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EFFECTIVENESS OF CORE MUSCLE STRENGTHENING EXERCISE ON WALKING ABILITY OF STROKE PATIENT

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for the acceptance of this dissertation entitled

EFFECTIVENESS OF CORE MUSCLE STRENGTHENING EXERCISE ON WALKING ABILITY OF STROKE PATIENT

Submitted by **Salma Nahrin Purba**, for the partial fulfilment of the requirement for the degree of Bachelor of Science in Physiotherapy (B.Sc. PT).

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DECLARATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also decline that same any publication, presentation or dissemination of information of the study. I would bind to take consent from the department of Physiotherapy of Bangladesh Health Profession Institute (BHPI).

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Contents

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Acronyms

ADL	Activity of Daily Living
BHPI	Bangladesh Health Professions Institute.
BMRC	Bangladesh Medical Research Council
CRP	Centre for the Rehabilitation of the Paralysed.
CVA	Cerebrovascular accident
ICH	Intracranial Hemorrhages
ROM	Range of Motion
SAH	Subarachnoid Hemorrhages
SPSS	Statistical Package for Social Science
TIA	Transient Ischemic Attack
TUG	Time Up & Go
WHO	World Health Organization
10 (MWT)	10 Meter Walk Test

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Abstract

Introduction: Stroke is the most common clinical manifestation of diseases which occurs motor, sensory, perceptual or cognitive deficiency and have serious impact on independence, functioning and quality of life of the stroke survivors. **Purpose:** The purpose of this study is to explore the effectiveness of core muscle strengthening exercise on walking ability of stroke patient. **Objectives:** To find out the effectiveness of core muscle strengthening exercise on walking ability of stroke patient. **Methodology:** This was Quasi-experimental quantitative type of study which was used in this study and that was Single blinded; This research was conducted with total 30 stroke patients who were listed from Neurology and Stroke Rehabilitation Unit of CRP, Savar, Dhaka. The subjects of the trial group performed core strengthening exercise 3 days per week of total 12 session within 4 weeks. All subjects were evaluated with a 10-meter walk test and Time Up and Go (TUG) test. **Results**: The finding of the study was carried out by using Wilcoxon test, Microsoft Excel and scientific calculator to find out the result. The mean age among 30 participants was 47.77±7.5. The mean duration of the patients after stroke in this research was 7.33±1.93. Gender distribution was male 63% and female 37%. Among 30 participants 63.3% were right side affected and 36.7% were left side. The mean score of 10 MWT was 42.23±11.3 to 29.93±9.8 sec and mean difference was 12.03sec (p=0.001, Z= 4.805) which was significant. Another result of the mean score of TUG test was 26.87±7.13 sec to 17.93±5.55 which was decreased and mean difference of was 8.94 Sec (p= 0.001, Z= 4.810) which indicated the result was significant and improvement of walking ability of stroke patient. **Discussion:** Sharma & Kaur, 2017 suggested that core muscle strengthening exercise combined with pelvic PNF was effective for improving trunk impairment, balance and gait of chronic stroke patients. **Conclusion**: The study concluded as core muscle strengthening exercise is effective to improve walking ability of stroke patient. Small amount of sample is included in this study and time duration was also limited. Further study should be done with RCT study design for more specific result.

***Key words*:** Stroke, walking ability, Core strengthening exercise.

CHAPTER – I INTRODUCTION

1.1 Background

stroke is a worldwide common and serious neurological disorder which is the second or third most common cause of mortality and long-term disability (Langhorne et al., 2011). From the previous study, stroke incidence rates over the last 4 decades in developing countries (100% increase) is greater than developed countries (42% decrease) due to absence of adequate prevention and treatment of stroke in middle or low-income countries (Kulshreshtha et al., 2012). After a stroke, motor, sensory, perceptual or cognitive deficiency may be happened and resulting have serious impact on independence, functioning and quality of life of the stroke survivors (Mercier et al., 2001).

In previous studies it has been demonstrated that, Stroke survivors have some deficiencies including muscle weakness, spasticity and loss of equilibrium on the affected side cause loss of postural adjustment and maintain postural alignment. Also found that the hemiplegic patients have shifted their body weight on the unaffected side more than on the affected side, as a result trunk asymmetry may appears which is the central key point of the body and for this the body may not in upright position (Zakaria et al., 2010).

Following stroke, there is paralysis or weakness has been occurred in one side of the body but trunk muscles are affected on both the sides leading to asymmetrical weight shifting, insufficient trunk rotation, difficulty in maintaining balance and gait (Shinde and Ganvir, 2014).

After a stroke in the first week only a third of persons are able to walk unassisted but at 3 weeks or at hospital discharge 50–80% of survivors can walk unassisted and by 6 months around 85% of stroke survivors are able to walk independently without physical assistance from another person (Balasubramanian et al., 2014). The ability to walk of stroke patients can be affected by various neurological deficits. These include impaired neuromuscular control, altered sensation, neglect (i.e. failure to respond to stimuli on the affected side) and visual deficits, thus increasing the risk for falls leading to subsequent injuries (Bouyok et al., 2006). The ability to walk at the speed, and distance are absolutely essential components for activity of daily living (ADL)at home and

community. Six months after stroke, walking speed of stroke patients with persistent hemiparesis gait almost a third of normal adults and only perform 40% of the walking distance from healthy people of the same age (Pohl et al., 2004).

Stroke survivors generally have a reduced stance phase and a prolonged swing phase on the paretic side. In addition, the walking speed decreases and the step length become shorter (Li et al., 2018). These gait abnormalities and balance impairment situated stroke survivors at high risk of falling (Batchelor et al 2012). While some patients may regain gait function, but many stroke patients still have the disability of decreased gait speed and endurance and that limit the independent transfer in the home and in society (Chen & Patten, 2006).

Hemiparesis is one of the most common impairments after stroke and contributes significantly to decrease gait performance. The main components in stroke rehabilitation are to improve that reduced gait performance by retraining of locomotor skills (Flansbjer et al., 2005). Post stroke stroke hemiparesis has been reported to intensely decrease muscle mass which is available for contraction during physical activity and weakness in the lower limb impaired mobility, especially gait function (Lexell & Flansbjer, 2008).

Gait dysfunction is common in people with neurological disabilities, resulting for not only from impairments accompanying with the injury, but also from the secondary cardiovascular and musculoskeletal disuse and physical inactivity. Muscle weakness and paralysis, poor motor control and soft tissue contracture contribute significantly to gait dysfunction after stroke (Balaban & Tak, 2014).

In rehabilitation Core strengthening has been rediscovered which is similar and near similar to lumber stabilization and others therapeutic exercise regimens. All terms describe that it has to be needed to control the muscular around the lumbar spine for maintaining the functional stability. The “core” has been defined as a “box” with the abdominals in the front, paraspinal and gluteal muscles in the back, the diaphragm as the roof, and the pelvic floor and hip girdle musculature as the bottom. In short, the core serves as the center of the functional kinetic chain. In the world of alternative medicine, the core has been referred to as the “powerhouse”, the foundation or engine of all limb movement (Akuthota and Nadler, 2004). Previous studies have shown About Two-thirds of stroke survivors have remaining neurological deficits that compromise functional

activities, with about half they are left with a number of physical restrictions which making them dependent on others for most activities of daily living (Onwudiwe et al., 2018). After stroke physical limitation in walking and other uses of the extremities is an essential element of overall quality of life. Up to 75% of stroke survivors have been reported to have the capability to climb stairs, walk distances at speeds necessary for independent community life (Balasubramanian et al., 2014).

Stability of the spine is dependent on muscular strength as well as proper sensory input which alerts the central nervous system about interaction between the body and the environment, providing continuous response and permitting modification of movement. larger ‘‘prime mover’’ muscles, such as the abdominal obliques and quadratus lumborum provide stability to the spine. It gives a coordinated contraction of all deep and superficial core muscles is needed for optimal spinal stabilization (Akuthota et al., 2008). These muscles have been used for the training of athletes and low back pain patients (Akuthota and Nadler, 2004).

The core stability exercises are bridge exercise with one leg raise, curl-ups with straight reaching, curl-ups with diagonal reaching, bird and dog exercise, side bridge, abdominal curl-ups cat and camel exercise (chung et al., 2013). Sharma & Kaur (2017) reported that, core stabilization program with pelvic PNF would help in improving trunk control and controlled mobility for improving balance, gait and functional ability in stroke patients. chung et al. (2013) suggested that the effect of core stabilization exercise on dynamic balance and gait functions in stroke patients.

1.2 Rationale:

Day by day the stroke incidence is increasing in our country. Common risk factors for stroke are high blood pressure, smoking, diabetes, high blood cholesterol levels, alcohol, salt intake, high fat diet, lack of exercise with gender, age, family history. Physiotherapy treatment is very important for improving walking ability and functional improvement of stroke patient. From previous study impairment after stroke may interfere with the person's activity of daily living (ADL's) & recreation and insists the financial cost on the community. So, it is very important to manage the cases of stroke with walking and functional impairment.

There are many physiotherapy techniques happen for the treatment and rehabilitation of stroke patient and some researches recommends that core strengthening is one of the important interventions for this condition which can help on walking function of stroke. Most of the studies have shown the effects of core muscle strengthening program on balance ability of stroke patient but a little research article has published on effectiveness of core muscle strengthening exercise on lower extremity function, especially walking performance for independent living in the community of chronic stroke patients. So, the purpose of this study is to compare the effectiveness of core strengthening exercise with conventional physiotherapy and conventional physiotherapy alone for the stroke patient.

Core strengthening exercise can be an effective method to ensure continuous training after discharge. The core strengthening exercise has a clinical advantage because it is simple and easy. The results of the study may help to guide physiotherapists to give evidence based treatment in patient with chronic stroke patients, which will be beneficial for both the patient with chronic stroke and for developing the field of physiotherapy profession

1.3 Aim:

Aim of this study is to identify the effectiveness of core muscle strengthening exercise to improve walking ability of stroke patient.

1.4 Objectives of the study:

General objective:

a) To find out the effectiveness of core muscle strengthening exercise on walking ability of stroke patient.

Specific Objective:

a) To explore socio-demographic (age, sex, educational status, employment) characteristics of stroke patient.
b) To measure the improvement of walking ability of a stroke patient before and after core muscle strengthening exercise with conventional physiotherapy.
c) To compare the functional disability before and after core muscle strengthening exercise with conventional physiotherapy of a stroke patient.

1.5 Hypothesis:

Alternative hypothesis:

Core muscle strengthening exercise combined with conventional therapy is effective on walking ability of stroke patients.

(Ha>Ho).

Null hypothesis:

core muscle strengthening exercise combined with conventional therapy is not effective on walking ability of stroke patients.

(Ho≠Ha)

1.6 Variables of the study:

Independent variables	Dependent variable
Core muscle strengthening exercise	Walking ability of stroke patient
Conventional therapy	
Age	
Sex	
Type of stroke	
Side of involvement	

1.7 Operational Definition:

Stroke:

In 1970, the World Health Organization defined stroke as 'rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin' (Coupland et al., 2017).

Core Strengthening:

Core strengthening has referred to the active component to the stabilizing system including deep/local muscles that provide segmental stability (e.g. transversus abdominis, lumbar multifidus) and/or the superficial/global muscles (e.g. rectus abdominis, erector spinae) that enable trunk movement/torque generation and also assist in stability in more physically demanding tasks (Akuthota et al., 2008).

Walking ability: walking is a complex motor activity consisting of a number of components including step length, stride length, step width, foot angle which are measured by different reliable and valid method (Hobart et al., 2003).

CHAPTER – II LITERATURE REVIEW

Stroke is a synonym with cerebrovascular accident (CVA). A stroke or cerebrovascular accident (CVA) occurs when the blood supply into the vessel of the brain is suddenly intermittent. Brain cells die from lack of oxygen and glucose in the blood or there is sudden bleeding in or around the brain. This can be due to ischemia caused by blockage (Sims & Muyderman, 2010).

Stroke is the most common clinical manifestation of diseases of the cerebral blood vessels and is a syndrome characterized by the acute onset of a neurologic deficit that persists for at least 24 hours, which reflects focal involvement of the central nervous system, and is due to a disturbance of the cerebral circulation (Ali et al., 2013). Stroke patients have the asymmetrical body which is induced by difference between paralyzed and non-paralyzed sides and these patients have difficulty in controlling posture (Lee et al., 2020).

Stroke is characterized by high morbidity, high disability and high mortality, which seriously threatens people's life and health. Recovery of walking ability is the concentration and ultimate goal of stroke rehabilitation training. core stability training could significantly improve the walking ability of stroke patients with hemiplegia. (Ting-Ting et al., 2018)

In addition, the common problem of decrease in core muscle function, especially the external muscles, causes paralysis of the core muscle, decreases contraction, and increases the tendency to fall towards the paralyzed side, causing asymmetry. Therefore, patients lose the ability to perform ADL (Activity of Daily Living), have difficulty in walking and standing. Additionally, most patients with unilateral paralysis have difficulty in controlling the trunk when adjusting posture (Yu & Park, 2013).

Stroke is divided into two basic level which are hemorrhagic and ischemic strokes (Boehme et al., 2017. Ischemic stroke the most common affects 80% of the Population whereas the hemorrhagic affects 20% (Dhawale et al., 2018). Ischemic strokes are caused by either cerebral thrombosis or embolism Hemorrhagic strokes are caused by subarachnoid hemorrhage or intra-cerebral hemorrhage. In past decades the proportional frequency of ischemic stroke in low- and middle-income countries is 20% lower than in

high-income countries, but the proportional frequency of primary intracerebral hemorrhage and subarachnoid hemorrhage are approximately double those currently reported in high-income countries (67%, 22%, and 7%, respectively, against 82%, 11%, and 3%, respectively. Stroke incidence 42% decrease in high-income countries and greater than 100% increase in low to middle income countries (Feigin et al., 2009).

According to American Heart Association (AHA) every year 780 000 new or recurrent strokes occurs. All of those 600000 strokes are first attacks, and 180000 are recurrent attacks. (Rosamond et al., 2008). Of all stroke 87% are ischemic strokes, 10% are intracranial hemorrhages (ICH), and 3% are subarachnoid hemorrhages (SAH) (Summers et al., 2009). Stroke is not only the leading causes of death but also functional impairments. Approximately, each year 20 million people suffer from stroke and of these 5 million do not survive (Ali et al., 2013)

Stroke is a major common health care problem leading to increased morbidity and mortality. In the past several decades many studies have successfully identified non-modifiable risk factors for stroke including age, gender, race, ethnicity, heredity and some modifiable risk factors for stroke including hypertension, diabetes, obesity, atrial fibrillation, previous history of stroke or TIA, myocardial infarction, angina, smoking and alcohol abuse. Among these risk factors, hypertension and diabetes are rapidly growing increases, leading to increase in cardiovascular diseases and stroke (Shah & Ataullah, (2009). Some modifiable risk factors are potentially treatable which predispose to stroke hypertension, cigarette smoking, obesity, physical inactivity, atrial fibrillation, diabetes mellitus, ischemic heart disease, alcohol abuse, asymptomatic carotid stenosis, transient ischemic attack and other cardiac disorders (Almani et al., 2008).

