trunk receives little attention. Unlike limb muscles, the abdominal muscles need a stable origin to act efficiently, that is the pelvis, the thorax or the central aponeurosis depending upon part of trunk that is moved. Counter rotation between the upper and lower trunk is the mobility over stability task which is essential for all the functional movements. The rotation of the trunk muscle activity is not unilateral, but requires static holding of contra lateral muscles to stabilize the central aponeurosis, so allowing the antagonist shorten and draws one side the pelvic or thorax forwards. In addition, the trunk rotators cannot function efficiently when their origin and insertion are approximated, as the spine is flexed (Davis, 1990). Another study on dynamic posturographic analysis found that trunk movements in person with stroke are executed by upper trunk with very minimal anterior tilt of the pelvis i.e. mobility over stability skill is impaired (Messier et al., 2004). In a contrast selective trunk muscle exercises are indeed related to clinical practice in patients with stroke. A randomized trial that added 10 hours additional trunk exercises to regular rehabilitation observed beneficial effect in improving trunk control, particularly the dynamic sitting postural control in sub-acute stroke (Verheyden et al., 2008). A study by Mudie et al. (2002) found that training the patient in the awareness of trunk position could improve sitting weight symmetry in sub-acute stroke. Several studies previously have reported the positive effects of trunk stabilization exercises on unstable surfaces possibly due to stimulation of the proprioceptors of the joint and muscle so that activates the postural muscles around the abdomen and pelvis, which

leads to improvements of balance and gait ability more than that on a stable surface (Yoo et al., 2014). Therefore, this trial was designed to assess the effectiveness of physio ball trunk rehabilitation exercise compared with physio bed trunk rehabilitation exercise program, considering improvement of trunk control and balance in hemiplegic patients after stroke.

1.2 Justification of the study

Stroke is one of the major causes of death and disability throughout the world. Post stroke survivals presents altered and reduced trunk movements that create challenge for the maintenance of the body balance and restoration of normal movements of the trunk and of the pelvis. Many evidence based findings available from literature review demonstrating the importance of trunk performance after stroke. Various studies have demonstrated the effects of different therapeutic approaches used after stroke such as neurophysiologic, motor learning, strengthening exercises of limb muscles etc. But most of the studies mainly concerned with the lower or upper extremity performance. As a result in comparison with limb rehabilitation, trunk and balance recovery is a rather neglected area of stroke rehabilitation.

A trunk rehabilitation exercise through balance training is also essential component for post stroke patients for recovery of balance and improvement in gait. Balance training is aimed at retraining of postural control, development of effective specific strategies so that functional tasks can be performed in changing environmental contexts and improving gait performance after stroke. Thus balance retraining is an important component of a comprehensive physical rehabilitation program. But the evidence supporting the effectiveness of trunk rehabilitation and balance training is limited. So this protocol assumed at determining the effect of trunk rehabilitation and balance training on trunk control, balance recovery of post stroke patients in neurological intervention settings. Besides it will help to establish right guidelines, idea and education about specific protocols of trunk rehabilitation exercise program to improve trunk control, balance and reduce as well as disability for patients with strokes.

1.3 Operational definition

Stroke, Physio Ball Trunk Exercice, Physio Bed Trunk Exercice, Trunk Control and Balance

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.

Physio Bed Trunk Exercise

Physio bed 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 exercice.

Trunk control

Trunk control is the ability of the trunk muscles to allow the body to perform selective movements of the trunk, maintain upright posture and or position and able to adjust according to weight shifts or transfer. This ability helps to maintain the centre of mass within the base of support (BOS) during static and dynamic postural adjustments.

Balance

Balance is defined as a complex process that involves the reception and integration of sensory inputs, planning and execution of movements that helps to achieve a goal requiring upright posture.

1.4 Study Objective

1.4.1 General objective of the study

To compare the effectiveness of physio ball trunk rehabilitation exercise with physio bed trunk rehabilitation exercise program for improving trunk control on trunk control and balance among hemiplegic stroke patient.

1.4.2 Specific objective

- ✓ To find out the baseline characteristics of participants.
- ✓ To find out the effectiveness of the physiotherapy ball exercise between and within group in comparison with physiotherapy bed exercise to improve balance for patients with stroke.
- ✓ To identify the effectiveness of physio ball trunk rehabilitation exercise between and within group in comparison with physiotherapy bed exercise to improve trunk control for the patients with stroke.

1.5 Hypothesis

Null Hypothesis H_0: $\mu_1 - \mu_2 = 0$ or $\mu_1 = \mu_2$; where μ1= mean of Physio ball trunk rehabilitation exercise group (Group A) and μ2= mean of physio bed trunk exercise group (Group B) with initial and final mean difference is same.

Physio ball trunk rehabilitation exercise along with conventional physiotherapy is no more effective than physio bed trunk rehabilitation exercise along with conventional physiotherapy for the treatment of hemiplegic stroke patient.

Alternative hypothesis H_a: $\mu_1 - \mu_2 \neq 0$ or $\mu_1 > \mu_2$; where μ1= mean of the physio ball trunk exercise group (Group A) and μ2= mean of the physio bed trunk exercise group (Group B) with initial and final mean difference is not same.

Physio ball trunk rehabilitation exercise along with conventional physiotherapy is more effective than physio bed trunk rehabilitation exercise along with conventional physiotherapy for the treatment of hemiplegic stroke patient.

CHAPTER II: LITERATURE REVIEW

Stroke is a common neurological condition in worldwide and it is increasing day by day. There are so many causes behind this problem and so many treatment procedures to solve this problem. Stroke patients face many difficulties including hand function, balance problem, gait problem, and movement difficulties. A common neurological insufficiency characterized by the sudden development of a clinical sign of focal disturbance secondary to a vascular event and persists more than 24 hours may know as stroke (Gayer & Gomes, 2009). Now a day's stroke is the major familiar cause of impairment in (ADLs) activities of daily living and it is increasing worldwide (Hsieh & Sheu, 2001).

Stroke definition according to the World Health Organization (WHO) ''A clinical syndrome consisting of rapidly developing clinical signs of focal (or global in 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) stated that there are so many causes that stroke patients have so many difficulties in their body function including upper extremity task, lower extremity task, balance problem, postural problem, and gait problem. 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).

Stroke is a disease that impairs sensory and motor functions by causing irreversible damage to the brain due to cerebral vascular problems (Warlow et al., 2003). Thus,

neurological deficits such as selective muscle activation, equilibrium reaction, balance control for postural maintenance, and movement control appear complex (Lundy-Ekman, 2013). Balance is continuously maintained by adjusting center of gravity in the base of surface. This adjustment is made via the sensory input from the visual, vestibular, and somatosensory systems, which are maintained by the central nervous system (Pollock et al., 2000). However, in stroke patients, these systems are affected depending on the location of the stroke lesion (Warlow et al., 2003), these results of have been demonstrated to decrease of balance control ability, limitation of ability to perform activities of daily living (ADL), loss of range of motion, imbalance of standing posture, and excessive weight bearing to the non-affected side (Dickstein et al., 1984; Lundy-Ekman, 2013; Sackley, 1990; Shumway-Cook & Woollacott, 2007).

Healthy individuals have the ability to maintain proper distribution of the body weight and to shift weight according to the task required is essential for normal balance. But this ability is commonly disturbed in individuals with stroke and they frequently show an increased postural sway, decreased dynamic stability and impaired weight-shifting ability onto the paretic side of the body both when sitting and standing. (Saeys et al., 2008).

Sitting balance is a predictor of functional recovery, and the role of the trunk muscles in maintaining balance is important because the center of mass becomes lower than that in the standing position (van de Port et al., 2006). Kim, Lee & Jeon (2015) reported that trunk muscle activation during a reaching task in stroke patients is highly correlated not only with trunk control but also with balance. To improve balance in the sitting position, pelvic tilt or bridging, weight-shifting, and trunk stabilization exercises using the arms and legs may be used as training methods

(Verheyden et al., 2009). The trunk muscles contract to counteract postural sway during shoulder or hip flexion exercise in the sitting position (Dickstein et al., 2004) , and the ability to regulate the alignment of the trunk is required to counteract the center of mass change during weight-shifting exercises (Lanzetta et al., 2004) .

Trunk control seems particularly important for balance as it stabilizes pelvis and the spinal column. Muscles of the trunk are involved in maintaining the trunk control and balance of the body. Many studies have reported the weakness of trunk flexor, extensor and bilateral trunk rotator muscles after stroke. Further, several authors have asserted the importance of assessing trunk function in order to predict the functional status at discharge of the stroke patients (Cabanas-Vald´esa, Caritat & Bagur-Calafat, 2013).

Selective trunk control exercise is essential in successful rehabilitation of patients with stroke. By improving trunk control through specific trunk rehabilitation exercise program ultimately improves selective mobility through stability of the trunk muscles. This outcome helps patients in the acquisition of basic activities of daily living (Das, Raja & Vedavathi, 2016).

A cross-sectional study by Verheyden et al. (2011) demonstrated that trunk control is related to measures of balance, gait and functional ability in patients with stroke. Similarly one of the randomized control trial of showed that additional trunk rehabilitation exercises early after stroke improved standing balance and ambulation. Both the components are inter-related to each other and training of one component has the transfer effect on the other component (Saeys et al. 2008).

Mudie et al. (2002) found that training the stroke patients in the awareness of trunk position enhanced weight symmetry. Trueblood et al. (1989) reported that propioceptive neuromuscular facilitation-based resisted anterior elevation and posterior depression of pelvic movements for lower trunk muscles resulted in an improvement in walking in early phase stroke patients.

Balance training on different support surface (affected side: stable surface, non-affected side: unstable surface) could facilitate a stronger beneficial effect on balance and walking ability than other balance trainings on different support surface in patients with stroke (Kong, Bang & Shin, 2015). The unstable surface trunk stabilization exercise improved the internal oblique and transversus abdominis muscles and balance ability (Yoo, Jeong & Lee, 2014).

Exercise on the unstable support surface enhanced the size of the cross-sectional area of the trunk muscles and balance ability significantly more than exercise on the stable support surface (Bae et al., 2016). Trunk exercises on an unstable surface improve trunk muscle activation, postural control, and gait speed in patients with hemiparetic stroke (Jung, Cho & In, 2016).

A meta analysis evaluate the efficacy of trunk exercises added to conventional rehabilitation on functional outcomes. This study concluded that there is moderate evidence that the addition of specific trunk exercise to conventional early stroke rehabilitation significantly improve standing balance and mobility after stroke (Sorinola, Powis & White, 2014). Additional trunk exercises to regular physiotherapy improved trunk lateral flexion performance in sub-acute stroke patients (Verheyden et al., 2009). A randomized controlled trial of truncal exercises early after stroke

reported an improved balance ability and mobility (Saeys et al. 2008). A recent randomized control trial of additional trunk exercises along with conventional exercise program resulting significant effects on balance, functional condition and ambulation in early stage stroke patients (Buyukavci et al., 2016). Another pre-post design found that the aquatic and land-based trunk exercise program significantly improved walking speed and cycle, stance phase and stride length of the affected side and the symmetry index of the stance phase among stroke patients (Park et al., 2016).

A pre-post test design study concluded that unstable surface trunk stabilization exercise improved the internal oblique and transversus abdominis muscles and balance ability (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).

CHAPTER III: METHODOLOGY

3.1 Study design

The study was a quantitative evaluation of single blinded randomized clinical trial research design with baseline assessment, post-treatment assessment, two groups comparison. Classic experimental research finding out the causal relationship between independent and dependent variables and infer the findings for generalization (Depoy and Giltin, 2015). 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 participants were blinded. A pretest before intervention and posttest after 16 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.

3.2Study Area

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

3.3 Study period

The duration of the study was 10 Months. This study was conducted from November 2019 to September 2020.

