Faculty of Medicine

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Effectiveness of Higher Function Training on Lower Extremity Motor Recovery among Patient with Chronic Stroke

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Bachelor of Science in Physiotherapy (B.Sc.PT)

DU Roll no: 1671

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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 Higher Function Training on Lower Extremity Motor Recovery among Patient with Chronic Stroke

Submitted by **David Timon Das**, for fulfillment of the requirement for the degree of Bachelor of Science in Physiotherapy (B.Sc. in PT)

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DECLARATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of the study. I would be bound to take written consent from the Saic College of Medical Science and Technology (SCMST).

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ACRONYMS

ADL	Activities of Daily Living
BBS	Berg Balance Scale
BI	Barthel Index
BMRC	Bangladesh Medical Research Council
CONSORT	Consolidated Standards of Reporting Trials
DDT	Dual-Task Training
FMA-LE	Fugl Meyer Assessment Lower Extremity
HFT	Higher Function Training
IRB	Institutional Review Board
LSWT	Lateral Stair Walking Training
PRT	Progressive Resistance Training
RCT	Randomized Controlled Trial
SCMST	Saic College of Medical Science and Technology
SPSS	Statistical Package for Social Science
STS	Sit-to-Stand.
WHO	World Health Organization.

ABSTRACT

Background: Stroke also causes a long-term disability, specifically damage to the motor performance of the lower limbs the damage to lower-limb motor performance limits mobility and autonomy. These facts justify the need to implement task-specific, functionally-specific rehabilitation incorporating the elements of strength, balance and coordination which will provide the relevance of the consideration of Higher Function Training (HFT) among people with chronic stroke. **Purpose:** To evaluate the effectiveness of HFT on lower extremity motor recovery in individuals with chronic stroke. **Methodology:** In a RCT study, 34 adult with chronic stroke were allocated to an experimental group receiving HFT with conventional physiotherapy and control group receiving only conventional therapy (17 per group). Outcome were measured pre and post intervention using BBS, Barthel Index and Fugl-Meyer Assessment. The study obtained IRB approval and followed ethical guidance. **Result**: HFT produced significantly greater gain in lower extremity motor recovery. Between group difference were not significant for balance ($p = 0.196$) and Barthel index ($p = 0.314$). But both group showed significant within group improvements on Barthel Index and Berg Balance Scale. **Conclusion:** The use of Higher Function Training (HFT) in addition to conventional physiotherapy significantly increased lower-limb motor recovery over a four weeks period, but, when compared with conventional care alone, did not provide any greater improvements to balance or activities of daily living (ADL) independence. The findings support HFT as an encouraging modality to increase the speed of motor recovery in people with chronic stroke; however, larger, long-term studies are needed to determine the sustainability of the effects and the extent of functional outcomes.

Keywords: *Higher Function Training, Chronic stroke, Motor recovery, Lower extremity.*

CHAPTER-I INTRODUCTION

1.1 Background

Stroke is the major cause of mortality and morbidity in the world and may be categorized to be either ischemic or hemorrhagic (Campbell et al. 2019, p.1). Stroke (including ischemic and hemorrhagic stroke) is the second leading causes of death with 5.5 million deaths per year and it affects 13.7 million people globally in every year. (GBD stroke collaborators, 2019, p.440). In East Asian countries including China and Mongolia, the incidence and mortality have been ranked among the highest in Asia (Venketasubramanian 2025, p.84). A national wide survey in Bangladesh reported a stroke prevalence of 11.39 per 1000 people, with the highest rate in the Mymensingh division (14.71 per 1000) and notably higher prevalence (30.10 per 1000) among those aged over 60 and hypertension, dyslipidemia, tobacco use, diabetes, ischemic heart disease are the most common risk factors observed among stroke patients in Bangladesh (Mondal et al. 2022, p.1).

Stroke is a neurological disorder characterized by blockage of blood vessels. The blood flow to the brain is supplied by two internal carotids anteriorly and two vertebral arteries posteriorly (the circle of Willis). Ischemic stroke is caused by deficient blood and oxygen supply to the brain; hemorrhagic stroke is caused by bleeding or leaky blood vessels that is classified into intracerebral and subarachnoid hemorrhage (Kuriakose & Xiao, 2020, p. 3).

The symptoms to stroke including sudden unilateral paralysis, visual loss, double vision, changes in speech, ataxia and non-orthostatic vertigo. Atypical symptoms of stroke include isolated vertigo, binocular blindness, amnesia, dysarthria, dysphagia, headache, confusion and change in consciousness (Hankey 2017, p.641). Post stroke abnormal gait patterns are responsible for substantial functional disability, inadequate level of locomotion and poor quality of life. Gait asymmetry is imbalance of functional activities between two sides of the body or lower limb (Li, Francisco and Zhou 2018, p. 3). Apathy can be seen in more than 50% of survivors at 1 year after occurring the stroke and also fatigue is a common and debilitating symptom in chronic stroke.

Besides, shoulder pain is common after stroke with an incidence during the first year of 1% to 22% (Winstein et al. 2016, p. e107).

Stroke results from multiple risk factor such as hypertension which is the most significant, followed by diabetes, hyperlipidemia, obesity, smoking, metabolic disorder and sedentary behavior (Benjamin et al., 2019, pp. e161). Also modifiable risk factors include tobacco use, unhealthy diet, physical inactivity, and harmful use of alcohol in Bangladesh, Asia, and beyond (Feigin et al., 2021, p.444).

It is common burden for stroke patients to experience acute hemiparesis of the lower leg, which substantially restrict their mobility (Winstein et al., 2016, p.e105). Motor deficits, including weakness and poor coordination, significantly elevate the risk of falls and many people have difficulty to standing up and walking independently (De Sousa et al. 2019, p.152). Persistent lower limb weakness affect activity limitation and participation restrictions (Dorsch et al. 2018, p.84). Additionally to inhibiting physical independence, these deficits lead to psychological complications by causing depression and anxiety, in addition to making the rehabilitation process more complicated (Hackett & Pickles 2014, p. 1020). Individuals who learn to apply cognitive challenges into motor exercises can experience improvements in movement accuracy, responsiveness and adaptations to real world environments (Vangilder et al. 2020 p. 462).

Rehabilitation for lower extremity motor recovery has progressed significantly, highlighting the importance of task-specific and functionally relevant training approaches. Motor impairment reduce activities of daily living, diminish quality of life. In order to minimize negative impacts, rehabilitation therapy including task specific and functional training helps to enhance functional recovery (Kim 2022. p. 13). Higher function training which combination of task specific and functional treatment that is designed for rehabilitation which enhance motor control, coordination, and neuroplasticity (Norman et al. 2022, p.1). Higher function training can be described as an intervention framework that includes task-oriented, functional, progressive, and integrated exercises designed to improve real-world motor abilities related to activities of daily living (ADLs) (Jharbade et al. 2024, p. 10).

Task-oriented training includes the practice of exercises that mimic daily activities, including sit-to-stand transfers, stair climbing, and gait training, progressive resistance

training. Sit-to-stand is one of the range of functional motor performance functions that we all face in everyday life. As the individual stands up, lower extremities carry the body weight and a good standing facility precedes the normal gait (Hyun, Lee and Lee 2021, p, 2). Likewise, stair walking or climbing is a part of individual's daily routine as it can improve static standing balance while lateral stair walking training can reduce lateral fall (Huang et al. 2021, p. 11). The situation that necessitates walking adaptability in the actual world is walking over uneven surfaces, which are neither firm nor flat hence Walking adaptability would be a fundamental need that ensures successful independence and safety when walking in a community (Balasubramanian, Clark and Fox 2014, p. 1). Proper walking always require muscle strength and resistance training can help to increase it. Progressive resistance training is a well-structured form of exercise that can help to increase muscle strength as its principle muscles are exercised against the maximum amount of external resistance or force they can sustain (in isometric training) or move (in dynamic training) for a small number of repetitions, in order to overload the muscle. Additionally, the exercise is systematically progressed, for example, by increasing the amount of resistance (Dorsch et al. 2018, p.84).

Resistance training using weights or bands has been demonstrated to enhance balance and walking speed, with benefits lasting months after the intervention (Vahlberg et al. 2017, p. 1619). Task-specific modified sit-to-stand exercises improve stability, weight-bearing symmetry and dynamic balance (Liu et al. 2016, p. 632), and stair climbing training improves hip strength, gait, balance and functional mobility (Huang et al. 2021, p. 12). Furthermore, training on uneven surfaces improves walking adaptation, which correlates with higher real-world walking activity (Sekiguchi et al. 2022, p. 7). Weight-shifting-focused balance training improves balance, postural control and symmetry (Liao et al. 2018, p. 5).

Combined rehabilitation program have been demonstrated that significance enhancement of balance, activities of daily living (ADL) performance and motor recovery (Hatem et al. 2016, p. 15). This study aims to evaluate the effectiveness of higher function training, which combines task-specific, strength, balance, and coordination exercises, on enhancing motor recovery and improving mobility and independence in individuals with chronic stroke.

1.2 Rationale

The Stroke is a significant cause of long-term disability worldwide, particularly in the context of motor impairments in the lower extremities. These impairments significantly restrict mobility and the capacity to perform daily tasks independently, thereby significantly diminishing quality of life. Higher Function Training (HFT) is a multifaceted approach that is gaining significant attention. It combines task-oriented, functional, progressive, and integrated rehabilitation techniques to specifically target the lower limb motor recovery in chronic stroke patients. The emphasis of this training is on real-world, goal-oriented movements, such as sit-to-stand, stair climbing, progressive resistance training, and walking on a variety of surfaces that are representative of common place challenges. Conventional rehabilitative interventions have tended to target single factors like strength training, balance activities, or resistance training, but the recent development of integrated higher-function training strategies demonstrates the importance of combining these into binding and gradual regimens. Most other previously existing studies are small, consider only the subacute phase, or only evaluate upper limb recovery, and there remains a gap in the understanding of the optimal intervention of chronic lower limb recovery. Although these advances have been present, there has been no substantial evidence whose evaluation of higher function training on lower extremity motor recovery has been particularly negative on patients with chronic stroke, especially in diverse settings and individuals. The purpose of this study is to address this void by conducting a systematic evaluation of the efficacy of HFT protocols that incorporate task-specific, strength, balance, and functional training exercises. The findings will furnish essential data to enhance patient independence, improve evidence based rehabilitation strategies. It is expected that the results of the current study will help to design better, more large-scale rehabilitation programs that may be customized according to the requirements of the chronic stroke patients and may eventually lead to better functional outcomes and lesser disability.

1.3 Research question

Is higher function training effective on improving lower extremity motor recovery in patients with chronic stroke?

1.4 Objectives

A. General objective

To evaluate the overall effectiveness of Higher Function Training on improving lower extremity motor recovery both experimental and control group in patients with chronic stroke.

B. Specific objective

1. To explore the socio-demographic and baseline characteristics of the participants.
2. To evaluate the effects of HFT on lower extremity motor recovery of both experimental and control group in patients with chronic stroke, using (FMA-LE) scale.
3. To investigate the benefits of HFT on activities of daily living (ADL) of both experimental and control group assessed through Barthel Index Score.
4. To assess the impact of HFT on balance of both experimental and control group in chronic stroke patients, measured by the Berg Balance Scale (BBS).

1.5 Research Hypothesis

Null hypothesis (Ho)

Higher Function Training (HFT) has no significant effect on lower extremity motor recovery, functional mobility, and balance in patients with chronic stroke compared to conventional rehabilitation.

$$\mu_1 - \mu_2 = 0 \text{ or } \mu_2 \geq \mu_1$$

Alternative hypothesis (Ha)

Higher Function Training (HFT) has a significant effect on lower extremity motor recovery, functional mobility, and balance in patients with chronic stroke compared to conventional rehabilitation.