Risk factors for hemorrhagic and ischemic stroke are similar but they have some notable differences in between them. Hypertension is a mostly important risk factor for hemorrhagic stroke, although it contributes to atherosclerotic disease that can lead to ischemic stroke also (Boehme et al., 2017). Though stroke is a disease of the brain but it can affect the entire body. Some warning signs of stroke are including sudden numbness or weakness of the face, arm, or leg; sudden confusion or trouble speaking or understanding speech; sudden trouble seeing in one or both eyes; sudden trouble with walking, dizziness, or loss of balance or coordination; or sudden severe headache with no

known cause (Dhawale et al., 2018). Spasticity, weakness, and balance impairment, loss of equilibrium on the affected side are some common deficits after stroke causing inability to maintain postural alignment (Pathak et al., 2014).

Assessing recovery after stroke is critical to treatment and research. In spite of severe disabilities and neurological impairments in the post-stroke period, most stroke patients attain some degree of recovery over time. some stroke patients show early recovery of motor function, occurring primarily during the first few months. While the degree of paralysis is a primary predictor but cannot be used to exactly predict the rate of motor recovery through the subacute phase (Lee et al., 2015).

Stroke is a leading cause of gait impairment which results a long-term disability and handicap of stroke survivor. Some characteristics of hemiparetic gait of stroke survivors are including asymmetry of stride time and length, reduced velocity, poor joint and posture control, muscle weakness, abnormal muscle tone, abnormal muscle activation patterns and altered energy expenditure, mostly affecting the paretic side. So the priority goal for most patients is recovery the walking ability for enhancing activities of daily living and quality of life (Pizzi et al., 2007). Most commonly impairment caused by stroke is motor deficit, which can be viewed as limitation of function in muscle control or limitation in mobility. Motor impairment can be caused by ischemic or hemorrhagic injury to the motor cortex, premotor cortex, motor tracts, or associated pathways in the brain or cerebellum (Langhorne et al., 2009).

In addition, the rate of clinical recovery is comparatively rapid during the first few weeks after a stroke, but gradually slow down between 1 and 3 months later. Recovery has slowed so much in between 3 and 6 months after stroke which is hardly noticeable. Improvement in lower motor function is observed in 65 % of patients with motor deficits but the probability of a normal recovery of the upper limb is very low (Lee et al.,2015). Approximately, more than 80% of stroke survivors have walking dysfunction. Spasticity and muscle weakness are main motor impairments after stroke. These impairments involve different regions of the upper limb, trunk and lower limb of one side. Consequently, a broad spectrum of gait abnormalities is seen clinically (Lee et al., 2018). From previous study, the greatest risk factor for falls and injury are systematically identified as gait disorders (Ali et al., 2013). Post-stroke patients do not walk safely and

have increased risk of falling toward the paretic side. Balance is an essential part of walking activities as well as sitting and standing which is correlated with locomotor function, functional abilities. So, falls and injury prevention strategies are the essential part of rehabilitation after stroke (Verma et al., 2010) After stroke (52-85) % patients re-gain the capacity to walk but have abnormal gait pattern usually remains different from that of healthy subjects (Pradon et al., 2013).

Postural stability integrates two mechanisms that control balance. Mechanisms are including the ability to maintain balance and the efficiency of responding to destabilizing forces. Both the maintenance and the recovery of balance are possible due to the the postural muscles coordinated work. The muscles which make up the core, which is the center of gravity of the anatomical position of the body. Core stability exercises improved the body's balance control. This effect was manifest 30 minutes after exercise and was continued for at least 24 hours after exercise (Szafraniec et al., 2018).

Walking ability has very important implications for health of older adults. Similarly Walking ability is also important for stroke survivors. Improving walking ability is one of the most often stated goals for people with stroke undergoing rehabilitation and also for stroke survivors living in the community. Though Ninety percent (90%) of stroke survivors have some functional disability with mobility but approximately 75 to 85% are discharged home after stroke (Eng & Tang, 2007).

After stroke physical rehabilitation or physiotherapy interventions have significant importance for reducing pain and spasticity. It also helps to increase range of motion (ROM), muscle force, mobility, walking ability, functional status, physical fitness, and quality of life (Goljar et al., 2010). After stroke dynamic balance and mobility can be achieved by increasing weight bearing, muscle strength and postural control (Van Criekinge et al., 2019). Rehabilitation is presented to all of stroke survivors in the subacute phase after receiving initial medical treatment to reduce their disability and quicken their freedom and restart ADL. Rehabilitation program in the early phase of a stroke is related to the good recovery of walking and functional independence standing in according to the concept “time is brain recovery” (Cabanas-Valdés et al., 2021).

The core is the biggest part of the human body which plays an important role in the stabilization and movement of body segments (Yu & Park, 2013). Two types of muscle

fibers comprise the core muscles such as slow-twitch and fast-twitch. Slow-twitch fibers (the deep muscle layer) which are shorter in length and are suitable for controlling intersegmental motion and responding to changes in posture and extrinsic loads. Key local muscles include transversus abdominus, multifidi, internal oblique, and the pelvic floor muscles. On the other hand, fast-twitch fibers (the superficial muscle layer) which are long and allowing them to produce large amounts of torque and gross movements. Key global muscles include erector spinae, external oblique, rectus abdominis muscles, and quadratus lumborum (Akuthota et al., 2008).

Core stability is usually used to strengthen the muscles around the abdominal, lumbar, and pelvic regions.The muscles of these regions play an important role in stability and controlling the lumbar posture by whole-body exercises(Yu & Park, 2013). The core is important in providing local strength and balance and is also central to almost all kinetic chains of Activity of Daily Living (ADL) (Szafraniec et al., 2018). Trunk training is performed as core stability, reaching, weight-shift or proprioceptive neuromuscular facilitation exercises. Previous evidence presented that trunk training is able to improve trunk control, sitting and standing balance and mobility of patient who are suffering from stroke (Van Criekinge et al., 2019).

Trunk stability is mostly important for maintaining antigravity postures including sitting and standing, and the smooth limb movements. Trunk muscle strength is lower in patients with stroke than that of healthy age-matched people. In addition, these weaknesses occur problem in ADL independence. Stroke patient have sensory deficits, cognitive disorders, apathy and unilateral spatial neglect. Accordingly, trunk muscle strength can be evaluated this factor and enhance ADL. Previous study suggested abdominal muscles weakness hampers the balance of stroke patients as well as their ability to dress, use a toilet, transfer, and walk. Trunk muscle training, including abdominal muscle exercises, can effectively improve the performance of these type of activities of daily living (Fujita et al., 2015).

functional recovery after a stroke described by the trunk control test is between 45 and 71%. Loss of trunk control can result from a decrease in trunk strength and range of motion, especially on the paretic side. The innervation of the trunk muscles is provided by both cerebral hemispheres. thus, unilateral stroke potentially weakens trunk muscle

function on the contralateral and ipsilateral sides of the body (Rose & Vasanthan, 2016). Recovery was moderately fast during the first 4 weeks after treatment, and then slowed between 3 and 6 months after stroke. Leg motor function recovery occurs between 3 and 6 months after stroke but all others variables show continuous improvement over 6 months after stroke. Improvement in lower motor function is higher in 65% of patients with initial motor deficits than the probability of normal recovery in the upper limbs is (<15%) (Lee et al., 2015). Improving gait is a major determinant of independent living. Approximately 80% of stroke survivors achieve this goal (Obembe et al., 2012).

Stroke patients regain independent gait. Previous studies have shown that approximately 20–66% can achieve to walk independently in the community again. Gait speed is a significant factor which is related to community walking but ability to walk in the community is depending on balance, motor function, endurance and assistive walking device (Van de Port et al., 2008). 70–80% of stroke patients have some Impairments including loss of strength, sensation, and coordination abilities resulting walking difficulties, balance disorders, and limb function disturbance (Sun et al., 2016). The core is central to almost all kinetic chains in the human body. Core strength, balance, and motion control can maximize all kinetic chains of upper and lower extremity function. In addition, core stability exercise training along with conventional therapy improves trunk control, dynamic sitting balance, standing balance, gait, and activities of daily living of poststroke patients (Cabanas-Valdes et al., 2016).

Core stability training can improve the walking ability and activity of daily living of stroke patients. The steady state of the muscles in the pelvis and trunk is controlled by core stability training, that creates a fulcrum for the movement of the upper and lower limbs, and coordinate the force of the upper and lower limbs to enhance the generation, transmission and control of power. Core muscle stability training can effectively improve the balance function and walking speed of stroke patients by increasing the thickness of transverse abdominis muscle (Chen et al., 2020). trunk muscle deficiencies after stroke and showed the correlation between paretic trunk muscles and limitations in daily living activities. The ability to maintain balance in sitting and standing is essential for functional activities including transferring, reaching and walking. Both trunk and limb muscles are

involved in the coordination and regulation of automatic postural responses (Rose & Vasanthan, 2016).

Postural adjustment of trunk muscles activity is impaired in patients with stroke. Trunk muscle weakness of the affected side is related with balance, stability and gait (Karthikbabu et al., 2011). Core stability exercises of the trunk muscles and pelvis may create stability and improving gait ability. About 39-72% of stroke patients reported feeling fatigue at the time of walking, which hampers successful rehabilitation and impair quality of life. Core stability exercise successfully improves walking speed and energy productivity during gait in stroke patients (Jung, 2017).

Core stability exercises can strengthen the transversus abdominis muscles, multifidus muscles, erector spinae muscles, rectus abdominis, pelvic floor muscles, and diaphragm and also coordinate contractions (McGill et al., 2003). Chung et al. (2013) informed that after applying core stability exercises, walking speed significantly improved in the experimental group against the control group. Hemiparetic gait is characterized by asymmetry, with poor selective motor control, delayed and disrupted equilibrium reactions, and reduced weight bearing on the affected limb and create an imbalance during walking (Balaban et al., 2014). Core stability exercises were effectively improving the ability of static balance as well as the ability of dynamic balance with hemiplegic stroke patient (Kim et al., 2015).

Many clinical studies confirm that exercise therapy is a one of the commonly used methods In the treatment of balance and gait dysfunction, that bring greater benefits in physical function for stroke patients. In addition, core stability exercises were shown to improve dynamic standing balance, functional autonomy, static balance, flexibility, and stability. Present study demonstrate that core stability exercises present with better effectiveness than conventional exercises (Sun et al., 2016). Rehabilitation allows the patient by providing home-based practice in a real-life environment, which can directly enhance functioning and participation in daily life tasks. Home rehabilitation and day unit treatment have to be more effective for trunk control, perception of walking and ADL than traditional treatment (Gjelsvik et al., 2014).

Generally, stroke patients have some muscle weakness of limbs and trunk on the affected side, that create dysfunction of trunk stability during static and dynamic functional

activities. Therefore, trunk stability is mostly important for successful walking and to decreasing the risk of falls in hemiparetic stroke patients. Core previous study reported that stabilization exercise using real-time feedback produces better improvement in gait performance in chronic hemiparetic stroke patients (Chung et al., 2014). After stroke the common problem of decreasing the core muscle function, especially the external muscles. That causes paralysis of the core muscle, decreases contraction and as well as increases the tendency to fall towards the paralyzed side which makes asymmetry. Core stability exercise helps to improve core muscle stability in lower trunk, thus help to improve quality of life (Yu & Park, 2013).

Generally, stroke patients have experience weakness of trunk muscles, as a result moves the center of gravity moves backward, thereby causing thoracic bending. This happens postural imbalance by reducing the activation of abdominal muscles. It may become the primary cause of reduced balance and gait abilities (Kim et al., 2015). Trunk function disorders are very common and which hampers functional ability of stroke patients. Trunk function is important for standing balance, mobility, and functional outcome after stroke. Core stability training has become beneficial for improving trunk function, standing balance, and mobility of stroke patients. Core stability training enhances the AROM of the pelvis in the sagittal plane, and improved lumbo-pelvic flexibility. (Haruyama et al., 2017). Pelvis is the key structure which connects the trunk to lower extremities for supporting the weight of the body and transfers the load to lower limbs. Also, pelvis is a part of the lower trunk to help individual is in the sitting position, standing and walking. Pelvic stability training is effective for improving the motor recovery of trunk and lower extremity, hip muscles strength, gait speed and activities of daily living in stroke patients (Dubey et al., 2018).

stroke patients have muscle weakness, abnormal muscle tone, and disorders of balance and posture control due to central nervous system damage. This resulting in difficulty in the control of movement. For these reasons, abnormal gait pattern has been developed and create lower extremity stance phase imbalance between of the affected side and the unaffected side. Decreasing cadence and gait velocity, asymmetrical weight distribution, and a difference between step length and stride length. So, walking independence is the

major goals of rehabilitation. A study suggests that the hip extensor strengthening exercise program may help to improve gait performance ability (Park et al., 2015).

Core stability means strengthen the muscles around the abdominal, lumbar, and pelvic regions, because the muscles of these regions give stability as well as in controlling the lumbar posture. The resulting muscles are: multifidus, transversus abdominis, external/internal oblique abdominis, paraspinalis, gluteus, diaphragm in rear part, and hip muscles (Marshall et al., 2005).

CHAPTER – III METHODOLOGY

This research was an experimental design to evaluate the effectiveness of Core muscle strengthening exercise on walking ability of stroke patient. To identify the effectiveness of this treatment protocol, 10 Meyer Walk Test (MWT), Time Up and Go (TUG) test is used as measurement tools for measuring the walking ability of stroke patient.

3.1 Study design:

Here Quasi-experimental quantitative design was used for the study design. this study included the single group under the pre-test and post-test design because here the one group of patients is tested under one condition, take the data before (pre-test score) and after (post-test score) physiotherapy treatment. Thus, two scores were compared to see if there were any differences between them. This design did not have a control group to compare with the experimental group.