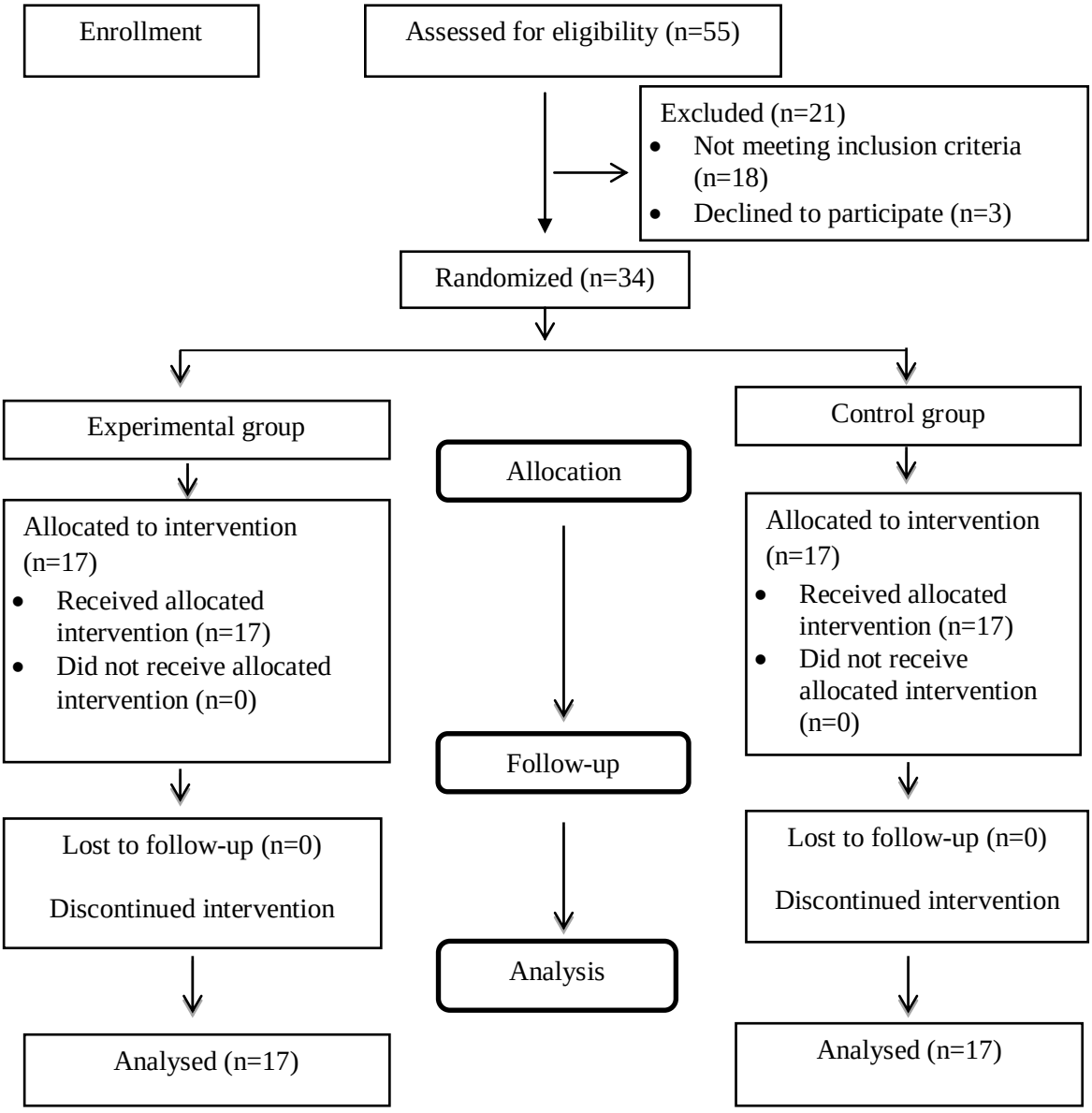


Figure-1: Flow chart of the phases of Randomized Control Trial

3.4 Study Population

The patient of the Hospital treated in Neurology Unit Outpatient of Physiotherapy Department. Patients was Diagnosed as Stroke.

3.6 Sample size

The patient who came to neurology unit of physiotherapy department, CRP, Savar from July 2020 to September 30, 2020 and who met the inclusion criteria was selected for the study. And total 34 participants met the criteria was included in the study. The participants who did not meet the inclusion criteria were excluded. Finally 34 participants selected as sample for this study. Among them 17 participants were in group A (physio ball trunk exercise group) and 17 participants in group B (physio bed trunk exercise group).

3.7 Sampling technique

In the study, sample was select from Hospital participants who meet inclusion criteria within study time frame (01.07.20 to 30.09.20). Total 34 patients met the criteria and all are allocated into study. Through simple random sampling techniques patients were allocated into Physio ball exercise (group A) and Physio bed exercise (group B) according to a 1:1 ratio (See Figure 1). Thus, after randomization 17 patients were allocated into group A and 17 were allocated into group B. Sealed envelopes were used for randomization that was carried out by Neurological unit of Physiotherapy Department.

3.8 Inclusion criteria:

Each center patients were requited from July 2020 to September, 2020 based on inclusion criteria.

Subject selection from CRP: Subject was selected from outpatient Neurology unit, Physiotherapy Department, CRP at Savar, Dhaka.

Male and female both were included: Both male and female who had stroke were included because Sherrington et al. (2016) showed that prevalence of male and female both are at high risk.

Patients diagnosed as stroke: Both ischemic or hemorrhagic stroke patients based on MRI or CT scan findings were included because physiotherapy favors in both types of stroke case diagnosis (Winstein et al., 2016).

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).

Age range between 35 to 70 years: This age range was selected because most of the people suffering from stroke around the age range showed most vulnerable (Timmermans et al., 2014).

Suffering from both acute and chronic stroke: Duration of stroke from within 1 month up to above duration stroke cases was included (Van Criekinge et al., 2019; Karthikbabu et al., 2011).

3.9 Exclusion criteria

Medically unstable patients, unstable cardiac disease (Kim, Jung & Lee, 2017).

Patient who had cognitive problem (Morich &Wijck, 2012).

Recurrent stroke history, neurological disease affecting balance other than stroke, musculoskeletal disorders affecting motor performance (Mishra et al., 2018).

Participants who were unwilling to participate.

Before taking part in study all participants were well informed about the aim and procedure of the training after randomly selection in group.

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

3.10 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.

3.10.1 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).

3.10.2 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 co-ordination of trunk movement. The TIS has sufficient reliability, internal consistency and validity for use in clinical practice and stroke research. Test retest and interobserver reliability for the TIS total score Intraclass correlations (ICC) was 0.96 and 0.99, respectively (Verheyden et al., 2004).

3.11 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.

All the participants received standard stroke rehabilitation (Physiotherapy, Occupational therapy and Physiotherapy) at CRP in official time. Alongside with regular treatment sessions, a 30 min trunk intervention was provided, 4 Days per week, for four consecutive weeks for the trial.

Assessments

Participants who were blinded for the intervention had assessed the trunk control and balance before the start of the treatment, at the end based on outcome measures (see assessment instruments of Appendix E).

Both group received exercise in individual session for 30 min, 4 days per week, for 4 constructive weeks.

Please see **Appendix F** and **Appendix G** for treatment protocol description.

3.12 Data Analysis

Statistical analysis was performed by using statistical package for social science (SPSS) version 23.

3.12.1Statistical test

Statistical analysis refers to the well-defined organization and interpretations of the data by systemic and mathematical procedure and rules (De Poy and Gitlin, 2015). All Statistical analysis was performed by using statistical package for social science (SPSS) version 23. Descriptive statistics for the pretest, posttests are presented. Chi-Square (χ^2) tests were used to determine whether the groups (group A and group B) differed on age, sex, affected side, and time after CVA. Mann-Whitney *U*-test was used for between group's analysis of balance and trunk impairment status. Within group analysis of balance and trunk impairment status was analyzed by Wilcoxon signed rank test (Hicks, 2009).

Effect size index (d) was calculated for each of the outcome measures and its subscales/components using the formula (Xball–Xplinth)/SD, where X ball and Xbed are the physio ball and physio bed means, and SD is the common standard deviation. The change scores of within group comparison, between pre- and post intervention levels were the groups mean, standard deviation and mean rank.

3.12.2Level 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, 2015).

3.13 Quality control and assurance

Blinding of Patients: Allocation of patient to group A and group B by using sealed envelopes.

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.

3.14 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) (Appendix II). After got permission for data collection data were obtained from Savar branches of CRP. All data and assessment files were stored in strict secure and maintained confidentiality (Appendix III).

CHAPTER IV: RESULT

After randomization between, targeted 17 patients were assigned to treatment group (n=17) and control group (n=17) (Figure 1). There is no drop out among both groups during post assessment. The dropout rate is very lower then hypothesized.

Table 1: Baseline characteristics patient

Characteristics	**Physio ball trunk exercise group(A)** (n=17)	**Physio bed trunk exercise group(B)** (n=17)	***p value*** (χ^2, *U)*
Age, mean (SD), y	53.88 (10.452)	55.82 (9.009)	0.691[a]
Gender, n (%) -Male	14(82.4)	13(70.6)	.633[a]
-Female	3 (17.6)	4(29.4)	
Affected body side, n (%)			
- Left	10(58.8)	8(47.1)	.732 [a]
-Right	7(41.2)	9(52.9)	
Dominant side affected, n (%)	9(52.9)	10(58.8)	1.0[a]
Onset of stroke, n (%) – Acute	7(41.2)	6 (35.3)	1 .0[a]
Chronic	10(58.8)	11(64.7)	
Outcome Measures-BBS	20(11)	21(10)	.986[b]
TIS	10(3)	11(3)	.781[b]

***p < .05;* a=x^2 test, b=*U* 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) and participants stroke characteristics (onset of stroke, affected side, dominant side).

Table 1 described that mean age of physio ball exercise group was 53.88(10.452) and Physio bed trunk exercise group mean age was 55.82 (9.009). In chi-square test, it was found that there is no statistical significance (p>.05) age difference found in pre-assessment of both groups. Besides, in physio ball exercise among 17 participants, 14(82.4%) were male and 3 (17.6%) participants were female. While 13(70.6) participants were male, and 4(29.4) participants were female in physio bed exercise group. In chi-square test both group showed there is no significant (p>.05) difference in their gender (Table 1). In Table 1, it was found that before treatment, both group has no significant (p>.05) difference in affected body side (physio ball exercise group:Rt-10(58.8%) and Lt-7(41.2%); Physio bed exercise group Rt- 8(48.7%) and Lt-9(52.9%). Above table 1 also showed that both groups have no statistically significant difference (p>.05) in dominant side affected category after stroke (Physio ball exercise group: 52.9% and Physio bed exercise group: 58.8%). Besides, before intervention in chi-square test both groups have no significant difference (p>.05) at onset of stroke characteristics. In physio ball exercise group among 17 participants 7 participants were in acute stage of stroke and 10 participants were in chronic stage of stroke. While in physio bed exercise group, among 17 participants 6 participants were in acute stage and 11 participants were in chronic stage.

In terms of before treatment evaluation or pre assessment (Table 1), Mann-Whitney U test revealed that there is no statistically significant difference (p>.05) between both groups in terms of outcome measures: Trunk Impairment Scale (p=.781) and Berg Balance Scale (p=.986).

Berg Balance Scale (BBS)

Table 2: Within group Comparison among outcome measures of BBS

Outcome Variable	Group A (Physio ball) n=17			Group B (Physio bed) n=17		
	Before Rx (T1)	**After Rx (T2)**	**T1- T2 (Before Rx -After Rx)**	**Before Rx (T1)**	**After Rx (T2)**	**T1- T2 (Before Rx- Follow up)**
	Median	***Median***	***p (Z-score)***	***Median***	***Median***	***p (Z-score)***
Berg Balance Scale (BBS)	22	40	.000 (-3.63)	22	38	.000 (-3.62)
1. Sit to stand	3	3	.004 (-2.86)	2	3	.001 (3.17)
2. Standing unsupported	3	4	.001 (-3.22)	2	4	.024 (-2.2)
3. Sitting unsupported	3	4	.004 (-2.88)	4	4	.009 (-2.5)
4. Standing to sitting	3	3	.000 (-1.2)	3	3	.001 (-3.6)
5.Transfer	2	4	.000 (-3.4)	2	3	.000 (-3.5)
6. Standing unsupported with eyes closed	1	3	.000 (-3.7)	1	3	.000 (-3.8)
7. Standing unsupported with feet together	1	3	.000 (-3.2)	1	2	.000 (-3.2)
8. Reaching forward in standing	1	3	.000 (-3.4)	1	3	.000 (-3.5)
9. Pick up objects from the floor while standing	1	2	.000 (-3.3)	1	2	.000 (-3.6)
10. Turning look behind over left and right shoulders in standing	1	3	.001 (-3.5)	1	3	.000 (-3.6)
11. Turns 360 degree	0	3	.000 (-3.2)	2	3	.000 (-3.5)
12. Place alternate foot on step	1	3	.000 (-3.5)	1	3	.000 (-3.7)
13. Standing unsupported one foot in front	1	2	.000 (-3.5)	1	2	.000 (-3.8)
14. Standing on one leg	1	1	.005 (-2.8)	0	1	.008 (-2.6)

p< .05

In BBS scale, A Wilcoxon signed-rank test showed that after intervention,16 constructive session elicits a statistically significant change in individuals with both physio ball exercise group (Z = -3.63, p = 0.000) and physio bed exercise group (Z = -3.62, p = 0.000) (Table 2). Indeed, after treatment total median Score rating was higher in physio ball group (median: 40) than physio bed exercise group (median: 38) in Table 2. Individual section of BBS scale also revealed statistically significant (p<.05) difference within group and physio ball exercise with higher median score than physio bed exercise group in every section of Berg Balance Scale (Table 2). In sit to stand category, Wilcoxon Signed-Ranks test indicated that after treatment both physio ball exercise group (p=0.004, Z = -2.86) and physio bed exercise group (p=.001, Z= -3.17) had been improve. However, after treatments median score rate of physio ball exercise is higher than physio bed group (Table 2). Furthermore, Wilcoxon Signed-Rank test proved that after treatment both group improved significantly (p<.05) in categories like standing unsupported, standing to sitting, sitting unsupported, transfer, standing unsupported with eyes closed, standing unsupported with feet together, reaching forward in standing, pick up objects from the floor while standing, turning look behind over left and right shoulders in standing, turning look behind over left and right shoulders in standing, turning look behind over left and right shoulders in standing, turns 360 degree, place alternate foot on step, standing unsupported one foot in front and Standing on one leg. Indeed, after intervention physio ball group participants has higher median score in every category of BBS than physio bed exercise group (Table 2).

However, Table 3 showed after treatment both groups had no statistically significant difference (p<.05) in total score of BBS.