$$\mu_1 - \mu_2 \neq 0 \text{ or } \mu_1 > \mu_2$$

Where,

Ho= Null hypothesis

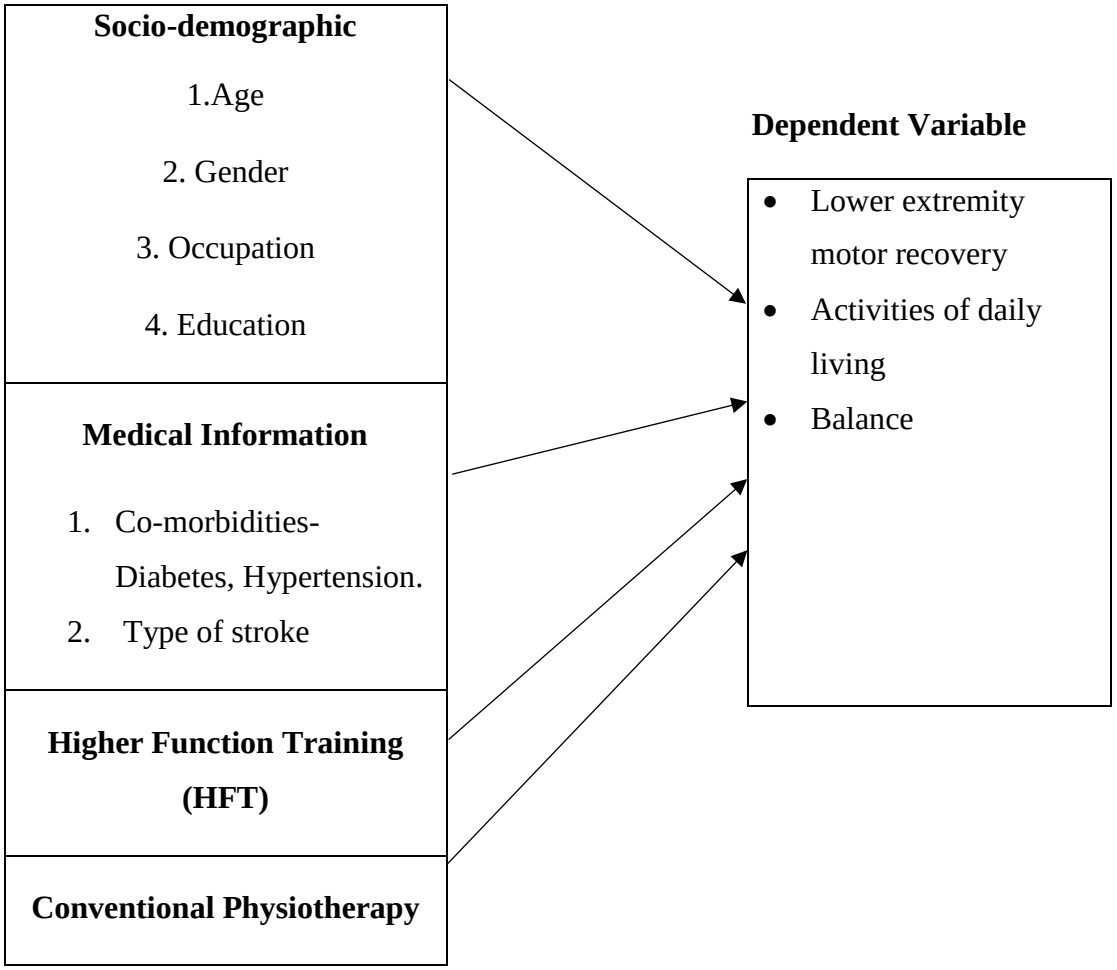
Ha = Alternative hypothesis

$\mu 1$ = Mean of experimental group

$\mu 2$ = Mean of control group

1.6 List of Variables

Independent variable



1.7 Operational definition of variables

Higher Function Training: Higher function training is a form of rehabilitation approach that concentrates on performing complex, goal-oriented, and performance specific activities resembling real life demands. It increases standard muscle strengthening or range of motion exercises with activities like sit-to-stand transfers, lateral stair climbing, balancing and weight-shifting exercises, and functional mobility training.

Functional Independence: The term functional independence describes an individual ability to safely and appropriately perform essential activities of daily living (ADLs) including self-care, mobility, communication, and engagement and does not require assistance of others.

Lower Extremity Motor Recovery: The recovery or improvement of voluntary muscle control, coordination and functional movement patterns in lower extremities and related structures following a neurological event (e.g., stroke) or musculoskeletal impairment. It also involves the recovery of ability to do simple motor tasks, such as standing, walking, stair climbing, balance and other locomotor activities that are essential to mobility and independence.

Balance Performance: Balance performance refers to an individual ability to maintain, achieve or restore a state of equilibrium during periods of maintenance of a position (e.g., standing or sitting) and dynamic activity (e.g., Walking, reaching, or stair climbing). It represents a combination of sensory-motor regulation (visual, vestibular, proprioceptive), motor control, and musculoskeletal performance which allows a person to balance the center of mass of the body within the base of support.

CHAPTER-II LITERATURE REVIEW

The stroke is one of the major causes of morbidity and mortality globally with a number of estimated 5.5 million deaths per year, and 13.7 million stroke cases and victims annually (GBD stroke collaborators, 2019, p.440). Stroke is a condition that happens when blood supply to the brain is interrupted and causes neurological loss which impairs several functions, which may include body movement, speech, and the mind. The two common forms of stroke include ischemic (induced by a blockage in blood vessel) and hemorrhagic that caused by a bleeding in brain (Kuriakose & Xiao, 2020, p. 3). Hemiparesis, gait disorder, postural instability, and reduced mobility are seen as the long-term effects of stroke, severely impairing the independence of a stroke survivor and ability to perform daily activities (Li, Francisco and Zhou 2018, p. 3).

The recovery of motor functions with aftereffects of stroke is one of the focal areas in the process of rehabilitation, and the importance is related to recovering gait and balance, which are highly impaired in the mechanisms of the neurological disturbance. In stroke survivors, an abnormal gait symmetry exists which is defined as a deviation in step length and stride of the affected and the unaffected leg. The imbalance promotes unstable and inefficient walking and exposes people to risks of falls, which is one of the most prevalent complications affecting people in the process of rehabilitation after a stroke (Hackett & Pickles 2014, p. 1020).

The Stroke continues to be a key contributor to long-term disability around the world. Post stroke survivors often have permanent lower-limb weakness, discoordination and an inability to balance and walk without problems, and the ability to move and navigate familiar environments, all factors that inhibit participation and independence. Recent stroke management guidelines recommend intensive and repetitive practice with specific tasks and purposefulness to trigger neuroplastic transformation and translate to functional recovery in the real world (Winstein et al. 2016, p. e99).

According to Pollock et al. (2014, p. 304) shows that active, repetitive and goal orientated rehabilitation has multiscale advantages and benefit in terms of balance assessment and activities of daily living (ADL), although there is a high level of effect heterogeneity and modalities. Higher function training can be conceptualized as an integrated, progressive program that combined task-oriented, functional, strengthening, balance, mobility and adaptability drills that reflect real life requirements including

complex activities such as sit to stand (STS), stair walking, obstacle on walking, resistance training (Jharbade et al. 2024, p. 10)

Walking adaptability indicates the capacity to adjust the gait to adapt to environmental demands (e.g., turns, time pressure, obstacles), which is the direct underpinning of safe ambulation in the community (Balasubramanian, Clark and Fox 2014, p. 2). Evidence increasingly separates walking capacity (clinical performance) and walking performance-according to real-world walking/movement. Closing that gap, many standard therapeutic interventions increase capacity without corresponding increases in actual walking out in the community; in that sense, adaptability-focused content holds appeal in higher function training to tie together capacity to walking in the community (Moore et al. 2022, p.13; Stretton et al. 2017, p.312).

Sit-to-stand (STS) is a fundamental movement that an individual needs in many activities like getting out of a chair or standing up after seated and beginning to take any steps. This functional movement involves complex interactions among the hip, knee, and ankle joints of the body and thus makes it a good task to train during stroke rehabilitation. Stroke patients tend to exhibit asymmetrical weight-bearing during sit-to-stand where they transport more weight with non-paretic limb as compared to the paretic one, resulting in lack of equilibrium and the inability to stand and walk. Some literature has been found to support the effectiveness of modifications to the sit-to-stand training as a positive strategy to enhance balance, symmetry and postural control in stroke patients. According to Liu et al. (2016, p. 632) obtained fifty stroke patients to undergo a randomized controlled trial (RCT) and were divided into a modified STS training group and a control group. The second intervention was to instruct patients in the experimental group that they should post paretic foot relative to the non-paretic foot during STS task, which elevated weight-bearing load on the paretic limb and The findings indicated notable differences between patients in the experimental group and the control group in the time to rise, weight-bearing symmetry, and center-of-pressure sway length (Liu et al. 2016, p.632).

Stair climbing is an important aspect of community mobility and is a key difficulty faced by stroke survivors because of unbalanced muscle strength, poor hip control, and disturbance of balance. Lateral stair walking (LSWT), which combines the activity of walking up and down a staircase with an increased focus on the lateral motion of the hips, has also gained traction as an intervention that effectively increases the strength

and balance of stroke patients. According to Huang et al. (2021, p. 12) showed that lateral stair walking training led to significant improvements on the muscle strength, motor recovery of lower extremities, walking performance and functional independence in chronic stroke patients. The analysis revealed that walking on a lateral stair was more challenging in terms of postural control, which required hip abductor muscles, and better stability (Huang et al. 2021, p. 12). This improvements were clinically meaningful, suggesting that LSWT could be a key component in a higher function training protocol for chronic stroke patient (Huang et al. 2021, p. 14).

Progressive resistance training (PRT) is a widely recognized and effective method for increasing muscle strength and mobility in stroke rehabilitation. Muscles are trained against the greatest amount of external force or load that they can manage (isometric training) or move (dynamic training) over limited amounts of repetitions, in order to overload the muscles. Moreover, the exercise is systematically advanced, such as by the amount of the resistance. (Dorsch et al. 2018, p.84). According to the study conducted by study, Vahlberg et al. (2017, p. 1619) reported that PRT that involved with progressive resistance and balance exercises resulted in significant balance and walking speed improvements in patients with stroke, and that improvements continued months after the intervention.

Additionally, the progressive protocols make sure that the strength of patients is enhanced along with their capacity to perform more involved functional movements. Besides, it has been found that PRT is highly effective in enhancing motor control and mobility in individuals who have suffered stroke through integration with tool specific work, including squat in a parallel, standing up from sitting, walking in various direction, walking over obstacles, and walking on a soft surface. The progressive nature of resistance training whereby patients are constantly challenged due to the improvement of their strength and functional abilities is another reason why resistance training plays a key part in higher-level functional training in chronic stroke patients (Dorsch et al. 2018, p. 84).

Daily ambulation often require divided attention (talking, scanning, problem solving). According to Zhang et al. (2024, p.2) demonstrated that dual task training (DDT) can improve walking performance, lower limb motor function and activities of daily living (ADL) status. Dual task training showed a remarkable enhancement in walking capacity, the lower-limb motor function, and cognitive capacity, evaluation of the

impact of stroke, mental status and activities of daily living in stroke patients which study was conducted by Mou and Jiang (2025, p. 2) in a systemic review. The obstacle-rich or augmented-reality stepping programs focus on speed in making foot-placement choices and visuomotor control. Comparative trials and protocols between treadmill-based adaptability therapy and overground obstacle courses show improvements in both walking speed and measures of adaptability, with practice volume (steps/session) proposed as a major factor (Timmermans et al. 2016, p. 8).

Recent insights into stroke rehabilitation emphasize the importance of integrated and individualized therapy programs that combine strength, combination, balance and functional task training to optimize motor recovery. According to Kwakkel et al. (2019, p. 7), there is a lack of research that combines training components into integrated protocols that reflect everyday functioning demands. The majority of studies have focused on individual components. In spite of the advances in stroke rehabilitation, little comprehensive evidence exists as to how efficient higher function training can be in supporting lower extremity motor recovery in chronic stroke. Integrated rehabilitation approaches that combine physical therapy modalities, including strength training, balance exercise, and task-specific practice improve motor function, balance and independence in activities of daily living for stroke patient (Pollock et al. 2014, p. 2).

An important part of the post-stroke rehabilitation process is to increase walking adaptability, which is adapting one gait to changing levels of environmental factors, e.g. walking on uneven surface. The study conducted by Sekiguchi et al. (2022, p. 7) investigated how walking on an uneven surface (artificial grass affected real-world walking activity) in stroke patients. Sekiguchi et al. (2022, p.7) observed a positive correlation between adjustments to the walking pattern that survivors of previous strokes had to make approaching the uneven surface to increase the length of the paretic step-that is, the length of the step on the stroke-affected side, which was associated with a greater number of steps they took on a day in a positive direction. This accuracy would probably indicate greater grounds of support and improved postural stability during locomotion.

Hemiparetic stroke patients have a hard time maneuvering an uneven surface because they cannot adequately perceive proprioceptive feedback on the affected side. This, however, indicates that chronic stroke sufferers can enhance their gait adaptivity with

the help of specific training on undulating surfaces, improving their neuromuscular physiological control and movement learning in complex conditions. The study conducted by Inui et al. (2023, p. 206) measured several key gait parameters during walking on both even and uneven surfaces, including trunk acceleration, knee flexion during swing phase, and thigh co-contraction index during the stance phase. These measures were used to understand how stroke survivors adapted their movements and stability when faced with the added challenge of walking on an uneven surface, such as artificial grass. The study also found differences in thigh co-contraction during the stance phase of gait. The high-functioning group demonstrated a reduction in co-contraction during the stance phase while walking on the uneven surface, which indicates better neuromuscular adaptation (Inui et al. 2023, p. 206).

The impairments of balance are a major effect of stroke that severely threatens functional mobility and community involvement. Such deficiencies are observable in various ways such as in the area of static balance, dynamic balance control and postural responses to disturbances. Even patients with mild stroke show long-term restrictions in balancing, with research showing twice the rate of falls than those of healthy patients and markedly poorer results on the full spectrum balance assessments (Roelofs et al. 2023, p. 795). Causes of post stroke deficits are disturbances in the sensorimotor integration processes, changes in muscle activation patterns and postural reflexes. Asymmetry of weight bearing has been especially stark since stroke patients tend to spend more weight on the non-paretic side and it becomes unstable and may give rise to falls. Stroke survivors have a significant reduction in balance confidence that causes activity restriction and consequent deconditioning (Chatterjee et al. 2018, p. 3).

HFT components collectively target gait velocity, mobility, functional independence, balance, motor recovery. Lateral stair walking training (LSWT) improves gait speed, balance, enhance timing to for rising a patient from chair, functional independence and lower extremity motor recovery (Huang et al. 2021, p. 11). Resistance and balance training accelerate comfortable walking speed, walking capacity, motor function and balance (Vahlberg et al. 2017, p. 1619). Crucially, adaptability exposure (uneven surface, obstacle) is associated with greater real world walking activity; a major translational objectives (Stretton et al. 2017, p.312; Sekiguchi et al. 2022, p. 7). Higher function training should integrate guard belts, rails, spotters and harnesses where it's necessary or indicated. Uneven surface drill requires edge markers, proper footwear

and step by step progression. Individualized modifications to fit guideline risk stratification need to be performed in patients with severe neglect, uncontrolled hypertension and cardiopulmonary limitation (Winstein et al. 2016, p. e107).