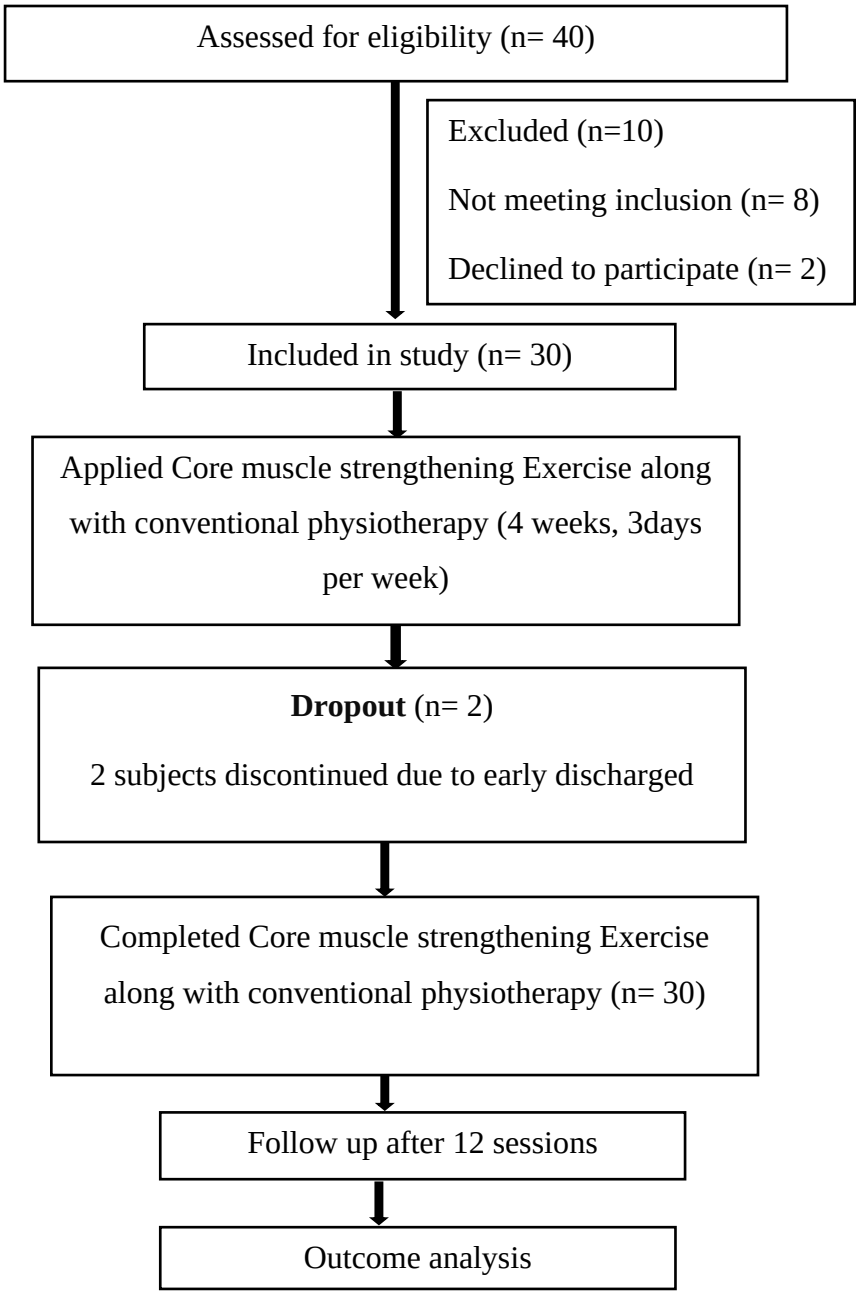
Quasi-experimental design differs from a true experimental design in that, although it contains an independent variable that is manipulated in order to look for an effect on a dependent variable, either control group or randomization is lacking. A pre-test (before intervention) and post-test (after intervention) were administered with each subject of the selected group to compare the walking ability of the stroke survivors before and after the treatment.

Quasi-experimental design (Pretest-Posttest):

The Pretest-Posttest design is valuable in describing what occurs after the introduction of the independent variable.

This design can answer questions about change over time in that the pretest is given before the introduction of the independent variable. If the subject walking ability of stroke survivors are tested before the intervention, a change in scores on the dependent variable can be reported but cannot be attributed to the influence of the independent variable.

3.2 CONSORT framework



3.3 Study area:

The Researcher was conducted the patient with stroke at Outdoor Neurology and Stroke Rehabilitation Unit, Department of Physiotherapy, CRP, Savar, Dhaka-1343.

3.4 Study Population:

A population refers to the entire group of people that meet the criteria set by the researcher. The populations of this study were the stroke patients being treated at CRP.

3.5 Duration of data collection:

Data was collected carefully and confidentially and maintained all ethical considerations. The researcher gave each participants a particular time to collect the data. Data was collected from June 2021 to October 2021.

3.6 Sample selection:

In this study, subjects who fulfill the inclusion criteria are selected as sample. Thirty-two (32) patients with stroke were selected from outdoor Neurology and Stroke Rehabilitation Unit, Department of Physiotherapy, CRP, Savar and then 32 patients with stroke assigned to core muscle strengthening exercises group by the physiotherapist. The study was a single blinded study. The samples were given a numerical number of 1,2,3. Total of 32 samples were included in this study in one group to conduct the study. Meanwhile, two (2) patients were dropped out from the study. Finally, study was conducted with 30 participants.

3.7 Sample Size:

The equation of the sample size calculation is given below:

n= $(\frac{z(1-\frac{a}{2})}{d})^2 \times pq$

Here,

Z $(1-\frac{a}{2})$ = 1.96

p = The reported prevalence of stroke in Bangladesh is 1.1% (Mondal et al., 2021)

q = 1-p

d = 0.05

Then, calculation is –

$n = (\frac{1.96}{0.05})^2 \times 0.011 \times 0.989$

$= 16.72$

So, effective sample size is 16.72

If we take 10% non-response rate, then final sample size is = effective sample size / (1 - non response rate anticipated).

Final sample size = $\frac{16.72}{(1-0.10)} = 18.19 \backsimeq 19$

According to this equation the sample should be 19. But researcher took 32 participants from outdoor Neurology and Stroke rehabilitation unit, Department of Physiotherapy, CRP, Savar, Dhaka. Researcher took these 30 participants between June 2021 to October 2021.These 32 participants were in a single group for pre-test and post-test intervention.

3.8 Inclusion criteria:

a) More than 6-month post stroke (Sharma & Kaur, 2017).
b) Age 35-60 years (Dhawale et al., 2018).
c) Patients including both the male and female (Dhawale et al., 2018).
d) Ischemic stroke patients are included (Sharma & Kaur, 2017).
e) First onset of unilateral stroke resulting in hemiplegic as diagnosed by a medical physician (Onwudiwe et al., 2018).
f) Independent gait ability with or without walking aid for a minimum of 10 m. (Sharma & Kaur, 2017)
g) The capacity to understand and follow instructions (Chung et al., 2013).
h) Adequate vision and hearing for completion of the study protocol (Chung et al., 2013).

3.9 Exclusion Criteria:

a) A history of previous stroke or other neurologic diseases or disorders (Chung et al., 2013).
b) patients with pusher syndrome (Chung et al., 2013).
c) Any comorbidity or disability other than stroke that precluded gait training (Onwudiwe et al., 2018).
d) subjects who could not communicate with therapists as a consequence of severe aphasia or cognitive impairment (Ko et al., 2016).
e) Fracture (Onwudiwe et al., 2018).
f) Participants with, severe spasticity or severe flaccidity in lower limbs and upper limbs were excluded (Sharma & Kaur, 2017).

3.10 Method of data collection:

3.10.1 Data collection tools:

a) Data collection form
b) Consent Form
c) Structured questionnaire
d) Stop Watch, meter scale
e) Pen, Papers, Pencil

3.10.2 Questionnaire:

The questionnaire was developed under the advice and permission of the supervisor following certain guidelines structured close ended questionnaire was used for data collection. To evaluate the walking ability of stroke patient 10 Meter Walk Test (MWT) and Time UP and Go test (TUG) was used.

3.11 Measurement tool:

3.11.1 (10-Meter walk Test):

10m walk test is for the measurement of gait speed performed by the patients

Equipment: Digital stopwatch, masking tape, measurement tape, quiet hallway or open space at least 14 m long

Note: The participant should be wearing flat shoes or shoes with a heel less than 1⁄2 inch.

1. In a quiet hallway or open space a 14 m. Line is drawn with tape at 0, 2, 12, and 14 m.

2. With the participant consent, measure the participant's heart rate and blood pressure. Do not start the test if the participant's blood pressure is 180/100 mm Hg or his or her heart rate is greater than 100 bpm

3. Give the participant the following information: "You are going to walk a distance of about 40 feet. We will repeat this distance 2 times. Both times will be completed at your comfortable step. Do you have any questions?"

4. Have the participant proceed to the start line (0 m). Before the first trial, tell the participant, "You are going to walk at a comfortable step to the chair. (Use appropriate descriptor of chair/location as needed but do not refer to the tape on the floor.) Continue walking until I saw 'STOP.' The start command will be 'Ready and go.'"

5. When you and the participant are ready, say, "Ready and Go.'" If the participant starts too early, have him or her start again.

6. Start the stopwatch when the participant's first foot crosses the plane of the 2-m line, and stops the stopwatch when the participant's first foot crosses the plane of the 12-m line. Have the participant continue walking until he or she reaches the chair after the 14-m line.

7. Record the time (in seconds to the hundredths) it took for the participant to walk the 10-m distance between the 2-m line and the 12-m line.

8. Have the participant rest, if needed, in the chair at the 14-m line.

9. The participant is going to repeat the exact same procedure as described above at a "comfortable step," except he or she will be walking from the 14-m line to the 0-m line. Start the stopwatch at the 12-m line, and stop the stopwatch at the 2m line.

10. Record the time (in seconds to the hundredths) for the second trial at a "comfortable pace." The participant can rest, if needed, in the chair at the 0-m line.

11. Take the average measurement of 1st and 2nd measurement of walking.

12. Immediately take the participant's pulse and blood pressure when he or she is sitting in the chair.

3.11.2 (Time Up & Go test):

Purpose - To assess mobility.

Equipment- Stopwatch

Direction- Patient wears their regular footwear and can use a walking aid. If needed. Begin by having the patient sit back in a standard and identify a line meter, or 10 fit away on the floor.

An adult who takes >/12 seconds to complete the TUG is at risk for falling.

1. Instruct the patient

When I say "Go," I want you to:

a) Stand up from the chair.
b) Walk to the line on the floor at your normal pace.
c) Turn.
d) Walk back to the chair at your normal pace.
e) Sit down again.

2.On the word "Go," begin timing.

3. Stop timing after patient sits back down.

4. Record Time

3.12 Data collection procedure:

The data collector fixed a date and time with his available time. Then the outdoor patients at Neurology and Stroke rehabilitation unit was taken purposively for the experiment. At first the data collector informed the participant about the contents of the consent form and also briefly understand the aims and objectives of the corresponding research project. All participant names coded to maintain confidentiality, diagnosed and referred by qualified physiotherapist and doctor. Each participant received physiotherapy intervention for walking ability of stroke patient.

Participant evaluated by 10-meter walk test and Time Up & Go (TUG) test questionnaire form. The participant received treatment as regular patients in the Neurology and Stroke rehabilitation unit of CRP. They continue their treatment as per their schedule. Each participant received 3 session per week. Treatment program arranged for 4 weeks by the researcher with the permeation from of that unit. Before started the treatment there did

the initial assessment where the researcher assessed walking ability of stroke patient that carried out in each area and provides the pretest score. After receiving 3 session per week in around 4 weeks intervention program, researcher was collected subjective and objective information including the walking speed measured by 10-meter walk test and Time Up & Go test questionnaire form.

The treatment applied by qualified Physiotherapist. And the data collector instructed the appointee about the treatment protocol. During this time, the participants were continued their treatment as per their schedule. The SPSS version 20.0 software was used in performance of statistical analyses for the mean and standard deviation. The normality of the distributions was tested with the Z-test.

3.13 Data analysis procedure:

Data was analyzed with the Statistical Package for Social Science (SPSS) version 20 software, Microsoft Excel and scientific calculator. At first put the name of variables into the variable view of SPSS. Then input the data in data view of SPSS. After input all data researcher checked the inputted data to ensure that there was no missing data and all data had been accurately copied from the questionnaire sheet to SPSS data view. Then analyzed data in SPSS for result making. By the normality test it was found that the data was not normally distributed. So result was made by nonparametric test like Wilcoxon Test was performed for finding result. Data was presented by using the bar graph, pie chart and table.

Wilcoxon Test:

This test is also known as ‘’Wilcoxon matched pair signed rank test’’ which is an alternative to the paired t test. when the data is not normally distributed then Wilcoxon test is required. When there are just two measures to be compared from the same case, and the data are normally distributed or the sample size is large, we apply a paired samples t test (also known as a related sample t test).

Wilcoxon Test for Large Samples (n>25)

In case of large sample sizes, ranks are assumed to be normally distributed. In this case, T is replaced by z statistic given as

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

Here,

n = number of pairs where differences is not 0

W_s = smallest of absolute values of the sum

Z= Value of Wilcoxon matched pair signed rank test

3.14 Intervention:

At first a common intervention program named conventional physiotherapy was executed for the groups. Conventional physiotherapy treatment for patients with stroke followed by different manual therapy along with home advices are practiced in clinical Department of Physiotherapy. The interventional procedure (treatment Strategy) depends on patient's condition and disease progress. Researcher collected opinion from staffs at least designated as Clinical Physiotherapist. They regarded conventional Physiotherapy as followings:

a) Positioning with postural correction
b) Functional activity
c) Neural connectivity exercise
d) Active facilitatory ROM exercise
e) Stretching for U/L and L/L-slow passive stretching
f) Co-ordination practice- Frenkel's exercise
g) Weight shifting

h) Weight bearing
i) Trunk mobilization exercise with or without physio ball
j) Balance training both static and dynamic
k) Bed mobility
l) Strengthening program (Isometric & Isotonic)
m) Gait re-education
    - Side to side walking
    - Backward walking
    - Box walking
    - Heel walking
    - Toe walking Parallel bar walking
    - Straight line walking
n) Proprioceptive exercise
o) Trunk control exercise
p) Soft tissue mobilization
q) Parallel bar walking
r) Transitional movement Practice

Then the trial group treated with core muscle strengthening exercise along with conventional physiotherapy. Clinical physiotherapist applied the core muscle strengthening exercises on each subject of the group and they will get 3 session per week, total 12 sessions of treatment within 4 weeks. It comprised with components: bed exercises and physio ball exercises in each exercise, position was continued for 7 seconds followed by 10 repetition with 2 sets. The rest interval between sets was 60 seconds (Onwudiwe et al., 2018). Exercise was done by the capability of the patient's performance and frequency was increased by the session progression.

Table 1: Core strengthening exercise treatment protocol:

Category	Exercise	Duration/repetition
Bed exercise	Bridging exercise	10 reps × 7 sec holds × 2 set
	Bridging exercise with leg cross	10 reps × 7 sec holds × 2 set
	Bridging exercise with one leg raise	10 reps × 7 sec holds × 2 set
	curl-ups with straight reaching	10 reps × 7 sec holds × 2 set
	curl-ups with diagonal reaching	10 reps × 7 sec holds × 2 set
	Bird dog exercise	10 reps × 7 sec holds × 2 set
	Side bridge exercise	10 reps × 7 sec holds × 2 set
	Curls up with arm cross	10 reps × 7 sec holds × 2 set
Physio ball exercise	Bridge-up	10 reps × 7 sec holds × 2 set
	Push-up	10 reps × 7 sec holds × 2 set
	Bridging exercise	10 reps × 7 sec holds × 2 set
	Bird dog exercise	10 reps × 7 sec holds × 2 set

Bridging exercise

Bridging exercise with leg cross

Bridging exercise with one leg raise

curl-ups with straight reaching

curl-ups with diagonal reaching

Curls up with arm cross

Side bridge exercise

Bird dog exercise

Push-up

Bridging exercise

Bridge-up

Bird dog exercise

Figure 1: Core muscle strengthening exercise

3.15 Significant level:

In order 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. 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.