Table 3: Between group comparison among BBS

	Pretest (n=17)			Post test (n=17)		
	Mean Rank			Mean Rank		
	Group A	Group B	*p value (U-score)*	Group A	Group B	*p value (U-score)*
BBS	**17**	**17**	**.986 (145)**	**19**	**15**	**.326 (108)**
1. Sit to stand	19.24	15.76	.288 (155)	20.12	14.88	.047 (100)
2. Standing unsupported	18.15	16.85	.696 (113)	17.85	17.15	.780 (138)
3. Sitting unsupported	15.68	19.32	.240 (113)	17.50	17.50	1.00 (144)
4. Standing to sitting	17.35	17.65	.923 (142)	19.32	15.68	.107 (113)
5.Transfer	17.62	17.38	.941 (142)	21.71	13.29	.004 (73)
6. Standing unsupported with eyes closed	17.29	17.71	.889 (144)	19.26	15.74	.266 (114)
7. Standing unsupported with feet together	17.00	18.00	.755 (136)	18.94	16.06	.378 (120)
8. Reaching forward in standing	16.94	18.06	.731 (131)	19.68	15.32	.176 (106)
9. Pick up objects from the floor while standing	16.79	18.21	.651 (132)	18.62	16.38	.490 (125)
10. Turning look behind over left and right shoulders in standing	17.29	17.71	.900 (141)	18.24	16.76	.591 (132)
11. Turns 360 degree	14.41	20.59	.053 (92)	17.41	17.59	.956 (143)
12. Place alternate foot on step	17.26	17.74	.881 (140)	17.94	17.06	.786 (137)
13. Standing unsupported one foot in front	17.79	17.21	.885 (139)	18.65	16.35	.481 (125)
14. Standing on one leg	19.79	15.21	.122 (105)	19.76	15.24	.193 (106)

$p < .005$

From this Table 3 data, Mann-Whitney U test result illustrate that after intervention total BBS score in the physio ball group was not significantly higher than the physio bed group ($U = 108$, $p = .326$). However, in individual section of BBS scale, participant's sit to stand was increased significantly ($U= 100$, $p= .047$) in physio ball exercise (Table 3). Besides, transfer skill also significantly increased ($U= 73$, $p= .004$) after physio ball exercise in comparison to physio bed exercise group participants (Table 3). In addition, Physio ball exercise group showed higher mean rank changes (pre test mean rank: 17; post test mean rank: 19) than control group (pre test mean rank: 17; post test mean rank: 15) in total score of BBS (Table 3). Furthermore, between group comparison after treatment physio ball exercise did not show significant difference ($p>.05$) in categories like standing unsupported, standing to sitting, sitting unsupported, transfer, standing unsupported with eyes closed, standing unsupported with feet together, reaching forward in standing, pick up objects from the floor while standing, turning look behind over left and right shoulders in standing, turning look behind over left and right shoulders in standing, turning look behind over left and right shoulders in standing, turns 360 degree, place alternate foot on step, standing unsupported one foot in front and Standing on one leg. However, based on mean rank data of Table 3, after intervention physio ball group participants has higher mean rank in every categories of BBS than physio bed exercise group.

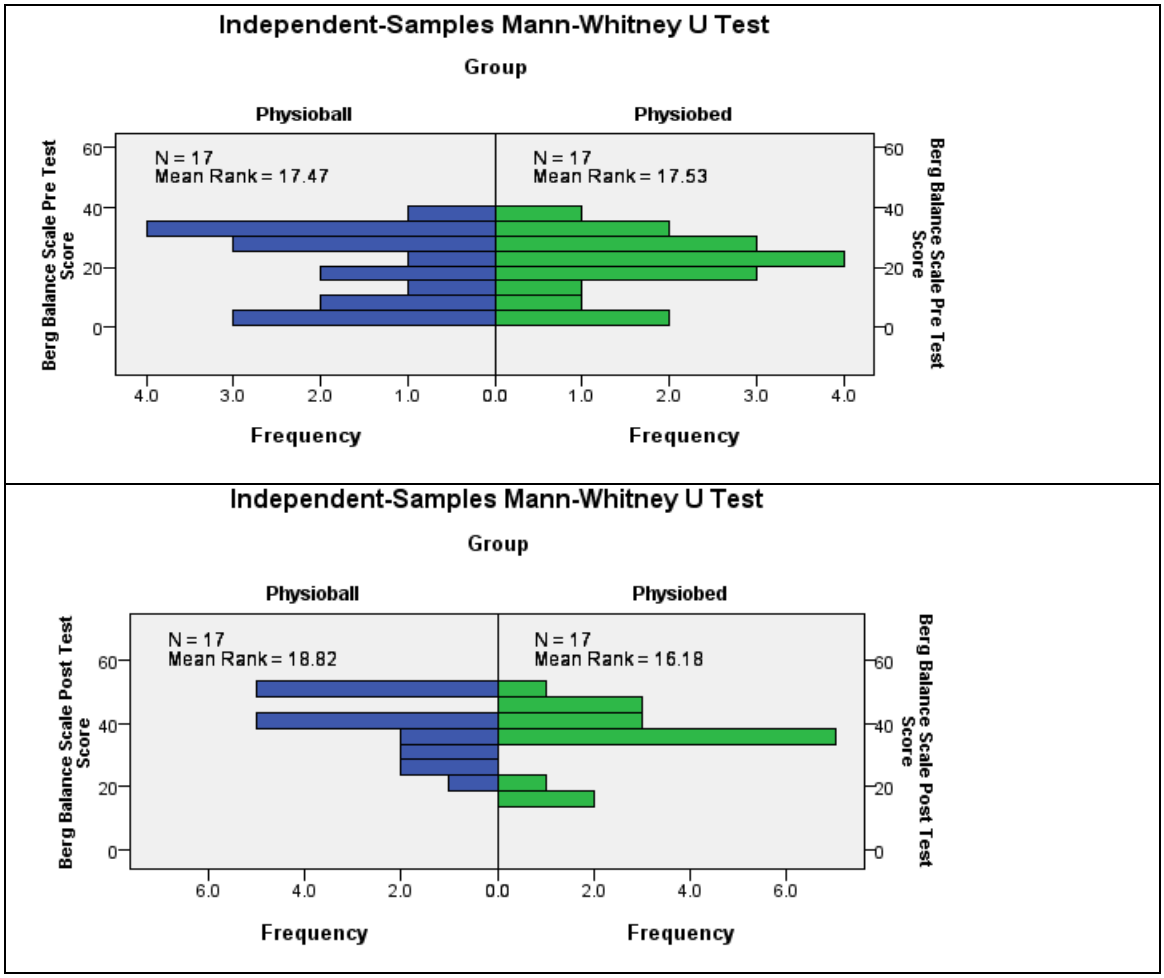


Figure 2: Mean Rank of BBS

Despite this, **figure 2** also shows physio ball exercise group showed relatively higher mean rank than physio bed exercise group in total score of BBS.

Above results of BBS indicate intervention has effects on both groups, especially intervention for group A (physio ball exercise) were more effective than Group B (physio bed exercise). Therefore, null hypothesis is rejected in section trunk control and functional balance (sit to stand and transfer) and overall result reveled that physio ball exercise group has higher improvement with statistical significance and higher mean rank change after treatment.

Trunk Impairment Scale (TIS)

Within group comparison, Wilcoxon signed rank test illustrated that TIS score improved significantly (p <.005) in both groups when comparing before and after physio ball exercise (Z= -3.7, p=.000) intervention and Physio bed exercise group (Z= -3.7, p=.000) intervention (Table 4).

Table 4: Within group Comparison among outcome measures of TIS

	Group A (Physio ball) n=17			**Group B (Physio bed)** n=17		
Outcome Variable	**Before Rx (T1)**	**After Rx (T2)**	**T1- T2 (Before Rx -After Rx)**	**Before Rx (T1)**	**After Rx (T2)**	**T1- T2 (Before Rx- Follow up)**
	Median	***Median***	***p (Z-score)***	***Median***	***Median***	***p (Z-score)***
Trunk Impairment Scale (TIS)	11	20	.000 (-3.7)	11	17	.000 (-3.7)
Static Sitting Balance (0-7)	5	7	.000 (-3.4)	5	6	.000 (-3.6)
Dynamic Sitting Balance (0-10)	4	8	.000 (-3.5)	4	6	.000 (-3.4)
Coordination (0-6)	2	5	.000 (-3.2)	2	5	.000 (-3.4)

p< .05

Table 4 also revealed that categories of TIS like static balance, dynamic balance and coordination were increased significantly (p<.05) after physio ball and physio bed exercise program. However, after treatment within group comparison physio ball exercise group showed higher changes in median scores than physio bed exercise program in all categories of TIS (Table 4).

The within-group score changed (2) on the static sitting balance subscale of the Trunk Impairment Scale suggests a 30% improvement for the physio ball exercise group in

the post-intervention phase (Table 4). While physio bed group score shows 15% improvement after treatment.

In terms of subscale dynamic sitting balance both groups improve after treatment but physio ball group score changed (4) and showed 40% where physio bed exercise score changed (2) and showed 20% improvement (Table 4). Besides, subscale coordination score changes (3) and shows 50% improvement in both physio ball exercise group and physio bed exercise group respectively (Table 4).

Table 5: Between group comparison among outcome measures of TIS

	Pretest (n=17)			**Post test (n=17)**		
	Mean Rank			**Mean Rank**		
	Group A	**Group B**	***p value (U-score)***	**Group A**	**Group B**	***p value (U-score)***
TIS	**17**	**17**	**.781 (152)**	**23**	**12**	**.002 (54)**
Static Sitting Balance (0-7)	17	17	.781 (137)	22	13	.001 (71)
Dynamic Sitting Balance (0-10)	16	19	.271 (177)	24	10	.000 (32)
Coordination (0-6)	13	21	.001 (71)	23	11	.041 (73)

$p < .005$

The result of Between group comparison (Mann-Whitney U test) illustrated that group differences is statistically significant (p<.05) in TIS scale and participant of physio ball exercise group indicates significant progress (U=54, p=.002) than physio ball exercise group after treatment with the changes of mean rank score from pre treatment to post treatment (Group A: 17 to 23 versus Group B: 17 to 12) (Table 5). Furthermore, the change score of within and between-group comparison for the three subscale of the Trunk Impairment Scale favors the physio ball group, the change being of the highest possible score with statistical significance (p<0.005). Thus, indicate physio ball group has higher improvement and between group comparison physio ball group shows statistically significant (p<.05) improvement in static sitting balance (U=71, p=.001), dynamic sitting balance (U=32, p=.000) and coordination (U =73, p=.041) (Table 5). In following Figure 3, physio ball exercise group also shows significant mean rank changes after treatment in comparison to physio bed exercise group.

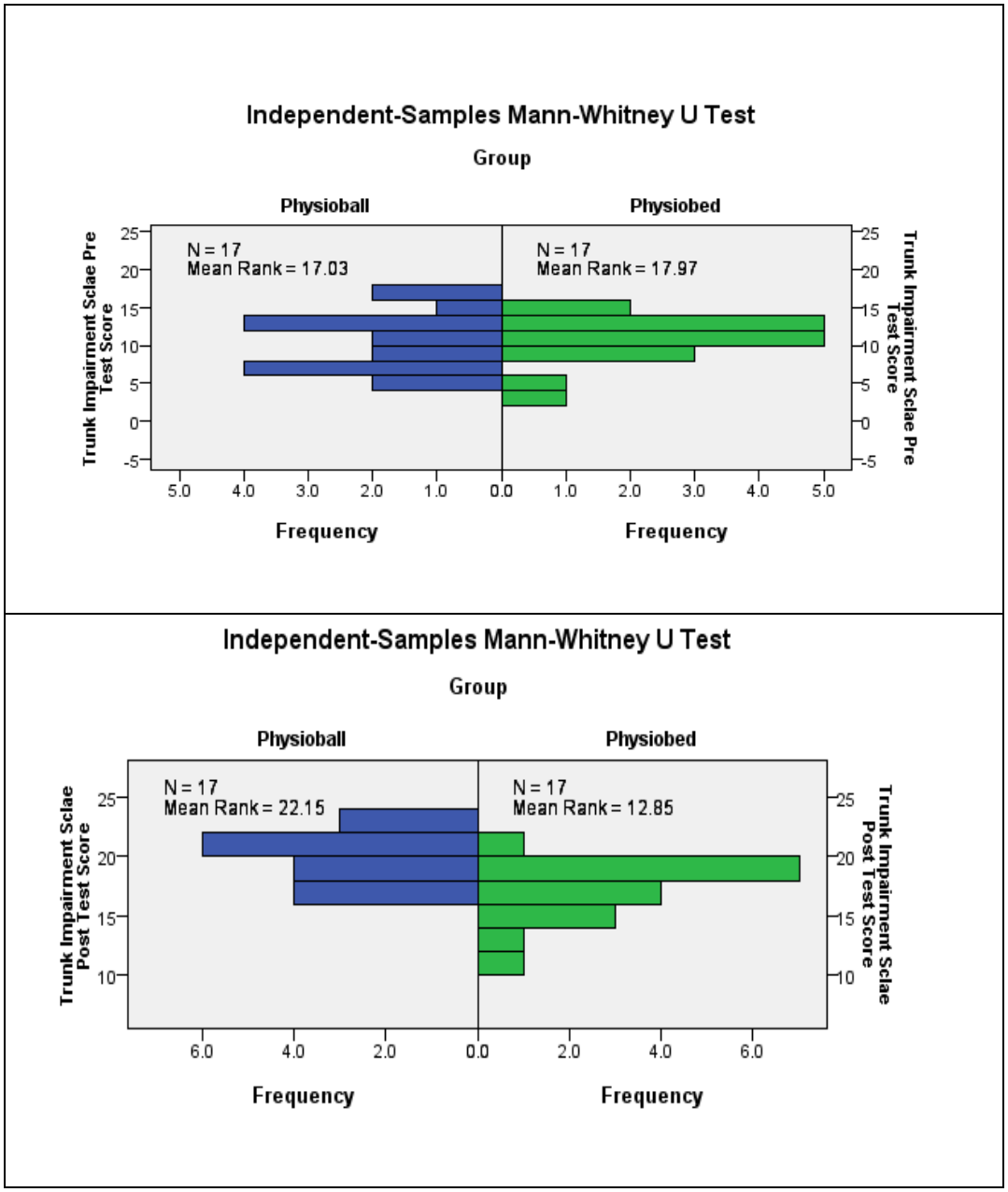


Figure 3: Mean Rank of TIS

Therefore, it concludes that treatment has statistically significant (p<.05) effect on TIS score and based on mean rank score difference physio ball trunk exercise has more progress than physio bed trunk exercise. Thus, mean null hypothesis on equivalence of mean is rejected. Based on all statistical test conclude that both groups

had improvement in trunk rehabilitation, but physio ball exercise group had higher improvement then physio bed exercise group.