Higher function training focused on lower extremity motor recovery that can be measured by Fugl-Meyer Assessment-Lower Extremity (FMA-LE) which was applied in a study conducted by Huang et al. (2021, p. 12). For measuring the balance level or balance performance Berg Balance Scale (BBS) was applied in a study conducted by Liu et al. (2016, p. 6). Besides, for measuring the ability of activities of daily living; Barthel Index (BI) scale was used in a study conducted by Huang et al. (2021, p. 12).

In stroke survivors, there are numerous studies that highlight the immense advantages of higher functioning training interventions like a sit-to-stand activity, lateral stair climbing and progressive-resistance exercise in helping towards motor recovery, balance and gait performance of stroke survivors. Although these interventions have a solid body of evidence, there is still a need to conduct further studies in terms of short term, long-term effects, optimal dosing, and combined effects of these interventions on the mobility of the individuals. The evidence provided in this literature review indicates a comprehensive and personalized way of rehabilitation, including task-oriented activities, and balance and strength training, may be the most successful route toward enhancing community mobility and independence in patients with stroke. Development of standardized protocols and investigation of the dose-response relationships of rehabilitation interventions should be the direction of future studies to maintain the consistency and sustainability of recovery.

Several studies have demonstrated that sit-to-stand and stair-climbing exercise modalities, combined with progressive resistance training lead to significant motor functioning and balance improvements among chronic stroke patients. The analysis finds a number of research gaps. One of its most notable gaps is a limitation in longitudinal follow-up, thus necessitating research that includes longer post-intervention follow-ups to determine the maintenance of rehabilitative improvements. There is also need for more research on the combined effects of different rehabilitation process. Furthermore, research should consider the impact of HFT on stroke patients with various severities of motor impairment, as this could provide insights into the most effective rehabilitation strategies for different subgroup. Lastly, economic analyses are necessary. Future research should evaluate the cost-effectiveness of HFT compared

with the traditional physiotherapy and the possibility of its application into everyday clinical practice.

CHAPTER- III METHODOLOGY

3.1 Study Design

This study design was a Randomized Controlled Trial (RCT) study. The research investigated the effectiveness of Higher Function Training on lower extremity motor recovery among Patient with Chronic Stroke.

3.2 Study Area

The area of the study was Pain-Paralysis Specialised & General Hospital at Manikganj.

3.3 Study Place

The study was conducted at Saic College of Medical Science and Technology (SCMST) at Mirpur-14, Dhaka-1216.

3.4 Study Period

Study period was one year (June 2024 to July 2025)

3.5 Study Population

The population of the study was patients with stroke of the Pain-Paralysis Specialised & General Hospital.

3.6 Sample Size

$$n = \frac{2\sigma^2 \left(\frac{z\alpha}{2} + z\beta\right)^2}{\Delta^2}$$

$$= \frac{2 \times 4.2 \times (1.96 + 0.84)^2}{(1.8)^2}$$

$$= \frac{2 \times 4.2 \times 7.84}{3.24}$$

$$= \frac{65.856}{3.24}$$

$$= 20.32$$

Here,

σ^2 = variance of the outcome measure = 4.2. (Huang et al. 2021, p. 13)

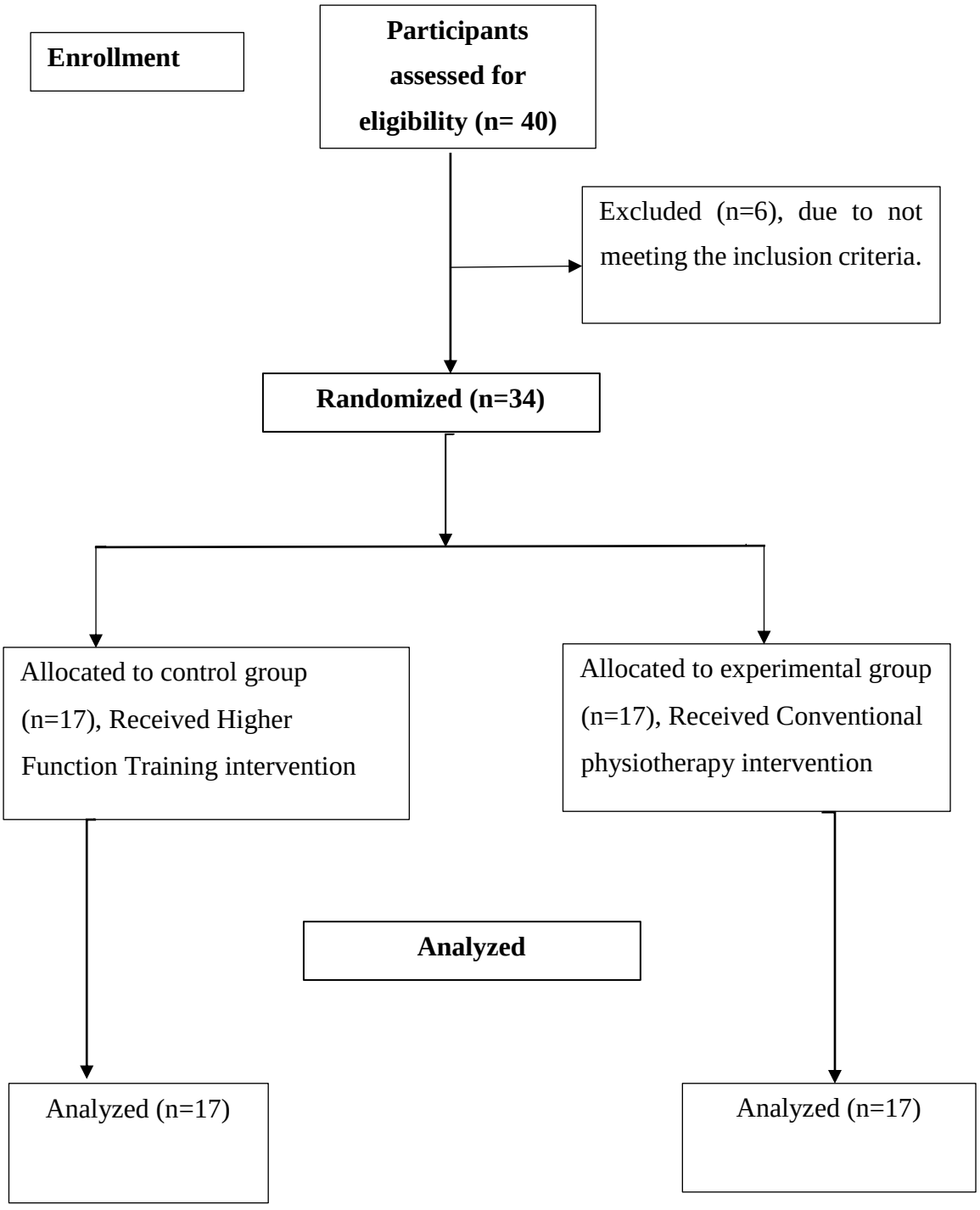
Δ= Mean difference (1.8) (Huang et al. 2021, p. 13)

$Z\alpha/2$ = For a 5% significance level ($\alpha = 0.05$, two-tailed) = 1.96

$Z\beta = (1 - \beta)$, for 80% power ($\beta = 0.20$) = 0.84

n = Sample size for one group

3.7 CONSORT (Consolidated Standards of Reporting Trails) Flow Chart



3.8 Sample Selection

Participants were selected based on inclusion criteria relevant to the study's objectives. A total of 34 participants who met these criteria were included in the study.

3.9 Sampling Technique

Convenience sampling technique was adopted to select the patient with stroke from Pain and Paralysis Specialised Hospital at Manikganj. Then screening of the patients was done on basis of inclusion criteria. The patients were included who met the inclusion criteria. Therefore, simple random sampling by lottery method was used to allocate the participants into experimental and control group.

3.10 Eligibility Criteria

3.10.1 Inclusion Criteria

1. Adults aged 40-60 years.
2. Clinically diagnosed hemorrhagic or ischemic stroke occurring at least 3 month before enrollment. (Maje and Ibrahim 2023, pp. 3)
3. Exhibiting residual lower limb motor dysfunction like weakness, poor balance.
4. Medically stable considered by general practitioner. (Vahlberg et al. 2017, p. 1616)
5. Participant must be willing to give informed written consent (Vahlberg et al. 2017, p. 1616)

3.10.2 Exclusion Criteria

1. Presence of neurological conditions like Dementia (Liao et al. 2018, p. 3; Vahlberg et al. 2017, p. 1616)
2. Major orthopedic surgery or actual orthopedic condition interfering locomotion (Sekiguchi, Honda and Izumi 2022, p. 3)
3. Cognitive or visual impairment (Huang et al. 2021, p. 11)
4. Severe communication problem (Vahlberg et al. 2017, p. 1616).

3.11 Method of Data Collection

3.11.1 Technique of data collection

Face to face formal interview technique was used to collect data from the selected patients with Stroke.

For determination of balance level, the Berg balance scale was used; for independence level, the Barthel Index Scale; and for lower extremity motor recovery, the Fugl-Meyer motor recovery scale to collect data from the selected patients with stroke.

3.11.2 Instrument of Data Collection

The main data collection tool used was a pretested structured questionnaire. The questionnaire itself was organized into multiple sections. The first part had questions on the identification of the patients whereas the second part covered the sociodemographic data. The third part included items of the Berg Balance Scale (BBS) concerning functional balance. The fourth section was Barthel Index to assess independence on activities of day to day living. The fifth section had the contents of Fugl-Meyer Assessment (FMA-Lower Extremity subscale) to assess motor recovery of lower extremity. All instruments to be used are standardized, internationally recognized, and validated in order to establish reliability and validity in the evidenced collected.

3.12 Tools for Data Collection

In this particular study, a written questionnaire, Standard neurological reflex hammer were used.

3.13 Data Collection Procedure

Out of the 40 patient, 40 cases of Stroke were selected from the outpatient services of Pain-Paralysis Specialised & General Hospital at Manikganj. Patient were screened and thus 6 patients were excluded on basis of the exclusion criteria. The 34 patients were allocated by randomization to experimental and control groups thereafter. Higher function training was done in experimental group and usual physiotherapy was done in control group. 17 patients were in the experimental group and the same number of patient were in control group. Twenty session of the treatment were completed by every patient in both groups. Balance level, activities of daily living (ADL) level, and Lower extremity motor assessment data was collected and that information viewed as pretest data. For the present intervention both higher function training and conventional physiotherapy was given for experimental group. Conventional physiotherapy was given for control group only. Both group receive similar 20 session. Berg Balance Scale was used for collecting information about balance, Barthel Index Scale for activities in daily living, Fugl-Meyer Assessment for lower extremity motor recover after completion of the intervention. Post test data of 34 Stroke patients have been regarded as information after the intervention. The researcher thanked the participants after the interview.

3.14 Intervention

<table>
<tr><td>Experimental Group (Received 4 weeks and 20 sessions of Higher Function Training with conventional physiotherapy)
Duration: 45 minute</td><td>Control group (Received 4 weeks and 20 sessions of conventional physiotherapy)
Duration: 45 minute</td></tr>
<tr><td>• Modified Sit to stand training- 10 minutes, 5 times a week (Affected foot always place behind the non-paretic foot) (Lie et al. 2015, p.4)</td><td rowspan="3">• Traditional Physiotherapy
1. Sit to stand training- 10 minutes, 5 times a week
2. Strengthening exercise of the affected side
3. Balance training
4. Gait training
5. Activities of daily living (ADL) training</td></tr>
<tr><td>• Lateral stair climbing - 10 minutes (Affected leg first for ascending) (Huang et al. 2021, p. 11)</td></tr>
<tr><td>1. Progressive resistance training: Warm up (cycling) - 10 minutes
High intensity functional exercise: (10) repetition for 15 min. Individual using belt around their waist (loaded weight range 1-12kg)
2. Squat in a walking stance
3. Body weight transfer in a walking stance
4. Standing up from sitting in a walking stance
5. Side and forward lunge
6. Walking forward in tandem gait
7. Walking in various direction
8. Walking with turns
9. Walking over obstacles
10. Walking on a soft surface
(Vahlberg et al. 2017, p. 1616)</td></tr>
</table>

Figure1

Figure2

Figure 3

Modified sit to stand programme: In experimental group, the affected foot was always placed behind the non-paretic foot. Figure 1 shows the non-paretic foot placed at 5° of dorsiflexion, figure 2 shows 10° of dorsiflexion and figure 3 shows 5° of dorsiflexion. In control group, affected foot and non-paretic foot was placed in similar position.

Lateral Stair Walking: The experimental group performed lateral stair walking training using different stair heights according to the patients' ability. The patients ascended the stairs using the affected leg first and descended with the unaffected leg first. For safety purposes, patient can held a handrail or therapist can assist during the lateral stair walking exercise.

3.15 Data Analysis

The statistical analysis was conducted using Statistical Software, e.g., SPSS version 22, MS Excel. Descriptive statistics were used to analyze the pretest and posttest values. To determine pre test and post test intervention between groups, Mann Whitney U test was used and to assess pre test and post test intervention within the group Wilcoxon Signed Rank test was used. The bar diagram and chart use Microsoft Excel 2013.

3.16 Statistical Significance

A p-value of <0.05 was considered significant, indicating that observed differences were unlikely due to chance.

