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Assessing the Gait Parameters and Walking Performance of Stroke Survivors: A Cross-Sectional Study

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CONTENTS

CHAPTER: I INTRODUCTION 1

1.1 Background 1
1.2. Justification 4
1.3 Research Question 5
1.4 General Objective 6
1.5 Specific Objectives 6
1.6 List of Variables 7
1.8 Operational Definition 8

CHAPTER: II LITERATURE REVIEW **9**

CHAPTER: III METHODOLOGY 18

3.1 Study Design 18
3.3 Study Place 18
3.4 Study Period 18
3.5 Study Population 18
3.6 Sample Size 18
3.8 Eligibility Criteria 19
3.8.1 Inclusion Criteria 19
3.8.2 Exclusion Criteria 19
3.9 Method of Data Collection 20
3.9.1 Technique of Data Collection 20
3.9.2 Instruments of Data Collection 20
3.9.3 Tools of Data Collection 20
3.9.4 Procedure of Data Collection 20
3.10 Management of Data 20
3.10.1 Data Editing 20
3.10.2 Data Entry 20
3.10.3 Data Analysis 21

3.11 Determination of Statistical Test 21
3.12 Result 21
3.13 Ethical Consideration 21

CHAPTER: IV RESULTS 23

CHAPTER: V DISCUSSION & LIMITATION 39

5.1 Limitation of the Study 40

CHAPTER: VI CONCLUSION & RECOMMENDATION 44

6.1 Conclusion 44
6.2 Recommendation 45

REFERENCES 46

APPENDIX: A 52

APPENDIX: B 54

APPENDIX: C 62

APPENDIX: D 66

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Acronyms

ABMSII- Ability for Basic Movement Scale

ADL- Activity of Daily Living

AFO- Ankle-foot orthoses

BMRC- Bangladesh Medical Research Council

CRP- Centre for the Rehabilitation of the Paralysed

FAC- Functional Ambulation Category

FES- Functional electrical stimulation

GBD- Global Burden of Diseases

GSFS- Global Stroke Fact Sheet

ICF- International Classification of Functioning, Disability and Health

QOL- Quality of Life

ROM- Range of Motion

SRU- Stroke Rehabilitation Unit

STS- Sit-to-stand motions

TUG- Time and go test

6MWT- 6-minute walk test

10 MWT- 10 Meter Walk Test

List of Tables

Table no 1: Age of the participants 23

Table no 2: Occupation of the participants. 25

Table no 3: Educational level of the participants. 26

Table no 4: Marital status of the participants. 28

Table no 5: Type of stroke of the participants. 29

Table no 6: Duration of stroke of the participants. 29

Table no 7: Affected side of the participants. 30

Table no 8: Comorbidity of the participants. 30

Table no 9: Type of weight bearing of the participants. 31

Table no 10: Treatment sessions received by the participants. 31

Table no 11: Mean and standard deviation of gait parameters. 32

Table no 12: Mean and standard deviation of the 10-meter walk test. 32

Table no 13: Mean and standard deviation of the TUG test. 33

Table no 14: Correlation between age with gait parameters and walking performance. 34

Table no 15: Correlation between BMI with gait parameters and walking performance. 35

Table no 16: Association between type of stroke with age group, gender, BMI status and living area. 36

Table no 17: Association between type of weight bearing, type of stroke and affected side. 37

Table no 18: Association between comorbidity with the duration of a stroke, number of treatment sessions received and type of weight-bearing. 37

List of Figures

Figure no 1: Age range of the participants. 24

Figure no 2: Gender of the participants. 24

Figure no 3: Living area of the participants. 27

Figure no 4: Family type of the participants. 27

Figure no 5: BMI range of the participants. 28

Abstract

Background: One of the main causes of permanent impairment is stroke. Over 80 percent of those who survive have a gait problem. The ability to walk has significant health consequences. Following a stroke, gait is a crucial indicator of functional independence and long-term survival. For stroke survivors, one of the most common aspirations is to regain their ability to walk. **Objective:** To measure the gait parameters and walking performance of stroke survivors. **Methodology:** The study used a cross-sectional design. The study, which was carried out at the Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka, had a sample size of 55 and was selected using the purposive sampling approach. Descriptive statistics, Microsoft Excel, and SPSS (statistical software for social science) 25 version were used to analyze the data. **Result:** The study examined the walking performance and gait metrics of fifty-five stroke patients. The mean age of the stroke survivors was 52.84 ± 9.72, and males are more likely to have one (70.9%) than women (29.1%). Walking performance and gait metrics were strongly impacted by BMI; stride length, step length, velocity, and cadence were all decreased by BMI. Gait asymmetry was also affected by age, stroke duration, and comorbidity. The average walking speed was 0.33 ± 0.13 m/s, the cadence was 66.04 ± 12.14 steps/min, the stride length was 53.56 ± 12.19 cm, and the step length was 28.55 ± 6.28 cm. 0.32 ±0.12 m/s was the 10-meter walk test speed. The average time to complete the TUG test was 25.98 ± 7.98 seconds. **Conclusion:** Stroke significantly impacts mobility and gait, with significant effects on stroke length, cadence, velocity, and walking performance leading to reduced quality of life. Further research is needed to develop a new device strategy and treatment plan for stroke patients on gait rehabilitation, highlighting the need for evidence-based physiotherapy practice.

Keywords: *Stroke, Gait, Walking performance, Rehabilitation, Timed Up and Go test, 10-meter walk test.*

CHAPTER- I INTRODUCTION

1.1 Background:

One of the most significant causes of death and disability in countries that are both developed and developing, strokes are a growing public health concern (Kuriakose and Xiao, 2020, p. 7609). Stroke is the greatest cause of long-term impairment globally, limiting the ability of a person to move and carry out daily tasks. Gait abnormalities are one of the most prevalent post-stroke problems, leading to decreased mobility, more fall risk, and an inferior standard of life (Mondal et al. 2022, p.100414).

A cerebral blood clot that obstructs normal flow or causes bleeding by rupturing arteries is one of the major morbidities associated with stroke, a neurological condition marked by the blockage of blood vessels (Naureen et al. 2024, p.755). Stroke is the second prime cause of death globally and the third main cause of disability, according to the global stroke fact sheet 2022. Stroke prevalence in Bangladesh was 1.10 percent overall (Shuvo et al. 2024, p. 108017). Adults aged 25 to 49 account for around 10–15% of all strokes (Murphy and Werring, 2020, p.562). The most common risk factor among stroke patients was hypertension (79.2%). Furthermore, the most recurring risk factors for stroke patients were smoking, diabetes, dyslipidemia, and inconsistent diets, with diabetes being the most common disease. 20.1% also suffered from ischemic heart disease (Mondal et al. 2022, p.100414). Ischemic stroke, caused by blood supply blockage, and hemorrhagic stroke, caused by abrupt bleeding, are two types of strokes that damage brain cells (Murphy and Werring, 2020). In the brain, these occlusions result in thrombotic and embolic situations that produce clots and necrosis (Kuriakose and Xiao, 2020, p.7609). Consequently, stroke sufferers typically have long-term emotional, cognitive, and functional challenges (Naureen et al. 2024, p.753).

Stroke survivors frequently experience hemiparesis, a medical condition identified by weakness on one side, resulting in unbalanced walking patterns. Among the most common gait disorders are decreased walking speed, imbalance in stride and step length, altered cadence, foot drop, poor weight distribution, and aberrant joint motions. These abnormalities diminish mobility and increase energy consumption, decreasing

independence and impacting social and emotional well-being (Kuriakose and Xiao, 2020, p.7609).

A typical outcome of stroke is gait impairment, which is typified by asymmetry, decreased speed, and an elevated metabolic cost of transportation. Since more than half of stroke survivors are unable to walk freely in the community, this inefficiency greatly adds to their burden of disability (Naureen et al. 2024, p.753).

Gait asymmetry refers to the differences in spatial and temporal parameters between the affected and unaffected limbs during walking. The generic metric of gait speed provides little insight into gait quality and strategy (Naureen et al. 2024, p.753). While gait speed and other gait metrics, including cadence, step length, duration in single support, and asymmetry, are strongly related (Norvang et al. 2022, p.535).

The main cause of gait problems in stroke patients is sensorimotor dysfunction, which includes spasticity, hypotonia, muscular weakness, and deficiencies in perception and proprioception. The post-stroke gait's spatial and temporal characteristics change significantly from those of healthy people (Mohan et al. 2021, p.650024).

Impaired strength and improper muscular activation are among the first symptoms of stroke survivors, followed by spasticity and mechanical abnormalities that lead to aberrant muscle extensibility and abnormal gait patterns (Kuriakose and Xiao, 2020, p. 7609). Hemiparetic gait is the most prevalent pattern of walking impairment following a stroke, affecting 75% of stroke patients in their ability to walk (Li, 2024, p.517). Post-stroke hemiplegia causes a major handicap called gait disruption, in which many patients need assistance walking. Additionally, people who have unstable walking may be at risk for falls. According to a study, a disruption in gait lowers social engagement and everyday life quality. As a result, one of the important aims of physical therapy for hemiparetic stroke patients is to increase walking abilities (Ii et al. 2021, p.306).

Gait impairment can have a major effect on a person's quality of life as well as his or her social and functional life, making even routine activities such as walking, dressing, and cooking difficult and frequently needing help and sometimes being dependent (Li, 2024, p.517). Many stroke survivors are at higher risk of falling, decreased balance and coordination, which can result in significant injuries and severe impact on mobility. Limited mobility can also contribute to social isolation since participating in activities becomes difficult, frequently leading to feelings of bad. Furthermore, decreased

physical activity can contribute to other health problems, such as heart disease and obesity, lowering overall well-being (Cirstea, 2020, p.2893). The financial burden of long-term rehabilitation, assistive gadgets, and caregiver assistance can cause additional stress for both survivors and their families. Stroke has a major influence on gait, resulting in mobility problems and diminished quality of life. Gait analysis is a critical technique in stroke rehabilitation, offering vital insights into walking performance and driving tailored therapy plans (Mohan et al. 2021, p.650024).

In gait rehabilitation, post-stroke gait evaluation is crucial. Instrumented gait analysis is a useful diagnostic tool for post-stroke rehabilitation, determining benchmark parameters and evaluating the severity of the stroke. It uses brain plasticity to assess healing while maintaining patient safety. XAI may be used to examine different gait metrics, such as kinematics, EMG patterns, and spatiotemporal aspects (Mohan et al. 2021, p.650024).

Gait analysis is essential in stroke therapy because it allows the identification of walking abnormalities and tailoring of treatment strategies to enhance mobility (Gelaw et al. 2019, p.100012). Therapists may learn a lot about walking efficiency and performance by monitoring specific characteristics. Stride length and step length indicate asymmetry and gait inefficiencies, allowing for more focused therapy. Walking speed is an important indicator of functional mobility and rehabilitation success, whereas cadence, or steps per minute, helps measure rhythm and coordination (Nedergard et al. 2021, p.17).