Besides, the effect size index calculated (Cohen *d*) for all the outcome measures are listed below: for total Trunk Impairment Scale (.6); Berg Balance Scale (.2). Here the effect for TIS size is 0.6 which means physio ball exercise has larger treatment effect in trunk rehabilitation according to Cohen's classification {0.1: small effect, 0.3: moderate effect and 0.5 and above: large effect}(Portney & Watkins, 2000). However, in BBS effect size is .2, thus indicate physio ball treatment has smaller effect in balance recovery after stroke.

CHAPTER V: DISCUSSSION

The aim of the study was to examine whether task-specific trunk exercises performed on the physio ball are more beneficial than similar exercises performed on the physiotherapy bed. The study results showed that trunk exercises performed on the physio ball are more effective than those on the physiotherapy bed for improving trunk controlled and the coordination, which measured by Trunk Impairment Scale, respectively. Furthermore, the experimental (physio ball) group showed greater improvement (changes in mean rank) 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 phsio ball exercise 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 (.6) observed in the total Trunk Impairment Scale supports for trunk exercises performed on the physio ball indicated an appreciable improvement and shows statistically significant outcome in comparison to physio bed exercise program. In 2020, a systematic review by Ravichandran et al. shows that 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). Finding of this systematic review 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 Viswaja et al. (2015) with the largest treatment effect (2.86), physio ball intervention had statistically significant (p<.05) improvement in trunk rehabilitation. Current study finding also shows physio ball exercise has significant improvement (p<.05) in trunk rehabilitation. Another systematic review 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 2018, a systematic review 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 reveled physio ball exercise has statically significant (p<.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 et

al., 2004). Furthermore, there was a reduced recruitment of high threshold motor units of trunk muscles after stroke (Chakraborty & Shende, 2016). 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. (2011) 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. (2006). 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. 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 carry-over small effect (.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<.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 poststroke 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.

References

American Stroke association (2016), High blood pressure guidelines. Retrieved on 16th January, http://www.strokeassociation.org.

An, S. H. and Park, D. S. (2017). The effects of trunk exercise on mobility, balance and trunk control of stroke patients. *Korean Society of Physical Medicine,* 12(1), 25-33.

Buyukavci, R., Sahin, F., Sag, S., Dogu, B. and Kuran, B. (2016). The impact of additional trunk balance exercises on balance, functional condition and ambulation in early stroke patients: Randomized controlled trial. *Turkish Journal of Physical Medicine and Rehabilitation,* 62(3), pp. 248-256.

Cabanas-Vald´esa, R., Caritat, G.U. and Bagur-Calafat, C. (2013), Trunk training exercises approaches for improving trunk performance and functional sitting balance in patients with stroke. *NeuroRehabilitation,* 33, pp. 575-592.

Chakraborty, A., & Shende, M. (2016). Effect of Swiss Ball Exercises on Sitting Balance and Trunk Coordination in Stroke Patients. *Indian Journal of Physiotherapy and Occupational Therapy-An International Journal*, 10(4), 32-37.

Das, J., Raja, R. and Vedavathi, R. (2016). "A Study to Assess The Effectiveness of Trunk Rehabilitation Programme on Trunk Control And Balance in Acute Ischemic Hemiparetic Stroke Patients" *Journal of Dental and Medical Sciences*, 15(12), pp. 72-81.

Davis, P. M. (1990). Problems Associated with the Loss of Selective Trunk Activity in Hemiplegia, In: P. M. Davis, Ed., Right in the Middle. Selective Trunk Activity in the Treatment of Adult Hemiplegia, Springer, New York, pp. 31-65.

Davis, P. M. (2003). Problems associated with the loss of selective trunk activity in hemiplegia. Right in the Middle. Selective trunk activity in the treatment of adult hemiplegia, sixth edition. Heidelberg: Springer, pp.31–66.

Depoy, E., and Gitlin, L.N., (2013). Introduction to research: Understanding and applying multiple strategies. 4th ed., Philadelphia: Elsevier Health Sciences.

Dickstein, R., Shefi, S., Marcovitz, E. and Villa, Y. (2004). Anticipatory Postural Adjustments in Selected Trunk Muscles in Post-Stroke Hemiparetic Patients. *Archives of Physical Medicine and Rehabilitation,* 85(2), 261-273. doi:10.1016/j.apmr.2003.05.011

Downs, S., Marquez, J., & Chiarelli, P. (2013). The Berg Balance Scale has high intra-and inter-rater reliability but absolute reliability varies across the scale: a systematic review. *Journal of physiotherapy, 59*(2), 93-99.

El-Helow, M.R., Zaman, M.I., Fathalla, M.M., El-Badway, M.A., El Nahhas, N., El-Nabil, L.M., Awad, M.R and Wild, K.V. (2015). Efficacy of modified constraint-induced movement therapy in acute stroke. *European Journal of Physical and Rehabilitation Medicine, 51,* 371-9.

Feigin, V.L., Forouzanfar, M.H., Krishnamurthi, R., Mensah, G.A., Connor, M., Bennett, D.A., Moran, A.E., Sacco, R.L., Anderson, L., Truelsen, T., O'Donnell, M., Venketasubramanian, N., Barker-Collo, S., Lawes, C.M., Wang, W., Shinohara, Y., Witt, E., Ezzati, M., Naghavi, M. and Murray, C. (2014). Global and regional burden of stroke during 1990-2010: findings from the Global Burden of Disease Study 2010. *Lancet,* Jan 18, *383*(9913), 245–54.

Fujiwara, T., Sonoda, S., Okajima, Y. and Chino, N. (2001). The relationships between trunk function and the findings of transcranial magnetic stimulation among patients with Stroke. *Journal of Rehabilitation Medicine, 33,* 249–255.

Gayer, J. D., & Gomes, C. R. (2009). *Stroke A Practical approach.* New York London: Lippincott Williams and Wilkins.

Hsieh, C. L., Sheu, C. F., Hsueh, I. P., and Wang, C. H. (2002). Trunk control as an early predictor of comprehensive activities of daily living function in stroke patients. *American Heart Association, 33,* 2626-2630.

Islam, M. A., Rahman, A., Aleem, M. A., & Islam, S. M. S. (2016). Prevalence and associated factors of depression among post-stroke patients in Bangladesh. *International Journal of Mental Health and Addiction, 14*(2), 154-166.

Jin, J. (2014). Warning Signs of a Stroke. *Journal of the American Medical Association, 311*(16), 1704. doi:10.1001/jama.2014.2296.

Johnson, W., Onuma, O., Owolabi, M. and Sachdev, S. (2016). Stroke: a global response is needed. *Bulletin of the World Health Organization 2016,* 94, 634–634A.

Jung, K., Kim, Y., Chung, Y. and Hwang, S. (2014). Weight-shift training improves trunk control, proprioception, and balance in patients with chronic hemiparetic stroke. *The Tohoku journal of experimental medicine, 232*(3), 195-199.

Karatas, M., Cetin, N., Bayramoglu, M. and Dilek, A. (2004). Trunk muscle strength in relation to balance and functional disability in unihemispheric stroke patients. *American Journal of Physical Medicine and Rehabilitation, 83*(2), 81-87.

Karthikbabu, S., Nayak, A., Vijayakumar, K., Misri, Z.K., Suresh, B.V., Ganesan, S. and Joshua, A.M. (2011), Comparison of physio ball and physio bed trunk exercises regimens on trunk control and functional balance in patients with acute stroke: a pilot randomized controlled trial. *Clinical Rehabilitation,* 25(8), 709–719.

Karthikbabu, S., Rao, B.K., Manikandan, N., Solomom, J.M. and Chakrapani, M. (2011). Role of Trunk Rehabilitation On Trunk Control, Balance And Gait In Patients With Chronic Stroke, A Pre Post Design. *Neuroscience & Medicine, 2*, 61-67.

Karthikbabu, S., Rao, B.K., Manikandan, N., Solomon, J.M., Chakrapani, M. and Nayak. A. (2011). Role of Trunk Rehabilitation on Trunk Control, Balance and Gait in Patients with Chronic Stroke. *Neuroscience and Medicine, 2,* 61-67.

Kılınc, M., Avcu, F., Onursal, O., Ayvat, E., Savcun Demirci, C., & Aksu Yildirim, S. (2016). The effects of Bobath-based trunk exercises on trunk control, functional capacity, balance, and gait: a pilot randomized controlled trial. *Topics in stroke rehabilitation*, *23*(1), 50-58.

Kim, J. H., Lee, S.M. and Jeon, S.H. (2015). Correlations among trunk impairment, functional performance, and muscle activity during forward reaching tasks in patients with chronic stroke. *Journal of Physical Therapy Science,* 27, 2955–2958.

Kim, A.S. and Johnston, S.C. (2011). Global Variation in the Relative Burden of Stroke and Ischemic Heart Disease. *Stroke, 124,* 314-323.

Kim, K., Jung, S. I. & Lee, D. K. (2017). Effects of task-oriented circuit training on balance and gait ability in subacute stroke patients: a randomized controlled trial. *Journal of physical therapy science*, *29*(6), 989-992.

Ko, E. J., Chun, M. H., Kim, D. Y., Yi, J. H., Kim, W. and Hong, J. (2016). The additive effects of core muscle strengthening and trunk NMES on trunk balance in stroke patients. *Annals of rehabilitation medicine*, *40*(1), 142.

Lanzetta, D., Cattaneo, D., Pellegatta, D. and Cardini, R. (2004). Trunk control in unstable sitting posture during functional activities in healthy subjects and patients with multiple sclerosis. *Archives of Physical Medicine and Rehabilitation, 85,* 279–283.

Messier, S., Bourbonnais, D., Desrosiers J. and Roy, Y. (2004). Dynamic Analysis of Trunk Flexion after Stroke. *Archives of Physical Medicine and Rehabilitation, 85*(10), 1619-1624. doi:10.1016/j.apmr.2003.12.043

Mishra, K. Ranjan., Mohanty, P.P. and Pattnaik, M. (2018), EFFECTS OF TRUNK EXERCISES ON PHYSIOBALL VS PLINTH ON TRUNK CONTROL AND FUNCTIONAL BALANCE IN POST STROKE HEMIPLEGIC PERSONS, *INDIAN JOURNAL OF RESEARCH, 6*(12), 86-88.

Morris, J. H., & Van Wijck, F. (2012). Responses of the less affected arm to bilateral upper limb task training in early rehabilitation after stroke: a randomized

controlled trial. *Archives of physical medicine and rehabilitation*, *93*(7), 1129-1137.

Mudie, M. H., Winzeler-Mercy, U., Radwan S. and Lee, L. (2002). Training Symmetry of Weight Distribution after Stroke: A Randomized Controlled Pilot Study Comparing Task-related Reach, Bobath and Feedback Training Approaches. *Clinical Rehabilitation, 16*(6), 582-592. doi:10.1191/0269215502cr527oa

Nayak, A., Vijayakumar, K., Misri, Z.K. and Karthikbabu, S. (2012). Does Training on Swiss Ball Improve Trunk Performance after Stroke? A single blinded, quasi experimental study design. *Indian Journal of Physiotherapy and Occupational Therapy*, *6*(1), 172-175.

O' Sullivan, S.B & Schimtz, 2000, Physical Rehabilitation assessment and treatment, 4th edn., F.A.Davis, Philadelphia, 519- 581.

Owolabi, M.O., Akarolo-Anthony, S., Akinyemi, R., Arnett, D., Gebregziabher, M., Jenkins, C., Lackland, D., Ovbiagele, B., Akpalu, A., Sagoe, K., Sarfo, F.S., Obiako, R. and Owolabi, L. (2015). The burden of stroke in Africa: a glance at the present and a glimpse into the future. *Cardiovascular Journal of Africa.*Mar-Apr; 26(2H3Africa Suppl), S27-36.

Park, B., Noh, J., Kim, M., Lee,L., Yang, S., Lee, W., Shin, Y., Kim, J., Lee, J., Kwak, T., Lee, T., Park, J.and Kim, J.(2016). A comparative study of the effects of trunk exercise program in aquatic and land-based therapy on gait in hemiplegic stroke patients. *Journal of Physical Therapy Science*, *28*(6), 1904–1908.