3.17 Informed consent

Informed consent was given to all respondents before filling in the questionnaire in written form. The researcher explained the role of the participants in this study. A written consent form was signed and returned by each participant, including a signature or finger trip for those who could not give a signature, or a witness signature. Thus, the participants were ensured that they understood the consent form and their participation was based on a purely voluntary basis. The subject gave consent for this research. As such, an Informed consent form was signed by each of the patients. The participants were made aware that they had a right to consult an outdoor doctor if they felt the treatment would not be able to keep the condition under control, or if the condition deteriorated. They were also informed that at any point during the study, they could decline to answer any question and were free to withdraw their consent and terminate participation. Every participant was allowed to take up their issue with the higher authority or administration of Pain Paralysis Specialized Hospital and their concerns were answered to the satisfaction.

3.18 Ethical Considerations

Strict adherence to ethical guidelines is paramount in this study. A formal project proposal has been submitted to the Department of Physiotherapy at Saic College of Medical Science and Technology (SCMST), and approval has been obtained from the Institutional Review Board (IRB) of SCMST to conduct the study. This study follows the guidelines set forth by the World Health Organization (WHO) and Bangladesh Medical Research Council (BMRC), ensuring the confidentiality of participant information at all times. Permission to collect data has been obtained from the study area authorities. Participants will be fully informed about the aims and objectives of the study before consenting to participate. Written consent will be obtained from each participant, and the process will be explained verbally as well. Participants will be assured of the confidentiality of their information, which will only be shared with the research supervisor. Participants will be informed of their rights, including the option to withdraw from the study at any time without consequences. To protect anonymity, participant names and addresses will not be used; instead, participation numbers will be assigned in all notes and transcripts. It will be made clear that information gathered may be presented in presentations, seminars, or written papers, but in a way that ensures no identification of individuals and poses no harm to them. Participants will be assured of their right to discuss any concerns related to the study with senior authorities. The ethical standards upheld in this study aim to protect participant welfare while maintaining the integrity and confidentiality of the research process.

CHAPTER- IV RESULTS

A total of 34 individuals were used in this study to examine effectiveness of higher function training to lower extremity motor recovery among Patient with Chronic Stroke The following paragraphs provide a summary of the investigation's findings.

Baseline characteristic

Table 4.1 Baseline Characteristics of Experimental (HFTG) and Control (CPG):

Variable	Experimental (HFTG)	Control (CPG)
	Mean± SD	
Age	55.53±10.846	65.94±14.14
Pre_ Barthel_score	34.41±28.498	25.59±25.913
Pre_BBS_score	20.82±15.308	13.88±15.712
Pre_Fugl_score	10.18±7.908	7.18±3.795

The mean age of participants in the experimental group (HFTG) was 55.53±10.85 years while that of the control group (CPG) was 65.94±14.14 years, showing a statistically significant difference. Regarding the baseline functional scores, the mean Barthel Index score was (34.41±28.49) in the experimental group and (25.59±25.91) in the control group (P = 0.347). The mean Berg Balance Scale (BBS) score was higher in the experimental group (20.82±15.308) compared to the control group (13.88±15.71). Similarly, the mean Fugl-Meyer lower extremity motor score was (10.18±7.908) in the experimental group and (7.18±3.795) in the control group. Overall, except for age, no statistically significant differences were found between groups in terms of baseline continuous variables, indicating general comparability of both groups prior to intervention.

Table 4.2: Sociodemographic information of Experimental and Control group

Variable	Experimental (HFT) n(%)	Control (Conventional) n(%)
Age Category		
35 - 55 years	7(41.2)	5(29.4)
56 – 75 years	10(58.8)	6(35.3)
76 - 95 years	0(0.0)	6(35.3)

The majority of participants in the experimental group were between 56-75 years (58.8%), whereas in the control group were between 56-75 years (35.3%). The control group participant were more evenly distributed across 56-76 years (35.3%) and 76-95 years (35.3%). There were no participants in experimental group between 76-95 years (0.0%).

Gender		
Male	8(47.1)	13(76.5)
Female	9(52.9)	4(23.5)

Gender distribution was relatively balanced in the experimental group (47.1% male and female 52.9%), while the control group had a higher proportion of males (76.5%).

Living area		
Urban	4(23.5)	4(23.5)
Rural	13(76.5)	13(76.5)

Most participants resided in rural areas (76.5%) in both experimental and control group.

Marital status		
Married	17(100.0)	17(100.0)

All participants in both experimental and control group were married (100%)

Educational Qualification		
Illiterate	5(29.4)	7(41.2)
primary	4(23.5)	4(23.5)
Secondary	0(0.00)	1(5.9)
HSC	2(11.8)	3(17.6)
Graduated	6(35.3)	1(5.9)
Post Graduated	0(0.00)	1(5.9)

In terms of educational qualification, illiteracy was common in both groups (29.4% and 41.2%), with a small number attaining graduation or higher. Secondary level and post-graduation was absent in experimental group (0.00%).

Monthly income		
<10k	5(29.4)	2(11.8)
10K - 20K	5(29.4)	8(47.1)
21 K - 30K	3(17.6)	4(23.5)
>30 K+	4(23.5)	3(17.6)

The majority of the participants in control group were between 10k-20k monthly incomes (47.1%).

Family type		
Nuclear	10(58.8)	10(58.5)
Extended	7(41.2)	7(41.2)

Family structure was almost evenly divided between nuclear and extended families (58.8% and 41.2% in both groups).

Occupation		
Service holder	3(17.6)	0(0.00)
Teacher	0(0.00)	2(11.8)
Farmer	1(5.9)	6(35.3)
Business	1(5.9	2(11.8)
Housewife	7(41.2)	4(23.5)
Banker	2(11.8)	0(0.00)
Retired	1(5.8)	1(5.9)
Labor	0(0.00)	1(5.9)
Others	2(11.8)	1(5.9)

Occupational backgrounds varied, with housewife (41.2%) and service holders (17.6%) being more common in the experimental groups, while farmers (35.3%) predominant in the control group.

4.3 Frequency distribution of participants:

4.3.1: Age distribution of Participants

Based on the age distribution of the subjects, it was found that this was the greatest subgroup with nearly half of the sample (47.06%) falling into the 56-75 years category. Only (17.65%) were over the age of 76 years (76 to 95 years old), whereas (35.29%) were in the younger age group (35 to 55 years old). This trend shows the prevalence of middle age and old-aged individuals in the study; this is in line with the natural distribution of stroke since the risk of stroke amplifies tremendously with age. A small sample in the 76-95 years age group might provide a constraint in learning more about recovery pattern in the oldest survivors of stroke. Therefore, the results may be regarded as representative of middle-aged and early-elderly groups, but might not correspond completely to such very elderly patients as the ones studied.

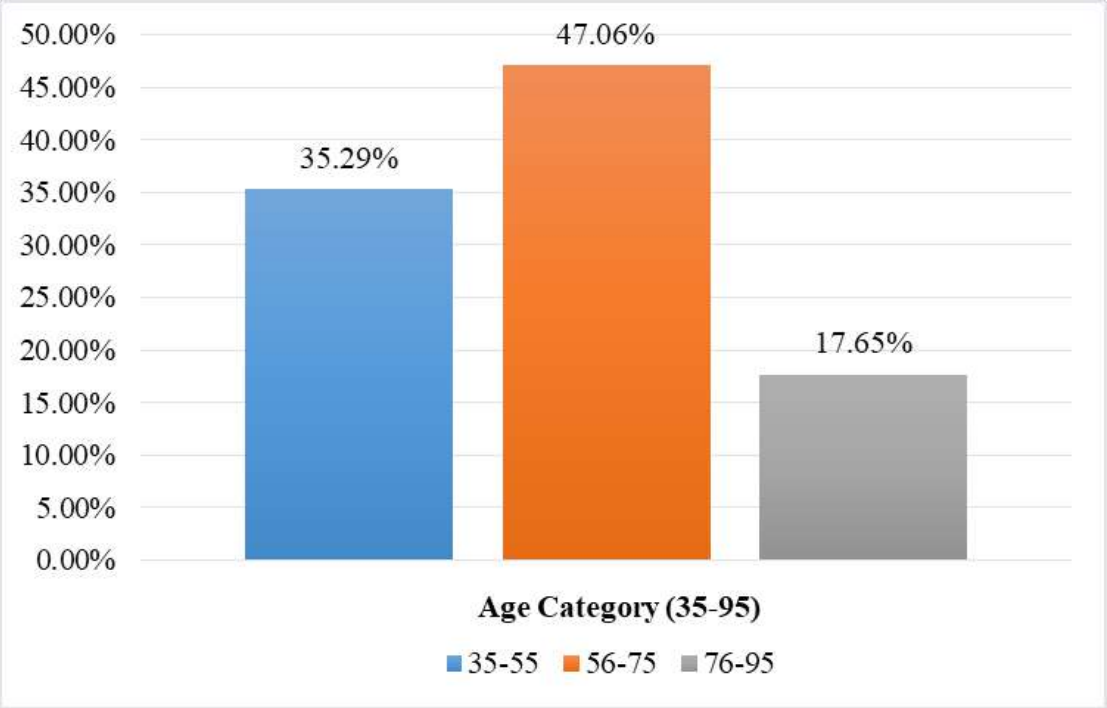


Figure no 1: Age distribution of the Participants

4.3.2: Gender distribution of participants.

The gender demographics indicate a high percentage of men (61.76%) as respondents, whereas the women proportionate are lesser (38.24%). This imbalance indicates that a higher number of men was recruited or influenced in the setting of the study. This representation could be reflected by some epidemiological studies that report slightly more incidences of stroke in men compared to women. Nevertheless, because of biological, social, and caregiving challenges, women may encounter unique difficulties in recovery after stroke. With an underrepresentation of female participants, results might tip the balance because gender-related differences in motor recovery may not be fully accounted. Thus, it is possible to improve the situation by creating a more equal gender ratio in the future.

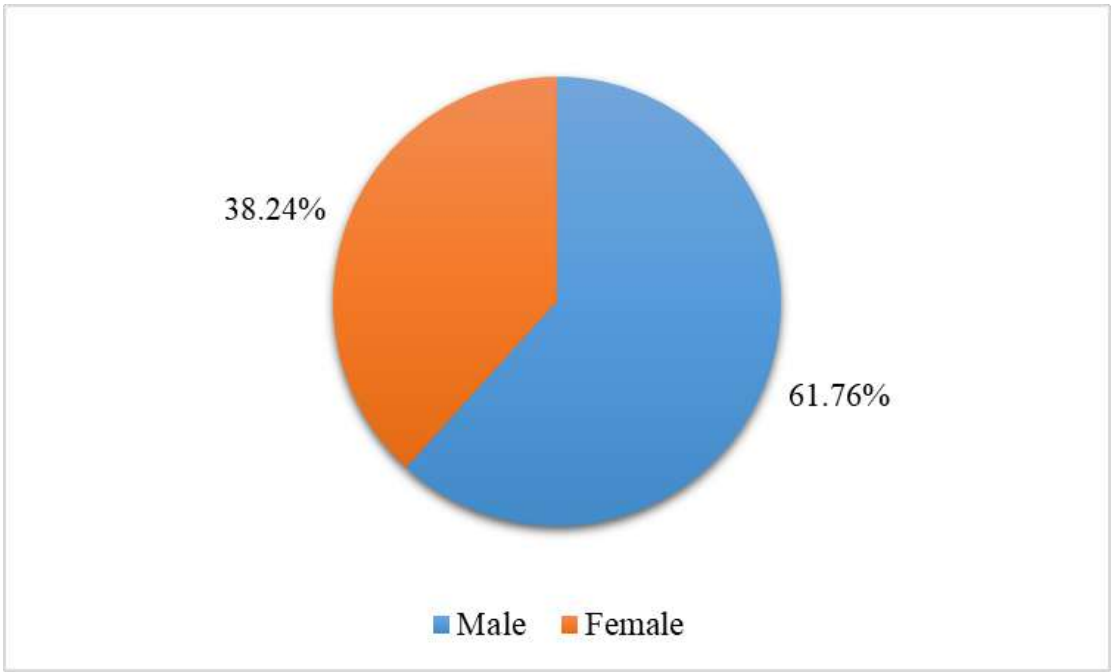


Figure no 2: Gender distribution of participants.

4.3.3: Living area distribution of participants

Most of the participants (76.47%) lived in the countryside, whereas (23.53%) lived in urban areas. This implies that the sample population of stroke patients in the study were majorly rural-based, which could indicate a healthcare access and awareness obstacle, as well as a lack of rehabilitation opportunity. This means that their results can be more applicable to rural populations as opposed to urban communities.