3.16 Ethical consideration:

At first Research proposal was submitted for approval to the administrative bodies of ethical committee of CRP. Again, before beginning the data collection, researcher obtained the permission from the concerned authorities for smooth access to data collection with insurance of patient's safety. In order to eliminate ethical claims, the participants were set free to receive treatment for other purposes as usual. Each participant was informed about the study before beginning and given written consent. The researcher received verbal and signed an informed consent form to participate in this study from every subject. The participants were informed that they were completely free to decline to answer any question during the study and were free to withdraw their consent and terminate participation at any time. If the patient wants to withdraw herself from the study, it would not affect their treatment in the physiotherapy department and they would still get the same facilities. Bangladesh Medical Research Council (BMRC) guideline and World Health Organization (WHO) Research guideline was followed by the researcher.

3.17 Informed Consent

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

Withdrawal of participation from the study would not affect their treatment in the physiotherapy department and they would still get the same facilities. Every subject had the opportunity to discuss their problem with the senior authority or administration of CRP and have any questioned answer to their satisfaction.

CHAPTER – IV RESULTS

Socio-demographic Information

Age range of the participants:

Among the 30 participants, age ranges were distributed into 3 categories including 35-44 years were (n= 9) 30%, 45-55 years were (n=11) 37%, 55-65 years were (n=10) 33%. Here mean age was 47.77 years, maximum age was 60 years and minimum age was 35 years

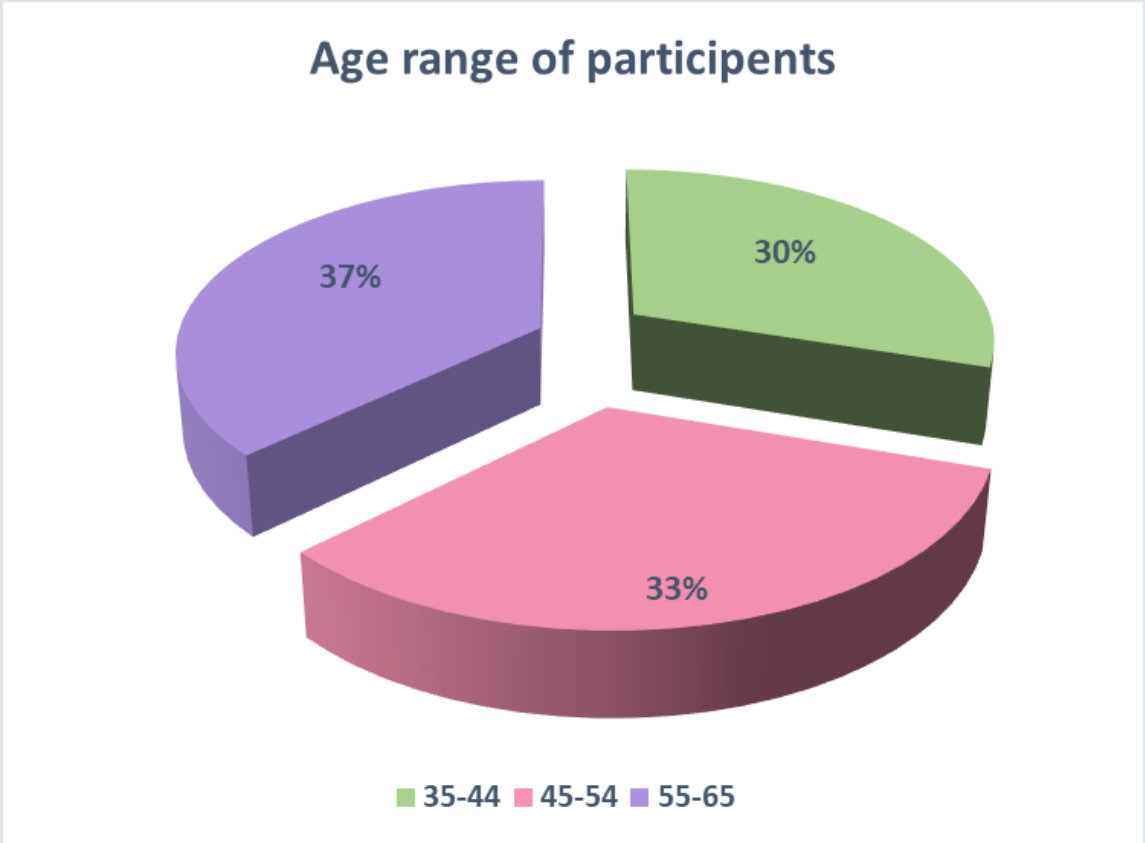


Figure-2: Age range of the participants

Gender distribution among the participants:

In the study 30 participants were selected as sample, in between them n=19 participants were male and n=11 participants were female. In percentage male participants were 63% and female participants were 37%.

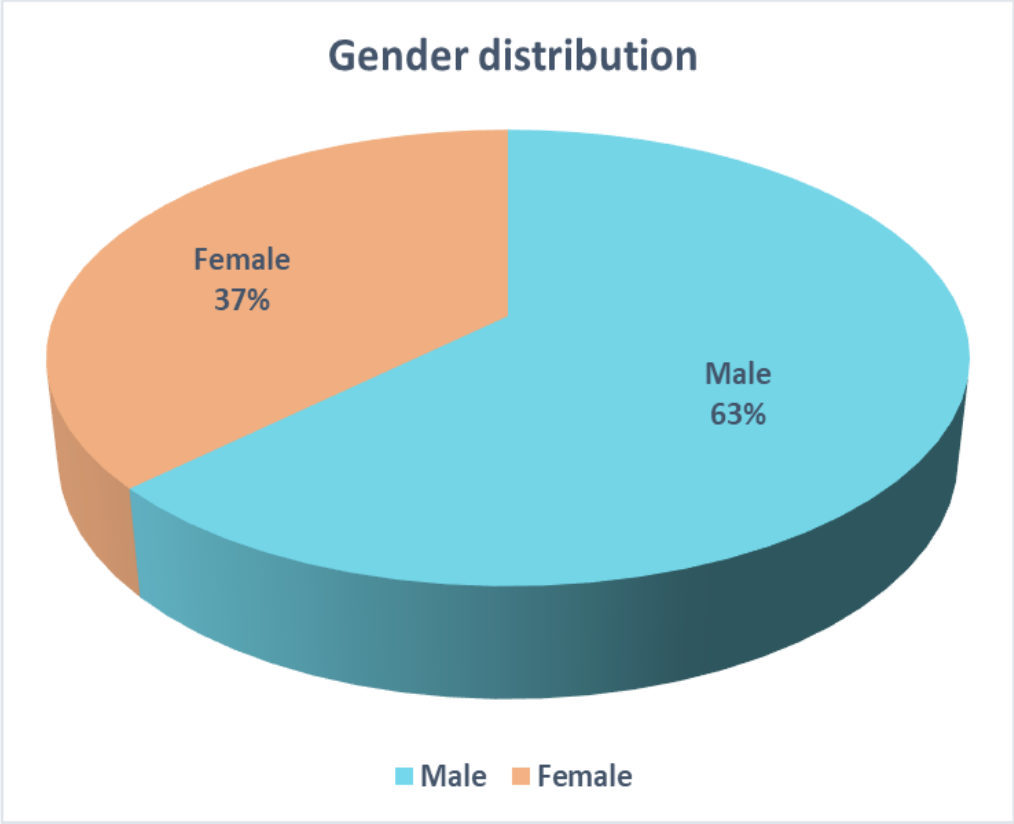


Figure 3: Gender distribution among participants

Weight range among the participants:

From the study it was founded that the mean weight of the participants was 64.97 kg. There were n=9 (30%) in between 51-60 kg, n=13 (43%) was 61-70 kg and n=8 (27%) was 71-80 kg

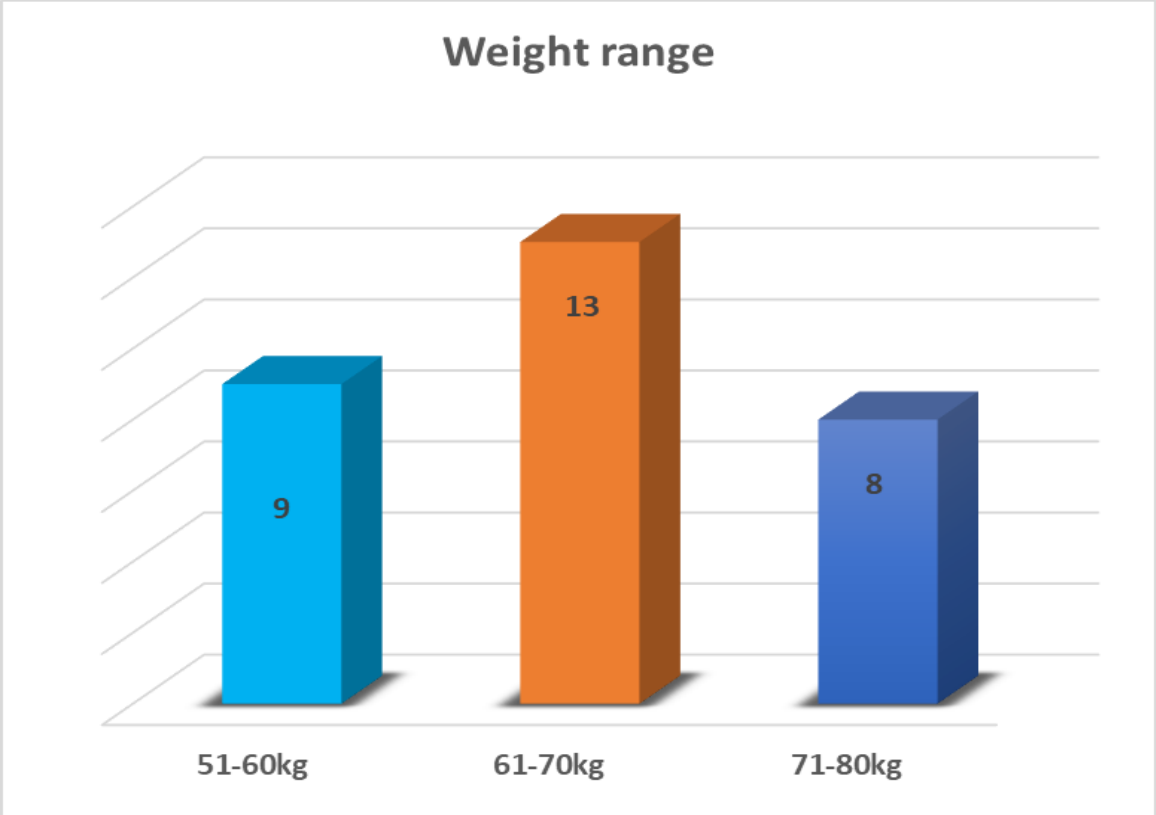


Figure 4: Weight range among the participants

Affected side:

In this study 30 stroke patient were included. Among them n=19 participants have right side involvement and n=11 have left side. In percentage 63% have right side affected and 37% have left side affected

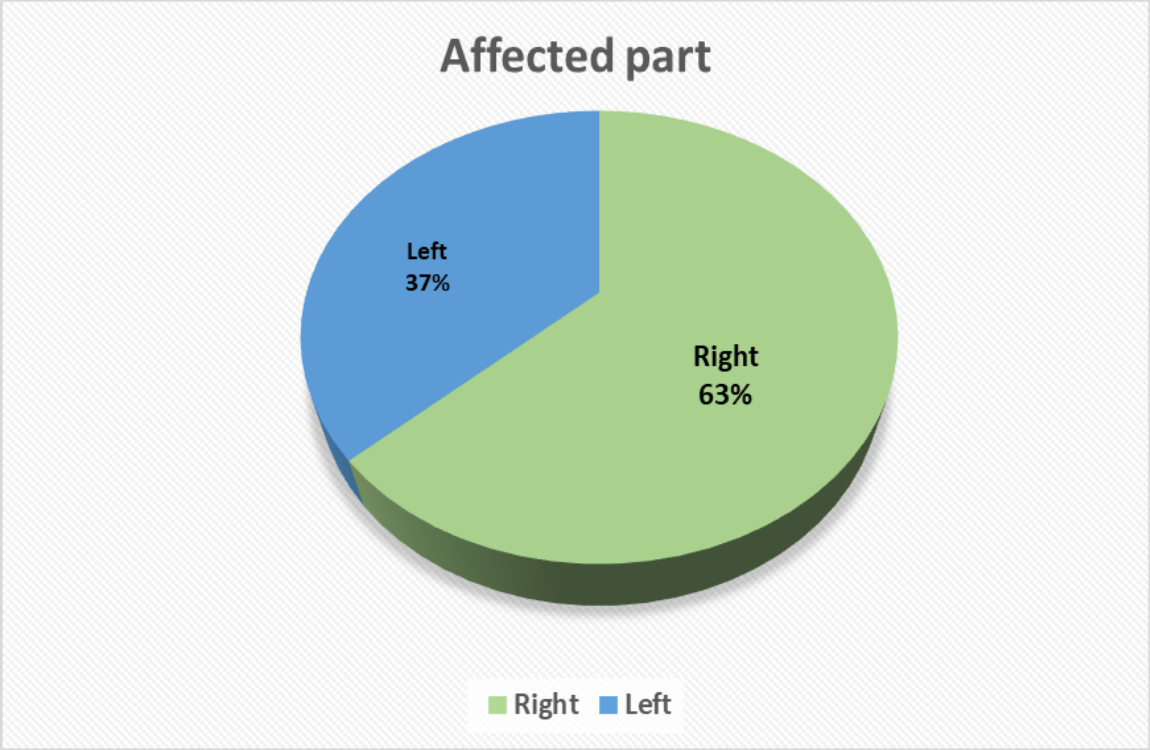


Figure 5: Affected side

Duration of incidence:

As sample 30 participants were included in this study. Among them (n=13) participants were 6 months poststroke, (n=9) were7 months post stroke, (n=3) were 8 months post stroke, (n=2) were 9 months, (n=1) was 11 months and (n=2) were 13 months post stroke.