Park, S. and Moon, S. (2016). Effects of trunk stability exercise using proprioceptive neuromuscular facilitation with changes in chair height on the gait of patients who had a stroke. *Journal of Physical Therapy Science, 28*, 2014–2018.

Parmer, P., Sumaria, S., & Hashi, S. (2011). Stroke: Classification and Diagnosis. The Pharmaceutical Journal. Retrieved on January 16, 2011, from https://www.pharmaceutical-journal.com

Portney, L.G. and Watkins, M.P. (2000). Foundations of clinical research, 2nd edn. Upper Saddle River: Prentice Hall Health, 651–659.

Rai, R.K., Arora, L., Sambyal, S. and Arora, R. (2014). Efficacy of Trunk Rehabilitation and Balance Training On Trunk Control, Balance and Gait in Post Stroke Hemiplegic Patients: A Randomized Controlled Trial. *IOSR Journal of Nursing and Health Science (IOSR-JNHS), 3*(3), 27-31.

Renald, S.F., and Regan, J.R., (2016), EFFICACY OF TRUNK EXERCISES ON gym BALL VERSUS BED IN IMPROVING TRUNK CONTROL IN HEMIPARETIC PATIENTS, *International Journal of Physiotherapy and Research,* 4(2),1444-50.

S. Edwards, (1996). An Analysis of Normal Movement as the Basis for the Development of Treatment Techniques. In: S. Edwards, Ed., Neurological Physiotherapy. A Problem Solving Approach, Churchill Livingstone, Philadelphia, 5-40.

S. Ryerson and K. Levit, (1997). Functional Movement: A Practical Model for Treatment, In: S. Ryerson and K. Levit, Ed., Functional Movement Reeducation. A Contemporary Model for Stroke Rehabilitation, Churchill Livingstone, Philadelphia, 1-14.

Saeys, W., Vereeck, L., Truijen, S., Lafosse, C., Wuyts, F.P. and Van de Heyning, P. (2008). Randomized Controlled Trial of Truncal Exercises Early After Stroke to Improve Balance and Mobility. *Neuro rehabilitation and Neural Repair,*10, 1-8.

Sherrington, C., Fairhall, N., Kirkham, C., Clemson, L., Howard, K., Vogler, C., & Sonnabend, D. (2016). Exercise and fall prevention self-management to reduce mobility-related disability and falls after fall-related lower limb fracture in older people: protocol for the RESTORE (Recovery Exercises and STepping On afteRfracturE) randomised controlled trial. *BMC geriatrics*, *16*(1), 34.

Sorinola, I.O., Powis, I. and White, C.M. (2014). Does additional exercise improve trunk function recovery in stroke patients? A meta-analysis. *NeuroRehabilitation*, 35, 205–213.

Tanaka, S., Hachisuka, K. and Ogata, H. (1998). Muscle Strength of the Trunk Flexion-Extension in Post-Stroke Hemiplegic Patients, *American Journal of Physical Medicine and Rehabilitation, 77*(4), 288-290. doi:10.1097/00002060-199807000-00005.

Timmermans, A. A., Spooren, A. I., Kingma, H., &Seelen, H. A. (2010). Influence of task-oriented training content on skilled arm-hand performance in stroke: a systematic review. *Neurorehabilitation and neural repair*, *24*(9), 858-870.

Trueblood, P.R., Walker, J.M., Perry, J. and Gronley JK. (1989). Pelvic exercise and gait in hemiplegia. *Physical Therapy*, 69(1), 18-26.

Tsuji, T., Liu, M., Hase, K. and Chino, N. (2003). Trunk Muscles in Persons with Hemiparetic Stroke Evaluated with Computed Tomography," *Journal of Rehabilitation Medicine, 35*(4), 184-188. doi:10.1080/16501970306126.

Van Criekinge, T., Truijen, S., Schröder, J.,Maebe, J.,Blanckaert, K., van der Waal, C., Vink, M. and Wim Saeys (2019). The effectiveness of trunk training on trunk control, sitting and standing balance and mobility post-stroke: a systematic review and meta-analysis, *Clinical Rehabilitation, 33*(6), 992–1002.

Van de Port, I.G., Kwakkel, G., Schepers, V.P. and Lindeman, E. (2006). Predicting mobility outcome one year after stroke: a prospective cohort study. *Journal of Rehabilitation Medicine, 38,* 218–223.

Verheyden, G, Vereeck, L, Truijen, S, Troch, M, Lafosse, C, Saeys, W, Leenaerts, E.., Palinckx, A. and De Weerdt, W., (2009). Additional exercises improve trunk performance after stroke: a pilot randomized controlled trial. *Neurorehabilitation and Neural Repair, 23*(3), 281-286.

Verheyden, G., Nieuwboer, A., Feys, H., Thijs, V., Vaes, K. and de Weerdt, W. (2005). Discriminant Ability of the Trunk Impairment Scale: A Comparison

between Stroke Patients and Healthy Individuals. *Disability and Rehabilitation, 27*(17), 1023-1028.

Verheyden, G., Nieuwboer, A., Mertin, J., Preger, R.,Kiekens, C. and De Weerdt, W. (2004). The trunk impairment scale: a new tool to measure motor impairment of the trunk after stroke. *Clinical Rehabilitation, 18,* 326–334.

Verheyden, G., Vereeck, L., Truijen, S., Troch, M., Her-regodts, I., Lafosse, C., Nieuwboer, A. and De Weerdt, W. (2006).Trunk Performance after Stroke and Relationship with Balance, Gait and Functional Ability. *Clinical Rehabilitation, 20*(5), 451-458. doi:10.1191/0269215505cr955oa

Verheyden, G., Vereeck, L., Truijen, S., Troch, M., La-Fosse, C., Saeys, W., Leenaerts, E., Palinckx, A. and De Weerdt, W. (2008). Additional Exercises Improve Trunk Performance after Stroke: A Pilot Randomized Controlled Trial. *Neurorehabilitation and Neural Repair, 23*(3), 281-286. doi:10.1177/1545968308321776.

Winstein, C. J., Wolf, S. L., Dromerick, A. W., Lane, C. J., Nelsen, M. A., Lewthwaite, R., ... &Azen, S. P. (2016). Effect of a task-oriented rehabilitation program on upper extremity recovery following motor stroke: the ICARE randomized clinical trial. *Jama, 315*(6), 571-581.

World Health Organization.(n.d). Stroke, Cerebrovascular accident. Retrieved on 23rd March, 2018. http://www.who.int/topics/cerebrovascular_accident/en.

Yoo, J., Jeong, J. and Lee, W. (2014). The Effect of Trunk Stabilization Exercise Using an Unstable Surface on the Abdominal Muscle Structure and Balance of Stroke Patients. *Journal of Physical Therapy Science, 26,* 857–859.

Zakaria, Y., Rashad, R. and Mohammed, R. (2010). Assessment of Malalignment of Trunk and Pelvis in Stroke Patients. *Egyptian Journal of Neurology Psychiatry & Neurosurgery, 47*(4), 599-604.

Appendix- A

Application for thesis proposal

Date: 25/06/2019

To
The Chairman,
Institute Review Board (IRB)
Bangladesh Heath Profession Institute (BHPI)
CRP, Chapain, Savar, Dhaka-1343, Bangladesh

Subject: Application for review and ethical approval of thesis.

Dear Sir,

With due respect, I am Faruq Ibn Sadeq, student of Part II , M.Sc in Physiotherapy Program at the Bangladesh Health profession institute(BHPI) under the faculty of medicine, University of Dhaka. As per the course curriculum,I haveto conduct a thesis entitled "Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial." Under my honorable supervisor Associate Prof. Mohammad Anwar Hossain. The aim of the study is to find out the comparative efficacy of the two interventions for improving trunk control and functional balance among hemiplegic stroke patients. The study will accommodate the participants from CRP Savar and Mirpur (Stroke Rehabilitation unit and Neurology Unit). Total 40 patients will be evaluated (2 groups). It is going to be True Experimental design where participant will get Physio Ball and Physio Bed Trunk Exercices 4 days per week, 45-50 minutes for 4 weeks. The participant will be evaluated by Trunk Impairment Scale, Berg Balance Scale and Objective measurement. A written consent will be taken prior to the experiment. The confidentially will be maintain and they can withdraw themselves at any time according to their wish. The trained professionals will be involved and the safety of the participants will be ensured. The participant will not be deprived from the usual therapy service. 2 qualified therapists will be assigned for data collection. Hopefully the study will be able to explore a specific Trunk Rehabilitation Exercise protocol/guideline and scientific evidence for this excellent service of this community, so that the patient in near future will be benefited.

Therefore, I look forward to have your kind approval for the thesis proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely yours,

Faruq Ibn Sadeq
Part-II, Roll no-10
Student of M.Sc in Physiotherapy (MPT), 3rd batch, session: 2016-17
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

Recommendation from the thesis supervisor

Mohammad Anwar Hossain
Associate Professor & head of Physiotherapy BHPI, CRP.

Attachment: Thesis Proposal, Questionnaire & consent.

Appendix- B

Institutional Review Board (IRB) Letter

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

BANGLADESH HEALTH PROFESSIONS INSTITUTE

Ref. CRP-BHPI/IRB/06/19/1304 *Date:* 25/06/2019

To
Faruq Ibn Sadeq
M.Sc. in Physiotherapy (MPT)
Session: 2017-2018, Student ID 111170050
BHPI, CRP-Savar, Dhaka-1343, Bangladesh

Subject: Approval of thesis proposal **"Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial"** by ethics committee.

Dear Faruq Ibn Sadeq,

Congratulations,

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above mentioned thesis, with yourself, as the Principal Investigator" The Following documents have been reviewed and approved:

S.N.	Name of Documents
1.	Thesis Proposal
2.	Questionnaire (English version & Bangla version)
3.	Information sheet & consent form.

The study involves use of **Trunk Impairment Scale, Berg Balance Scale** and Objective measurement to explore the trunk control and balance status of hemiplegic stroke patients that may take 40 to 50 minutes to answer and fill in the questionnaire by assessors. Since, there is no likelihood of any harm to the participants, the members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 10.00 AM on 20th October, 2017 at BHPI.

The institutional Ethics committee expects to be informed about the progress of the study, any changes occurring in the course of the study, any revision in the protocol and patient information or informed consent 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
Assistant Professor, Dept. of Rehabilitation Science
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ, ফোন ঃ ৭৭৪৫৪৬৪-৫, ৭৭৪১৪০৪ ফ্যাক্স ঃ ৭৭৪৫০৬৯
CRP-Chapain, Savar, Dhaka-1343, Tel : 7745464-5, 7741404, Fax : 7745069, E-mail : contact@crp-bangladesh.org, www.crp-bangladesh.org

Appendix- C

Application for Data collection

Date: 11.07.2019

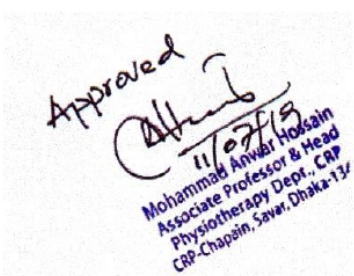
To
The Head of Department of Physiotherapy
Centre for the Rehabilitation of the Paralysed (CRP)
Chapain, Savar, Dhaka: 1343

Subject: Seeking permission to collect data conduct M.Sc in Physiotherapy Part-II thesis.

Sir

With due respect I would like to draw your kind attention that I am a student of 3rd batch M.Sc. in Physiotherapy program at Bangladesh Health Professions Institute (BHPI)- an academic institute of CRP under Faculty of Medicine of University of Dhaka (DU). I have to conduct a thesis entitled, **"Compare the Effectiveness of Physio Ball and Physio Bed Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Clinical Trial"** under my honorable supervisor Associate Prof. Mohammad Anwar Hossain. Conducting this research project is partial fulfillment of M. Sc in Physiotherapy degree. I want to collect necessary data for the research project from Neurology Unit, Savar, Dhaka. The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 10.00 am on 20th October, 2017 at BHPI. I would like to assure ethical principle would be followed as per guidelines of organization.

Therefore, please grant me your kind permission regarding my thesis work at your reputed organization.