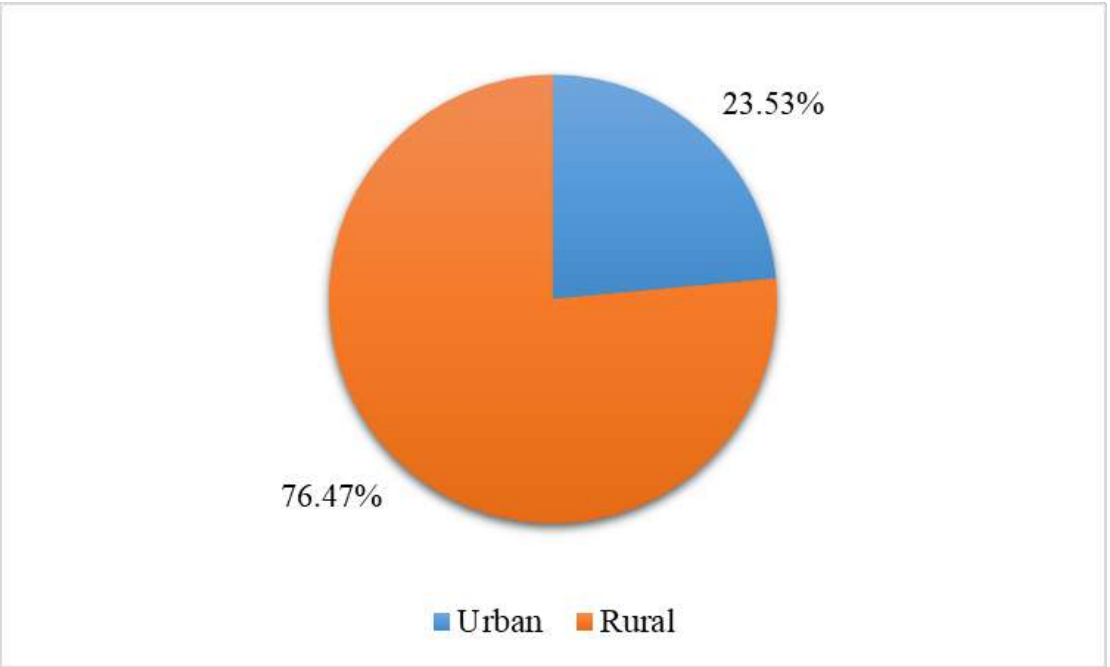


Figure no 3: Living area distribution of participants.

4.3.4: Educational qualification distribution of participants

The participants will demonstrate their educational status which showed that Illiterate people were the largest subgroup (35.29%), followed by primary education (23.53%). Hardly any had secondary (2.9%) or higher secondary education (14.71%), with graduates making (20.59%) and a mere (2.94%) having a postgraduate level education. The educational background also plays a significant role in the rehabilitation process because it may affect health literacy, knowledge of treatment, and compliance with treatment. The prevalence of lower-educated participants also implies that approaches to reach and treat them need to be approached in a low-gate way that will be effective in such groups.

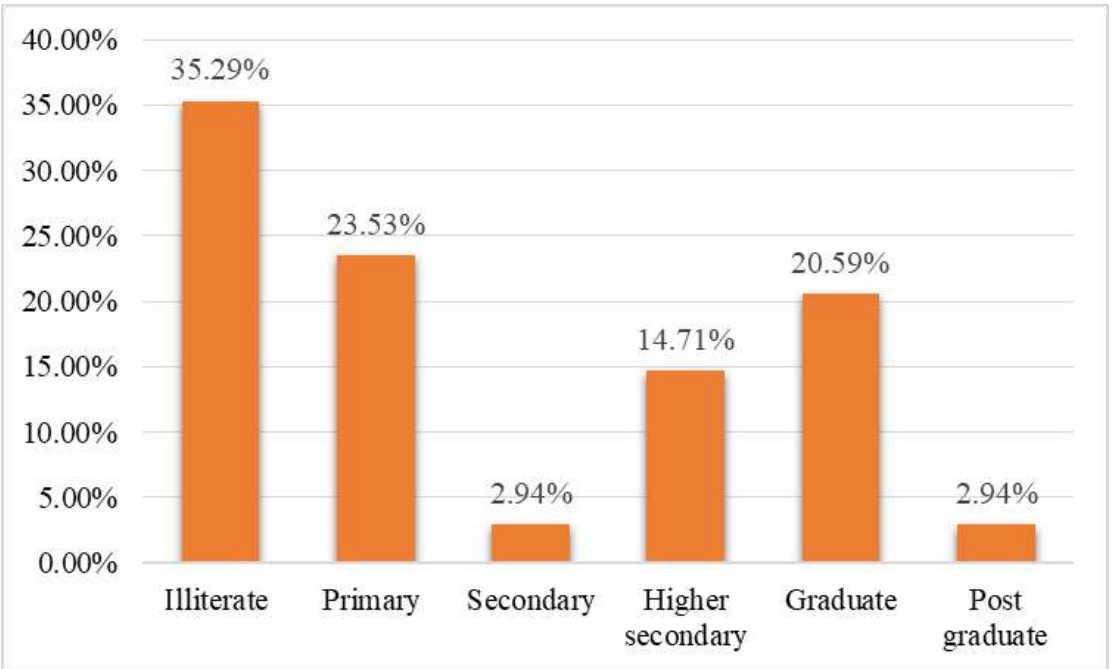


Figure no 4: Educational qualification distribution of participants

4.3.5: Monthly income distribution of participants

The incomes level of participants in the family as the part of the total income distribution shows that most were from low categories as far as income levels are concerned. Approximately 29.4 percent of them were getting less than 10,000 BDT and other 29.4 percent between 10,000 to 20,000 BDT. By contrast, 17.6 percent of them had incomes of 20,000-30,000 BDT and 23.5 percent of them had over 30,000 BDT monthly. Financial wellbeing might also have a considerable impact on stroke rehabilitation, since it interferes with the availability of specialized care, supportive equipment and long-term treatment.

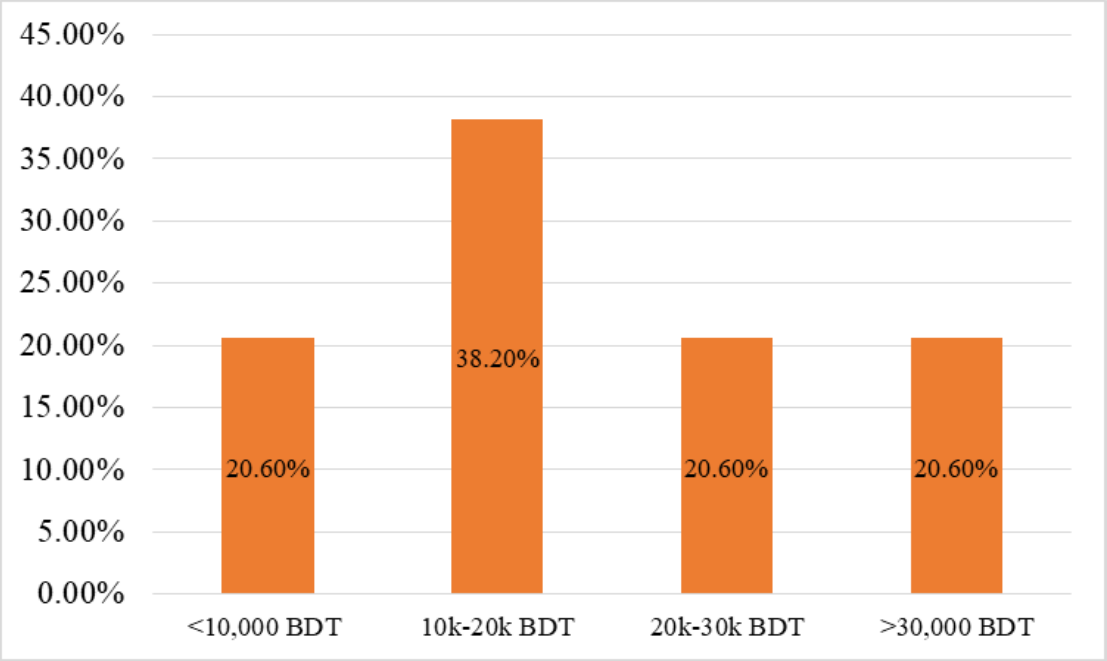


Figure no 5: Monthly income distribution of participants

4.3.6: Marital status distribution of participants

In this study all the respondents were married (100%). Although this does not offer any variance to make a comparison, it also implies that most of the participants must have had spousal support throughout their recovery. It may have a beneficial effect on the compliance to therapy and emotional wellbeing.

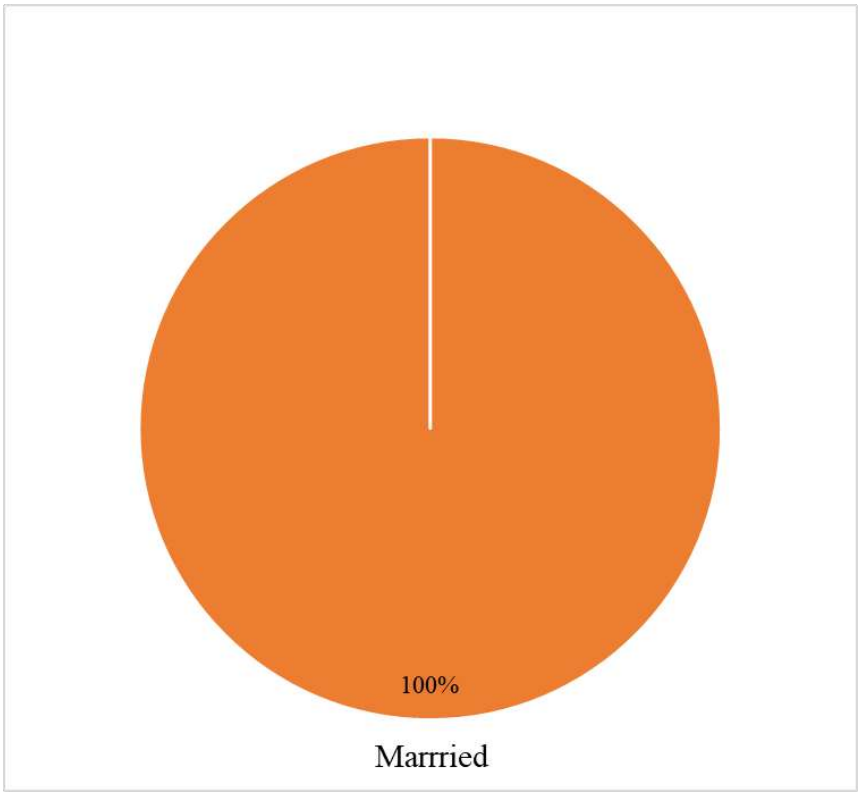


Figure no 6: Marital status distribution of participants

4.3.7: Family type distribution of participants

There was a relatively balanced type of family structure. The majority of the participants (58.8%) belonged to nuclear families, and 41.2 percent of them belonged to extended families. Family type could be a factor in rehabilitation because the larger extended family can offer more resources of caregivers, and physical support, whereas the nuclear family might offer spousal involvement that is closer. The two systems have their own advantage but the distribution in this instance implies that most people depended on small family set ups.

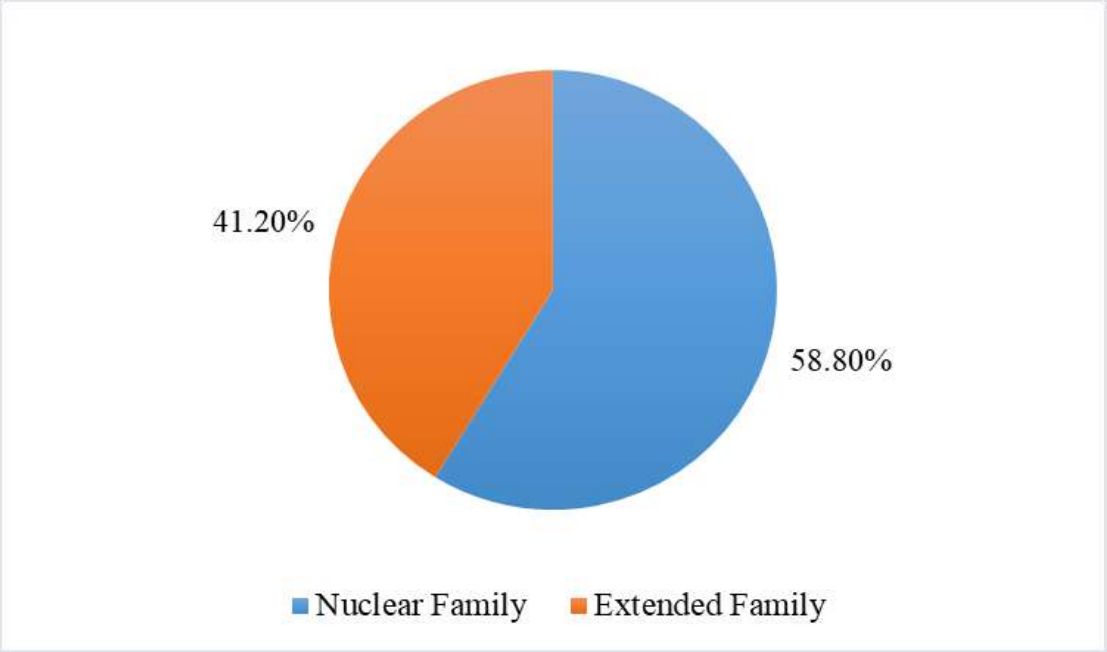


Figure no 7: Family type distribution of participants

4.3.8. Occupation of participants

According to the occupation distribution, housewives (32.40%) figured the biggest portion with farmers (20.60%) taking the second position. The number of business owners, service holders, and other occupations constituted 8.80 percent of the sample. Less significant percentages were noted concerning teachers, the bankers, and the retired persons (5.90% each) and the lowest percentage was the laborers (2.90%). This distribution of occupations implies that the study population was mainly non-formal and agricultural sectors and many of the participants did not have a high volume of structured physical activity, prior to their stroke. This may affect the rehabilitative service requirements, since strategies may have to be more task oriented involving more home care or farm related activities.