1.2 Justification:

One of the major causes of permanent impairment is stroke (Cirstea, 2020, p.2893). Stroke has an important impact on survivors' physical, mental, and psychosocial aspects, reducing functional ability and negatively influencing health-related quality of life (Islam et al. 2024, p.1411422). Stroke patients experience gait disruption, which limits their independence and increases their risk of fall-related accidents and secondary disabilities. More than 80 percent of the survivors have impaired gait. As a result, stroke victims confined to homes reduced social and economic participation (Cirstea, 2020, p.2892).

Because walking performance and the gait parameter are directly correlated with functional capacities, it is vital to understand these aspects in stroke survivors. Individual walking ability is directly influenced by gait factors such as step length, stride length, cadence, and single-leg stance duration.

Regaining or enhancing walking capacity is frequently given priority in stroke patients' rehabilitation regimens. Clinicians can customize therapies to address certain weaknesses and improve rehabilitation results by measuring gait characteristics. For instance, determining asymmetries in step length or timing might direct interventions meant to enhance walking symmetry and balance. During their rehabilitation, stroke patients' progress can be objectively monitored using gait markers and walking performances. Clinicians can track advancements or pinpoint regions needing more support by routinely evaluating these metrics. In our nation, little research has been done on this subject about the current circumstances. This research will help clinicians achieve their rehabilitation goals by providing information that future researchers can use to develop novel orthotic devices and rehabilitation techniques that target specific gait abnormalities. Additionally, evaluating walking performance and gait parameters will help identify individual impairments, which will aid in the development of a customized rehabilitation plan based on each patient's needs. All in all, this will improve the impacted people's quality of life.

1.3 Research Question:

- What are the gait parameters and walking performance of stroke survivors at CRP, Savar, Dhaka?

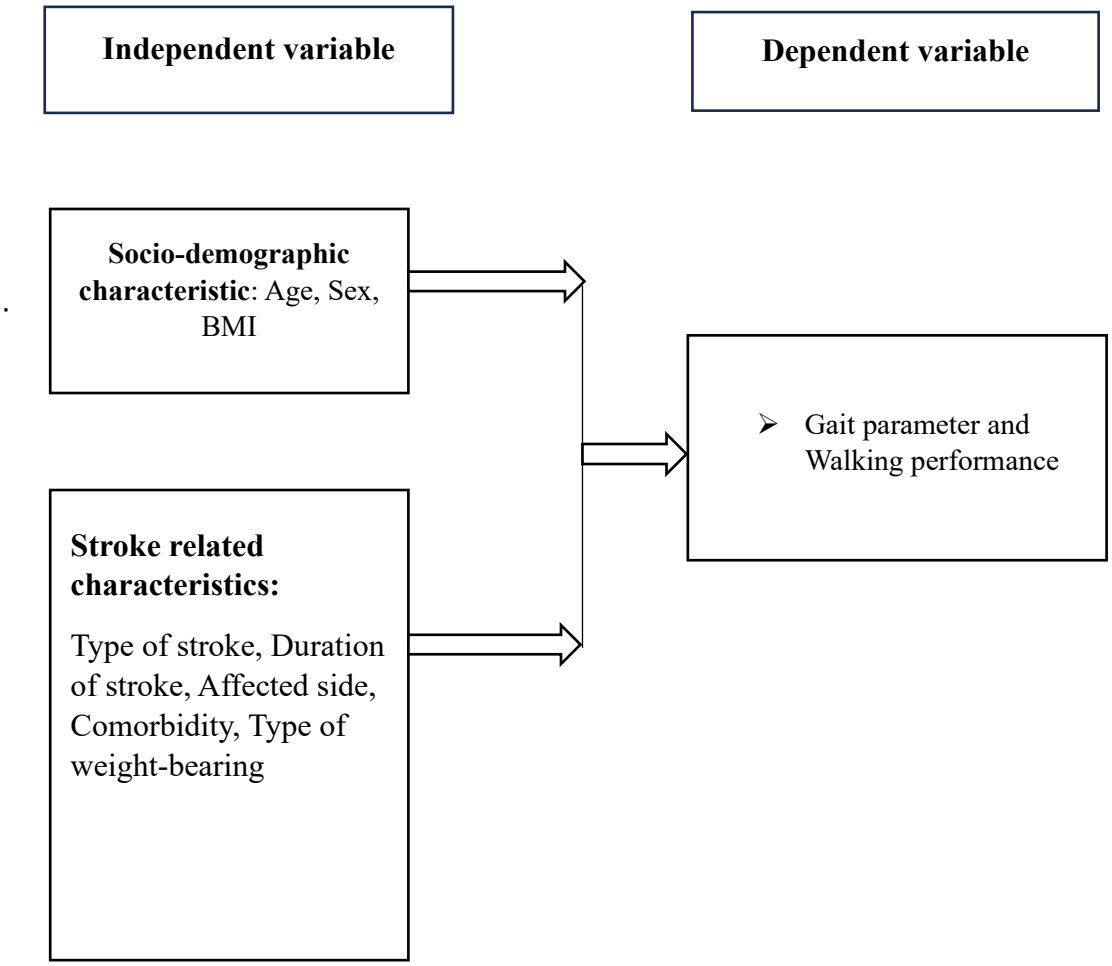
1.4 General Objective:

- To measure the gait parameters and walking performance of stroke survivors at CRP, Savar, Dhaka.

1.5 Specific Objectives:

- To measure key gait parameters of stroke survivors by measurement tape and stopwatch at the Neurology unit, CRP, Savar.
- To determine the walking performance of stroke survivors by 10-meter walk test and TUG test at the Neurology unit, CRP, Savar.
- To find out the socio-demographic characteristics of stroke patients at the Neurology unit, CRP, Savar.
- To analyze the association and correlation between gait parameters and walking performance with sociodemographic and disease-related variables.

1.6 Conceptual Framework:



1.8 Operational Definition:

Stroke:

Stroke is a medical condition that occurs when blood flow to a part of the brain is interrupted or reduced, preventing the brain tissue from getting enough oxygen and nutrients. This leads to the sudden loss of brain function, which may cause weakness, speech difficulties, or other impairments depending on the affected area. If the stroke affects the right side of the brain, it causes weakness or stiffness on the left side of the body, and if it affects the left side of the brain, the right side of the body is affected. Many people who have a stroke also have other health problems like diabetes, high blood pressure, asthma, or kidney issues. Stroke can also change how a person bears their weight, which can be even (symmetrical) or uneven (asymmetrical).

Gait parameters:

- **Stride length:**

Stride length is the distance a person moves forward during a complete step cycle. It is measured from when one foot touches the ground to the next time the same foot touches the ground again.

- **Step length:**

Step length is the distance between where one foot is in contact with the ground and where the other foot contact during walking.

- **Velocity:**

Velocity is how fast a person walks, measured by the distance they cover in a definite amount of time.

- **Cadence:**

Cadence is the number of steps a person takes in one minute during a period of walking.

Walking performance:

Walking performance refers to how well a person can walk, including their speed, balance, and ability to walk over a certain distance or time. Walking performance is measured in this study using the 10-meter walk test and the TUG test.

CHAPTER: II LITERATURE REVIEW

Stroke is a clinical and public health issue in both developed and developing nations (Shankaranarayana et al. 2021, p.133). Low and middle-income countries are disproportionately affected by stroke, a serious global health concern (Krishnamurthi et al. 2020, p.172).

Stroke is the second most prevalent cause of death worldwide as well as the third main cause of death in addition to disability, according to the global stroke fact sheet 2022 (Shuvo et al. 2024, p.108017). The rate of stroke remained least among individuals aged 18 to 40 and highest among individuals over 60. Males had a greater incidence than females, and the frequency varied by age group. Rural regions have a greater frequency of strokes (Mondal et al. 2022, p.108017). Stroke prevalence among individuals aged 40–49, 50–59, 60–69, 70–79, and 80+ years was found to be 2%, 3%, 0%, and 1%, respectively (Sadat et al. 2023, p.37882). According to an approximate document, the overall prevalence of stroke among the elderly was 7.4%, 7.0% in men, and 6.4% in women. As the average age of the old population increased, the prevalence of stroke increased as well (Rajati et al. 2023, p.4).

Both sexes had a noteworthy prevalence of stroke (1.53%), with almost 1% of women and 2.3% of men affected (Kalita et al., 2023). Low- and middle-income countries are disproportionately affected by stroke, a serious global health concern (Krishnamurthi et al. 2020, p.173). Of Asian 4.7 billion people, 9.5–10.6 million strokes occur each year (Tan et al. 2024, p.60). The Central European, Eastern European, and Central Asian GBD super-region had the elevated GDP for stroke prevalence overall (3.01%) (Gerstl et al. 2023, p.2383).

Among stroke patients, hypertension was the most common risk factor (79.2%). Then came others like diabetes (28.8%), ischemic heart disease (20.1%), dyslipidemia (38.9%), and tobacco use in any form (37.2%) (Mondal et al. 2022, p. 100414). Age, sex, ethnicity, and genetics are the main factors that affect stroke risk. These are stroke risk factors that cannot be modified (Murphy and Werring, 2020, p.563).

A stroke happens when there is a disruption or cessation of blood flow to a portion of the brain that is responsible for normal brain function (Grotta et al. 2021, p.208). A

cerebral artery rupture or occlusion may result in a stroke. Stroke is recognized as the third greatest cause of mortality worldwide, after cancer and cardiovascular disease, and one of the most prevalent neurological conditions that can be severely disabling for middle-aged and older adults (Kalita et al. 2023, p.16880). Approximately 87% of stroke-related disability-adjusted life years and 85% of all stroke deaths take place in low-income nations (Murphy and Werring, 2020, p.562). Furthermore, estimates from GBD 2016 demonstrate that the worldwide burden of stroke is still substantial, with 116.4 million disability-adjusted life years (DALY) and 5.5 million deaths in 2016 (Krishnamurthi et al. 2020, p.173).

Strokes may be broadly classified into two primary categories: hemorrhagic stroke and ischemic stroke (Mondal et al. 2022, p.100414). In stroke patients, ischemic occlusions account for around 85% of deaths; intracerebral hemorrhage accounts for the remaining percentage. Thrombotic and embolic disorders are brought on by ischemic occlusion in the brain. Hemorrhagic stroke has a significant fatality rate and makes for 10–15% of all strokes. Blood vessels burst in this disease due to internal damage and stress on the brain tissue. It causes the vascular system to become toxic, which leads to infarction (Kuriakose and Xiao, 2020, p.7609).

Stroke is the prime cause of adult disability worldwide and the third most frequent cause of death in rich or developed nations. It is common to walk asymmetrically after a stroke. The side of the asymmetric group that was most impacted had the longest swing duration. (Rozanski et al. 2020, p.1850). It reduces the patient's mobility and results in an asymmetrical gait. One example of a gait asymmetries or abnormalities is a reduced walking speed in a single-limb posture or irregular or sluggish stepping. Additionally, time can cause different walking accelerations, which lowers walking accuracy (Peters et al. 2021, p.12).