Sincerely,

Faruq Ibn Sadeq
Part-II, Roll-10
Student of M.Sc. in Physiotherapy
3rd batch, session 2016-17
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Appendix- D

সম্মতিপত্র

আসসালামুআলাইকুম।

আমি ফারুক ইবনে সাদেক এম এস সি কোস্ এর জন্য এই গবেষনা পরিচালনা করছি। ফিজিওথেরাপি গবেষনার শিরোনাম "হেমিপ্লেজিক স্ট্রোক রোগীদের মধ্যে ট্রাঙ্ক কন্ট্রোল এবং ব্যালেন্সের উন্নতির জন্য ফিজিও বল এবং ফিজিও বেড ব্যায়ামের কার্যকারিতা তুলনাকরন: একটি রেন্ডমাইজড ক্লিনিক্যাল ট্রায়াল"। এই গবেষনা দ্বারা আমি স্ট্রোক রোগীদের জন্য ফিজিও বল এবং ফিজিও বেড ব্যায়ামের মাধ্যমে ট্রাঙ্ক কন্ট্রোল ব্যায়াম সম্পর্কিত প্রভাবসমূহ জানতে চাই। এখন আমি হেমিপ্লেজিক স্ট্রোক রোগীদের আর্থসামাজিক, ভারসাম্য এবং স্ট্রোকজনিত ট্রাঙ্ক এর ক্ষয়ক্ষতির প্রভাব সম্পর্কিত তথ্য সংগ্রহের জন্য কিছু প্রশ্ন করতে হবে। এতে প্রায় ৪০-৪৫ মিনিট সময় লাগবে।

আমি আপনাকে জানাতে চাই যে এটি সম্পূর্ণরূপে একাডেমিক গবেষণা এবং অন্য কোনো উদ্দেশ্যে ব্যবহার করা হবে না। গবেষণায় আপনার অংশগ্রহণের স্ট্রোক রোগীদের আপনার বর্তমান বা ভবিষ্যৎ চিকিৎসায় গুরুত্বপূর্ণ প্রভাব ফেলবে। আপনার দ্বারা সরবরাহিত সমস্ত তথ্যের গোপনীয়তা রক্ষা করা হবে এবং কোনও প্রতিবেদন বা প্রকাশনার ক্ষেত্রে এটি তথ্য উৎসের গোপনীয়তা বজায় নিশ্চিত করা হবে।

এই গবেষণায় আপনার অংশগ্রহণটি স্বেচ্ছামূলক এবং আপনি কোনও নেতিবাচক পরিণতি ছাড়াই এই গবেষণায় যে কোন সময় নিজেকে প্রত্যাহার করতে পারেন। আপনি এমন কোনও নির্দিষ্ট প্রশ্নের উত্তর না দেওয়ার অধিকারও পাবেন যা আপনি পছন্দ করেন না বা সাক্ষাৎকারে উত্তর দিতে চান না।

যদি আপনার অংশগ্রহণকারী হিসাবে গবেষণা বা আপনার অধিকার সম্পর্কে কোন প্রশ্ন থাকে, আপনি আমার এবং / অথবা আমার গবেষণার সুপারভাইজার মোহাম্মদ আনোয়ার হোসেন, সহকারী অধ্যাপক এবং হেড অব ফিজিওথেরাপি বিএইচপিআই, সিআরপি, সাভার, ঢাকা এর সাথে যোগাযোগ করতে পারেন।

আমি শুরু করার আগে আপনার কোন প্রশ্ন আছে?		তাই সাক্ষাৎকারে এগিয়ে যেতে আপনার সম্মতি আছে?	
হ্যাঁ	না	হ্যাঁ	না

স্বাক্ষর এবং অংশগ্রহণকারীর তারিখ _____

স্বাক্ষরকারী এবং সাক্ষাতকারের তারিখ _____

স্বাক্ষর এবং ফিজিওথেরাপিস্টের তারিখ _____

CONSENT STATEMENT (English)

Assalamualaikum,

I am Faruq Ibn Sadeq conducting this thesis for M.Sc. in Physiotherapy program titled "**Compare the Effectiveness of Physio Ball and Plinth Trunk Exercices for Improving Trunk Control and Balance among Hemiplegic Stroke Patients: A Randomized Controlled Trial".** By this I would like to find out the effect of trunk control exercise through physio ball and plinth trunk control exercise 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, Nasirul Islam, Associate Professor, 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- E

কোড নং

প্রশ্নপত্র

অংশ- ১ ব্যাক্তিগত তথ্যঃ

রোগীর নাম

বর্তমান ঠিকানা স্থায়ি ঠিকানা

মোবাইল নামারঃ ১।

২।

অংশ- ২ আর্থসামাজিক তথ্যঃ

রোগীর আইডিঃ

পরীক্ষণের তারিখঃ

সেরা সঠিক উত্তর বাম পাশ বাক্সে টিক (√) চিহ্ন দিন

প্রশ্ন সংখ্যা	প্রশ্ন / তথ্য	অংশগ্রহণকারী প্রতিক্রিয়া	কোড নং.
১.১	বয়স (বছরে):	……..বছর	
১.২	লিঙ্গ	• পুরুষ • মহিলা	০১ ০২
১.৩	ওজন	.... কেজি	
১.৪	বৈবাহিক অবস্থা	• বিবাহিত • অবিবাহিত • বিবাহ বিচ্ছিন্ন • বিধবা / বিপ্লতিক	০১ ০২ ০৩ ০৪

১.৫	শিক্ষাগত অবস্থা	• অশিক্ষিত • শিক্ষিত • প্রাথমিক • মাধ্যমিক স্কুল সার্টিফিকেট (এসএসসি) • উচ্চ মাধ্যমিক সার্টিফিকেট (এইচএসসি) • স্নাতক • স্নাতকোত্তর বা উপরে • অন্যান্য (নির্দিষ্ট করুন).....।	০১ ০২ ০৩ ০৪ ০৫ ০৬ ০৭ ০৮
১.৬	বসবাসকারী এলাকা	• গ্রামীণ পরিবেশ • শহর অঞ্চল • পাহাড়ি অঞ্চল	০১ ০২ ০৩
১.৭	পেশা	• চাকুরীজীবী • ব্যবসায়ী • গৃহিনী • শিক্ষার্থী • শিক্ষকতা • শ্রমজীবী • কৃষক • অন্যান্য .....।	০১ ০২ ০৩ ০৪ ০৫ ০৬ ০৭ ০৮
১.৮	পারিবারের ধরন	• একক পরিবার • যৌথ পরিবার	০১ ০২
১.৯	পত্নীর সংখ্যা	.....	
১.১০	প্রথমবার স্ট্রোক	• হ্যাঁ	০১

		• না	০২
১.১১	স্ট্রোকের ধরন	• ইস্কিমিক • হেমারেজিক	০১ ০২
১.১২	পক্ষাগাত আক্রান্ত শরীরের পার্শ্ব	• বাম • ডান	০১ ০২
১.১৩	প্রভাবশালী পার্শ্ব আক্রান্ত হওয়া	• হ্যাঁ • না	০১ ০২
১.১৪	স্ট্রোকের সময়কাল/ ব্যপ্তি	• একিউট(চার সপ্তাহ - তিন মাস) • ক্রনিক (তিন মাস থেকে এক বছর)	০১ ০২
১.১৫	পূর্ববর্তী রোগের ইতিহাস	• উচ্চ রক্তচাপ • ডায়াবেটিস • হার্ট ডিজিজ • ডিসলিপিডিমিয়া • অন্যান্য	০১ ০২ ০৩ ০৪ ০৫

বার্গ ব্যালেন্স/ ভারসাম্য স্কেল

অংশ- ৩ ব্যালেন্স সম্পর্কিত তথ্যঃ

সাধারণ নির্দেশনা

প্রতিটি নির্দেশনার জন্য সর্বনিম্ন প্রতিক্রিয়া √ চিহ্নের মাধ্যমে সংরক্ষন করা হয়।

SN	প্রশ্ন / নির্দেশনা	প্রতিক্রিয়া
২.১	বসা থেকে দাঁড়ানো (দয়া করে দাঁড়ান। সহায়তার জন্য আপনার হাত ব্যবহার করার চেষ্টা করবেন না)	৪- হাতের সাহায্য ছাড়া দাঁড়াতে পারে এবং ভারসাম্য রক্ষা করতে পারে। ৩- হাতের সাহায্য নিয়ে নিজে নিজে দাঁড়াতে পারে। ২- হাতের সাহায্য নিয়ে কয়েকবার চেষ্টার পর দাঁড়াতে পারে। ১- দাঁড়াতে অথবা ভারসাম্য রক্ষা করতে নুন্যতম সহযোগিতা লাগে। ০-দাঁড়াতে মোটামুটি অথবা সম্পূর্ন সহযোগিতা লাগে।
২.২	অবলম্বন ছাড়া দাঁড়ানো (অনুগ্রহপূর্বক কোন কিছুর সাহায্য ছাড়া ২ মিনিট দাঁড়ান)	৪- নিরাপদভাবে ২ মিনিট দাঁড়াতে পারে। ৩- পর্যবেক্ষণসহ ২ মিনিট দাঁড়াতে পারে। ২- অবলম্বন ছাড়া ৩০ সেকেন্ড দাঁড়াতে পারে। ১- কয়েকবার চেষ্টার পর অবলম্বন ছাড়া ৩০ সেকেন্ড দাঁড়াতে পারে। ০- অবলম্বন ছাড়া ৩০ সেকেন্ড দাঁড়াতে অক্ষম।
২.৩	পিঠে অবলম্বন ছাড়া কিন্তু মেঝে অথবা টুল দিয়ে পায়ে অবলম্বনের সাহায্যে বসা (অনুগ্রহপূর্বক হাত ভাঁজ করে	৪- নিরাপদভাবে ২ মিনিট বসতে পারে। ৩- পর্যবেক্ষণসহ ২ মিনিট বসতে পারে। ২-২- ৩০ সেকেন্ড বসে থাকতে পারে।

	২ মিনিট বসুন)	১- ১-১০ সেকেন্ড বসে থাকতে পারে। ০- অবলম্বন ছাড়া ১০ সেকেন্ড বসে থাকতে অক্ষম।
২.৪	দাঁড়ানো থেকে বসা (অনুগ্রহপূর্বক বসুন)	৪- নুন্যতম হাতের সাহায্য দ্বারা নিরাপদে বসতে পারে। ৩-হাতের সাহায্য দ্বারা বসতে পারে। ২-ভারসাম্য রক্ষার জন্য চেয়ারের সাথে পা ব্যবহার করে। ১-নিজে নিজে ভারসাম্যহিণভাবে বসতে পারে। ০-বসতে সাহায্যকারীর প্রয়োজন হয়।
২.৫	স্থানান্ত্মর (অনুগ্রহপূর্বক হাতে ভর দিয়ে চেয়ারের একদিকে এবং ভর ছাড়া অন্যদিকে স্থানান্ত্মর হতে চেষ্টা করন্নন)	৪-নুন্যতম হাতের সাহায্য দ্বারা নিরাপদে স্থানান্ত্মর হতে পারে। ৩- হাতের সাহায্য দ্বারা নিরাপদে স্থানান্ত্মর হতে পারে। ২-মৌখিক নির্দেশনা অথবা পর্যবেড়্গাণ মাধ্যমে স্থানাত্মর হতে পারে। ১-একজন সাহায্যকারীর প্রয়োজন হয়। ০- দুইজন সাহায্যকারীর প্রয়োজন হয়।
২.৬	অবলম্বন চাড়া চোখ বন্ধ অবস্থায় দাঁড়ানো (অনুগ্রহপূর্বক চোখ বন্ধ করন্নন এবং ১০ সেকেন্ড দাঁড়ান।)	৪- ১০ সেকেন্ড নিরাপদে দাঁড়াতে পারে। ৩-পর্যবেক্ষণের মাধ্যমে ১০ সে নিরাপদে দাঁড়াতে পারে। ২-৩ সেকেন্ড দাঁড়াতে পারে। ১-৩ সেকেন্ড চোখ বন্ধ রাখতে পারে না কিন্তু দাঁড়াতে পারে। ০-পড়ে যাওয়া রোধ করতে সাহায্যের প্রয়োজন ।
২.৭	দুই পা একত্র করে অবলম্বনহীভাবে দাঁড়ান (অনুগ্রহপূর্বক দুই পা একত্র	৪-দুই পা একত্র করে স্বাধীনভাবে ১ মিনিট দাঁড়াতে পারে। ৩-পর্যবেক্ষণসহ দুই পা একত্র করে স্বাধীনভাবে ১ মিনিট

	করে কোন সাহায্য ছাড়া দাঁড়ান)	দাঁড়াতে পারে। ২-দুই পা একত্র করে দাঁড়াতে পারে তবে ৩০ সেকেন্ড এর কম। ১-দাঁড়াতে সাহায্যের প্রয়োজন হয় কিন্তু ১৫ সেকেন্ড পা একত্র করে রাখতে পারে। ০-দাঁড়াতে সাহায্যের প্রয়োজন হয় এবং ১৫ সেকেন্ড পা একত্র করে রাখতে পারে না।
২.৮	দাঁড়ানো অবস্থায় দুইহাত উঁচু করে সামনের দিকে ঝুঁকা (দুই হাত ৯০ ডিগ্রি উঁচু করবেন । আঙ্গুল সোজা রেখে 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 পর্যবেক্ষনের প্রয়োজন হয়। ০-ভারসাম্য হারিয়ে ফেলে অথবা অন্যের সহায়তা লাগে।
২.৯	দাঁড়ানো অবস্থায় মেঝে থেকে কোন বস্তু তোলা (মেঝেতে আপনার পায়ের সামনে রাখা জুতাটি তুলুন)	৪-সহজে এবং নিরাপদে জুতাটি তুলতে পারে। ৩-জুতা তুলতে পারে কিন্তু পর্যবেক্ষন প্রয়োজন হয়। ২-জুতার ২-৫ সেমি পর্যন্ত যেতে পারে কিন্ তুলতে পারে না তবে ভারসাম্য রক্ষা করতে পারে। ১-জুতা তুলতে পাওে না এবং চেষ্টার সময় পর্যবেক্ষণ প্রয়োজন হয়। ০-চেষ্টা করতে পারেনা অথবা ভারসাম্য রক্ষার জন্য সাহায্যকারী প্রয়োজন হয়।
২.১০	দাঁড়ানো অবস্থায় ডান এবং বাম কাঁধ দিয়ে পিছনে তাকানো।	৪-দুই দিকেই ঘুরতে পারে এবং সমানভাবে ভর দেয়। ৩-শুধুমাত্র একদিকে ঘুরতে পারে এবং অন্যদিকে কম ভর

	(এক পায়ের সামনে আর এক পা দিয়ে দাঁড়ান। যদি না পারেন তবে দুই পায়ের দুরত্ব বাড়িয়ে দাঁড়ান)	৩-৩০ সেকেন্ড নিজে নিজে এক পা সামনে দিয়ে দাঁড়াতে পারে। ২-ছোট ধাপ দিয়ে নিজে নিজে ৩০ সেকেন্ডদাঁড়াতে পারে। ১-ধাপ দিতে সাহায্য কিন্তু ১৫ সেকেন্ড থাকতে পারে। ০-ধাপ দেয় অথবা দাঁড়ানোর সময় ভারসাম্য হারিয়ে ফেলে।
২.১৪	এক পায়ে দাঁড়ানো (অবলম্বন ছাড়া যতক্ষান সম্ভব এক পায়ে দাঁড়ানো)	৪-নিজে নিজে পা তুলতে পারে এবং ১০ সেকেন্ড এর বেশি সময় থাকতে পারে। ৩- নিজে নিজে পা তুলতে পারে এবং ৫-১০ সেকেন্ড থাকতে পারে। ২-নিজে নিজে পা তুলতে পারে এবং ৩ সেকেন্ড বা কম থাকতে পারে। ১-পা তুলতে চেষ্টা করে কিন্তু ৩ সেকেন্ড রাখতে পারে না তবে নিজে নিজে দাঁড়াতে পারে। ০-চেষ্টা করতে পারেনা এবং পড়ে যাওয়া রোধে সাহায্যের প্রয়োজন।

মোট নম্বর:..... তারিখ: ..... পরীক্ষকের স্বাক্ষর:.....