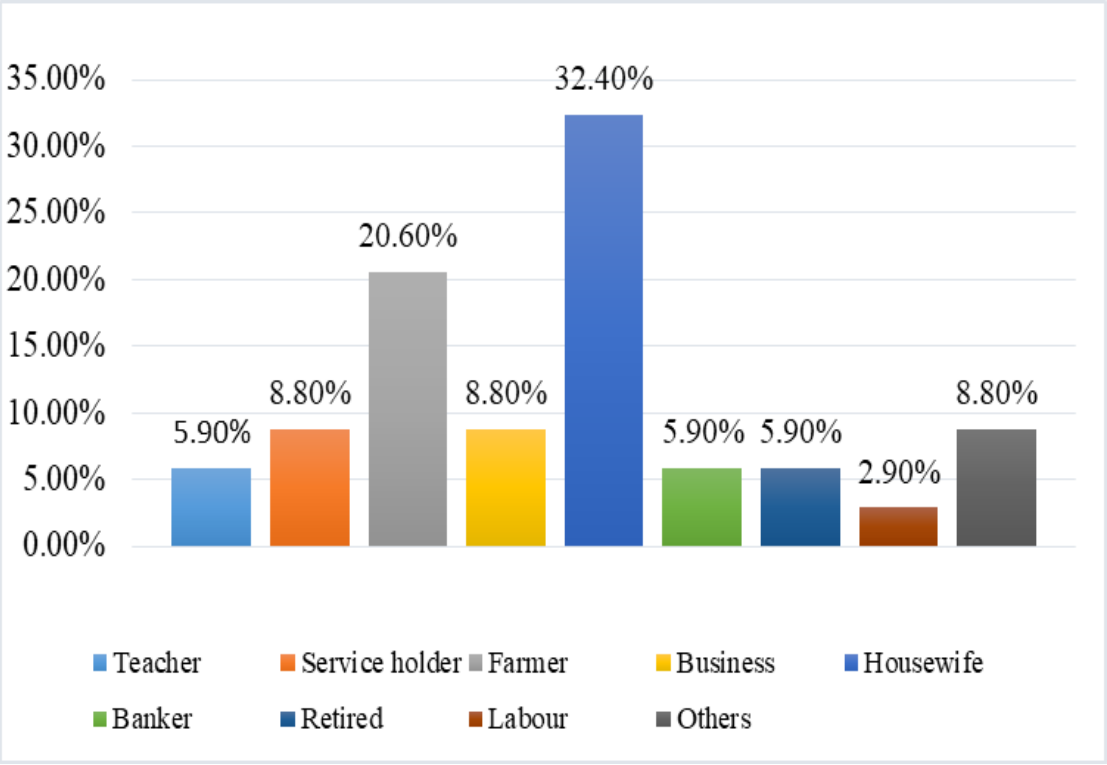


Figure no 8: Occupation of participants

4.4. Between group comparison of ADL (Post BI):

Difference between Barthel Index scale	Category of the participants	N	Mean Rank	Sum of Ranks	Mann Whitney U Score	P
	Experimental	**17**	**19.21**	**326.50**	**115.500**	**0.314**
	Control	**17**	**15.79**	**268.50**		
	Total	**34**				

The Mann-Whitney U test had been applied to compare the difference in Barthel Index values between the experimental and control groups. The experimental group (n = 17) had a mean rank of 19.21 and a total rank of 326.50, and the control group (n = 17) had a mean rank of 15.79 and a total rank of 268.50. The Mann-Whitney U value was 115.50, resulting in a p-value of 0.314.

Since the p-value is greater than 0.05, these findings show that there is no statistically significant difference in the improvement of Barthel Index scores between the experimental and control groups. This means that, while both groups demonstrated functional improvement, the degree of improvement was comparable.

4.5. Between group comparison of Balance (Post BBS):

Difference between Berg Balance Test	Category of the participants	N	Mean Rank	Sum of Ranks	Mann Whitney U Score	P
	Experimental	**17**	**19.68**	**334.50**	**107.500**	**0.196**
	Control	**17**	**15.32**	**260.50**		
	Total	**34**				

The Mann-Whitney U test had been applied to compare the difference in Berg Balance Test scores between the experimental and control groups. The experimental group (n = 17) had a mean rank of 19.68 and a total rank of 334.50, and the control group (n = 17) had a mean rank of 15.34 and a total rank of 260.50. The Mann-Whitney U value was 107.50, resulting in a p-value of 0.196.

Since the p-value is greater than 0.05, these findings show that there is no statistically significant difference in the improvement of Berg Balance Test scores between the experimental and control groups. This indicates that while both groups enhanced their balance, this level of improvement was similar for both.

4.6. Between group comparison of Motor Recovery (Post FMA-LE):

Difference between FUGL MEYER Score:	Category of the participants	N	Mean Rank	Sum of Ranks	Mann Whitney U Score	P
	Experimental	17	22.35	380.00	62.00	0.004
	Control	17	12.65	215.00		
	Total	34				

The Mann-Whitney U test had been applied to compare the difference in Fugl-Meyer scores between the experimental and control groups. The experimental group (n = 17) had a mean rank of 22.35 and a total rank of 380.00, and the control group (n = 17) had a mean rank of 12.65 and a total rank of 215.00. The Mann-Whitney U value was 62.00, resulting in a p-value of 0.004.

The p-value is less than 0.05, which means that there is a statistically significant difference in the Fugl-Meyer scores between the control group and the experimental group. Compared to the control group, this result shows that the experimental group made a large improvement in their motor recovery.

4.7. Within group comparison of ADL for experimental group (Post BI):

Post test – Pre test Barthel Index score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.627	0.000
Positive Rank	17	9.00	153.00		
Ties	0				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in Barthel Index outcomes for the experimental group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The test statistic produced a Z value of -3.627 and a p-value of 0.000 ($p < 0.05$), signifying a statistically significant enhancement in Barthel Index values in the experimental group post-intervention. This indicates that the experimental group had significant improvements in their activities of daily living (ADL) function following the intervention.

4.8. Within group comparison of ADL for control group (Post BI):

Post test – Pre test Barthel Index score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.631	0.000
Positive Rank	17	9.00	153.00		
Ties	0				
Total	17				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in Barthel Index outcomes for the control group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The Wilcoxon test result indicated a p-value of 0.000 ($p < 0.05$) and a Z value of -3.631. The control group's Barthel Index scores demonstrated a statistically significant improvement, indicating that participants showed improved functional independence post-intervention, even in the absence of the experimental intervention.

4.9. Within group comparison of Balance for experimental group (Post BBS):

Post test – Pre test Berg Balance score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.624	0.000
Positive Rank	17	9.00	153.00		
Ties	0				
Total	17				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in Berg Balance outcomes for the experimental group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The test statistic produced a Z value of -3.624 and a p-value of 0.000 ($p < 0.05$), signifying a statistically significant enhancement in Berg Balance values in the experimental group post-intervention. This indicates that the experimental group had significant improvements in balance ability following the intervention.

4.10. Within group comparison of Balance for control group (Post BBS):

Post test – Pre test Berg Balance score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.653	0.000
Positive Rank	17	9.00	153.00		
Ties	0				
Total	17				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in Berg Balance outcomes for the control group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The Wilcoxon test result indicated a p-value of 0.000 ($p < 0.05$) and a Z value of -3.653. The control group's Berg Balance scores demonstrated a statistically significant improvement, indicating that participants showed improved balance ability in post-intervention, even in the absence of the experimental intervention.

4.11. Within group comparison of Motor recovery for experimental group (Post FMA-LE):

Post test – Pre test FUGL MEYER score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.626	0.000
Positive Rank	17	9.00	153.00		
Ties	0				
Total	17				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in FUGL MEYER outcomes for the experimental group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The test statistic produced a Z value of -3.626 and a p-value of 0.000 ($p < 0.05$), signifying a statistically significant enhancement in FUGL MEYER score in the experimental group post-intervention. This indicates that the experimental group had significant improvements in motor recovery following the intervention.

4.12. Within group comparison of Motor recovery for control group (Post FMA-LE):

Post test – Pre test FUGL MEYER score	N	Mean Rank	Sum of Rank	Wilcoxon signed rank test based on Z rank	P- Value
Negative Rank	0	0.00	0.00	-3.630	0.000
Positive Rank	17	9.00	153.00		
Ties	0				
Total	17				

The Wilcoxon Signed Rank Test was performed to evaluate the within-group difference in Fugl Meyer outcomes for the control group (n = 17). The results indicated 0 negative ranks, signifying that no participant's functional score was reduced from pre-test to post-test. 17 positive ranks were observed, indicating enhancements among all individuals, with no ties present. The average rank for positive ranks was 9, with a total rank sum of 153, but negative ranks were entirely absent.

The Wilcoxon test result indicated a p-value of 0.000 ($p < 0.05$) and a Z value of -3.630. The control group's Fugl Meyer score demonstrated a statistically significant improvement, indicating that participants showed improved balance ability in post-intervention, even in the absence of the experimental intervention.

CHAPTER-V DISCUSSION & LIMITATIONS

5.1 Discussion:

The current research involved 34 participants, and the gender, residential environment, and the family composition were similar between the experimental and control groups. Whereas most of the participants lived in the rural region (76.5%), no statistically different demographic differences occurred between both groups. However, the mean age was lower in the experimental group (HFT) (55.53 ± 10.85) than that in the control group (65.94 ± 14.14), which was statistically significant. This age discrepancy might be given impact on the overall results, as age-related factors impact stroke recovery in course. The study mostly looked at the use of lower extremity motor recovery and functional mobility and balance. Higher Function Training (HFT) was administered to the experimental group, and traditional physiotherapy to the control group.

A valid assessment of lower extremity motor function, the Fugl-Meyer score, showed a statistically significant difference in changes of the experimental group better ($p = 0.004$), indicating that HFT was more effective than traditional physiotherapy in helping achieve motor recovery. Such results support the hypothesis that HFT through a combination of task-specific, strength, balance, and coordination activities may have had a significant positive effect on the motor recovery of chronic stroke survivors. According to the Huang et al. (2021, p. 11) study demonstrated that by applying lateral stair walking enhance motor recovery but didn't show significance in difference between experimental and group where ($P = 0.772$).

Although in both groups, functional independence according to the Barthel Index improved, no statistically significant difference was found between the two groups ($p = 0.314$). The implications of this finding are that whereas all of the interventions can positively impact the state of activities of the daily life (ADL), HFT does not necessarily have a significantly greater effect in this area as compared with the traditional physiotherapy. According to the Huang et al. (2021, p. 11) study demonstrated that by applying lateral stair walking enhance the state of activities of the daily life through Barthel Index (BI) which shows significant difference between experimental and control group ($P = 0.039$).

Although in both groups, functional independence according to the Barthel Index improved, no statistically significant difference was found between the two groups ($p = 0.314$). The implications of this finding are that whereas all of the interventions can positively impact the state of activities of the daily life (ADL), HFT does not necessarily have a significantly greater effect in this area as compared with the traditional physiotherapy. The perceived inferiority could be explained by reverse orientation to ADL features of the Barthel Index as opposed to the determination of motor performance on the basis of lower-enhanced motor tasks.

In this study, both experimental and control groups showed significant balance improvement as established by the Berg Balance Scale (BBS) ($p < 0.05$). Nonetheless, slightly higher improvements were observed in the experimental group (mean rank =19.68) compared with the control (mean rank =15.32), but the difference was not found to be statistically significant ($p =0.196$). Both interventions showed positive effects on balance, but it can be inferred that the systematizing quality of the HFT intervention does not suggest a significantly strong benefit or advantage over traditional physiotherapy with regards to the balance recovery process. According to the Liu et al. (2016, p. 632) demonstrated that frontal stair training can improve balance performance measured by Berg Balance Scale which indicate significant result for both different and within group comparison ($P = 0.003$) and ($P = 0.000$). Another study conducted by Seo, Park and Park (2015, p. 1461) indicate that sit to stand training can improve balance performance where significant level of group difference ($P = <0.05$). The age factor was also found to have great influence on the recovery process since better gains were recorded in the younger group of the experimental group. This is consistence with existing literature that younger stroke survivors generally experience more substantial functional recovery.

5.2 Limitations of this Study:

- Small sample size: The participant sample which was used in the study was very small (only 34 patients), which limited the applicability of the results to the wider population of patients with chronic stroke.
- Age imbalance: There was also statistically significant age difference between the experimental and control groups; such differential factor might have influenced results because younger participants tend to recover faster.
- Gender Imbalance: The control group had a higher proportion of males (76.5%), whereas the experimental group was more balanced. This uneven distribution may affect the generalizability of results, especially gender related differences in stroke recovery.
- Absence of follow up: Lack of post intervention follow up means that the sustainability of the improvements observed in motor function, balance, ADL remains uncertain.
- Limited outcome measure: While Fugl-Meyer, Barthel Index, Berg Balance Scale were used, other aspect of motor function such as gait adaptability, quality of life were not assessed.

CHAPTER- VI CONCLUSION & RECOMMENDATIONS

6.1 Conclusion:

The study aimed to evaluate the effectiveness of Higher Function Training (HFT) in improving lower extremity motor recovery, balance and functional independence in patient with chronic stroke. The result indicate that while both HFT and conventional physiotherapy lead to significant improvements in balance and activities of daily living (ADLs), HFT demonstrated a statistically significant advantage in enhancing lower extremity motor recovery as measured by the Fugl-Meyer Assessment. Despite these promising result, no significant differences were found between the two intervention in terms of functional independence and balance suggesting that both approaches are beneficial for stroke rehabilitation.

The findings support the potential of HFT as an effective rehabilitation strategy for chronic stroke patients, especially in improving motor function, but also highlight the need for future studies with longer follow up periods and larger sample size to assess the long term sustainability of these gains. The study's strengths, such as its randomized controlled trail design and use of validated assessment tools, contribute to the reliability of the results. However, the absence of follow up data and small sample size are key limitation that should be addressed in future research to provide more evidence on the long term effectiveness of HFT in stroke rehabilitation.

Higher Function Training is an effective intervention to enhancing motor recovery in chronic stroke patients which can promote the rehabilitation process of that patient.