Stance and swing are the two primary stages of a gait cycle, subdivided into five and three functional phases. Walking objectives are influenced by the stance phase, which lasts 60% of the cycle, and the swing phase, which lasts 40%. Every functional step helps to define the walking objective effectively. As in the case of people with post-stroke gait impairment, any irregularities seen in the phases or events of gait may be connected to musculoskeletal and/or neuro-muscular issues (Mohan et al. 2021, p. 100414).

After a stroke, some frequent abnormalities have been found, including early calf muscle onset, prolonged quadriceps and hamstring firing, and absence or reduced amplitude of tibialis anterior activation (Rozanski et al. 2020, p.1852). Consequently, gait speed can be significantly impacted by post-stroke deficits in hip power generation and ankle plantar flexor force output. Reduced stride length and paretic stance time are two more frequent spatiotemporal deficits that lead to uneven gait patterns and diminished cadence (Peters et al. 2021, p.14). The researcher said that normally males had noticeably longer steps (+2.21cm) and wider steps (+2.77cm), although their cadence was lower (-5 steps/min) (Lau et al. 2020, p.1760). The spatiotemporal gait characteristics that were most often evaluated were cadence and speed. Less often used metrics were swing symmetry, temporal gait symmetry, stride length, single limb support time, and double limb support time (Peters et al. 2021, p.15). Their decreased mobility frequently prevents them from going outside at all because of walking disturbances. The capacity to walk is still there in about 70% of people, but they are unable to move at a regular pace, which limits their everyday activities. For stroke patients and their families, one of the main objectives is to regain the ability to walk at a pace that is close to normal (Kalita et al. 2023, p.16880).

An essential technique for evaluating a stroke patient's ambulatory and balance function is gait analysis. It offers numerical information on joint angle, stance time, stride length, and gait speed. Clinicians can determine acceptable gait-related characteristics and provide rehabilitative treatment with the help of an understanding of these elements. Gait impairment is common in stroke patients. Clinicians and researchers frequently utilize gait speed because it is a valid indicator of ambulatory abilities in stroke patients (Chang et al. 2021, p.6).

Little focus has been placed on the long-term effects and difficulties (such as musculoskeletal, medical, and psychological issues) that arise after a stroke. The most frequent side effects following a stroke include incontinence of the stool and urine, as well as post-stroke convulsions. Cognitive decline and musculoskeletal issues: Hemiplegic shoulder discomfort (9% - 40% of hemiplegic stroke cases), spasticity and hypertonicity (up to 60% of stroke patients) (Chohan et al. 2019, p.617). Furthermore, a majority of long-term post-stroke patients still face some walking difficulty and limited mobility (Peters et al. 2021, p.13).

For population health screening, rehabilitation, and the evaluation of preventive and rehabilitative programs, gait assessment is essential (Lau et al. 2020, p.1754). The goal of stroke rehabilitation is to assess and improve walking capacity, especially in the initial weeks following a stroke, utilizing standard tools to identify changes, choose suitable rehabilitation environments, and get patients ready for release (Cheng et al. 2020, p.7). Accordingly, 44%, 42%, 19%, and 28% of physical therapists regularly used standardized walking measures after a stroke to assess walking, track walking change, create a walking recovery prognosis, and assess discharge readiness. The 6-minute walk test (6MWT) and 10-meter walk test (10mWT) are recommended by international post-stroke physical therapy guidelines for evaluating gait in post-stroke rehabilitation due to their excellent reliability and the fact that walk test performance is correlated with strength and other relevant factors (Cheng et al. 2020, p.6).

Only 11% and 32% to 44% of physical therapists use the 6MWT and walking speed measurements in stroke patients, respectively, despite the significance of walking function. Inadequate research, different procedures for the 10mWT and 6MWT, inapplicability for stroke patients, and recommendations for a 30-meter walkway, which is unavailable in many hospital settings, are some of the factors restricting its utilization. For reliable results, a uniform procedure should be applied throughout the care spectrum (Cheng et al. 2020, p.7).

Another test that many researchers use to evaluate stroke patients' walking abilities and track their propensity to fall is the Timed Up and Go. It is an extremely practical clinical tool (Rossler et al. 2023, p.2000).

Walking ability can be evaluated using metrics such as the Functional Ambulation Category (FAC), which gauges a patient's need for human assistance independent of assistive technology use. It is related to the ICF's activities domain and uses an ordinal scale with scores ranging from 0 to 5 (Selves et al. 2020, p.37882). To evaluate basic movement performance at the bedside, the Ability for Basic Movement Scale (ABMSII) has been revised and validated. The ABMSII is used to evaluate the prognosis of everyday life activities during the acute episode of stroke. Furthermore, dependent patients with acute stroke can also have their functional changes evaluated using the ABMSII (Gu et al. 2020, p.104484).

Independent walking is one of the primary objectives of stroke recovery and a significant predictor of general autonomy and quality of life. It affects general health in addition to determining one's degree of independence in day-to-day activities. What a person can accomplish in a standardized, controlled setting is known as motor capacity, and what they accomplish in their everyday surroundings is known as motor performance (Selves et al. 2020, p.784).

Stroke victims have shorter strides and steps, longer stance times, and ambulatory dysfunction, which can cause impairment and impede everyday activities. To sustain gait, the trunk, upper limb, and head must all advance alternately and rhythmically. Limited upper limb movement and asymmetric lower limb movement are the causes of hemiplegic individuals' unbalanced gait. Therapeutic strategies use a variety of training techniques to help hemiplegic individuals with their walking, balance, and ADLs (Marzolini et al. 2021, p.e022588).

Asymmetry in weight-bearing and impaired motor function may increase the risk of falls during transitional movements, such as sit-to-stand (STS) motions. Rehabilitating this group aims to enhance balance and weight-bearing symmetry during STS movement. However, it is not always possible to determine whether a performance improvement indicates genuine healing or compensation in stroke rehabilitation studies (Vive et al. 2024, p.6).

Cognitive and motor deficits that impact balance, coordination, and gait are among the functional alterations that stroke survivors frequently encounter. Their everyday activities and functional independence may be severely impacted by these deficiencies. Reintegrating into society is much easier and their quality of life is improved when these issues are addressed through gait therapy. For survivors and their families to achieve full recovery and functional independence, extensive rehabilitation and support are essential (Teodoro et al. 2024, p.1358).

There are several methods for rehabilitating techniques, such as self-rehabilitation programs, robotic-assisted treatment, virtual reality, treadmill training with or without body weight support, and circuit class training. Additionally, according to Marzolini et al. (2021), trunk exercises, task-specific exercises, multisensory training, and mechanical balance training are strategies for enhancing balance skills. Additionally, neurodevelopment treatment, task-oriented training, virtual reality training, treadmill

use, and Nordic walking training are ways to improve gait. In clinics, treadmill training (TT) is a typical therapy strategy used to help stroke patients with their balance and gait (Hornby et al. 2020, p.52).

During post-stroke rehabilitation, these approaches should be used at certain times based on the patient's functional condition (Selves et al. 2020, p.37882). Recently, ankle-foot orthoses have been used to help stroke survivors walk and walk more easily. Clinicians should offer functional electrical stimulation (FES) or ankle-foot orthoses (AFO) for people who have poststroke hemiplegia and reduced lower extremity motor control. Walking endurance, dynamic balance, gait speed, and other mobility can all be enhanced with these orthoses (Johnston et al. 2021, p.113).

Robotic-assisted gait training is becoming more popular because it can help people with strokes who have aberrant walking patterns. To create movement mistakes, researchers have demonstrated that people adjust to force perturbations applied to their legs, initially causing the leg trajectory to diverge from the baseline. However, when the force perturbation is removed, the leg trajectory shifts in the opposite direction, causing an aftereffect. Step length has been increased in people with post-stroke and incomplete spinal cord injuries using this adaption mechanism (Calabro et al. 2021, p.461).

Electromechanically aided gait training is an efficient gait rehabilitation technique, and highly repetitive exercise restores gait function. Numerous research studies have shown that electromechanical rehabilitation is successful. A recently created electromechanical exoskeleton-assisted gait training tool is called Exowalk. Its distinctive exoskeleton design allows the sufferer to walk. This design offers stable standing with minimal risk of falling, eliminating the need for a cane or walker, unlike other popular exoskeletons. These designs are easy to use and don't require a harness to sustain weight (Nam et al. 2019, p.27).

Studies show task specificity and training intensity are key factors in enhancing functional improvement after a stroke. Extensive task-oriented practice can increase walking proficiency more than typical stroke survivors. Functional weight-bearing exercises can improve gait function and muscle strength, coordination, and sensory organization (Vive et al. 2024, p.3).

Stroke rehabilitation has been shown to improve functional results in high-income nations. Research has shown that better results are achieved with more intense

treatment. Following a stroke, physiotherapy can increase functional independence, and functional gains can enhance stroke survivors' quality of life and psychosocial outcomes (Islam et al. 2024, p.1411422). Several therapies have been suggested for the rehabilitation of stroke victims who have neurologic dysfunctions. Rehabilitation interventions for stroke patients include walking training, motor imagery, isolated segment and muscle workouts, passive kinesiotherapy, active resistance exercises, virtual reality, practice-oriented tasks, and circuit-based activities. Eleven studies found that circuit-based exercise outperformed traditional therapies in terms of gait speed and balance, but not in terms of functional mobility (Bonini-Rocha et al. 2018, p.400).

Research has been published on the impact of Nordic walking training on elderly rehabilitation and neurologically damaged people. When comparing Nordic walking to regular overground walking to gauge seniors' walking abilities, it was shown that Nordic walking improved gait speed 106% more effectively than overground walking (Marzolini et al. 2021, p.e022588).

Lower-limb paresis that impairs gait is one of the main symptoms following a stroke. Lower-limb therapy for stroke patients includes several components, including assistive devices, balance-coordination training, orthoses, and inducing motor recovery. Mirror therapy (MT) has a well-established track record of helping stroke patients recover their upper limbs, both with and without exercises. The idea of visual illusion serves as the foundation for the MT mechanism. The movement of the paretic body part (hidden next to the mirror) is interpreted as the movement of the non-paretic portion in front of the mirror (reflective side). Even with a completely paralyzed limb, MT enables a person to experience normal (Arya et al. 2019, p.1194).