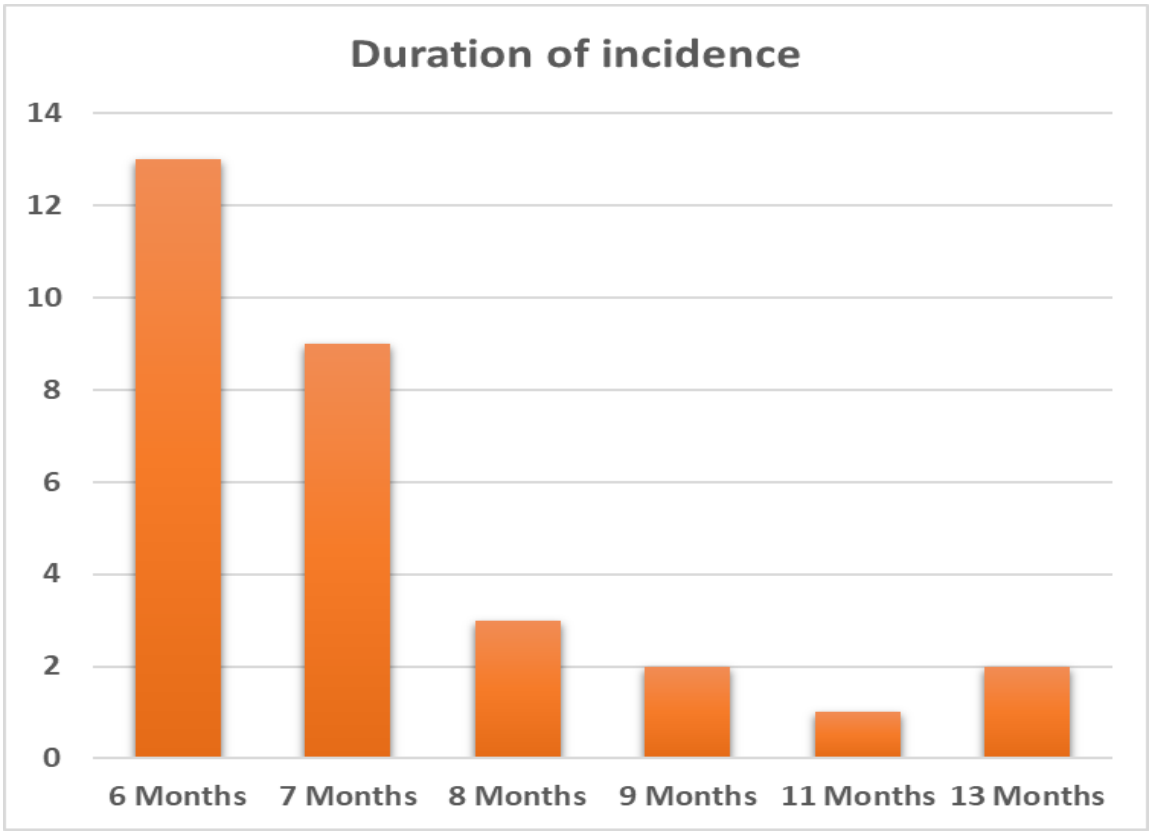


Figure-6: Duration of incidence of stroke

Occupation:

Among all the 30 participants (n=9) were service holder, (n=3) were businessman, (n=11) were housewife, (n=7) were others. In percentage service holders were 30%, businessman were 10%, housewife were 36.7%, others were 23.3%.

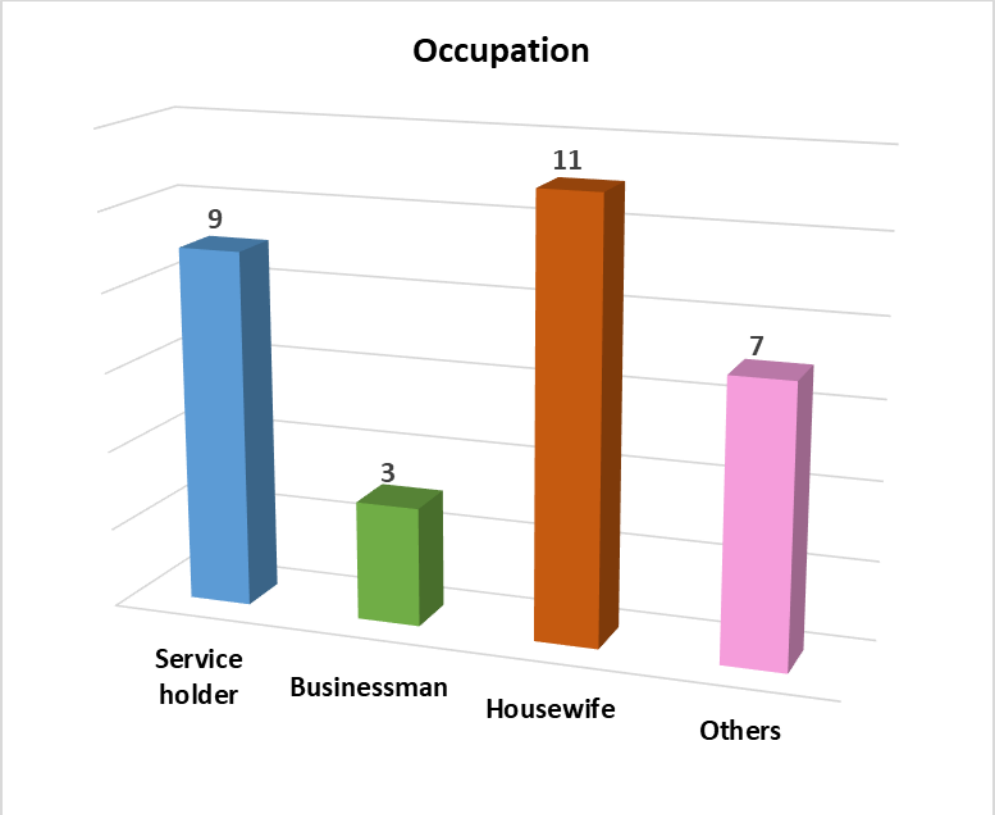


Figure 7: Occupation of the participants

Educational level:

Among 30 participants, n=3 (10%) was illiterate, n=9 (30%) was primary passed, n=2 (6.7%) was S.S.C. passed, n=7 (23.3%) was H.S.C. passed, n=3 (10%) was graduate, n=6 (20%) were masters and above.

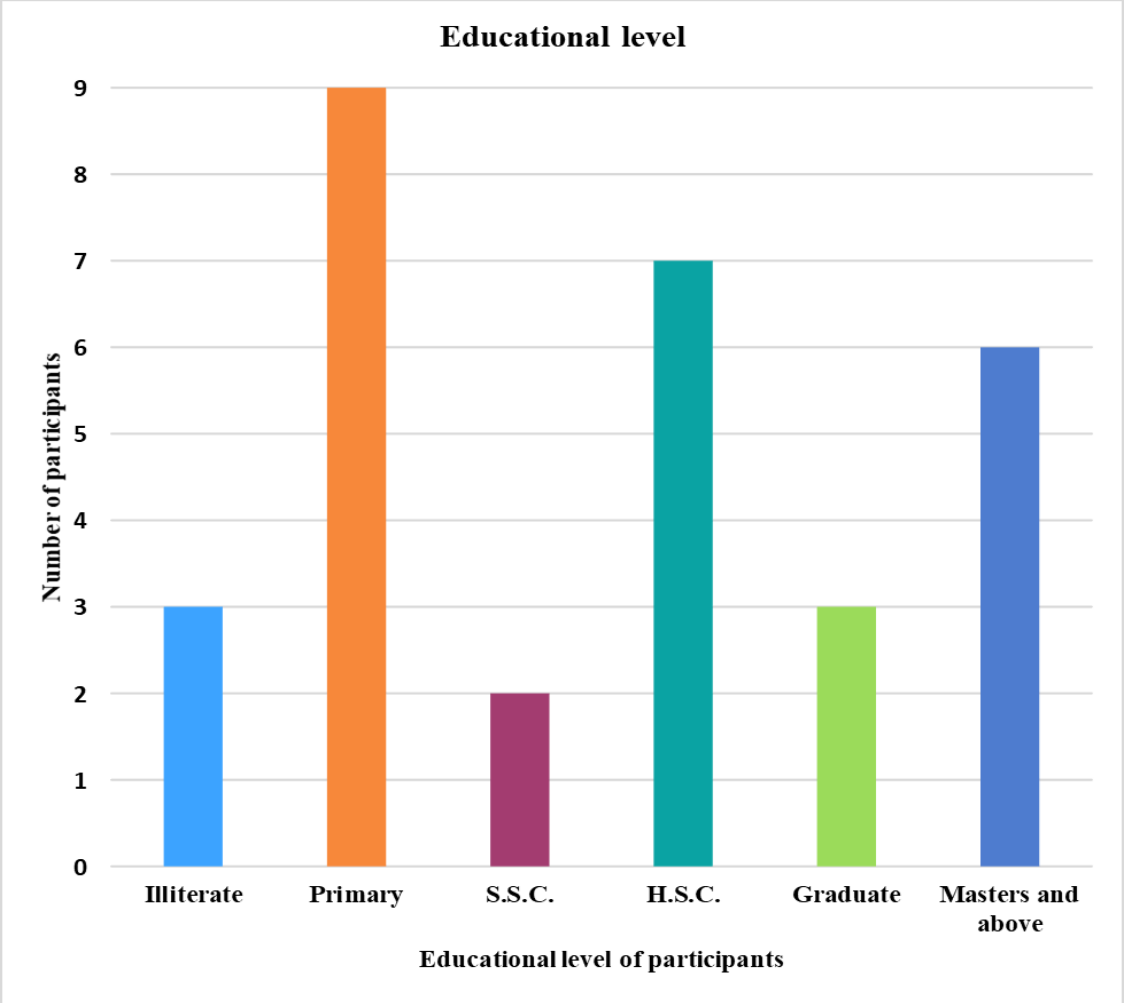


Figure 8: Educational level of participants

Living area:

30 participants were included in this study. Among them 43.30% (n=13) are living in rural area and 56.70% (n=17) are living in urban are.

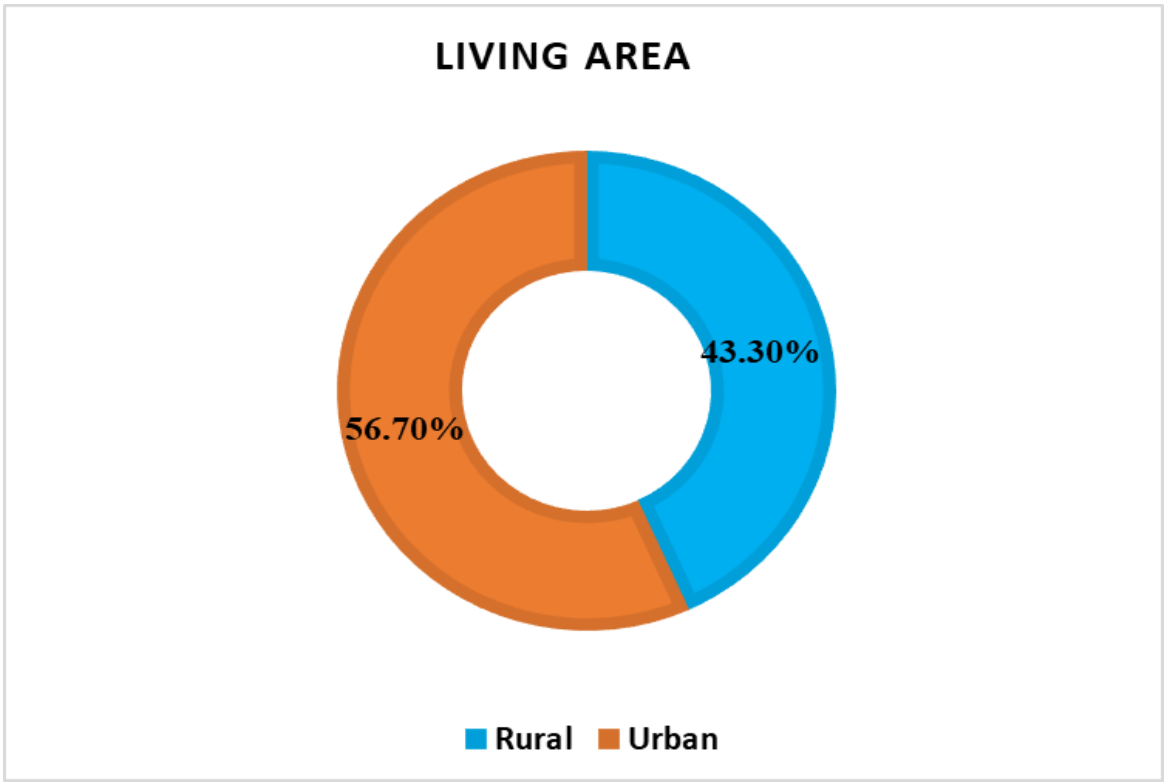


Figure 9: Living area of participants

Table 2: Percentage of Hypertension, Diabetes mellitus, Personal habit of participants

Variable	Present (n)	Percentage %	Absent (n)	Percentage %
Hypertension	19	63.3%	11	36.7%
Diabetes mellitus	15	50%	15	50%
Personal habit (smoking/betel leaf)	6	20%	24	80%

From the table we have found that among 30 participants n=19 (63.3%) has hypertension and n=11 (36.7%) has no hypertension. Diabetes mellitus have present in n=15 (50%) and Diabetes mellitus absent in n=15 (50%). In between 30 participants n=6 (20%) has personal habit and n=24 (80%) has no personal habit.

Physiotherapy treatment received before conducting:

Among 30 participants of the stroke patients, 40% (n=12) patients received 7-8 sessions, 26.7% (n=8) patient received 8-9 sessions and 33.3% (n=10) patient received >10 session physiotherapy treatment.

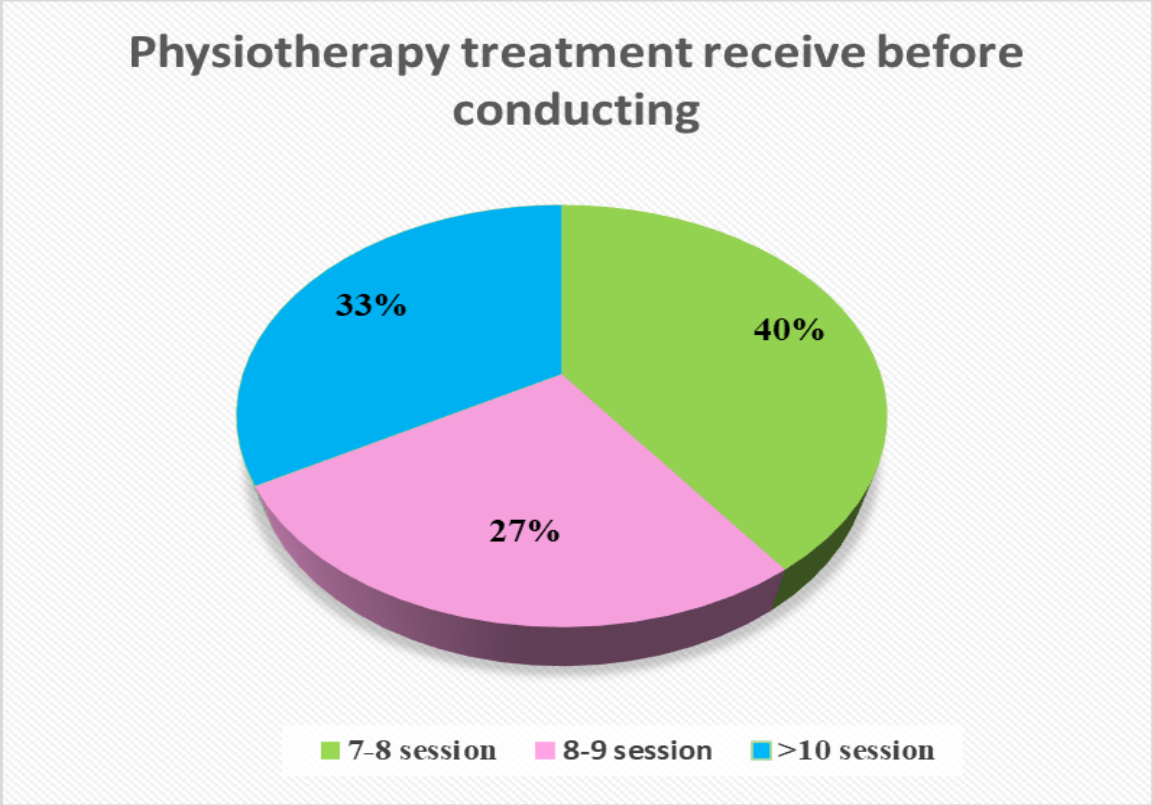


Figure 10: Physiotherapy treatment received before conducting

Measurement of 10 Meter Walk Test (MWT) comparison using Wilcoxon Signed Rank test within the trail group:

Table 3: Rank and test statistics of 10 Meter walk test of stroke patient within the trail group

Measurement of (10) MWT (Pre-test)-(Post-test)	N	Z	P value
Positive rank	0	4.805	0.001*
Negative rank	30		
Ties	0		
Total	30		

From this table it was describe that the comparison of the participant's before (pretest) and after (post-test) of 10 Meter Walk Test (MWT) score. The table showed that in the trail group patient have no increase of 10 Meter Walk Test (MWT) score after taking Core muscle strengthening exercise along with Conventional physiotherapy. 30 participants of trial group had higher score in 10 Meter Walk Test (MWT) before the intervention and the score reduced after the application of the Core muscle strengthening exercise along with conventional physiotherapy. Moreover, table indicate that no participant's score remained same as pretest score of 10 (MWT).