6.2 Recommendations

1. Further research with larger sample size: Given the relatively small sample size in this study, future research should aim to recruit a larger and diverse group of participants that can enhance the generalizability of the findings.
2. Long term follow up studies: To assess the sustainability of the improvements achieved through HFT, future studies should incorporate long term follow up periods. This will provide valuable insights into whether the benefits observed post intervention are maintained over time.
3. Targeting specific stroke subtype: Future studies should consider investigating the effect of HFT on different subtype of stroke (ischemic and hemorrhagic).This would help to determine whether certain stroke type may benefit more from specific rehabilitation protocols.
4. Expanded outcome measure: Future research should measure another outcome such as gait parameter and quality of life. This would provide a more comprehensive understanding of the impact of HFT on stroke survivors.

CHAPTER- VII REFERENCE LIST

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Appendix- A

Permission letter for IRB

SCMST-BPT/IRB/...03-10/25/08...

To
David Timon Das
4th Year Student of B.Sc. in Physiotherapy
Session: 2019-20, Registration No: 8780
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Subject: Approval of the thesis proposal **"Effectiveness of Higher Function Training to Lower Extremity Motor Recovery among Patient with Chronic Stroke"** by ethics committee.

Dear David Timon Das
Congratulations.
The Institutional Review Board (IRB) of SCMST 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 & consent form.

The members of the Ethics committee have approved the study to be conducted in the presented form at the meeting held at 09.00 AM on 04th September 2024 at SCMST.

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

Best regards,
04.09.24
Dr. Abul Kasem Mohammad Ehamul Haque
Principal, SCMST &Chairman, Institutional Review Board (IRB)
SAIC College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Date: 03/09/2024
To
The Chairman,

Appendix-B

Permission letter for data collection

SAIC COLLEGE OF MEDICAL SCIENCE AND TECHNOLOGY

Approved by Ministry of Health and Family Welfare
Affiliated with Dhaka University

Date: 15/04/2025

Ref :

Date : .....

To
The Managing Director
Pain-Paralysis Specialised & General Hospital
Manikganj, Bangladesh

Subject: **Prayer for permission to collect data from Pain-Paralysis Specialised & General Hospital, Manikganj to conduct a research project.**

Sir,

With due respect and humble submission to state that I am a student of B.Sc. in Physiotherapy at SAIC College of Medical Science and Technology (SCMST). As a part of our course curriculum, we have to conduct a research project for the partial fulfillment of the requirement for the degree of B.Sc. in Physiotherapy. My research title is "Effectiveness of Higher Function Training to Lower Extremity Motor Recovery among Patients with Chronic Stroke. The aim of the study is to evaluate the overall effectiveness of higher function training on improving lower extremity motor recovery in patients with chronic stroke. This is an experimental study under the supervisor Md. Shahidul Islam, Assistant Professor and Clinical head of SCMST. I have chosen the Pain-Paralysis Specialised & General Hospital at Manikganj, Bangladesh to collect data from the stroke patients.

So, I, therefore, pray and hope that you would be kind enough to give permission for data collection that will help me to complete my study.

Yours Faithfully
David Timon Das
B.Sc. in Physiotherapy (4th Year)
Session: 2019-2020
SCMST, Mirpur-14, Dhaka-1216, Bangladesh.

Permitted

Address: Saic Tower, M-1/6, Mirpur-14, Dhaka-1206. Mobile: 01936005804
E-mail: simt140@gmail.com, Web:www.saicmedical.edu.bd

Conventional Physiotherapy

(Received 4 weeks and 20 sessions of conventional physiotherapy)

Duration: 45 minute

Traditional Physiotherapy:

1. Sit to stand training- 10 minutes, 5 times a week
2. Strengthening exercise of the affected side- 10 minutes, 5 times a week
3. Balance training- 10 minutes, 5 times a week
4. Gait training- 10 minutes, 5 times a week
5. Activities of daily living (ADL) training- 5 minutes, 5 times a week

Dr. Md. Shahidul Islam
Senior Consultant & Managing Director
Pain-Paralysis Specialized & General Hospital

Appendix- C

Questionnaire Bangla & English

সম্মতি পত্র

আসসালামু আলাইকুম,

আমি ডেভিড তিমন দাস, ঢাকা বিশ্ববিদ্যালয়ের চিকিৎসা অনুষদের অধীনে সাইক কলেজ অব মেডিকেল সায়েন্স অ্যান্ড টেকনোলজি (এসসিএমএসটি) এর বিএসসি ফিজিওথেরাপির চতুর্থ পেশাদারের শিক্ষার্থী। আমার স্নাতক ডিগ্রি অর্জনের জন্য আমাকে একটি গবেষণা প্রকল্প পরিচালনা করতে হবে এবং এটি আমার অধ্যয়নের একটি অংশ। আমার গবেষণার শিরোনাম "স্ট্রোক পরবর্তী রোগীদের মধ্যে শরীরের নিচের অংশের মাংসপেশির পুনরুদ্ধারের উপর উচ্চতর প্রশিক্ষণের কার্যকারিতা।"। আমার গবেষণা প্রকল্পটি পূরণ করার জন্য আপনার স্ট্রোক পরবর্তী মাংসপেশির অবস্থা, ব্যক্তিগত ও অন্যান্য তথ্য সংগ্রহ করতে হবে। সুতরাং, আপনি এই গবেষণায় একজন সম্মানিত অংশগ্রহণকারী হতে পারেন এবং কথোপকথনের সময়টি দুই বার করে ১৫-২০ মিনিট হবে। আমি আপনাকে জানাতে চাই যে এটি একটি সম্পূর্ণরূপে একাডেমিক গবেষণা ও এটি অন্য কোনও উদ্দেশ্যে ব্যবহার করা হবে না। আমি আপনাকে আশ্বাস দিচ্ছি যে সমস্ত তথ্য গোপন রাখা হবে। আপনার অংশগ্রহণ ঐচ্ছিক হবে। এই গবেষণা থেকে আপনি যে কোনো সময় আপনার সম্মতি ও অংশগ্রহণ প্রত্যাহার করতে প্রবেন। আপনার যদি কোন প্রশ্ন পছন্দ না হয় সেক্ষেত্রে আপনি প্রশ্ন প্রত্যাখান করার অধিকার রাখেন।

গবেষণা সম্পর্কে আপনার যদি কোনও প্রশ্ন থাকে তাহলে আপনি আমার সুপারভাইজার ডাঃ শহীদুল ইসলাম (পিটি), সহযোগী অধ্যাপক ,সাইক কলেজ অফ মেডিকেল সায়েন্স অ্যান্ড টেকনোলজি এর সাথে যোগাযোগ করতে পারেন। শুরু করার আগে আপনার কি কোন প্রশ্ন আছে?

সুতরাং, আমি সাক্ষাতকারটি চালিয়ে যেতে পারি?

হ্যাঁ না

অংশগ্রহণকারীর স্বাক্ষর ..... তারিখ.....

সাক্ষীর স্বাক্ষর ..... তারিখ.....

গবেষকের স্বাক্ষর, ... তারিখ.....

সামাজিক জনতাত্তিক ও স্বাস্থ্য-সম্পর্কিত প্রশ্নাবলি

(*অনুগ্রহ করে যথাযথ ঘরে ✓ চিহ্ন দিন বা ফাঁকা স্থান পূরণ করুন*)

প্রশ্ন নং	**প্রশ্ন**	**উত্তর**
১	নাম:	_____
২	বয়স (বছর):	_____
৩	লিঙ্গ:	□ পুরুষ □ মহিলা □ অন্যান্য
৪	বৈবাহিক অবস্থা:	□ অবিবাহিত □ বিবাহিত □ তালাকপ্রাপ্ত □ বিধবা/বিপত্নীক
৫	শিক্ষাগত যোগ্যতা:	□ অশিক্ষিত □ প্রাথমিক □ মাধ্যমিক □ উচ্চমাধ্যমিক □ স্নাতক □ স্নাতকোত্তর
৬	পেশা:	_____
৭	মাসিক পারিবারিক আয়:	□ <১০,০০০ টাকা □ ১০,০০০–২০,০০০ টাকা □ ২০,০০০–৩০,০০০ টাকা □ >৩০,০০০ টাকা
৮	বসবাসের স্থান:	□ শহর □ গ্রাম □ মফস্বল
৯	পরিবারের মোট সদস্য সংখ্যা:	_____
১০	রোগের ধরন:	□ ইসকেমিক স্ট্রোক □ হেমোরেজিক স্ট্রোক
১১	আক্রান্ত দিক:	□ ডান পাশে □ বাম পাশে
১২	স্ট্রোক হওয়ার সময়কাল (মাসে):	_____
১৩	কি ধরণের চিকিৎসা পেয়েছেন?	□ ইনডোর/হাসপাতাল □ আউটডোর/ক্লিনিক □ কোনো চিকিৎসা নেননি

১৪	পূর্বে ফিজিওথেরাপি নিয়েছেন কি?	□ হ্যাঁ □ না
১৫	বর্তমানে ফিজিওথেরাপি নিচ্ছেন কি?	□ হ্যাঁ □ না
১৬	সহ-উপসর্গ (Comorbidities):	□ উচ্চ রক্তচাপ □ ডায়াবেটিস □ হৃদরোগ □ হাঁপানি □ অন্য: _____
১৭	চলাফেরার জন্য সহায়তা দরকার হয় কি?	□ না □ হ্যাঁ – সহায়ক উপকরণ: _____
১৮	বর্তমানে কোনো ব্যথা রয়েছে কি?	□ হ্যাঁ □ না – ব্যথার অবস্থান: _____
১৯	ধূমপান করেন কি?	□ কখনো না □ পূর্বে করতেন □ বর্তমানে করেন
২০	অ্যালকোহল গ্রহণ করেন কি?	□ কখনো না □ মাঝে মাঝে □ নিয়মিত
২১	স্ট্রোক হবার পূর্বে কি নিয়মিত হাঁটা/চলাফেরা করতেন?	□ হ্যাঁ □ না
২২	বর্তমানে দৈনিক কতটা হাঁটতে পারেন?	□ <১০ মিটার □ ১০-৫০ মিটার □ ৫০-১০০ মিটার □ >১০০ মিটার
২৩	মোবাইল বা সহায়ক যন্ত্রে যোগাযোগ করতে পারেন কি?	□ হ্যাঁ □ না
২৪	পরিবারের সহায়তা পান কি?	□ হ্যাঁ □ না – যদি না, কেন? _____

Berg Balance Scale (BBS) স্কোরিং প্রশ্নাবলি (বাংলা)

রোগীর আইডি: _____ তারিখ: _____

নং	কার্যকলাপ (Activity)	০	১	২	৩	৪
১	বসা অবস্থান থেকে দাঁড়ানো	☐	☐	☐	☐	☐
২	সাহায্য ছাড়া দাঁড়িয়ে থাকা (২ মিনিট)	☐	☐	☐	☐	☐
৩	চেয়ারে সাহায্য ছাড়া বসে থাকা (২ মিনিট)	☐	☐	☐	☐	☐
৪	দাঁড়ানো অবস্থা থেকে বসে যাওয়া	☐	☐	☐	☐	☐
৫	এক চেয়ারে বসে অন্য চেয়ারে স্থানান্তর	☐	☐	☐	☐	☐
৬	চোখ বন্ধ রেখে দাঁড়িয়ে থাকা (১০ সেকেন্ড)	☐	☐	☐	☐	☐
৭	দুই পা একসাথে রেখে দাঁড়িয়ে থাকা	☐	☐	☐	☐	☐
৮	সামনে হাত বাড়িয়ে বস্তু ধরার চেষ্টা	☐	☐	☐	☐	☐
৯	মেঝে থেকে বস্তু তোলা	☐	☐	☐	☐	☐
১০	কাঁধের উপর দিয়ে পেছনে তাকানো	☐	☐	☐	☐	☐
১১	৩৬০ ডিগ্রি ঘুরে দাঁড়িয়ে থাকা	☐	☐	☐	☐	☐
১২	একটি স্টুলে বিকল্পভাবে পা রাখা	☐	☐	☐	☐	☐
১৩	একটি পা অন্যটির সামনে রেখে দাঁড়ানো	☐	☐	☐	☐	☐
১৪	এক পায়ে দাঁড়িয়ে থাকা	☐	☐	☐	☐	☐

মোট স্কোর লিখুন (0 – ৫৬): _____ / ৫৬

আপনার মোট স্কোর অনুযায়ী নিচের বিভাগে টিক দিন (✓):

বিভাগ (Category)	স্কোর সীমা	টিক দিন (✓)
ভালো ভারসাম্য	৪১ – ৫৬	☐
মাঝারি ভারসাম্য	২১ – ৪০	☐
দুর্বল ভারসাম্য	০ – ২০	☐

বার্থেল ইনডেক্স মূল্যায়ন ফর্ম (Barthel Index Assessment Form – Bangla Version)