The most popular use of treadmill-based RAGT (t-RAGT) is in conjunction with body weight support. This is done either with exoskeleton orthoses that move the lower body extremity joints in time with the gait phases or with end-effector robots that drive two footplates, mimicking the phases of gait. Prior studies found that when compared to conventional gait training alone, RAGT in conjunction with traditional physiotherapy may have a marginally greater or comparable beneficial impact on gait speed and ambulation (Nedergard et al. 2021, p.11). Regaining the capacity to walk is a primary rehabilitation objective for stroke patients, and promising strategies including fitness training, high-intensity therapy, and repetitive-task training are typically used to

improve results. Walking distance can be enhanced with treadmill training following a stroke, but ground walking training cannot significantly improve walking speed or balance (Gelaw et al. 2019, p.100012). In gait rehabilitation programs, virtual reality (VR) is often utilized to provide repeated and diverse training, improve patient motivation, reduce perceived exertion, and increase flexibility. The device uses constraint-induced movement therapy, provides patients with feedback, and allows for customized training based on the individual needs of the patient (Selves et al. 2020, p.37882). The considerable gains shown in all analyzed trials suggest that PNF therapy considerably improves gait metrics in stroke patients. PNF practices increase mobility, improve balance, and help in the recovery from a stroke. For neuromuscular reeducation, these workouts use resistance and stretching across numerous muscle groups. To form a comprehensive rehabilitation program, they can be paired with other therapeutic therapies such as occupational therapy, speech therapy, and physical therapy (Gunning et al. 2019, p.23). The PNF and cognitive therapeutic exercise groups both showed notable improvements; however, because of their varied treatment approaches and regimens, cognitive therapeutic exercise is not a good comparison (Boob and Kovela, 2022, p.233).

TENS, an electrical stimulation technique, can help stroke patients who frequently have spasticity. TENS can reduce ankle spasticity, improve gait, and increase task-related training efficacy, according to a study with 30 patients that found that TENS groups reduced ankle spasticity more than other groups (Marcolino et al. 2020, p.565).

People who suffer from acute-onset central nervous system (CNS) injuries, including strokes, frequently have long-lasting locomotor impairments, which may be measured by reductions in walking distance and gait speed over a predetermined amount of time (timed distance). To increase walking distance or speed, clinicians should provide virtual reality-based training or walking instruction to ambulatory patients more than six months following acute CNS damage. Walking speed and distance may not be enhanced by strength training, circuit training, cycling, or virtual reality-based balancing training (Hornby et al. 2020). The evaluation of multiple dimensions of locomotion, including functional disability, balance, walking, and independence in performing ADL, is necessary simultaneously (Gelaw et al. 2019, p.100012). Stroke is a primary cause of permanent impairment, frequently resulting in compromised sensorimotor, gait function, and spasticity. During the chronic phases of the illness,

anomalies in gait continue, and only a tiny portion of these people can walk normally in public. Locomotor training regimens for chronic stroke survivors with mild impairments are viable to implement (Peters et al. 2021, p.11).

Vertical step regularity and gait harmony may predict discharge gait speed in patients with subacute stroke (Igarashi et al. 2023, p.42).

CHAPTER: III METHODOLOGY

3.1 Study Design:

The study was a descriptive type of cross-sectional to assess the gait characteristics and walking ability of stroke survivors. Cross-sectional studies are observational studies that determine exposure and outcome at the same time for each participant, making them simple, inexpensive, and easy to conduct (Kesmodel, 2018). Individuals' data was gathered at a single moment in time, making it possible to analyze the gait parameters of all those who fulfilled the inclusion criteria.

3.2 Study Area:

Data for the present study were collected from the post-stroke patients who came in the Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka for continued physiotherapy treatment.

3.3 Study Place:

The study was carried out at the Centre for the Rehabilitation of the Paralysed (CRP), Savar, Dhaka.

3.4 Study Period:

This study was finished within one year from the proposal approval date. It was an academic part of the Bachelor's course, so it had to be completed within time. However, it started in September 2023 and completed in August 2024.

3.5 Study Population:

The study was performed among stroke survivors who received rehabilitation services from the Neurology unit of the Physiotherapy Department at the Centre for the Rehabilitation of the Paralyzed (CRP), Savar, Dhaka, Bangladesh.

3.6 Sample Size:

Sampling was the act, policy, or method of choosing a representative sample or portion of a population to determine the characteristics of the entire population.

The sampling procedure for the cross-sectional study was done by following the equation-

We know that_,

$$n = \frac{Z^2 pq}{d^2}$$

Here,

n = required sample size

z = confidence level at 95% (standard value of 1.96)

p (Prevalence)= p is the prevalence taken as 11.39% (Mondal et al. 2021)

q = 1-p

d = margin of error at 5% (standard value of 0.05)

So, the sample size is 156.

3.7 Sampling Technique:

The sampling technique was purposive sampling. It was a non-probability sampling method. The participant was selected among stroke patients who met the established inclusion criteria at the neurology unit, CRP, Savar.

3.8 Eligibility Criteria:

3.8.1 Inclusion Criteria:

- Age level 40 - 80 years. (Sadat et al., 2023, p.37882)
- Duration of stroke onset 3 months to 2 years. (Cirstea, 2020, p.2892)
- Both male and female patients are included.
- Having the ability to walk independently or with minimal assistance.

3.8.2 Exclusion Criteria:

- Mentally ill and medically unstable patient.
- Lack of ability to walk independently or individuals with other neurological conditions or severe physical impairments affecting their ability to walk.

3.9 Method of Data Collection:

3.9.1 Technique of data collection:

Data was gathered by face-to-face interviews with close-ended questions and assessed the gait parameters and walking performance during the data collection at CRP-Savar, Dhaka.

3.9.2 Instruments of data collection:

- Questionnaire which included the close-ended question.

3.9.3 Tools of data collection:

- Measurement tape
- Stopwatch
- 10-meter walk test
- TUG Test (time up and go test)

3.9.4 Procedure of data collection:

The research proposal was submitted to the Ethical Review Board (EBR) of SCMST and approval was obtained from the Board. The investigator obtained written permission from the ethical review board (SCMST). Bangladesh Medical Research Council (BMRC) and World Health Organization (WHO) guidelines were also followed to conduct the study. The investigator visited the CRP, Savar, and was selected to carry out the study in this place. Getting permission from the hospital authority.

3.10 Management of Data

3.10.1 Data editing:

It was identified by analyzing the collected data to correct mistakes, inequity, or other faults. The prime goal of data editing was to certify the precision, and authenticity of the data before scanning data to make a result.

3.10.2 Data entry:

Data entry is the process of converting raw data from various sources into a digital format or a data management system, such as a spreadsheet, database, or data entry software. It is a fundamental step in research, business, and other domains where data needs to be organized, analyzed, and utilized efficiently. Data entry involves carefully

inputting information from paper documents, questionnaires, surveys, or other sources into a computer or electronic system.

3.10.3 Data analysis:

After data collection, the accuracy of the data was examined. Descriptive statistics, Spearman's rank correlation test, and Chi-square test were used to analyze data. Microsoft Excel and SPSS (statistical package for social science) 25 versions were applied.

3.11 Determination of Statistical Test:

The statistical tests for this study were selected based on the nature and distributed nature of the data that were collected. For quantitative, abnormally distributed data (e.g., age, velocity, 10-meter walk test, TUG test) and normally distributed data (e.g., BMI, stride length, step length, cadence) Spearman's rank correlation test was applied to assess the correlation between quantitative variable. Chi-square tests were employed to assess associations between categorical groups (e.g., gender, family type, type of stroke, comorbidity, duration of stroke, treatment sessions received). For quantitative variables also descriptive statistics (such as mean and standard deviation) were calculated.

3.12 Result:

The outcome of the study was presented with tabulations, charts, graphs, and describe in the result section of this work.

3.13 Ethical Consideration:

The research proposal was submitted to the Ethical Review Board (EBR) of SCMST and approval was obtained from the Board. The investigator obtained written permission from the ethical review board (SCMST). Bangladesh Medical Research Council (BMRC) and World Health Organization (WHO) guidelines were also followed to conduct the study. Data were collected from the stroke sufferer at the Neurology unit, CRP, Savar, where the project worker also took permission from the hospital managing committee to continue the study. Before the question-and-answer session with the stroke patients, the details of the study were described in detail to them. The person who agreed was included in this work. The participants were up to date that their engagement would be open to choice and that they had the power to exit from the

work at any time without any problem or risk. They were additionally assured that their information that they gave. Permission was given by each patient who engaged in the study by signing the consent form.

CHAPTER: IV RESULTS

The aim of this study was to assess the gait parameters and overall walking performance of stroke survivors, which provides significant knowledge about their mobility challenges. To accomplish this, the researcher collected data on various aspects of gait as well as walking performances. To make the data more accessible and interpretable, the findings were visually depicted with bar graphs, pie charts, and tables. The study also included an investigation of socio-demographic characteristics and health-related data, which helped to investigate how various factors impact gait and mobility. Several scales were used to assess gait and walking performance, and the results were presented in different diagrams and tables for readability.

4.1 Sociodemographic Information:

4.1.1 Age:

Table no 1: Age of the participants

Total number	Minimum age	Maximum age	Maen age
55	40	79	52.84

The results demonstrated that the 55 participants had an average age of 52.84 years (SD = 9.72). The age range was as follows. 40-49 years 30.9% (n=17); 50-59 years 45.5% (n=25); 60-69 years 16.4% (n=9); and 70-79 years 7.3% (n=4). And where the greatest percentage of participants (45.5%) were aged 50-59 years (Figure 1).

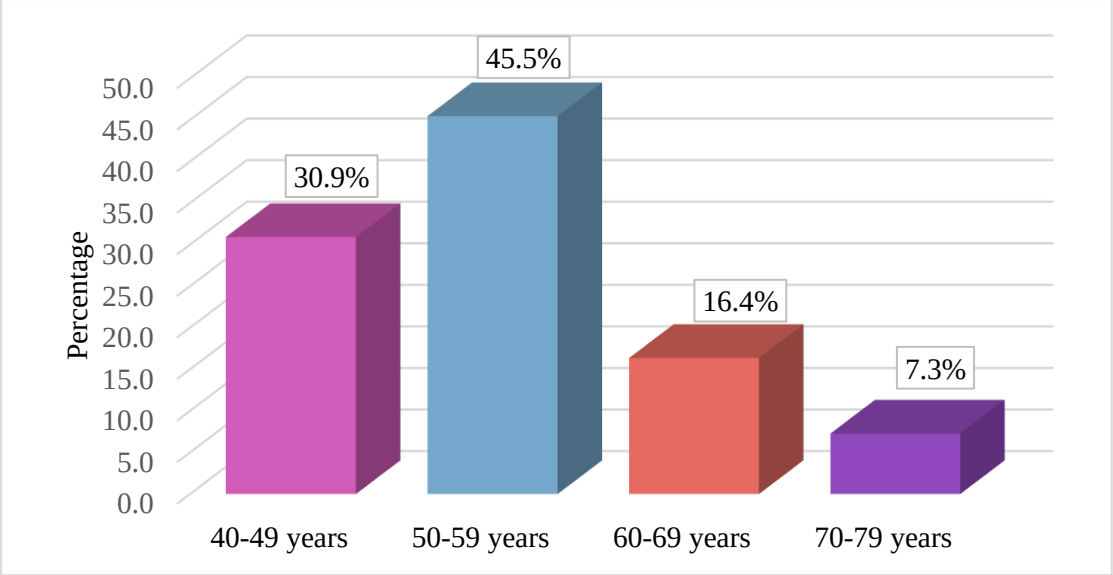


Figure no 1: Age range of the participants.