By examining the final test statistics portion of table by Wilcoxon signed-rank test it was discovered that, after 4 weeks of the treatment course it showed a statistically significant change in the score of walking ability in 10 (MWT) ($Z=4.805$ $P=0.001*$). Where 0.001 is less than 0.05 ($P<0.05$) which indicated that it was significant among 30 participants. Moreover, $Z=4.805$ which is greater than 1.96 ($Z>1.96$), so null hypothesis rejected and alternative hypothesis accepted. Therefore, it can be said that Core strengthening along with conventional physiotherapy can improve walking ability of stroke patient.

Table 4: Mean score of 10-meter walk test (MWT) in second in a trial group:

10 Meter Walk Test (Sec)	Mean
Pre-test	42.23 Sec
Post-test	29.93 Sec
Mean difference = 12.3 Sec	

In this study 30 participants were included.10 Meter Walk Test is a measurement tool to measure the walking ability of stroke patient. In above pre-test mean score was 42.23 sec and post-test mean score was 29.93 sec. The difference between mean was 12.3sec. For this sample it may interpreted that pot-test time is less than pre-test time. It indicated that, the required 12.3 sec less time than pre-test.

Table 5: Mean score of 10-meter walk test (MWT) in meter/second in a trial group:

10 Meter Walk Test (m/s)	Mean
Pre-test	.25 m/s
Post-test	.36 m/s
Mean difference = .11 m/s	

In above pre-test mean score was .25m/s and post-test mean score was .36 m/s. The difference between mean was .11 m/s. This table indicated that meter was increased by walking when time was decreased from pre-test to post-test.

Measurement of TUG Test comparison using Wilcoxon Signed Rank test within the trail group:

Table 6: Rank and test statistics of TUG test of stroke patient within the trail group

Measurement of TUG test (Pre-test)-(Post-test)	N	Z	P value
Positive rank	0	4.810	0.001*
Negative rank	30		
Ties	0		
Total	30		

From this table it was describe that the comparison of the participant's before (pretest) and after (post-test) Time Up and Go (TUG) test score. The table showed that in the trail group none of the patient have increased score of Time Up and Go (TUG) test after taking Core strengthening along with Conventional therapy. 30 participants of trial group had higher score in TUG test score before the intervention and the score reduced after the application of the Core muscle strengthening exercise along with conventional physiotherapy. Moreover, table indicate that no participant's score remained same as pretest score of TUG test.

By examining the final test statistics portion of table by Wilcoxon signed-rank test it was discovered that, after 4 weeks of the treatment course it showed a statistically significant change in the score of TUG test ($Z= 4.810$, $P= 0.001^*$). Where 0.001 is less than 0.05 ($P<0.05$) which indicated that it was significant among 30 participants. Moreover, $Z=4.810$ which is greater than 1.96 ($Z>1.96$), so null hypothesis rejected and alternative hypothesis accepted. Therefore, it can be said that Core strengthening along with conventional physiotherapy can improve walking ability of stroke patient.

Mean score of Time Up and Go (TUG) test in a trial group:

In this study 30 participants were included. Time Up and Go Test is another measurement tool to measure the walking ability of stroke patient. In above pre-test mean score was 26.87sec and post-test mean score is 17.93 sec. The difference between mean was 8.94sec. For this sample it may interpreted that pot-test time is less than pre-test time. It indicated that, the required 8.94 sec less time than pre-test.

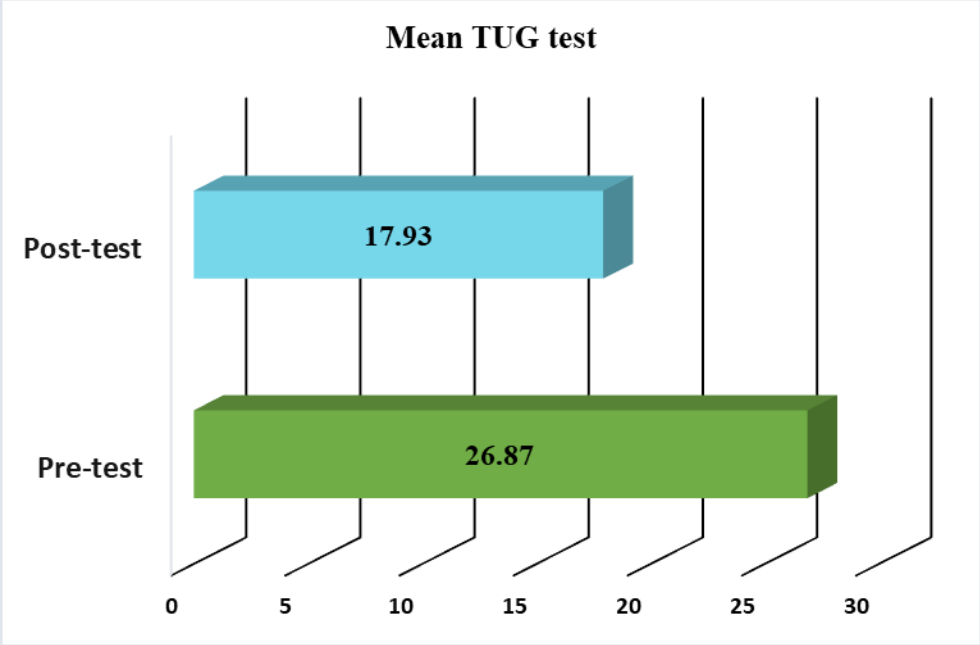


Figure 11: Mean TUG test

CHAPTER – V DISCUSSION

The purpose of This study was to determine the effectiveness of core muscle strengthening exercise on walking ability of stroke patient. As postinjury symptoms, stroke patients have some deficits as postinjury symptoms like decreased motor control, difficulty with co-ordination, balance problem and abnormal gait (Chung et al., 2013). In this experimental study 30 patients with stroke were enrolled who received specific physiotherapy intervention. They received 12 sessions by the way of 3 session per week during a period of 4 weeks from the outdoor Neurology and stroke rehabilitation unit of CRP, Savar for the improvement.

The functional outcome of walking ability was measured by 10-MWT and TUG test. Many walking tests are available to assess walking ability in stroke survivors. (Sharma & Kaur, 2017) used Wisconsin Gait Scale (WGS) to evaluate gait quality of individuals after stroke with hemiplegia. Walking speed, walking distance and functional mobility measurement is more valid test for measuring walking ability. Gait speed was measured by 10-m walk test (10-MWT). In previous study researcher used 10 Meter Walk Test (MWT) and TUG test to measure walking ability of stroke survivors (Lee et al., 2018).

Age was one of variable in this study. In a study it is showed that 38-47 years were 18.8%, 48-57years were 37.5%, 58-67 years were 33.3%, 68-77 years were 10.4% (Onwudiwe et al., 2018). In this study it was found that between participants the age distribution was 35-44 years were 30%, 45-55 years were 37%, 55-65 years were 33%. The mean age was 47.77 years with standard deviation (± 7.555), maximum age was 60 years and minimum age was 35 years.

It was also be found that among all the participants almost (n=19) 63 % of them were male and n=11 (37%) of them were female, where all the female participants were housewife. In other study (n=30) 62.5% male and (n=18) 37.5% were female (Onwudiwe et al., 2018).

Among 30 participants about 63% of patients who were affected at the right side where 37% affected by left side. So the right side became more affected than the left side. (Sharma & Kaur, 2017) found among 13 participants 61.5% had right side affected and 38.5% had left side affected in the study.

From the study it was founded that 30% in between 51-60 kg, 43% was 61-70 kg and 27% was 71-80 kg. It also found that the mean weight was 64.97±5.35 kilograms. In other study showed the mean weight 71.30± 9.23 kg (Sharma & Kaur, 2017). In a study in Bangladesh, 28% participant were service holder, 17% participant were businessman, 16% participant were house wife, (Hossain et al., 2011). In this study, 30% were service holder, 10% were businessman, 36.7% were housewife, 23.3% were others.

In Nigeria, a study showed that among 48 stroke survivors 10.4% had no formal education, 18.3% had primary education, 16.7% had secondary education, 54.6% had tertiary education (Onwudiwe et al., 2018). In this study among 30 participants, 10% was illiterate, 30% was primary passed, 6.7% was S.S.C. passed, 23.3% was H.S.C. passed, 10% was graduate, 20% were masters and above.

30 patients with stroke were included as sample of the study, among them almost 43.30% lived in rural and 56.70% lived in urban. Other study shows in Bangladesh, 54% participants lived in urban area and 46% participant lived in rural area (Hossain et al, 2011).

From the study among 30 participants (63.3%) has hypertension and (36.7%) has no hypertension. Diabetes mellitus have present in (50%) and Diabetes mellitus absent in (50%). In between 30 participants (20%) has personal habit and (80%) has no personal habit. Boehme et al. (2017) stated that Hypertension is a particularly important risk factor for hemorrhagic stroke. Another study showed that 63% of the stroke patients were suffering from hypertension, 53% participant were smoker and 21% diabetes militias (Hossain et al., 2011).

In this research mean duration after stroke with standard deviation was 7.33± 1.93. In another researcher found mean Time since stroke 12.15± 3.89 (Sharma & Kaur, 2017). The study revealed that 40% patients received 7-8 sessions, 26.7% patient received 8-9 sessions and 33.3% patient received >10 session physiotherapy treatment. Another study showed that stroke patient received physiotherapy session on average 13.6 days, average number of patients in physical therapy session per day was 1.5 (Jette et al., 2005).

In this study the researcher found that the significant improvement of walking ability of chronic stroke patients. Here in the trial group, the mean score of TUG test was

26.87±7.13 sec to 17.93±5.55 which was decreased and mean difference of was 8.94 Sec (p=0.001) which indicated the result was significant and improvement of walking ability of stroke patient. In other study the before and after TUG scores for subjects in the core stabilization exercise group showed a significant decrease, from 33.06±18.39 sec to 27.64±13.73 sec (p=0.029) (Chung et al., 2013).

In this study researcher also found the mean score of 10 MWT was 42.23±11.3 to 29.93±9.8 sec and mean difference was 12.03sec (p=0.001) which was significant. Lee et al. (2018) found that the score of 10 MWT was 14.22± 8.43 to 12.93± 7.93 and p=0.00(p<0.01) which indicated the result was significant.

Sharma & Kaur, 2017 suggested that core muscle strengthening combined with pelvic PNF was effective for improving trunk impairment, balance and gait of chronic stroke patients. In this study researcher measure the walking ability with Wisconsin Gait Scale (WGS) and found the significant difference (P=0.001).

Chung et al. (2013) reported that Core muscle strengthening training improves the stability of the lower trunk and pelvis, thereby improving static and dynamic balance. They also found that core training improved stride length, cadence, and speed in the stroke participants.

A recent study demonstrated that, diaphragm and deep abdominal muscle exercise program is effective for patients are suffering difficulty in walking ability, balance ability, trunk asymmetry, abnormal alignment, mobility of trunk muscles, power, or endurance (Lee et al., 2018).

In Wilcoxon test for 10 MWT and TUG test, the both results are significant. It indicates that, no participate has experienced increased walking duration after core strengthening along with conventional physiotherapy. By this test the results were found to be significant in 10 MWT (P=0.001) and TUG test (P=0.001). That actually means, Core strengthening is effective on walking ability of stroke patient.

Limitation of the study:

The study was conducted with 30 patients with stroke, which was a very small number of samples and was not sufficient enough for the study to generalize the wider population of this condition. Due to time limitation the external validity of the study decreased but maintained internal validity during data collection. In this study the participant gets only 4 weeks treatment sessions due to lack of time limitation. In this research the result was significant but if time was increased then result might be same or non-significant. For COVID-19 pandemic situation time was limited and patients were not available who might be fulfill the inclusion criteria. If data was collected from Mirpur or others branch of CRP, result had been more specific. But for time limitation and pandemic situation Data was collected only from CRP. However, the treatment was effective but it could not check the long-term effect. so, it was difficult to keep confidential the aims of the study for blinding procedure. Therefore, single blinding method was used in this study and it lacks the absolute minimization of physiotherapist's bias during delivering treatment.

CHAPTER – VI CONCLUSION AND RECOMMENDATION

6.1 Conclusion:

The result of this experimental study has recognized that the Core muscle strengthening exercise was very effective on walking ability of stroke patient. It was a Quantitative trial study. The result of the current study indicates that the conventional physiotherapy with Core strengthening exercise can be an effective therapeutic approach to improve walking ability of stroke patient. From this result researcher found the significant changes between pre-test and post-test due to the selection of a well- defined population of stroke patients using specific inclusion and exclusion criteria. In this study also null hypothesis rejected and alternative hypothesis accepted. With the Improvement of walking ability of stroke patients have the opportunities to return normal daily activities and work. Core strengthening treatment protocol has a clinical advantage because it is simple, easy and also cost-effective. Overall, participants in this research showed a greater benefit, which indicate that Core strengthening along with conventional physiotherapy is effective for stroke patient. Because of some limitation, this study has lack of generalize ability. This study should be expanded to confirm the validity of findings.

6.2 Recommendation:

The aim of the study was to identify the effectiveness of Core muscle strengthening exercise of stroke patients in improving walking ability. But the study had some limitations. So, some steps will be taken for the better success for further study in this study, the researcher provided 3 session per week total 12 sessions of treatment within 4 weeks which was very small duration for identifying improvement, so the duration should be expanded. In this study only one group is selected for the experiment but in future researcher should be selected control group and experimental group, so that this treatment can be more evidence based for this kind of the patients. Another treatment protocol should be added with Core strengthening exercise for more specific result. Double blinding procedure should be maintained. Here researcher used only two measurement tools for walking ability which was not enough, so further study will be needed with more measurement tools.