ট্রাঙ্ক ইমপেইয়ারমেন্ট স্কেল

বিভাগ -৩: স্ট্রোকের লোকেদের জন্য ট্রাঙ্ক ইমপেয়ারমেন্ট স্কেলের মূল্যায়ন

সমস্ত আইটেমের জন্য শুরু করার সময় রোগীর অবস্থান: সোজা হয়ে বসা, পায়ের পাতা সমতল, হাঁটু এবং কোমর ৯০ ° ভাঁজ, পিঠের পেছনের দিকে কোন পিঠে অবলম্বন ছাড়া, হাত কোলের উপর বিশ্রাম। বিষয় প্রতিটি আইটেমের জন্য সেরা কর্মক্ষমতা স্কোর করা হয়। পর্যবেক্ষক পরীক্ষার মধ্যে নির্দেশনা মৌখিক এবং ইশারার মাধ্যমে দিতে পারবেন।

আইটেম	কার্য বিবরণ	স্কোর বিবরণ	স্কোর	মন্তব্য
স্ট্যাটিক / স্থির বসার ভারসাম্য				
৩.১	১০ সেকেন্ডের জন্য শুরু অবস্থান রাখুন	পড়ে যাওয়ার আবস্থা আথবা হাতের সহায়তা প্রয়োজন	০	স্কোর ০ হলে, ট্রাঙ্ক ইমপেয়ারমেন্ট স্কেলের সর্বমোট ফলাফল ০ হবে
		১০ সেকেন্ডের জন্য অবস্থান বজায় রাখতে সক্ষম	২	
৩.২	থেরাপিস্টের সাহায্যে দুর্বলতম পায়ের উপর শক্তিশালী পা আড়াআড়ি উঠিয়ে ১০ সেকেন্ডের জন্য অবস্থান ধরে রাখবেন	পড়ে যাওয়ার আবস্থা আথবা হাতের সহায়তার প্রয়োগ	০	
		১০ সেকেন্ডের জন্য অবস্থান বজায় রাখতে সক্ষম	২	
৩.৩	রোগী নিজেই দুর্বলতম পায়ের উপর শক্তিশালী পা উঠিয়ে আড়াআড়ি করে ১০ সেকেন্ডের জন্য অবস্থান ধরে রাখবেন	পড়ে যাওয়ার আবস্থা আথবা হাতের সহায়তার প্রয়োগ	০	
		হাতের সহায়তার প্রয়োগ	১	
		শরীরের ১০ সেমি এর মত স্থানচ্যুতি আথবা হাতের সহায়তার প্রয়োগ	২	
		শরীর আথবা হাতের সহযোগিতা ব্যতীত নাড়তে সক্ষম	৩	

		ডানপাশের প্রসারণ)		
৩.৯	আইটেম ৩.৭ পুনরায় করুন (বিকল্প পদ্ধতির ব্যবহার আথবা না করা)	বিকল্প পদ্ধতির ব্যবহার করা (হাত, পা, হাঁটু, নিতম্ব)	০	
		বিকল্প পদ্ধতির ব্যবহার না করা	১	
৩.১০	আসন থেকে ডান পেলভিস / শ্রোণীচক্র উত্তোলন করে পুনরায় পূর্বের অবস্থানে ফেরত আসা (ট্রাঙ্ক / শরীরের নড়নক্ষমতার মূল্যায়ন)	ট্রাঙ্ক / শরীরের উপযুক্ত নড়নক্ষমতার অভাব পর্যবেক্ষণ	০	স্কোর ০ হলে, আইটেম ৩.১১ এ ০ হবে
		ট্রাঙ্ক / শরীরের উপযুক্ত নড়নক্ষমতার পর্যবেক্ষণ (ডান পাশের সংকোচন, বাম পাশের প্রসারণ)	১	
৩.১১	আইটেম ৩.১০ পুনরায় করুন (বিকল্প পদ্ধতির ব্যবহার আথবা না করা)	বিকল্প পদ্ধতির ব্যবহার করা (হাত, পা, হাঁটু, নিতম্ব)	০	
		বিকল্প পদ্ধতির ব্যবহার না করা	১	
৩.১২	আসন থেকে বাম পেলভিস / শ্রোণীচক্র উত্তোলন করে পুনরায় পূর্বের অবস্থানে ফেরত আসা (ট্রাঙ্ক / শরীরের নড়নক্ষমতার মূল্যায়ন)	ট্রাঙ্ক / শরীরের উপযুক্ত নড়নক্ষমতার আভাব পর্যবেক্ষণ	০	স্কোর ০ হলে, আইটেম ৩.১৩ এ ০ হবে
		ট্রাঙ্ক / শরীরের উপযুক্ত নড়নক্ষমতার পর্যবেক্ষণ (বাম পাশের সংকোচন, ডানপাশের প্রসারণ)	১	
৩.১৩	আইটেম ৩.১২ পুনরায় করুন (বিকল্প পদ্ধতির ব্যবহার আথবা না করা)	বিকল্প পদ্ধতির ব্যবহার করা (হাত, পা, হাঁটু, নিতম্ব)	০	
		বিকল্প পদ্ধতির ব্যবহার না করা	১	
উপমোট			**/১০**	
কোঅড্‌িনেশন				
৩.১৪	কাঁধের কাঁটা ৬ বার ঘুরাবেন	ডান দিকে ৩ বার সরাতে না পারা	০	স্কোর ০

	(প্রতি কাঁধের পার্শ্ব ৩ বার করে সামনে ঘুরাবেন)	অসামঞ্জস্যিক ঘূর্ণন	১	হলে, আইটেম ৩.১৩ এ ০ হবে
		সামঞ্জস্যিকঘূর্ণন	২	
৩.১৫	আইটেম ৩.১৪ পুনরায় করুন, ৬ সেকেন্ডের মাঝে সম্পন্ন করতে হবে	অসামঞ্জস্যিক ঘূর্ণন	০	
		সামঞ্জস্যিক ঘূর্ণন	১	
৩.১৬	পেলভিস / শ্রোণীচক্র ৬ বার ঘুরাবেন (প্রতি হাঁটুর পার্শ্ব ৩ বার করে সামনে ঘুরাবেন)	ডান দিকে ৩ বার সরাতে না পারা	০	স্কোর ০ হলে, আইটেম ৩.১৭ এ ০ হবে
		অসামঞ্জস্যিক ঘূর্ণন সামঞ্জস্যিক	১	
		সামঞ্জস্যিক ঘূর্ণন	২	
৩.১৭	আইটেম ৩.১৬ পুনরায় করুন, ৬ সেকেন্ডের মাঝে সম্পন্ন করতে হবে	অসামঞ্জস্যিক ঘূর্ণন	০	
		সামঞ্জস্যিক ঘূর্ণন	১	
উপমোট			**/৬**	
ট্রাঙ্ক ইমপেয়ারমেন্ট স্কেলের সর্বমোট ফলাফল			**/২৩**	

Questionnaire (English)

SECTION-1: Socio Demographic Information

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

Patient ID:

Date of test:

Please give tick (√) mark at the left side box of the best correct answer

Question Number	**Questions/ Information on**	**Response of the participant**
1.1	Age	○ 20-30 years ○ 31-40 years ○ 41-50 years ○ 51-60 years ○ > 60 years
1.2	Weight	……..... Kg
1.3	Date of incidence of stroke:	DD/MM/YY.....
1.4	Affected side	○ Rt ○ Lt
1.5	Type of stroke	○ Ischemic ○ Hemorrhagic
1.6	Marital status	○ Married ○ Unmarried ○ Divorced ○ Widow
1.7	Educational qualification	○ Illiterate ○ Primary ○ SSC ○ HSC ○ Graduation ○ Masters or higher
1.8	Occupation	○ Service holder ○ Businessman ○ Housewife ○ Student ○ Teacher ○ Labor ○ Farmer ○ Other.....
1.9	Living area	○ Rural ○ Urban ○ Hill tracks

1.10	Family type	○ Nuclear family ○ Extended family
1.11	Family type	○ Nuclear family ○ Extended family
1.12	How long you have received physiotherapy treatment?	○ 1-2 session ○ 3-4 session ○ 5-6 session ○ 7-8 session ○ > 8 session
1.13	Access Road	○ Mud ○ Brick ○ Pitch
1.14	Smoking / Tobacco Habit	○ Yes ○ No

SECTION-2: Assessment of balance

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

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

2.1 SITTING TO STANDING

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

a) 4 able to stand without using hands and stabilize independently

b) 3 able to stand independently using hands

c) 2 able to stand using hands after several tries

d) 1 needs minimal aid to stand or stabilize

e) 0 needs moderate or maximal assist to stand

2.2 STANDING UNSUPPORTED

INSTRUCTIONS: Please stand for two minutes without holding on

a) 4 able to stand safely for 2 minutes

b) 3 able to stand 2 minutes with supervision

c) 2 able to stand 30 seconds unsupported

d) 1 needs several tries to stand 30 seconds unsupported

e) 0 unable to stand 30 seconds unsupported

If a subject is able to stand 2 minutes unsupported, score full points for sitting unsupported. Proceed to item #4.

2.3 SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR ON A STOOL

INSTRUCTIONS: Please sit with arms folded for 2 minutes.

a) 4 able to sit safely and securely for 2 minutes

b) 3 able to sit 2 minutes under supervision

c) 2 able to able to sit 30 seconds

d) 1 able to sit 10 seconds

e) 0 unable to sit without support 10 seconds

2.4 STANDING TO SITTING

INSTRUCTIONS: Please sit down

a) 4 sits safely with minimal use of hands

b) 3 controls descent by using hands

c) 2 uses back of legs against chair to control descent

d) 1 sits independently but has uncontrolled descent

e) 0 needs assist to sit

2.5 TRANSFERS

INSTRUCTIONS

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

a) 4 able to transfer safely with minor use of hands

b) 3 able to transfer safely definite need of hands

c) 2 able to transfer with verbal cuing and/or supervision

d) 1 needs one person to assist

e) 0 needs two people to assist or supervise to be safe

2.6 STANDING UNSUPPORTED WITH EYES CLOSED

INSTRUCTIONS

Please close your eyes and stand still for 10 seconds.

a) 4 able to stand 10 seconds safely

b) 3 able to stand 10 seconds with supervision

c) 2 able to stand 3 seconds

d) 1 unable to keep eyes closed 3 seconds but stays safely

e) 0 needs help to keep from falling

2.7 STANDING UNSUPPORTED WITH FEET TOGETHER

INSTRUCTIONS

Place your feet together and stand without holding on.

a) 4 able to place feet together independently and stand 1 minute safely

b) 3 able to place feet together independently and stand 1 minute with supervision

c) 2 able to place feet together independently but unable to hold for 30 seconds

d) 1 needs help to attain position but able to stand 15 seconds feet together

e) 0 needs help to attain position and unable to hold for 15 seconds

2.8 REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING

INSTRUCTIONS

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

a) 4 can reach forward confidently 25 cm (10 inches)

b) 3 can reach forward 12 cm (5 inches)

c) 2 can reach forward 5 cm (2 inches)

d) 1 reaches forward but needs supervision

e) 0 loses balance while trying/requires external support

2.9 PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION

INSTRUCTIONS

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

a) 4 able to pick up slipper safely and easily

b) 3 able to pick up slipper but needs supervision

c) 2 unable to pick up but reaches 2-5 cm from slipper and keeps balance independently

d) 1 unable to pick up and needs supervision while trying

e) 0 unable to try/needs assist to keep from losing balance or falling

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

INSTRUCTIONS

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

a) 4 looks behind from both sides and weight shifts well

b) 3 looks behind one side only other side shows less weight shift

c) 2 turns sideways only but maintains balance

d) 1 needs supervision when turning

e) 0 needs assist to keep from losing balance or falling

2.11 TURN 360 DEGREES

INSTRUCTIONS

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

a) 4 able to turn 360 degrees safely in 4 seconds or less

b) 3 able to turn 360 degrees safely one side only 4 seconds or less

c) 2 able to turn 360 degrees safely but slowly

d) 1 needs close supervision or verbal cuing

e) 0 needs assistance while turning

2.12 PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED

INSTRUCTIONS:

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

a) 4 able to stand independently and safely and complete 8 steps in 20 seconds

b) 3 able to stand independently and complete 8 steps in > 20 seconds

c) 2 able to complete 4 steps without aid with supervision

d) 1 able to complete > 2 steps needs minimal assist

e) 0 needs assistance to keep from falling/unable to try

2.13 STANDING UNSUPPORTED ONE FOOT IN FRONT

INSTRUCTIONS

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

a) 4 able to place foot tandem independently and hold 30 seconds

b) 3 able to place foot ahead independently and hold 30 seconds

c) 2 able to take small step independently and hold 30 seconds

d) 1 needs help to step but can hold 15 seconds

e) 0 loses balance while stepping or standing

2.14 STANDING ON ONE LEG

INSTRUCTIONS

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

a) 4 able to lift leg independently and hold > 10 seconds

b) 3 able to lift leg independently and hold 5-10 seconds

c) 2 able to lift leg independently and hold ≥ 3 seconds

d) 1 tries to lift leg unable to hold 3 seconds but remains standing independently

e) 0 unable to try of needs assist to prevent fall

Total Score:

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

SECTION-3: Assessment of the Trunk Impairment Scale for People with Stroke

Starting position for all items: Sitting, thighs horizontal and feet flat on support, knees 90° flexed, no back support, hands and forearms resting on the thighs. The subject gets 3 attempts for each item. The best performance is scored. The observer may give feedback between the tests. Instructions can be verbal and nonverbal (demonstration) (Verheyden, et al., 2006).