4.1.2 Gender:

In 55 individuals, 16 were female (29.1%) and 39 were male (70.9%) (Figure 2). The study revealed a higher prevalence of stroke among male participants, with over two-thirds being male.

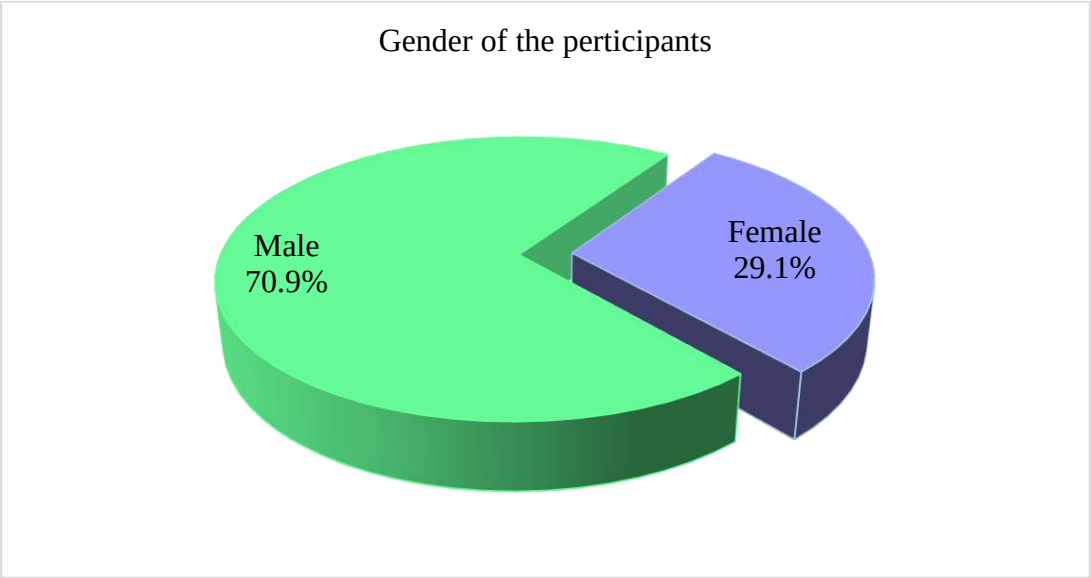


Figure no 2: Gender of the participants.

4.1.3 Occupation:

Table no 2: Occupation of the participants.

Occupation	Frequency (n)	Percentage (%)
Business	11	20.0
Expatriate	4	7.3
Farmer	2	3.6
Government Service	3	5.5
Housewife	14	25.5
Private job	8	14.5
Retired	4	7.3
Student	1	1.8
Teacher	8	14.5
Total	55	100.0

The study was carried out with 55 participants. Among them, 20% (n=11) were in business, 7.3% (n=4) were expatriates, 3.6% (n=2) were farmers, 5.5% (n=3) were in government service, 25.5% (n=14) were housewife, 14.5% (n=8) had private jobs, 7.3% (n=4) were retired, 1.8% (n=1) were students, and 14.5% (n=8) were teachers.

4.1.4 Educational Level:

Table no 3: Educational level of the participants.

Educational level	Frequency (n)	Percentage (%)
Graduate	8	14.5
HSC	15	27.3
Illiterate	3	5.5
Primary	8	14.5
Secondary	21	38.2
Total	55	100.0

The table shows the educational levels of 55 individuals who were the participants in this study. The largest group, 21 people (38.2%), had completed secondary education. The next group of these participants was 15 people (27.3%) who had finished HSC (Higher Secondary Certificate). Furthermore, 8 people (14.5%) were graduates, and another 8 people (14.5%) had completed primary education. A small group of 3 people (5.5%) were illiterate.

4.1.5 Living Area:

Here, the outcome revealed that 43.6% (24) lived in urban & 56.4% (31) lived in rural areas. More stroke survivors were from the rural area according to the present study result.

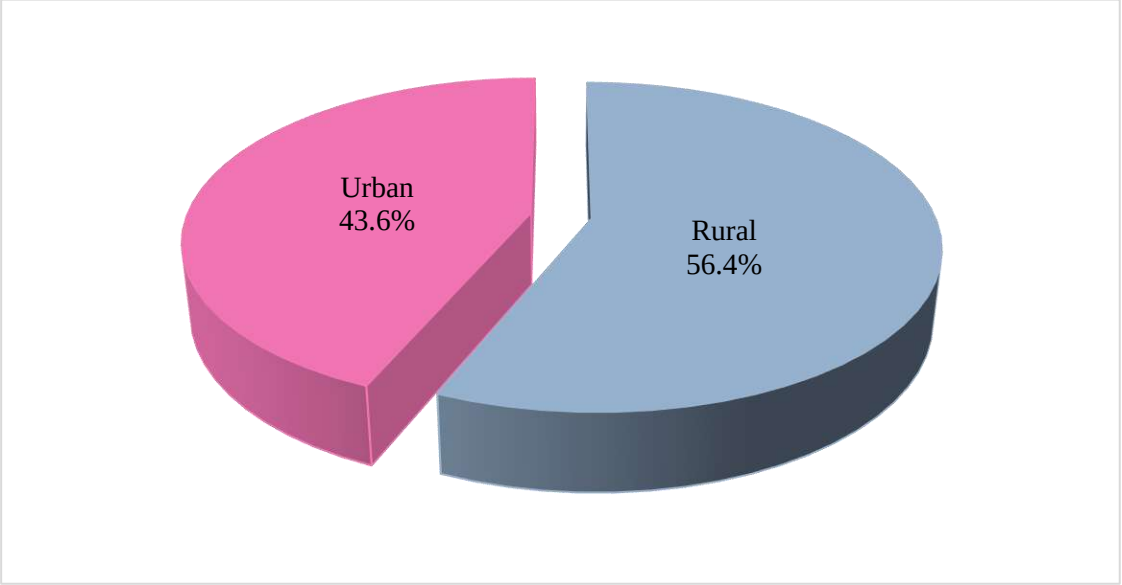


Figure no 3: Living area of the participants.

4.1.6 Family Type:

The study explored that in the 55 participants, 58.2% (32) had extended family & 41.8% (23) had nuclear family (Figure 4).

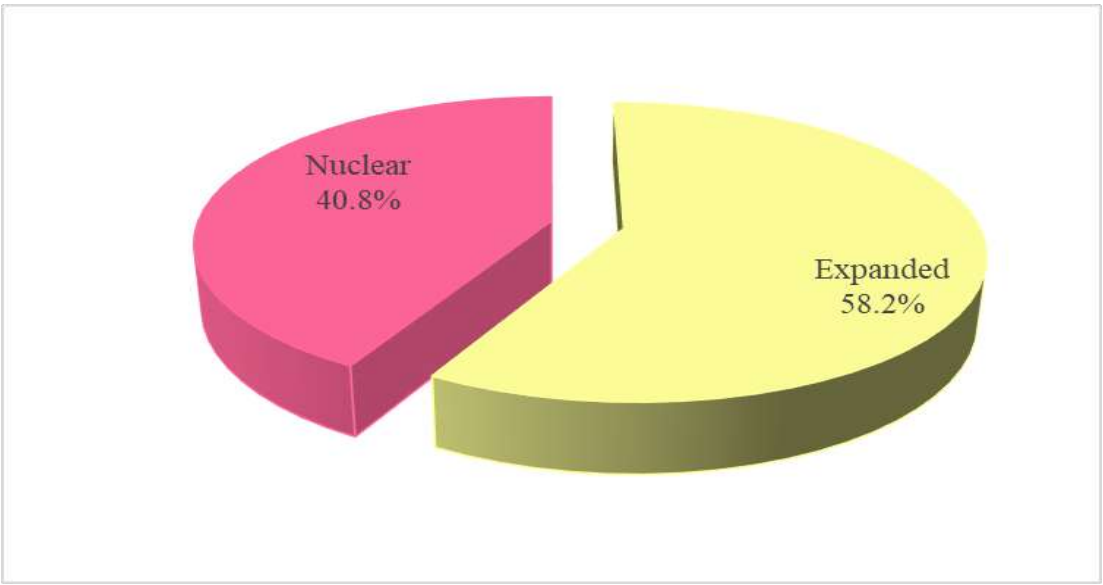


Figure no 4: Family type of the participants.

4.1.7 Marital Status:

Table no 4: Marital status of the participants.

Marital Status	Frequency (n)	Percentage (%)
Married	54	98.2
Unmarried	1	1.8
Total	55	100.0

Here, 98.2% (n=54) were married from all participants, and on the other hand, 1.8% (n=1) were unmarried.

4.1.8 BMI:

55 people were included in the sample for which the BMI data was gathered. A mean BMI of 24.64 (SD of ±3.21) was recorded. The study found that the majority of 55 participants (50.9%) had a normal BMI, with 41.8% being overweight, 5.5% obese, and 1.8% underweight (Figure 5).

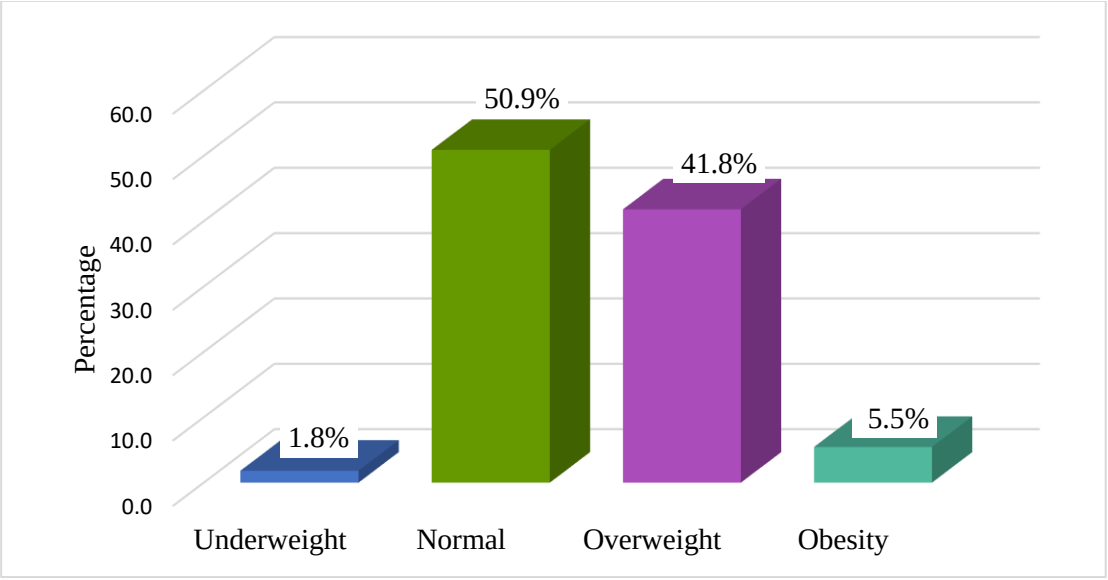


Figure no 5: BMI range of the participants.