References

Ali, S.J., Ansari, A.N., Rahman, A., Imtiyaz, S., and Rashid, B., (2013). Post-stroke hemiplegic gait: A review. The Pharma Innovation Journal, 3(8):36-41.

Almani, S.A., Shaikh, M., Shaikh, M.A., Shaikh, K., Rahopoto, Q., Baloch, G.H., and Shah, M.I., (2008). Stroke: frequency of risk factors in patients admitted at Liaquat University Hospital Hyderabad/Jamshoro. J Liaquat Uni Med Health Sci, 7(3):151-6.

Akuthota, V., and Nadler, F.S., (2004). Core strengthening. Arch Phys Med Rehabil, 85(3 suppl 1):86-92.

Akuthota, V., Ferreiro, A., Moore, T., and Fredericson, M., (2008). Core stability exercise principles. Current sports medicine reports, 7(1):39-44.

Batchelor, F.A., Mackintosh, S.F., Said, C.M., and Hill, K.D., (2012). Falls after stroke. International Journal of Stroke, 7(6): 482-490.

Bayouk, J.F., Boucher, J.P., and Leroux, A., (2006). Balance training following stroke: effects of task-oriented exercises with and without altered sensory input. International Journal of Rehabilitation Research, 29(1): 51-59.

Balaban, B., and Tok F., (2014). Gait disturbances in patients with stroke. American Academy of Physical Medicine and Rehabilitation, 6(7): 635-42.

Balasubramanian, C.K., Clark, D.J., and Fox, E.J., (2014). Walking adaptability after a stroke and its assessment in clinical settings. Stroke research and treatment, 2014:1-21.

Boehme, A.K., Esenwa, C., and Elkind, M.S., (2017). Stroke risk factors, genetics, and prevention. Circulation research, 120(3):472-495.

Coupland, A.P., Thapar, A., Qureshi, M.I., Jenkins, H., and Davies, A.H., (2017). The definition of stroke. Journal of the Royal Society of Medicine, 110(1):9-12.

Cabanas-Valdés, R., Boix-Sala, L., Grau-Pellicer, M., Guzmán-Bernal, J.A., Caballero-Gómez, F.M., and Urrútia, G., (2021). The Effectiveness of Additional Core Stability Exercises in Improving Dynamic Sitting Balance, Gait and Functional Rehabilitation for Subacute Stroke Patients (CORE-Trial): Study Protocol for a Randomized Controlled Trial. International Journal of Environmental Research and Public Health, 18(12):6615-6631.

Chen, X., Gan, Z., Tian, W., and Lv, Y., (2020). Effects of rehabilitation training of core muscle stability on stroke patients with hemiplegia. Pakistan Journal of Medical Sciences, 36(3):461.

Chen, G., and Patten, C., (2006). Treadmill training with harness support: selection of parameters for individuals with post-stroke hemiparesis. Journal of Rehabilitation Research and Development, 43(4): 485.

Chung, E.J., Kim, J.H., and Lee, B.H., (2013). The effects of core stabilization exercise on dynamic balance and gait function in stroke patients. Journal of physical therapy science, 25(7): .803-806.

Chung, E., Lee, B.H., and Hwang, S., (2014). Core stabilization exercise with real-time feedback for chronic hemiparetic stroke: a pilot randomized controlled trials. Restorative neurology and neuroscience, 32(2):313-321.

Cabanas-Valdés, R., Bagur-Calafat, C., Girabent-Farrés, M., Caballero-Gómez, F.M., Hernández-Valiño, M., and Urrútia Cuchí, G., (2016). The effect of additional core stability exercises on improving dynamic sitting balance and trunk control for subacute stroke patients: a randomized controlled trial. Clinical rehabilitation, 30(10):1024-1033.

Dubey, L., Karthikbabu, S., and Mohan, D., (2018). Effects of pelvic stability training on movement control, hip muscles strength, walking speed and daily activities after stroke: a randomized controlled trial. Annals of neurosciences, 25(2):80-89.

Dhawale, T., Yeole, U., and Pawar, A., (2018). Effect of trunk control exercises on balance and gait in stroke patients-randomized control trial. International Journal of Physical Education, Sports and Health, 5(6):15-18

Eng, J.J., and Tang, P.F., (2007). Gait training strategies to optimize walking ability in people with stroke: a synthesis of the evidence. Expert review of neurotherapeutics, 7(10):1417-1436.

Fujita, T., Sato, A., Togashi, Y., Kasahara, R., Ohashi, T., and Yamamoto, Y., (2015). Contribution of abdominal muscle strength to various activities of daily living of stroke patients with mild paralysis. Journal of Physical Therapy Science, 27(3):815-818.

Feigin, V.L., Lawes, C.M., Bennett, D.A., Barker-Collo, S.L., and Parag, V., (2009). Worldwide stroke incidence and early case fatality reported in 56 population-based studies: a systematic review. The Lancet Neurology, 8(4):355-369.

Flansbjer, U.B., Holmbäck, A.M., Downham, D., Patten, C., and Lexell, J., (2005). Reliability of gait performance tests in men and women with hemiparesis after stroke. Journal of Rehabilitation Medicine, 37(2): 75-82.

Goljar, N., Burger, H., Rudolf, M., and Stanonik, I., (2010). Improving balance in subacute stroke patients: a randomized controlled study. International Journal of Rehabilitation Research, 33(3):205-210.

Gjelsvik, B.E.B., Hofstad, H., Smedal, T., Eide, G.E., Næss, H., Skouen, J.S., Frisk, B., Daltveit, S., and Strand, L.I., (2014). Balance and walking after three different models of stroke rehabilitation: early supported discharge in a day unit or at home, and traditional treatment (control). British Medical Journal open, 4(5): 4358-4369.

Hobart, J.C., Riazi, A., Lamping, D.L., Fitzpatrick, R., and Thompson, A.J., (2003). Measuring the impact of MS on walking ability: the 12-Item MS Walking Scale (MSWS-12). Neurology, 60(1):31-36.

Haruyama, K., Kawakami, M., and Otsuka, T., (2017). Effect of core stability training on trunk function, standing balance, and mobility in stroke patients: a randomized controlled trial. Neurorehabilitation and neural repair, 31(3):240-249.

Hossain, A.M., Ahmed, N.U., Rahman, M., Islam, M.R., Sadhya, G., and Fatema, K., (2011). Analysis of Sociodemographic and Clinical Factors Associated with Hospitalized Stroke Patients of Bangladesh. Faridpur Medical College Journal, 6(1):19-23.

Jette, D.U., Latham, N.K., Smout, R.J., Gassaway, J., Slavin, M.D., and Horn, S.D., (2005). Physical Therapy Interventions for Patients with Stroke in Inpatient Rehabilitation Facilities. Journal of American physical therapy association, 85(3):238-248.

Jung, K.M., (2017). Effects of core stability exercises on energy expenditure during gait in subacute stroke patients. Journal of Korean Society for Neurotherapy, 21(1):7-13.

Kulshreshtha, A., Anderson, L.M., Goyal, A., and Keenan, N.L., (2012). Stroke In South Asia: A Systematic Review of Epidemiologic Literature from 1980 to 2010. Neuroepidemiology, 38(3): 123-129.

Karthikbabu, S., John M, S., Manikandan, N., Bhamini K, R., Chakrapani, M., and Akshatha, N., (2011). Role of trunk rehabilitation on trunk control, balance and gait in patients with chronic stroke: a pre-post design. Neuroscience & Medicine, 2(2):61-67.

Kim, K.Y., Chun, S.P., Kang, T.G., and Kim, G.D., (2015). Effects of core stability training on postural control ability and respiratory function in chronic stroke patients. Adv Sci Technol Lett, 88:181-186.

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):142-151.

Li, S., Francisco, G.E., and Zhou, P., (2018). Post-stroke hemiplegic gait: new perspective and insights. Frontiers in physiology, 9: 1021.

Lexell, J., and Flansbjer, U.B., (2008). Muscle strength training, gait performance and physiotherapy after stroke. Minerva medica, 99(4):353-368.

Lee, J.Y., Jeon, J., Lee, D.Y., Hong, J., Yu, J., and Kim, J., (2020). Effect of trunk stabilization exercise on abdominal muscle thickness, balance and gait abilities of patients with hemiplegic stroke: A randomized controlled trial. Neurorehabilitation, 47(4):435-442.

Lee, K.B., Lim, S.H., Kim, K.H., Kim, K.J., Kim, Y.R., Chang, W.N., Yeom, J.W., Kim, Y.D., and Hwang, B.Y., (2015). Six-month functional recovery of stroke patients: a multi-time-point study. International journal of rehabilitation research, 38(2):173-180.

Langhorne, P., Coupar, F., and Pollock, A., (2009). Motor recovery after stroke: a systematic review. The Lancet Neurology, 8(8):741-754.

Langhorne, P., Bernhardt, J., and Kwakkel, G., (2011). Stroke Rehabilitation. Lancet, 377(9778): 1693-702.

Lee, H.J., Kang, T.W., and Kim, B.R., (2018). Effects of diaphragm and deep abdominal muscle exercise on walking and balance ability in patients with hemiplegia due to stroke. Journal of Exercise Rehabilitation, 14(4):648.

McGill, S.M., Grenier, S., Kavcic, N., and Cholewicki, J., (2003). Coordination of muscle activity to assure stability of the lumbar spine. Journal of electromyography and kinesiology, 13(4):353-359.

Marshall, P.W., and Murphy, B.A., (2005). Core stability exercises on and off a Swiss ball. Archives of physical medicine and rehabilitation, 86(2):242-249.

Mondal, M.B.A., Hasan, A.H., Khan, N., and Mohammad, Q.D., (2021). Prevalence and Risk Factors of Stroke in Bangladesh: A Nationwide Population-Based Survey. medRxiv,1-20

Mercier, L., Hebert, R., Rochette, A., and Dubois, M.F., (2001). Impact of Motor, Cognitive, and Perceptual Disorders on Ability to Perform Activities of Daily Living After Stroke. American heart association, 32(11): 2602-2608.

Obembe, A.O., Olaogun, M.O.B., and Adedoyin, R.A., (2012). Differences in gait between haemorrhagic and ischaemic stroke survivors. Journal of Medicine and Medical Sciences, 3(9):556-561.

Onwudiwe, C.O., Ezema, C.I., Nweke, M.C., Anukam, G.O., and Okoy, G.C., (2018). Effects of core strengthening exercises on dynamic balance and gait speed in stroke survivors. International Journal of Basic, Applied and Innovative Research, 7(2):47-54.

Pizzi, A., Carlucci, G., Falsini, C., Lunghi, F., Verdesca, S., and Grippo, A., (2007). Gait in hemiplegia: evaluation of clinical features with the Wisconsin Gait Scale. Journal of rehabilitation medicine, 39(2):170-174.

Pathak, S., Nayak, A., and Kedambadi, R.C., (2014). The relationship between pelvic alignment and trunk control in stroke subjects: a cross-sectional study. International Journal of Research in Medical Sciences, 2(4):1483-1487.

Pradon, D., Roche, N., Enette, L., and Zory, R., (2013). Relationship between lower limb muscle strength and 6-minute walk test performance in stroke patients. Journal of Rehabilitation Medicine, 45(1):105-108.

Pohl, P.S., Perera, S., Duncan, P.W., Maletsky, R., Whitman, R., and Studenski, S., (2004). Gains in distance walking in a 3-month follow-up poststroke: what changes?. Neurorehabilitation and neural repair, 18(1): 30-36.

Park, B.S., Kim, J.H., Kim, M.Y., Lee, L.K., Yang, S.M., Jeon, H.J., Lee, W.D., Noh, J.W., Lee, J.U., Kwak, T.Y., and Lee, T.H., (2015). Effect of a muscle strengthening exercise program for pelvic control on gait function of stroke patients. Journal of physical therapy science, 27(3):641-644.

Rose, S., and Vasanthan, R., (2016). Effect of trunk strengthening exercise on functional outcome in post stroke patients. International Journal of Current Research, 8(6):33658-33665.

Rosamond, W., Flegal, K., Furie, K., Go, A., Greenlund, K., Haase, N., Hailpern, S. M., Ho, M., Howard, V., Kissela, B., Kittner, S., Lloyd-Jones, D., McDermott, M., Meigs, J., Moy, C., Nichol, G., O'Donnell, C., Roger, V., Sorlie, P., Steinberger, J., Thom, T., Wilson, M., and Hong, Y., (2008). Heart Disease and Stroke Statistics--2008 Update: A Report From the American Heart Association Statistics Committee and Stroke Statistics Subcommittee. Circulation, 117(4): 25–146.

Sims, N.R., and Muyderman, H., (2010). Mitochondria, oxidative metabolism and cell death in stroke. Biochimica et Biophysica Acta (BBA)-Molecular Basis of Disease, 1802(1):80-91.

Szafraniec, R., Barańska, J., and Kuczyński, M., (2018). Acute effects of core stability exercises on balance control. Acta of bioengineering and biomechanics, 20(3):145-151.

Shinde, K., and Ganvir, S., (2014). Effectiveness of trunk proprioceptive neuromuscular facilitation technique after stroke: a metaanalysis. National Journal Of Medical and Allied Sciences, 3(2): 29-34.

Sharma, V., and Kaur, J., (2017). Effect of core strengthening with pelvic proprioceptive neuromuscular facilitation on trunk, balance, gait, and function in chronic stroke. Journal of exercise rehabilitation, 13(2): 200-205.

Summers, D., Leonard, A., Wentworth, D., Saver, J.L., Simpson, J., Spilker, J.A., Hock, N., Miller, E., and Mitchell, P.H., (2009). Comprehensive overview of nursing and interdisciplinary care of the acute ischemic stroke patient: a scientific statement from the American Heart Association. Stroke, 40(8):2911-2944.

Shah, N., and Ataullah, S., (2009). Frequency of cerebral infarction and haemorrhage in the patients of stroke. Journal of Ayub Medical College Abbottabad, 21(4):102-105.

Sun, X., Gao, Q., Dou, H., and Tang, S., (2016). Which is better in the rehabilitation of stroke patients, core stability exercises or conventional exercises?. Journal of Physical Therapy Science, 28(4):1131-1133.

Ting-Ting, L., Meng-Jie, L., Ya-Qian, L., Li-Na, M., and Chang-De, J., (2018). Effects of core stability exercise on rehabilitation in stroke patients with hemiplegia: a meta-analysis. Translational Medicine Report Non-drug Therapy, 1(2):41-52.

van de Port, I.G., Kwakkel, G., and Lindeman, E., (2008). Community ambulation in patients with chronic stroke: how is it related to gait speed?. Journal of Rehabilitation Medicine, 40(1):23-27.

Verma, R., Arya, K.N., Sharma, P., and Garg, R.K., (2012). Understanding gait control in post-stroke: implications for management. Journal of bodywork and movement therapies, 16(1):14-21.

Van Criekinge, T., Truijen, S., Schröder, J., Maebe, Z., Blanckaert, K., van der Waal, C., Vink, M., and Saeys, W., (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.

Yu, S.H., and Park, S.D., (2013). The effects of core stability strength exercise on muscle activity and trunk impairment scale in stroke patients. Journal of exercise rehabilitation, 9(3):362.