Item	Task Description	Score Description	Score	Remarks
Static Sitting Balance				
3.1.1	Keep starting position for 10 s	Falls or needs arm support	0	If 0, total TIS score is 0
		Maintains position for 10 s	2	
3.1.2	Therapist crosses strongest leg over weakest leg, keep position for 10 s	Falls or needs arm support	0	
		Maintains position for 10 s	2	
3.1.3	Patient crosses strongest leg over weakest leg	Falls	0	
		Needs arm support	1	
		Displaces trunk _10 cm or assists with arm	2	
		Moves without trunk or arm compensation	3	
Sub Total			**/7**	
Dynamic Sitting Balance				
3.2.1	Touch seat with right elbow, return to starting position (task achieved or not)	Does not reach seat, falls, or uses arm	0	If 0, items 2_3 are also 0
		Touches seat without help	1	
3.2.2	Repeat item 1 (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 3 is also 0
		Appropriate trunk movement (shortening right side, lengthening left side)	1	
3.2.3	Repeat item 1 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensation strategy used	1	
3.2.4	Touch seat with left elbow, return to starting position (task achieved or not)	Does not reach seat, falls, or uses arm	0	If 0, items 5_6 are also 0
		Touches seat without help	1	
3.2.5	Repeat item 4 (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 6 is also 0
		Appropriate trunk movement (shortening left side, lengthening right side	1	
3.2.6	Repeat item 4 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensatory strategy used	1	
3.2.7	Lift right side of pelvis from seat, return to starting position (evaluate trunk movement)	No appropriate trunk movement	0	If 0, item 8 is also 0
		Appropriate trunk movement (shortening right side, lengthening left side)	1	
3.2.8	Repeat item 7 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot	0	
		No compensation strategy used	1	
3.2.9	Lift left side of pelvis from	No appropriate trunk movement	0	If 0, item 10

	seat, return to starting position (evaluate trunk movement)	Appropriate trunk movement (shortening left side, lengthening right side)	1	is also 0
3.2.10	Repeat item 9 (compensation strategies used or not)	Compensation used (arm, hip, knee, foot)	0	
		No compensation strategy used	1	
Sub Total			**/10**	
Coordination				
3.3.1	Rotate shoulder girdle 6 times (move each shoulder 3 times forward)	Does not move right side 3 times	0	If 0, item 2 of also
		Asymmetric rotation	1	
		Symmetric rotation	2	
3.3.2	Repeat item 1, perform within 6 s	Asymmetric rotation	0	
		Symmetric rotation	1	
3.3.3	Rotate pelvis girdle 6 times (move each knee 3 times forward)	Does not move right side 3 times	0	If 0, item 4 is also 0
		Asymmetric rotation	1	
		Symmetric rotation	2	
3.3.4	Repeat item 3, perform within 6 s	Asymmetric rotation	0	
		Symmetric rotation	1	
Sub Total			**/6**	

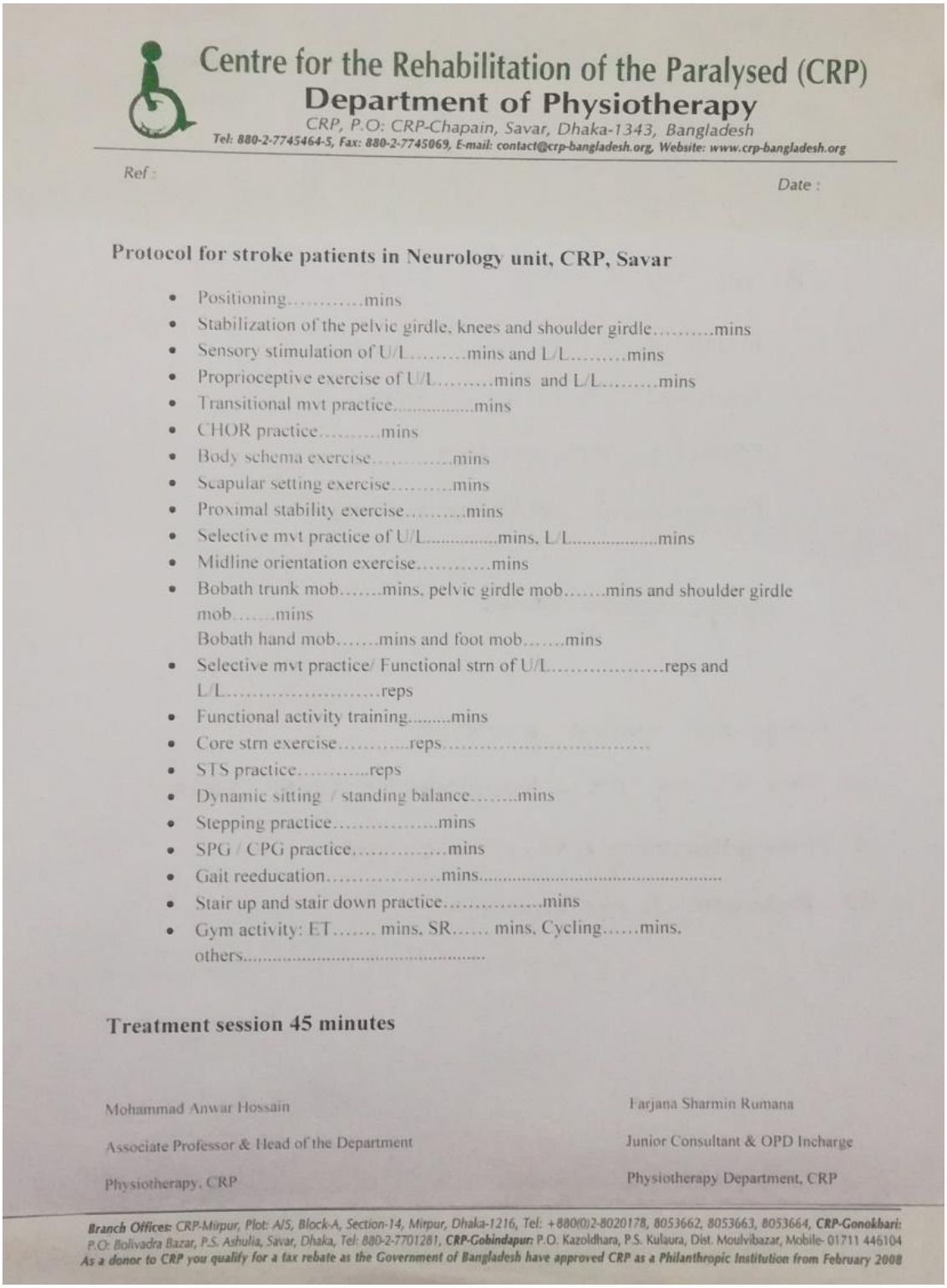
Total Trunk Impairment Scale /23

Total Score:

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

Appendix- F

Conventional Treatment for both Group



Centre for the Rehabilitation of the Paralysed (CRP)
Department of Physiotherapy
CRP, P.O: CRP-Chapain, Savar, Dhaka-1343, Bangladesh
Tel: 880-2-7745464-5, Fax: 880-2-7745069, E-mail: contact@crp-bangladesh.org, Website: www.crp-bangladesh.org

Ref :

Date :

Protocol for stroke patients in Neurology unit, CRP, Savar

- Positioning.....mins
- Stabilization of the pelvic girdle, knees and shoulder girdle.....mins
- Sensory stimulation of U/L.....mins and L/L.....mins
- Proprioceptive exercise of U/L.....mins and L/L.....mins
- Transitional mvt practice.....mins
- CHOR practice.....mins
- Body schema exercise.....mins
- Scapular setting exercise.....mins
- Proximal stability exercise.....mins
- Selective mvt practice of U/L.....mins, L/L.....mins
- Midline orientation exercise.....mins
- Bobath trunk mob.....mins, pelvic girdle mob.....mins and shoulder girdle mob.....mins
  Bobath hand mob.....mins and foot mob.....mins
- Selective mvt practice/ Functional strn of U/L.....reps and L/L.....reps
- Functional activity training.....mins
- Core strn exercise.....reps.....
- STS practice.....reps
- Dynamic sitting / standing balance.....mins
- Stepping practice.....mins
- SPG / CPG practice.....mins
- Gait reeducation.....mins.....
- Stair up and stair down practice.....mins
- Gym activity: ET..... mins, SR..... mins, Cycling.....mins, others.....

Treatment session 45 minutes

Mohammad Anwar Hossain
Associate Professor & Head of the Department
Physiotherapy, CRP

Farjana Sharmin Rumana
Junior Consultant & OPD Incharge
Physiotherapy Department, CRP

Branch Offices: CRP-Mirpur, Plot: A/5, Block-A, Section-14, Mirpur, Dhaka-1216, Tel: +880(0)2-8020178, 8053662, 8053663, 8053664, CRP-Gonokbari: P.O: Bolivadra Bazar, P.S. Ashulia, Savar, Dhaka, Tel: 880-2-7701281, CRP-Gobindapur: P.O. Kazoldhara, P.S. Kulaura, Dist. Moulvibazar, Mobile- 01711 446104
As a donor to CRP you qualify for a tax rebate as the Government of Bangladesh have approved CRP as a Philanthropic Institution from February 2008

Appendix- G

Treatment Protocol through Physioball and Physio bed

Duration of treatment time

Each treatment session lengths will be 30 minutes duration.

Treatment session

Total 4 weeks, 4 sessions per week.

Exercises consisted of selective movements of the upper and lower part of the trunk in supine and sitting. The physio ball group performed trunk exercises on a (unstable surface) physio ball while the plinth group performed same exercises on a (stable surface) plinth. 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 change.

(1) Reducing the base of support

(2) Increasing the lever arm

(3) Advancing the balance limits

(4) Increasing the hold time

(5) Increasing number of repetitions on the basis of patients' performance.

Conventional exercises include tone facilitation, stretching and range of movement exercises for the hemiplegic side.

Exercises include following.

Trunk exercises on Physio ball	Trunk exercises on bed
Supine lying	
Pelvic bridging: in supine lying both the patient's legs placed on a gym ball and asked to lift the pelvis off the support surface. Initially the ball positioned beneath the knees and advanced to the lower leg. ***Unilateral bridging:*** lifting the uninvolved leg off the ball while maintaining the pelvic bridge position. ***Trunk rotation:*** placing the both the patient's legs on the gym ball and asked to move the ball to both the left and the right by rotating the pelvis. Initially the ball placed beneath the knees and then advanced towards the ankles.	***Pelvic bridging:*** in supine lying both the patient's legs are placed on the bed and asked to lift the pelvis off the bed. ***Unilateral bridging:*** lifting the uninvolved leg off the bed while maintaining the pelvic bridge position. ***Trunk rotation:*** rotating the pelvis to both the left and the right sides in crook lying position.
Sitting position	
Static sitting balance (on physio ball only): patient seats on the gym ball with hips and knee bent at 90 degrees and the feet keeps flat on the support surface.	
Trunk flexion- extension: patient flexes and extends the trunk without moving the trunk forwards or backwards. ***Upper trunk lateral flexion:*** initiating movement from the shoulder girdle so as to bring the elbow towards the ball. ***Lower trunk lateral flexion:*** initiating movement from the pelvic girdle so as to lift the pelvis off the ball and bring it towards the ribcage. ***Forward reach:*** asking the patient to reach a fixed point at shoulder height by forward flexing the trunk at the hips. ***Lateral reach:*** 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	***Trunk flexion- extension:*** the patient flexes and extends the trunk without moving the trunk forwards or backwards ***Upper trunk lateral flexion:*** the patient touches the exercise bed with one elbow and returns to the starting position. ***Lower trunk lateral flexion:*** the patient lifts one side of the pelvis and returns to the starting position. ***Forward reach:*** asking the patient to reach a fixed point at shoulder height by forward flexing the trunk at the hips. ***Lateral reach:*** 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.