4.2 Condition Related Information:

4.2.1 Type of Stroke:

Table no 5: Type of stroke of the participants.

Type of stroke	Frequency (n)	Percentage (%)
Hemorrhagic	4	7.3
Ischemic	51	92.7
Total	55	100.0

The table highlights the types of strokes they experienced. Ischemic strokes were the most common, affecting 51 people (92.7%). In contrast, hemorrhagic strokes were much less frequent, occurring in only 4 people (7.3%).

4.2.2 DURATION OF STROKE

Table no 6: Duration of stroke of the participants.

Duration of stroke	Frequency (n)	Percentage (%)
3month-1year	46	83.6
More than 1year	9	16.4
Total	55	100.0

The table showed how long 55 individuals had been surviving. Most of them, 46 people (83.6%), had their stroke for a duration of 3 months to 1 year. Meanwhile, a smaller group of 9 people (16.4%) had been the duration of their stroke for more than 1 year.

4.2.3 Affected Side:

Table no 7: Affected side of the participants.

Affected side	Frequency (n)	Percentage (%)
Left	34	61.8
Right	21	38.2
Total	55	100.0

About 55 people participated in this study. Among them, 38%(n=21) are right-side affected and 62%(n=34) are left-side affected.

4.2.4 Comorbidity:

Table no 8: Comorbidity of the participants.

Comorbidity	Percentage (%)	Frequency (n)
Hypertension (HTN)	83.6	46
Others (heart disease, asthma, diabetes)	16.4	9
Total	100.0	55

The table showed the comorbidities of 55 individuals. The majority, 46 people (83.6%), had hypertension (HTN). A smaller group, 9 people (16.4%), had other conditions such as heart disease, asthma, or diabetes.

4.2.5 Type of Weight Bearing:

Table no 9: Type of weight bearing of the participants.

Type of weight-bearing	Percentage (%)	Frequency (n)
Asymmetrical	49.1	27
Symmetrical	50.9	28
Total	100.0	55

Weight-bearing patterns among the 55 participants demonstrate that 49.1% (27 people) have an asymmetrical pattern, whereas 50.9% (28 people) have a symmetrical pattern.

4.2.6 Treatment Session Received

Table no 10: Treatment sessions received by the participants.

Treatment session received	Frequency (n)	Percentage (%)
11-20 session	8	14.5
more than 20 sessions	47	85.5
Total	55	100.0

The table shows the distribution of treatment sessions received by 55 people. Among them, 8 patients (14.5%) attended between 11 and 20 sessions, while the majority, 47 patients (85.5%), received more than 20 sessions.

4.3 Gait Parameters:

Table no 11: Mean and standard deviation of gait parameters.

Selective gait parameters	Minimum (cm)	Maximum (cm)	Mean	Standard deviation (SD)
Stride length (cm)	30	76	53.56	12.19
Step length (cm)	16	41	28.55	6.28
Speed (m\s)	0.17	0.62	0.33	0.13
Cadence	41	95	66.04	12.14

Among 55 stroke survivors, the average stride length was 53.56 ± 12.19 cm, step length 28.55 ± 6.28cm, walking speed 0.33 ± 0.13 m/s, and cadence 66.04 ± 12.14 steps/min.

4.4 Walking Performance

4.4.1 10-meter walk test (MWT)

Table no 12: Mean and standard deviation of the 10-meter walk test.

Test	Mean (m/s)		Standard deviation (SD)	
10-meter walk test	0.32		0.12	
	Male	Female	Male	Female
	0.33	0.30	0.12	0.11

The average walking speed of 55 stroke survivors on the 10-meter walk test was 0.32 m/s (SD = 0.12). There were minor gender variations in walking performance, with males averaging 0.33 m/s (SD = 0.12) and females averaging 0.30 m/s (SD = 0.11).

4.4.2 TUG Test

Table no 13: Mean and standard deviation of the TUG test.

Test	Mean (sec)		Standard deviation	
TUG test	26.04		7.13	
	Male	Female	Male	Female
	25.95	26.25	5.422	7.786

This study evaluated the walking abilities of 55 stroke survivors using the time up and go (TUG) test. The participant's average time to finish the test was 25.98 seconds, with a standard deviation of 7.98 seconds.

4.5 Association and Correlation of Gait Parameters, Walking Performance, Sociodemographic and Disease-Related Variables:

4.5.1 Correlation between age with gait parameters and walking performance:

Table no 14: Correlation between age with gait parameters and walking performance.

Variables	Gait parameters and walking performance	r_s value	p-value	Significance
Age	Stride length	- 0.05	0.70	Not significant
	Step length	- 0.02	0.83	Not significant
	Velocity	- 0.25	0.05	Significant
	Cadence	-0.28	0.03	Significant
	10-meter walk test	- 0.25	0.06	Not significant
	TUG test	0.27	0.04	Significant

The Spearman's Rank Correlation test was used since normality tests revealed that several variables (such as age, velocity, the 10-meter walk test, and the TUG test) were not normally distributed. Spearman's test is a non-parametric approach that may be used to assess the strength and direction of monotonic correlations between variables in the absence of normal distributions. A number between -1 and +1 reflects the degree of this relationship, with 0 representing no connection at all. The table showed the correlation between age, selected gait metrics, and walking performance. Stride length and step length indicated minimal negative correlation with age but were not statistically significant, as proven by low r_s values (-0.05 and 0.02) with high p-values (0.70 and 0.83). Velocity had a minor negative association with age (-0.25) and the p-value was (0.05) statistically significant. Cadence has a low negative correlation (-0.28) with age, and the p-value (0.03) suggests a significant correlation. The 10-meter walk test showed a moderate negative association (-0.25), but with a p-value of 0.06, it was not statistically significant. However, the TUG test showed a significant positive association (0.27) with age, with a statistically significant p-value of 0.04.

4.5.2 Correlation between BMI with gait parameters and walking performance:

Table no 15: Correlation between BMI with gait parameters and walking performance.

Variables	Gait parameters and walking performance	r_s value	P-value	Significance
BMI	Stride length	- 0.21	0.12	Not Significant
	Step length	- 0.22	0.10	Not Significant
	Velocity	- 0.27	0.04	Significant
	Cadence	-0.27	0.04	Significant
	10-meter walk test	- 0.28	0.03	Significant
	TUG test	0.29	0.03	Significant

The Spearman's correlation test was used because many variables, such as velocity, the 10-meter walk test, and the TUG test, were not normally distributed. And found relationships between BMI, gait characteristics, and walking performance. A moderate negative correlation was discovered between BMI and both velocity (r_s=-0.27, p=0.04) and cadence (r_s=-0.27, p=0.04), indicating that as BMI increases, walking speed and cadence decreases. BMI shows a negative connection with the 10-meter walk test (r_s=-0.28, p=0.03), indicating that higher BMI results in worse performance on the test. A moderate positive connection was discovered between BMI and the TUG test (r_s=0.29, p=0.03). Higher BMI was associated with longer time necessary to complete the test, indicating poor mobility. However, the associations between BMI and stride length (r_s=-0.21, p=0.12) and step length (r_s=-0.22, p=0.10) were low and not statistically significant.

4.5.3 Association between type of stroke with age group, gender, BMI status and living area:

Table no 16: Association between type of stroke with age group, gender, BMI status and living area.

Disease-related variable	Socio-demographic Variable	Chi-square value	P-value	Significance
Type of stroke	Family type	0.50	0.47	Not significant
	Gender	1.77	0.18	Not significant
	Marital status	0.08	0.77	Not significant
	Living Area	1.73	0.18	Not significant

This table showed the results of chi-square tests, used to determine if there's a statistically significant relationship between the type of stroke and various factors like family type, gender, marital status, and living area. The p-values for all tests were greater than 0.05, indicating no significant association between the type of stroke and any of these factors. This suggests that these factors did not influence the type of stroke experienced.

4.5.4 Association between type of weight bearing, type of stroke and affected side:

Table no 17: Association between type of weight bearing, type of stroke and affected side.

Variable 1	Variable 2	Chi-square value	P-value	Significance
Type of weight-bearing	Type of stroke	1.15	0.28	Not Significant
	Affected side	1.64	0.20	Not Significant

This table showed the results of chi-square tests that observed the relationship between stroke type and two factors such as weight-bearing type and afflicted side. The p-values for both were more than 0.05 (0.28 and 0.20, respectively). This indicates that there was no statistically significant relationship between the type of stroke and the weight-bearing or affected side.

4.5.5Association between comorbidity with the duration of stroke, the number of treatment sessions received and type of weight bearing:

Table no 18: Association between comorbidity with the duration of a stroke, number of treatment sessions received and type of weight-bearing.

Variable 1	Variable 2	Chi-square value	P-value	Significance
Comorbidity	Duration of stroke	5.99	0.43	Not Significant
	Treatment sessions received	9.10	0.04	Significant
	Type of weight-bearing	8.18	0.04	Significant

The table shows the results of chi-square tests that investigated the link between comorbidity and stroke length, number of treatment sessions, and type of weight bearing. The number of therapy sessions and type of weight bearing were both significantly related to comorbidity. Because both of these p-values were less than 0.05 (0.04, 0.04), respectively. However, the length of the stroke wasn't significantly associated with comorbidities, since the p-value was 0.42, which was more than 0.05.

CHAPTER: V DISCUSSION & LIMITATION

Among stroke survivors, walking impairment is most common. Over 80% of stroke survivors have severe walking difficulties (Li et al. 2021, p.105377). Stroke patients may experience post-injury symptoms such as impaired motor control, coordination, balance issues, and irregular gait. Gait speed, cadence, step length and spatial asymmetry are all typical in post-stroke (Nedergard et al. 2021, p.17).

The study assessed various gait parameters and walking performance of stroke patients. In this observation study, 55 patients were included according to the inclusion criteria. With a greater stroke death rate than in North America or Europe, the burden of stroke is especially severe in Asia. Stroke in China is the prime etiology of both disability and mortality. According to the study population of people 60 years of age and older, the overall standardized prevalence rate of stroke patients who survived was 4.94% (Xia et al. 2019, p.1455)

Strokes are more prevalent in the elderly and young (Rajati et al. 2023, p.101746). According to reports, the prevalence of stroke was 2%, 3%, 0%, and 1% among those in the 40–49, 50–59, 60–69, 70–79, and 80+ age groups (Sadat et al. 2023, p.37882). This study also showed that most stroke sufferers were middle-aged and elderly people and the average age of the participants was 52.84 ± 9.72 years. The majority of the participants was 45.5% and their age range was 50-59 years. The second highest was (30.9%) 40-49 years. Stroke rates significantly differ between men and women, with men experiencing earlier and more frequent strokes (incidence 33% higher, and prevalence 41% higher) (Avan et al. 2019, p.195). This study found the prevalence of stroke patients was greater in men (70.9%) than in women (29.1%). These findings are consistent with those of the study conducted by Naureen et al. in 2024. Males (62.5%) suffered more than females (37.5%), according to this study (Naureen et al. 2024, p.755).