কার্যকলাপ (Activity)	**স্কোরের মানদণ্ড**	**স্কোর**
১. খাওয়া	0 = সম্পূর্ণ সহায়তা প্রয়োজন 5 = কিছু সহায়তা 10 = সম্পূর্ণ স্বাধীন	□ ০ □ ৫ □ ১০
২. স্নান	0 = সহায়তা প্রয়োজন 5 = স্বাধীন	□ ০ □ ৫
৩. ব্যক্তিগত পরিচর্যা	0 = সহায়তা প্রয়োজন 5 = স্বাধীন	□ ০ □ ৫
৪. পোশাক পরা	0 = সহায়তা প্রয়োজন 5 = কিছু সহায়তা 10 = স্বাধীন	□ ০ □ ৫ □ ১০
৫. মূত্রনিঃসরণ নিয়ন্ত্রণ	0 = অসংযম বা সম্পূর্ণ সহায়তা 5 = মাঝে মাঝে দুর্ঘটনা 10 = সম্পূর্ণ নিয়ন্ত্রণ	□ ০ □ ৫ □ ১০
৬. মূত্র নিয়ন্ত্রণ	0 = অসংযম বা সম্পূর্ণ সহায়তা 5 = মাঝে মাঝে দুর্ঘটনা 10 = সম্পূর্ণ নিয়ন্ত্রণ	□ ০ □ ৫ □ ১০
৭. শৌচাগারে যাওয়া	0 = সহায়তা প্রয়োজন 5 = কিছু সহায়তা 10 = স্বাধীন	□ ০ □ ৫ □ ১০
৮. বিছানা-চেয়ার স্থানান্তর	0 = সম্পূর্ণ সহায়তা 5 = প্রধান সহায়তা 10 = কিছু সহায়তা 15 = স্বাধীন	□ ০ □ ৫ □ ১০ □ ১৫
৯. হাঁটা/চলাফেরা	0 = সহায়তা ছাড়া চলাফেরা অসম্ভব 5 = হুইলচেয়ার বা প্রধান সহায়তা 10 = কিছু সহায়তা 15 = স্বাধীন	□ ০ □ ৫ □ ১০ □ ১৫
১০. সিঁড়ি উঠানামা	0 = সহায়তা প্রয়োজন 5 = কিছু সহায়তা 10 = স্বাধীন	□ ০ □ ৫ □ ১০
	মোট স্কোরঃ _____ / ১০০	

ফুগল-মেয়ার অ্যাসেসমেন্ট (FMA) – লোয়ার এক্সট্রিমিটি (বাংলা সংস্করণ)

ক্রম	আইটেম/ক্রিয়া	স্কোর (০–২)
ক. রিফ্লেক্স অ্যাক্টিভিটি (চিত হয়ে শুয়ে)		
১.. Flexores (ফ্লেক্সর)	হাঁটুর ফ্লেক্সর রিফ্লেক্স	□ ০ □ ২
২. Extensors (এক্সটেন্সর) নুন্যতম একটি	হাটু / গোড়ালির রিফ্লেক্স (Achilles)	□ ০ □ ২
খ. স্বেচ্ছায় সমন্বিত চলন বাধা দিয়ে নিশ্চিত হওয়া (চিত হয়ে শুয়ে)		
৩.	হিপ ফ্লেক্সন	□ ০ □ ১ □ ২
৪.	হাঁটু ফ্লেক্সন	□ ০ □ ১ □ ২
৫.	গোড়ালি ডর্সিফ্লেক্সন	□ ০ □ ১ □ ২
৬.	হিপ এক্সটেনশন	□ ০ □ ১ □ ২
৭.	হিপ এডাকশন	□ ০ □ ১ □ ২
৮.	হাটু এক্সটেনশন	□ ০ □ ১ □ ২
৯.	গোড়ালি প্ল্যান্টার ফ্লেক্সন	□ ০ □ ১ □ ২
গ. স্বেছায় মিশ্র সমন্বিত মুভমেন্ট বসা অবস্থায়		
১০. হাটু ভাজ করা সম্পুর্ন সোজা অবস্থা থেকে	০= সক্রিয় নয়, ১= ৯০ ডিগ্রির কম পারে, ২= ৯০ ডিগ্রির বেশি পারে	□ ০ □ ১ □ ২
১১. গোড়ালির ডরসিফ্লেকশন (গোড়ালি উচু করা)	০= পারে না, ১= অল্প পারে, ২= সম্পুর্ন পারে	□ ০ □ ১ □ ২
ঘ. স্বেছায় অল্প বা সমন্বয় ছাড়া মুভমেন্ট দাঁড়িয়ে (হিপ ০ ডিগ্রি)		
১২. হাটু ফ্লেক্সন ৯০ ডিগ্রিতে, ভারসাম্য সহযোগিতা প্রযোজ্য		□ ০ □ ১ □ ২

১৩. গোড়ালি ডরসিফ্লেক্সন	০= সক্রিয়ভাবে পারে না, ১= অল্প পারে, ২= পুরোপুরি পারে	□ ০ □ ১ □ ২
ঙ. সাধারণ রিফ্লেক্স কার্যক্রম		
হাটু ফ্লেক্সর,প্যাটেলার, আচিলিচ (Patella, achillis)		□ ০ □ ১ □ ২
চ কো-অর্ডিনেশন ও গতি চিত হয়ে শুয়ে চোখ বন্ধ করে, ৫ বার যত দ্রুত সম্ভব		
১৪. কম্পন (Tremor)		□ ০ □ ১ □ ২
১৫. সমন্বয়ের অভাব (Dysmetria)		□ ০ □ ১ □ ২
১৬. সময়	০= ৬ সেকেন্ড এর সমান বা বেশি, ১= (২-৫ সেকেন্ড); ২= (২ সেকেন্ড এর কম)	□ ০ □ ১ □ ২
মোট স্কোর (সর্বোচ্চ: 34)		_____

Inform Consent

Assalamualaikum,

I am David Timon Das, 4th Professional, B.Sc. in Physiotherapy student at SAIC College of Medical Science and Technology (SCMST) under the Faculty of Medicine, University of Dhaka. To obtain my Bachelor degree, I have to conduct a research project and it is a part of my study. My research title is "Effectiveness of Higher Function Training on Lower Extremity Motor Recovery among Patient with Chronic Stroke". I would like to know about some personal & other related questions about your health condition to fulfill my research project. So, you can be a respected participant in this research and the conversation time will be two times 15-20 minutes. I would like to inform you that this is a purely academic study and will not to be used for any other purposes. I assure you that all data will be kept confidential. Your participation will be voluntary. You may have the right to withdraw consent and discontinue participation at any time from this study. You also have the right to reject a particular question that you don't like. If you have any queries about the study, you may contact with my supervisor Md. Shahidul Islam, Associate Professor, SAIC College of Medical Science & Technology. Do you have any questions before I start?

So, I can proceed with the interview.

Yes ☐ No ☐

Signature of the participant…… Date……..

Signature of the witness……. Date……..

Signature of the researcher……. Date……

Sociodemographic Questionnaire in English

(Please tick the appropriate box or fill in the blank spaces)

No.	**Question**	**Answer**
1	Name:	_____
2	Age (year):	_____
3	Gender:	☐ Male ☐ Female ☐ Others
4	Marital Status:	☐ Unmarried ☐ Married ☐ Divorced ☐ Widowed
5	Educational Qualification:	☐ Illiterate ☐ Primary ☐ Secondary ☐ Higher secondary ☐ Graduate ☐ Post-graduate
6	Profession:	_____
7	Monthly income:	☐ <10000 BDT ☐ 10k-20k BDT ☐ 20k-30k BDT ☐ > 30k BDT
8	Living area:	☐ Urban ☐ Rural
9	Total family member:	_____
10	Type of stroke:	☐ Ischemic ☐ Hemorrhagic
11	Affected side:	☐ Right ☐ Left
12	Duration Since Stroke (in Months):	_____
13	Past medical treatment	☐ Indoor/Hospital ☐ Outdoor/clinic ☐ No treatment
14	Received Physiotherapy Previously	☐ Yes ☐ No
15	Currently Receiving Therapy	☐ Yes ☐ No
16	Comorbidities:	☐ Hypertension ☐ Diabetes ☐ Heart disease ☐ Asthma ☐ Others: _____
17	Uses Assistence	☐ No ☐ Yes – Type of Assistive Device Used: _____

18	Current presence of pain	☐ Yes ☐ No, site of pain: _____
19	Habit of smoking	☐ Never ☐ Past ☐ Present
20	Habit of alcohol	☐ Never ☐ Sometimes ☐ Regular
21	Walking ability before stroke	☐ Yes ☐ No
22	How far patient can currently walk	☐ <10 m ☐ 10-50 m ☐ 50-100 ☐ >100m
23	Can use mobile phone or device independently	☐ Yes ☐ No
24	Gets family support in mobility or ADLs	☐ Yes ☐ No –If not, why? _____

Berg Balance Scale (BBS) Questionnaire

Patient's Name: _____

Patient's ID: _____ *Date:* ----------

No.	(Activity)	0	1	2	3	4
1	Sitting to standing	☐	☐	☐	☐	☐
2	Standing unsupported (2 min)	☐	☐	☐	☐	☐
3	Sitting unsupported (2 min)	☐	☐	☐	☐	☐
4	Standing to sitting	☐	☐	☐	☐	☐
5	Transfers	☐	☐	☐	☐	☐
6	Standing with eyes closed (10 s)	☐	☐	☐	☐	☐
7	Standing with feet together	☐	☐	☐	☐	☐
8	Reaching forward with outstretched arm	☐	☐	☐	☐	☐
9	Retrieving object from floor	☐	☐	☐	☐	☐
10	Turning to look behind	☐	☐	☐	☐	☐
11	Turning 360 degrees	☐	☐	☐	☐	☐
12	Placing alternate foot on stool	☐	☐	☐	☐	☐
13	Standing with one foot in front	☐	☐	☐	☐	☐
14	Standing on one foot	☐	☐	☐	☐	☐

Total Score (0 – 56): _____ / 56

Mark in the below according to the score (✓):

(Category)	Score range	(✓)
Low fall risk	41 – 56	☐
Medium fall risk	21 – 40	☐
High fall risk	0 – 20	☐

(**Barthel Index Assessment Form – English Version**)

(Activity)	**(Scoring Criteria)**	**(Score)**
1. (Feeding)	0 = Unable 5 = Needs help 10 = Independent	☐ 0 ☐ 5 ☐ 10
2. (Bathing)	0 = Dependent 5 = Independent	☐ 0 ☐ 5
3. (Grooming)	0 = Need help 5 = Independent	☐ 0 ☐ 5
4. (Dressing)	0 = Dependent 5 = Need help 10 = Independent	☐ 0 ☐ 5 ☐ 10
5. (Bowel Control)	0 = Incontinent 5 = Occasional accident 10 = Continent	☐ 0 ☐ 5 ☐ 10
6. (Bladder Control)	0 = Incontinent 5 = Occasional accident 10 = Continent	☐ 0 ☐ 5 ☐ 10
7. (Toilet Use)	0 = Dependent 5 = Need some help 10 = Independent	☐ 0 ☐ 5 ☐ 10
8. (Transfers: Bed to Chair and Back)	0 = Unable 5 = Major help 10 = Minor help 15 = Independent	☐ 0 ☐ 5 ☐ 10 ☐ 15
9. (Mobility)	0 = Immobile 5 = Wheelchair independent 10 = Walks with help of one person 15 = Independent	☐ 0 ☐ 5 ☐ 10 ☐ 15
10. (Stairs)	0 = Unable 5 = Need help 10 = Independent	☐ 0 ☐ 5 ☐ 10
	Total Score:	----------

FUGL-MEYER LOWER EXTREMITY (FMA-LE) Assessment:

No	Item/Activity	Score
A. Reflex activity, supine position		
1. Flexors: knee flexors	Knee flexor reflex	☐ 0 ☐ 2
2. Extensors: patellar, Achilles (at least one)	Knee / Ankle reflex (Achilles)	☐ 0 ☐ 2
B. Volitional movement within synergies supine position		
3.	Hip flexion	☐ 0 ☐ 1 ☐ 2
4.	Knee flexion	☐ 0 ☐ 1 ☐ 2
5.	Ankle dorsiflexion	☐ 0 ☐ 1 ☐ 2
6.	Hip extension	☐ 0 ☐ 1 ☐ 2
7.	Hip adduction	☐ 0 ☐ 1 ☐ 2
8.	Knee extension	☐ 0 ☐ 1 ☐ 2
9.	Ankle plantarflexion	☐ 0 ☐ 1 ☐ 2
C. Volitional movement mixing synergies sitting position		
10. Knee flexion from actively or passively extended knee	0= no active motion, 1= less than 90°, 2 = more than 90° active flexion	☐ 0 ☐ 1 ☐ 2
11. Ankle dorsiflexion	0 = no active motion, 1= limited dorsiflexion, 2= complete dorsiflexion	☐ 0 ☐ 1 ☐ 2
D. Volitional movement with little or no synergy (standing position)		

12. Knee flexion to 90°,balance support is allowed		☐ 0 ☐ 1 ☐ 2
13. Ankle dorsiflexion compare with unaffected side	0 = no active motion, 1= limited dorsiflexion, 2= complete dorsiflexion	☐ 0 ☐ 1 ☐ 2
E. Normal reflex activity		
knee flexors, Patellar, Achilles		☐ 0 ☐ 1 ☐ 2
F. COORDINATION/SPEED, supine, after one trial with both legs, eyes closed		
14. Tremor		☐ 0 ☐ 1 ☐ 2
15. Dysmetria		☐ 0 ☐ 1 ☐ 2
16. Time	0= 6 or more seconds slower, 1= (2-5 seconds slower); 2= (less than 2 seconds)	☐ 0 ☐ 1 ☐ 2
Total score (Max: 34)		_____

Appendix- D

Gant Chart

Activities/ months	Aug 24	Sept 24	Oct 24	Nov 24	Dec 24	Jan 25	Feb 25	Mar 25	April 25	May 25	Jun 25	July 25
Proposal presentation												
Introduction												
Literature review												
Methodology												
Data collection												
Data Analysis												
Result												
1st progress presentation												
Discussion												
Conclusion & Recommendation												
2nd progress presentation												
Communication with supervisor												
Final submission												