Zakaria, Y., Rashad, U., and Mohammed, R., (2010). Assessment of Malalignment of Trunk and Pelvis in Stroke Patients. Egypt J Neurol Psychiat Neurosurg, 47(4): 599-604 .

APPENDIX

Verbal Consent Form

Title: Effectiveness of core muscle strengthening exercise on walking ability of stroke patient.

Assalamualaikum\ Namashker,

I am Salma Nahrin Purba, the 4th year B.Sc. (Hon's) in Physiotherapy student of Bangladesh Health Professions Institute (BHPI) under Medicine faculty of University of Dhaka. To obtain my Bachelor degree, I shall have to conduct research and it is a part of my study. The participants are requested to participate in the study after reading the following. My research title is "Effectiveness of core muscle strengthening exercise on walking ability of stroke patient". Through this study I will find Effectiveness of core muscle strengthening exercise on walking ability of stroke patient. If I can complete the study successfully, the patients may get the benefits of improve neurology outdoor physiotherapy service. To implement my research project, I need to collect data from the patients. Therefore, you could be one of my valuable subjects for my study.

I am committed that the study will not pose any harm or risk to you. You have the absolute right to withdraw or discontinue at any time without any hesitation or risk. I will keep all the information confidential which I obtained from you and personal identification of the participant would not be published anywhere. If you have any query about the study, you may contact with the researcher Salma Nahrin Purba or supervisor Fabiha Alam, , Lecturer, Department of Physiotherapy BHPI, CRP, Savar, Dhaka-1343.

Do you have any questions before I start?

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

☐ = Yes ☐ = No

Signature of the participant & Date…….

Signature of the researcher & Date……..

Signature of the witness & Date……..

মৌখিক সম্মতিপত্র

শিরোনামঃ স্ট্রোক রোগীর হাঁটার ক্ষমতার উপর কোর পেশী শক্তিশালীকরণ ব্যায়ামের কার্যকারিতা।

আসসালামু আলাইকুম/নমষ্কার,

আমি সালমা নাহরিন পূর্বা, বাংলাদেশ হেলথ প্রফেশন্স ইনস্টিউট এর বি.এস.সি. ইন ফিজিওথেরাপি বিভাগের ৪র্থ বর্ষের শিক্ষার্থী, আমার গবেষণা প্রকল্পটি বাংলাদেশ হেল্থ প্রফেশন্স ইনস্টিটিউট এ পরিচালনা করছি যা আমার ৪র্থ বর্ষ বি.এস.সি. ইন ফিজিওথেরাপি কোর্সের অধিভুক্ত। অংশগ্রহনকারীদেরকে নিম্নলিখিত অংশটুকু পড়ার পর অংশগ্রহণ করার অনুরোধ রইল।

আমি "স্ট্রোক রোগীর হাঁটার ক্ষমতার উপর কোর পেশী শক্তিশালীকরণ ব্যায়ামের কার্যকারিতা" এর উপর গবেষণা করছি। এই গবেষণার মাধ্যমে আমি স্ট্রোক রোগীর হাঁটার ক্ষমতার উপর কোর পেশী শক্তিশালীকরণ ব্যায়ামের কার্যকারিতা খুঁজে পাব। আমি যদি সফলভাবে অধ্যয়নটি সম্পূর্ণ করতে পারি, তাহলে রোগীরা স্নায়ুবিদ্যার আউটডোর ফিজিওথেরাপি পরিষেবার উন্নতির সুবিধা পেতে পারে। আমার গবেষণা প্রকল্প বাস্তবায়ন করতে, আমাকে রোগীদের কাছ থেকে তথ্য সংগ্রহ করতে হবে। অতএব, আপনি আমার অধ্যয়নের জন্য আমার মূল্যবান বিষয় হতে পারেন।

আমি প্রতিশ্রুতিবদ্ধ যে অধ্যয়নটি আপনার কোন ক্ষতি বা ঝুঁকি তৈরি করবে না। কোনো দ্বিধা বা ঝুঁকি ছাড়াই যেকোনো সময় প্রত্যাহার বা বন্ধ করার পরম অধিকার আপনার আছে। আমি আপনার কাছ থেকে প্রাপ্ত সমস্ত তথ্য গোপন রাখব এবং অংশগ্রহণকারীর ব্যক্তিগত পরিচয় কোথাও প্রকাশ করা হবে না।

এই অধ্যয়নে অংশগ্রহণকারী হিসেবে যদি আপনার কিছু জানার থাকে তাহলে আপনি আমাকে অথবা / এবং আমার সুপারভাইজার ফাবিহা আলম দিশা, লেচারার, ফিজিওথেরাপি বিভাগ, বিএইচপিআই, সিআরপি, সাভার, ঢাকা-১৩৪৩ উনার সাথে যোগাযোগ করতে পারেন।

আমি শুরু করার আগে আপনি কি কিছু জানতে চান?

আমি আপনার অনুমতি নিয়ে এই সাক্ষাতকার শুরু করতে পারি?

হ্যাঁ ☐

না ☐

অংশগ্রহণকারীরস্বাক্ষর ও তারিখ.....

উপাত্তসংগ্রহকারীর স্বাক্ষর ও তারিখ.....

গবেষকের স্বাক্ষর ও তারিখ.....

Questionnaire

Title: Effectiveness of core muscle strengthening exercise on walking ability of stroke patient.

Questionnaire (English)

This questionnaire is developed to assessment of walking ability of stroke patients and this part will be filled by physiotherapist using a black coloured ball pen.

Part-1: Patient's identification:

a.	Identification number:
b.	Date of interview:
c.	Patient's name:
d.	Address:
e.	Contact number:
f.	Place of data collection:
g.	Consent taken:

Part:2 Sociodemographic information (Tick which is appropriate):

a.	Age	.....years
b.	Sex	-Male - Female
c.	What is your marital status?	-Married -Unmarried -Widow -Divorced
d.	Weight	..... Kg
e.	Affected body side	- Right - Left -Both
f.	Occupation	
g.	Type of stroke	-Ischemic -Hemorrhagic
h.	Duration of incidence of stroke	.....months

i.	Did you have hypertension before stroke?	-Yes -No
j.	Do you have diabetes mellitus	-Yes -No
k.	Do you have any carer?	-Yes -No
l.	What is your educational level?	-Illiterate -Primary -S.S.C -H.S.C -Graduate -Masters and above -Others
m.	Living area	-Rural -Urban - Semi-urban

n.	Personal Habit (Smoking /Betel leaf)	-Yes -No
o.	Family Size	-Nuclear Family -Joint Family
p.	Who is earning member?	-Patient himself/herself -others(specify)
q.	How long you have received physiotherapy treatment?	=1-2 session =3-4 session = 5-6 session = 7-8 session = 8-9 session = > 10 session

Part 3: Measurement of walking:

10 meter walk test

a. Blood pressure: Date:

b. Heart rate:

c. Measurement of 10-meter walk test:

10-meter walk test (m/s)	Pre-test	Post-test
1st time walk measurement		
2nd time walk measurement		
Average measurement		

Time Up and Go test (TUG):

General instruction:

Purpose - To assess mobility.

Equipment- Stopwatch

Direction- Patient wears their regular footwear and can use a walking aid. If needed. Begin by having the patient sit back in a standard and identify a line meters, or 10 fit away on the floor.

An adult who takes >/12 seconds to complete the TUG is at risk for falling.

1. Instruct the patient

When I say “Go,” I want you to:

- Stand up from the chair.
- Walk to the line on the floor at your normal pace.
- Turn.
- Walk back to the chair at your normal pace.
- Sit down again.

2.On the word “Go,” begin timing.

3. Stop timing after patient sits back down.

4. Record Time

Time Up and Go test (TUG) (Second)	Pre-test	Post-test
First time measure		

প্রশ্নাবলী (বাংলা)

শিরোনামঃ "স্ট্রোক রোগীর হাঁটার ক্ষমতার উপর কোর পেশী শক্তিশালীকরণ ব্যায়ামের কার্যকারিতা"

এই প্রশ্নপত্রটি স্ট্রোক রোগীদের হাঁটার ক্ষমতা মূল্যায়নের জন্য তৈরি করা হয়েছে এবং এই অংশটি ফিজিওথেরাপিস্ট একটি কালো রঙের বল কলম ব্যবহার করে পূরণ করবেন।

১ম অংশঃ রোগী সনাক্তকরণঃ

ক	সনাক্তকরণ নাম্বারঃ
খ	সাক্ষাৎকারের তারিখঃ
গ	রোগীর নামঃ
ঘ	ঠিকানাঃ
ঙ	মোবাইল নাম্বারঃ
চ	তথ্য সংগ্রহের স্থানঃ
ছ	সম্মতি নেয়া হয়েছেঃ

২য় অংশঃ আর্থসামাজিক– বৈষয়িক তথ্যাবলী (কোনটি উপযুক্ত তা টিক দিন):

১.	বয়স	.....বছর
২.	লিঙ্গ	-পুরুষ -মহিলা
৩.	বৈবাহিক অবস্থা	-বিবাহিত - অবিবাহিত -বিধবা

		-তালাকপ্রাপ্ত
৪.	ওজন	..... কেজি
৫.	শরীরের আক্রান্ত অংশ	-ডান - বাম -উভয়েই
৬.	পেশা	
৭.	স্ট্রোকের ধরণ	-ইস্কেমিক -হ্যামরহেজিক
৮.	স্ট্রোকের ঘটনার সময়কাল	.....মাস
৯.	স্ট্রোকের পূর্বে আপনার কি হাইপারটেনশন ছিল?	-হ্যাঁ -না
১০.	আপনার কি ডায়াবেটিস আছে?	-হ্যাঁ -না
১১.	আপনার কি কোন সাহায্যকারী আছে?	-হ্যাঁ -না
১২.	আপনার শিক্ষাগত যোগ্যতা কি?	-কোনো প্রাতিষ্ঠানিক শিক্ষা নেই

		-প্রাথমিক শিক্ষা -মাধ্যমিক শিক্ষা -উচ্চমাধ্যমিক শিক্ষা -স্নাতক -স্নাতোকোত্তর -অন্যান্য
১৩.	বসবাসের জায়গা	-গ্রাম - শহর -উপশহর
১৪.	ব্যাক্তিগত অভ্যাস (সিগারেট /পান)	-হ্যাঁ -না
১৫.	পরিবারের ধরণ	-একান্নবর্তী পরিবার -যৌথ পরিবার
১৬.	উপার্জনকারী ব্যাক্তি কে?	-রোগি নিজেই -অন্যান্য(নির্দিষ্ট)

১৭.	আপনি কতদিন ধরে ফিজিওথেরাপী চিকিৎসা নিয়েছেন?	=১-২ সেশন =৩-৪ সেশন = ৫-৬ সেশন = ৭-৮ সেশন = ৯-১০ সেশন = > ১০ সেশন

৩ য় অংশঃ হাঁটার পরিমাপ

১০ মিটার ওয়াক টেষ্ট

১. রক্ত চাপ: তারিখ:

২. হৃদ কম্পন:

৩. ১০-মিটার ওয়াক টেষ্ট পরিমাপ:

১০ মিটার ওয়াক টেষ্ট(মিটার/সেকেন্ড)	প্রাক-পরীক্ষা	পোস্ট-টেস্ট
১ ম সময় হাঁটার পরিমাপ		
২য় সময় হাঁটার পরিমাপ		
গড় পরিমাপ		

টাইম আপ এন্ড গো টেস্টঃ

উদ্দ্যশ্যঃ মোবিলিটি এসেস করা

নির্দেশনাঃ রোগী যথারীতি তাদের জুতা পরবে এবং প্রয়োজন হলে ওয়াকিং এইড ব্যবহার করতে পারবে। রোগীকে একিট চেয়ারে বসেত হবে এবং ৩ মিটার লাইন শনাক্ত করতে হবে।

রোগীর নির্দেশনাঃ

যখন যেতে বলা হবেঃ

- চেয়ার থেকে উঠে দাঁড়ান
- লাইন বরাবর সোজা হাঁটেন
- ঘুরে দারান
- সোজা হেঁটে পুনরায় চেয়ারের দিকে আসেন
- পুনরায় চেয়ারের বসে যান

যাও বলার সাথে সাথে সময় শুরু হবে এবং চেয়ারের বসা পর্যন্ত সময় ধারন করেত হবে।

সময় পরিমাপ

টাইম আপ এন্ড গো টেস্ট(সেকেন্ড)	প্রাক-পরীক্ষা	পোস্ট-টেস্ট
১ম সময় পরিমাপ		

Permission Letter

Date: 24th March, 2021

Head

Department of Physiotherapy

Centre for the Rehabilitation of the Paralysed (CRP)

Through: Head, Department of Physiotherapy, BHPI

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

Sir,

With due respect and humble submission to state that I am Salma Nahrin Purba, a student of 4th year B. Sc. in Physiotherapy at Bangladesh Health Professions Institute (BHPI). The Ethical committee has approved my research project entitled: **"Effectiveness of Core Muscle Strengthening Exercise on Walking Ability of Stroke Patient."**under the supervision of Fabiha Alam, Lecturer, Department of Physiotherapy, BHPI, CRP, Savar, Dhaka-1343. I want to collect data for my research project from the Department of Physiotherapy at CRP. So, I need permission for data collection from the Neurological Unit of Physiotherapy Department at CRP (CRP, Savar, Dhaka-1343) I would like to assure that anything of the study will not be harmful for the participants.

I, therefore pray and hope that your honor would be kind enough to approve my thesis proposal and give me permission to start data collection and oblige thereby.

Sincerely

Salma Nahrin Purba

Salma Nahrin Purba

4th professional B.Sc. in Physiotherapy

Roll: 42, Session: 2015-16, ID:112150313

BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Forward
24.03.2021

Approved
08/06/21
MOHAMMAD ANWAR HOSSAIN
Senior Consultant &
Head of Physiotherapy Dept
Associate Professor, BHPI
CRP Savar, Dhaka-1343

Recommended & Forwarded
08.06.2021
Md. Shofiqul Islam
Associate Professor & Head
Department of Physiotherapy
Bangladesh Health Professions Institute (BHPI)
CRP, Chapain, Savar, Dhaka-1343

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

Ref: CRP/BHPI/IRB/06/2021/456

Date: 6th June 2021

Salma Nahrin Purba
4th year B.Sc. in Physiotherapy
Session: 2015-2016, Student ID: 112150313
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Subject: Approval of the thesis proposal **"Effectiveness of Core Muscle Strengthening Exercise on Walking Ability of Stroke Patient."** by ethics committee.

Dear Salma Nahrin Purba,
Congratulations.
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with yourself, as the principal investigator. The following documents have been reviewed and approved

Sr. No.	Name of the Documents
1	Dissertation proposal
2	Questionnaire (English version)
3	Information sheet and consent form

The study involves use of a questionnaire to explore Effectiveness of core muscle strengthening exercise on walking ability of stroke patient that may take 20 to 30 minutes to answer the questionnaire and there is no likelihood of any harm to the participants. The members of the Ethics committee approved the study to be conducted in the presented from at the meeting held at 8.30AM on 1st March, 2020 at BHPI (23rd IRB Meeting).

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.

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