The percentage of stroke survivors living in urban regions was 58.9%, whereas the percentage in rural areas was 41.1% (Mondal et al. 2022, p.100414). Although earlier research indicated that the prevalence of stroke was greater in urban regions, our results showed that the prevalence was greatest in rural regions (56.4%). The study found that 4.0% of stroke survivors were unmarried and 12.1% were married out of every

thousands of the population (Mondal et al. 2022, p.100414). We also saw the same thing in marriage 98.2 %.

The average BMI was 23.9 (Shuvo et al. 2024, p.108017). The mean BMI of stroke survivors was 28.72, according to Naureen et al. 2024. This was roughly the same as the results of our study and that BMI of 24.64 (SD of ±3.21) was recorded. Additionally, walking performance and gait parameters were remarkably connected with the BMI. A moderate negative correlation was discovered between BMI and both velocity (rs=-0.27, p=0.04) and cadence (rs=-0.27, p=0.04), indicating that as BMI increases, walking speed and cadence decreases. BMI shows a negative connection with the 10-meter walk test (rs=-0.28, p=0.03), indicating that higher BMI results in worse performance on the test. A moderate positive connection was discovered between BMI and the TUG test (rs=0.29, p=0.03). Higher BMI was associated with a longer time necessary to complete the test, indicating poor mobility. However, the associations between BMI and stride length (rs=-0.21, p=0.12) and step length (rs=-0.22, p=0.10) were low and not statistically significant.

About 87% of strokes were ischemic, with hemorrhagic strokes being less common than ischemic strokes (Ahmed et al. 2024, p.389). The author reports that the majority of strokes were ischemic (90%) and hemorrhagic (10%) (Cheng et al. 2020, p.6). The study also revealed that 92.7% of patients had an ischemic stroke and 7.3% had a hemorrhagic stroke. Additionally, this study demonstrated that the type of stroke and affected side had no association with walking performance and gait parameters. In terms of statistics, this association was not significant. Of all stroke risk factors, hypertension makes up 63%. Cardiovascular disease, diabetes mellitus, and high cholesterol come in second and third, respectively, at 24% and 21% (Sadat et al., 2023, p.37882). This study also found that, at 83.6% of the population, hypertension (HTN) is the most common comorbidity. Other comorbidities include such as heart disease, asthma, and diabetes which was about 16.4%. The patients' weight-bearing style and comorbidities were significantly correlated (p=0.04). This affects a person's general gait. The comorbidity had a significant association with the number of treatment sessions received. Additionally, there is a near to substantial correlation between TUG test time and comorbidity. It suggests that the TUG test duration may lengthen and impair gait quality.

Gait symmetry also altered the arrangement of body weight bearing. Without therapy, the majority of stroke patients experience uneven weight bearing. Of the 55 individuals, 49.1% had an asymmetrical pattern in their weight-bearing patterns, whereas 50.9% have a symmetrical pattern. However, because there is a substantial correlation between walking ability and gait asymmetries, this study demonstrates that equal or comparable post-stroke patients exhibited asymmetrical gaits. The gait asymmetry may lessen if the number of therapy sessions is increased (Rozanski et al. 2020, p.1852). This study found that the comorbidity has a significant impact on the gait asymmetry.

To evaluate the gait parameter, estimate the spatial-temporal gait parameters, including cadence, step time, stride time, stride length, velocity, stance phase, swing phase, and double stance phase. Stroke survivors typically have a longer paretic side swing phase and a reduced stance phase (Wang et al. 2020, p.72). Additionally, the stride length is shortened and the walking pace is reduced. Stroke survivors typically have a longer paretic side swing phase and a reduced stance phase. Additionally, the stride length is shortened and the walking pace is reduced. Stroke patients walking without a railing have an average stride length of 91.6 (± 27.97) to 93.49 (± 28.8) km/h (Wang et al. 2020, p.72). This study found that the stride length was considerably shorter than usual. The mean stride length in this study was 53.56 cm. This study demonstrated that stroke survivors' stride lengths were greatly reduced. In addition, it lowered the cadence and speed.

The study presents a two-foot-worn Gaitboter system using inexpensive, wearable sensors for gait analysis. The gaitboter and myomotion showed stride lengths of 48.544 cm and 40.815 cm, respectively (Cheng et al. 2020, p.5). According to this study, the average walking speed was 0.33 m/s, the average stride length was 53.56 cm, the average step length was 28.55 cm, and the cadence was 66.04 steps per minute.

The 10-meter walk test is frequently regarded as the standard or ideal for determining gait speed (Peters et al. 2021, p.13). Post-stroke patient the 10mWT (m/s) result was 0.94 ± 0.36 (Cheng et al. 2020, p.5). This investigation revealed, in the 10-meter walk test, the mean walking velocity of 55 stroke survivors was 0.32 m/s. Walking speeds were slightly different for men and women, with men averaging 0.33 m/s and women 0.30 m/s. The findings of this investigation were comparable to those of Cheng et al. 2020.

When compared to normal individuals, the hemiparetic patients' performance on the TUG test was significantly affected. This survey indicates that completing the task took an average of 25.98 seconds. It showed a significantly reduced walking speed and a higher chance of the subject or stroke patient falling.

5.1 Limitation of the study:

1. Here, the calculated sample size of the present study was 156, due to a shortage of time data could not be collected from the original sample size. The researcher had to collect data from 55 stroke survivors attending CRP for treatment. The small number of participants affected the result statistically.
2. The sample size was not enough compared to the required sample. So, the result could not be generalized.
3. The purposive sampling technique was applied to selected study participants (stroke survivors) for the present study. So, the representativeness of the sampling units could not be ensured. As a result, it affected the quality of the study. The probability sampling technique is appropriate for such a study.
4. A dissertation needs huge effort and time. The research worker is a student in 4th year, B.Sc. in physiotherapy with having not sufficient exposure to research activity. The present research is her first research work. As a result, some issues are coming in the thesis.

CHAPTER: VI CONCLUSION & RECOMMENDATION

6.1 Conclusion

One important characteristic of hemiplegic gait in stroke survivors is spatial and temporal asymmetry, which may increase energy expenditure and fall risk. Walking impairment following a stroke can impact functional mobility by limiting participation and activities.

It has a severe effect on mobility and gait after a stroke. Stride length, cadence, velocity, and walking performance were all statistically significant in this study, along with a few sociodemographic and disease-related factors such as age, BMI, comorbidity and nature of weight bearing. A person with trouble walking becomes alone and declines in their quality of life. Evidence of physiotherapy practice in this subject backed by research is essential. Physiotherapists' use of evidence-based practice in all areas of medicine. There aren't many studies on this topic. These are not enough to overview all aspects of the large area. Therefore, the future workforce in physiotherapy had to seek out further study in this area. It will assist in developing a new device strategy to create this site and addressing the treatment plan to produce the appropriate treatment.

6.2 Recommendation

This study's objective was to assess gait parameters and walking performance metrics in stroke patients. The outcome that the researcher discovered during the investigation has satisfied the purpose of this study. The outcome of the ongoing study serves as the foundation for the guidance.

1. Following a stroke, the gait measures showed a considerable alteration, and their daily activities were drastically reduced. Therefore, programs for early intervention and rehabilitation should be designed to address each person's unique needs and limitations.

2. More study is needed to focus on the long-term impact of stroke on gait metrics and the efficacy of rehabilitation therapies over time.

3. To improve the validity and reliability of the findings, future research should explore increasing the sample size. A bigger sample size would produce more general results, allowing for a better understanding of stroke survivors' gait characteristics and walking performance.

4. Other measuring scales, such as the Berg Balance Scale and the Functional Ambulation Classification (FAC), should be taken into consideration to determine an effective and efficient result in a generalized form.

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APPENDIX: A

সম্মতিপত্র

শিরোনাম: স্ট্রোক পরবর্তী রোগীদের গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা মূল্যায়ন: একটি ক্রস-সেকশনাল গবেষণা।

আসসালামু আলাইকুম/ নমষ্কার,

আমি চুমকি আক্তার, সাইক কলেজ অব মেডিকেল সায়েন্স অ্যান্ড টেকনোলজি (এসসিএমএসটি) এর বি.এস.সি. ফিজিওথেরাপি বিভাগের ৪র্থ বর্ষের শিক্ষার্থী। আমাকে একটি গবেষণা পরিচালনা করতে হবে যা আমার প্রাতিষ্ঠানিক কাজের একটি অংশ। অংশগ্রহণকারীদের নিম্নলিখিত অংশটুকু পড়ার পর অংশগ্রহন করার অনুরোধ করছি।

আমার গবেষণার শিরোনাম হল "স্ট্রোক পরবর্তী রোগীদের গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা মূল্যায়ন: একটি ক্রস-সেকশনাল গবেষণা"। এই গবেষণার মাধ্যমে আমি স্ট্রোক রোগীর গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা পরিমাপ করব। আমার গবেষণার উদ্দেশ্য হল স্ট্রোক পরবর্তী রোগীদের গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা পরিমাপ করা। যদি আমি এই গবেষণাটি সফলভাবে সম্পন্ন করতে পারি তবে এই গবেষণাটি স্ট্রোক রোগীর গেট প্যাটার্ন সম্পর্কে তথ্য সরবরাহ করবে যা ভবিষ্যতে গবেষকরা উদ্ভাবনী পুনর্বাসন কৌশল তৈরীতে ব্যবহার করতে পারবেন। আর এর ফলে রোগীরা উন্নত সেবা পাবেন। আমার গবেষণাটি সম্পন্ন করার জন্য আমাকে স্ট্রোক রোগীদের থেকে তথ্য সংগ্রহ করতে হবে।

সুতরাং, আপনি আমার গবেষণার একজন সম্মানিত অংশগ্রহণকারী হতে পারেন এবং আমি আপনাকে আমার গবেষণার অংশ হতে অনুরোধ করছি । আমি আপনাকে জানাতে চাই যে এটি একটি বিশুদ্ধরূপে একাডেমিক গবেষণা ও অন্য কোনও উদ্দেশ্যে ব্যবহার করা হবে না। আমি আশ্বাস দিচ্ছি যে সমস্ত তথ্য গোপন রাখা হবে। আপনি পছন্দ করেন না এমন একটি নির্দিষ্ট প্রশ্নের উত্তর না দেওয়ার অধিকারও আপনার রয়েছে। এই গবেষণা সম্পর্কে আপনার যদি কোনও প্রশ্ন থাকে তবে আপনি আমার সাথে বা আমার সুপারভাইজার ডাঃ মোহাম্মদ হাবিবুর রহমান, ফিজিওথেরাপি সহকারী অধ্যাপক, এসএসটি (বাউবি) উনার সাথে যোগাযোগ করতে পারেন।

শুরু করার আগে আপনার কি কোন প্রশ্ন আছে?

সুতরাং আমি আপনার অনুমতি নিয়ে এই সাক্ষাৎকার শুরু করতে পারি?

☐ হ্যাঁ

☐ না

সাক্ষাৎকার গ্রহণকারীর স্বাক্ষর..... তারিখ……..

অংশগ্রহণকারীর স্বাক্ষর..... তারিখ……..

সাক্ষীর স্বাক্ষর..... তারিখ……...

INFORM CONSENT

Title: Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study.

Assalamu-alaikum/ Namashker,

I am Chumki Akter, a student of B.Sc. in physiotherapy at Saic College of Medical Science and Technology (SCMST), Mirpur, Dhaka. I shall have to conduct a research which is a part of my academic activity. The participants are requested to participate in the study after reading the following.

My research title is "Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study". Through this research, I will measure the gait parameters and the walking performance of stroke patients. The objective of my study is to measure the gait parameters and walking performance of stroke survivors. If I complete this study successfully, this research will provide information about gait patterns of stroke patients that future researchers can use to create innovative rehabilitation techniques. And, this will improve the impacted people's quality of life. To fulfill my research project, I need to collect data from stroke patients.

So, you can be a respected participant in my research and I would like to request you as a subject of my study. I would like to inform you that this is a purely academic study and will not be used for any other purpose. I assure you that all data will be kept confidential. You also have the right to answer a particular question that you don't like. If you have any queries about the study, you may contact with me or my supervisor Dr. Mohammad Habibur Rahman, Assistant Professor of Physiotherapy, SST (BOU).

Do you have any questions before I start?

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

☐ Yes

☐ No

Signature of the Interviewer…… Date……

Signature of the participant……. Date…….

Signature of the witness……. Date…….

APPENDIX: B

প্রশ্নপত্র (বাংলা)

"স্ট্রোক পরবর্তী রোগীদের গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা মূল্যায়ন: একটি ক্রস-সেকশনাল গবেষণা"

ব্যাক্তিগত তথ্য

এই প্রশ্নপত্রটি স্ট্রোক পরবর্তী রোগীদের গেইট প্যারামিটার এবং হাঁটার কর্মক্ষমতা মূল্যায়ন করার জন্য তৈরি করা হয়েছে এবং এই বিভাগটি ফিজিওথেরাপিস্টরা একটি কালো রঙের বল কলম ব্যবহার করে পূরণ করবেন।

আইডি:

নাম :

ঠিকানা :

গ্রাম :

পোস্ট অফিস:

পুলিশ স্টেশন:

জেলা :

মোবাইল নম্বর :

অংশ-এ : সামাজিক তথ্যবলি :

(আপনার জন্য সবচেয়ে উপযুক্ত উত্তরটি বেছে নিন এবং উত্তর সারিতে আপনার উত্তর লিখুন)

ক্রমিক সংখ্যা	প্রশ্ন	উত্তর
১.১	লিঙ্গ ১. পুরুষ ২. মহিলা ৩. অন্যান্য	
১.২	বয়স	..... বছর ..... মাস
১.৩	পেশা	
১.৪	শিক্ষাগত যোগ্যতা	

	১. অশিক্ষিত ২. প্রাথমিক ৩. মাধ্যমিক ৪. উচ্চমাধ্যমিক ৫. স্নাতক	
১.৫	বসবাসের স্থান ১. গ্রাম ২ শহর	
১.৬	পরিবারের ধরন ১. একক পরিবার ২. যৌথ পরিবার	
১.৭	বৈবাহিক অবস্থা ১. অবিবাহিত ২. বিবাহিত ৩. ডিভোর্স	
১.৮	উচ্চতা (মিটার)	
১.৯	ওজন (কেজি)	

অংশ বি: রোগ সম্পর্কিত তথ্যাবলি

ক্রমিক সংখ্যা	প্রশ্ন	উত্তর
২.১	স্ট্রোকের ধরন ১. ইস্কেমিক ২. হেমোরেজিক	
২.২	স্ট্রোকের সময়কাল	

	১. ০-১৫ দিন ২. ১৬-৩০ দিন ৩. ১-৩ মাস ৪. ৩ মাস ১ বছর ৫. ১ বছরের বেশি	
২.৩	কোন পাশ আক্রান্ত? ১. ডান ২. বাম	
২.৪	অন্যান্য জটিলতা (একের বেশি উত্তর হলে একাদিক উত্তর লিখতে পারবেন) ১. হার্টের সমস্যা ২. উচ্চ রক্তচাপ ৩. হাপাঁনি ৪. ডায়াবেটিস ৫. মানসিক রোগ যেমন ডিমেনশিয়া	
২.৫	শারীরিক ওজন বহনের ধরন ১। উভয় পাশে সমান ২। যেকোন এক পাশে	
২.৬	কতটি সেশন দেওয়া হয়েছিল? (ফিজিওথেরাপি) ১. ০-৫ সেশন ২. ৬-১০ সেশন ৩. ১১-২০ সেশন ৪. ২০ এর অধিক সেশন	

অংশ সি- স্কেল সম্পর্কিত তথ্যবলি

গেইট প্যারামিটার-সম্পর্কিত স্কেল

৩.১ স্ট্রাইড লেন্থ(সেমি.) ঃ

৩.২ স্টেপ লেন্থ (সেমি.) ঃ

৩.৩ গতি

(দুরত্ব/সময়) ঃ

৩.৪ ক্যাডেঞ্জ ঃ

হাঁটার দক্ষতা সম্পর্কিত স্কেল

৩.৫ ১০ মিটার ওয়াক টেষ্ট ঃ

ধাপ	ফলাফল
প্রথম ট্রায়াল (সেকেন্ড)	
দ্বিতীয় ট্রায়াল (সেকেন্ড)	
গড় সময় (সেকেন্ড)	
হাটাঁর গতি (মিটার/সেকেন্ড)	

- সহায়ক ডিভাইসের ব্যবহার: ☐ হ্যাঁ ☐ না

৩.৬ টাইম আপ এন্ড গো টেস্টঃ

- প্রয়োজনীয় সময় (সেকেন্ড):
- পর্যবেক্ষণ: (কোনটি উপস্থিত থাকলে টিক দিন)

১. ধীর গতি

২. ভারসাম্য হারিয়ে ফেলা

৩. ছোট পদক্ষেপ (স্ট্রাইড লেন্থ)

৪. সামান্য বা কোনও বাহুর দোলন নেই

৫. এলোমেলো পদক্ষেপ

৬. ঘুরা এবং দিক পরিবর্তন করার ক্ষমতা

৭. এন ব্লক বাঁক

৮. সহায়ক ডিভাইসের ব্যবহার

QUESTIONNAIRE (English)

Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study.

Personal information

This questionnaire is developed to assess the gait parameters and walking performance of stroke survivors and this section will be filled by physiotherapists using a black colored ball pen.

Respondent ID No:

Name:

Age:

Address: Village:

Post Office:

Police Station:

District:

Mobile number:

Section-A: Sociodemographic information:

(Please choose the option that best suits you and write your answer in the response row)

SL. NO.	QUESTION	RESPONSE
1.1	Gender 1. Male 2. Female 3. Others	
1.2	Age	……year ……month
1.3	Occupation	

1.4	Educational level 1. Illiterate 2. Primary 3. Secondary 4. HSC 5. Graduate	
1.5	Living area 1. Rural 2. Urban	
1.6	Family type 1. Nuclear 2. Expanded	
1.7	Marital status 1. Unmarried 2. Married 3. Divorce 4. Separated	
1.8	Height in meter	
1.9	Weight in kg	

Section B: Condition related information

SL.NO.	QUESTION	RESPONSE
2.1	Type of stroke 1. Ischemic 2. Hemorrhagic	

2.2	Duration of the incident of stroke 1. 0-15 day 2. 16-30 day 3. 1-3 month 4. 3month – 1 year 5. More than 1 year	
2.3	Affected side 1. Right 2. Left	
2.4	Comorbidity (You can choose more than one option) 1. Heart disease 2. HTN (Hypertension) 3. Asthma 4. Diabetes 5. Mental health issues like dementia	
2.5	Type of weight-bearing 1. Symmetrical 2. Asymmetrical	
2.6	How many sessions were received (physiotherapy) 1. 0-5 session 2. 6-10 session 3. 11-20 session 4. More than 20 sessions	

Section C: Scale related question

Gait parameter-related scale

3.1 Stride length (cm):

3.2 Step length (cm):

3.3 Speed (distance \ time):

3.4 Cadence:

Walking performance-related scale

3.5 10-meter walk test:

Step	Result
First trial (second)	
Second trial (second)	
Average time (second)	
Walking speed (meter/second)	

- Use of assistive device:

  ☐ Yes

  ☐ No

3.6 Time up and go test:

- Time requires in second:
- Observation:
  1. Slow tentative pace
  2. Loss of balance
  3. Short stride
  4. Little or no arm swing
  5. Shuffling
  6. Ability to turn and change direction
  7. En bloc turn
  8. Use of assistive device

APPENDIX: C

Permission Latter

Date: 11.08. 2024

Head of Physiotherapy department

Centre for the Rehabilitation of the Paralyzed (CRP),

Savar, Dhaka-1343

Subject: Prayer for permission to collect data from the neurology unit of CRP-Savar and CRP-Mirpur 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 part of our course curriculum, we have to conduct a research project to partially fulfill the requirement for the degree of B.Sc. in Physiotherapy. My research title is "**Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study**" and the aim of the study is to measure the gait parameters and walking performance of stroke survivors. This is a cross-sectional study under the supervision of Dr. Mohammad Habibur Rahman, Assistant Professor of Physiotherapy, SST (BOU). I have chosen the neurology unit of CRP-Savar and CRP-Mirpur to collect data from stroke patients who will come to CRP for physiotherapy treatment.

So, I pray and hope that you would be kind enough to permit data collection to help me complete my study.

Approved

Kindly contact with Zakir Hossain, Senior PT as co-ordinated for data collection.

11/08/24

Prof. Dr. Mohammad Anwar Hossain, PhD
Professor, Physiotherapy Dept, BHPI
Senior Consultant & Head, Physiotherapy Dept,
CRP, Savar, Dhaka-1343

Yours Faithfully

Chumki Akter

Chumki Akter

B.Sc. in Physiotherapy

Session: 2018-2019

Saic College of Medical Science and Technology (SCMST)

Mirpur-14, Dhaka-1216, Bangladesh

SCMST-BPT/IRB/.....05 - 23/008

To
Chumki Akter
4th Year Student of B.Sc. in Physiotherapy
Session: 2018-2019, Reg No: 10416
Saic College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

Subject: Approval of the thesis proposal **"Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study"** by ethics committee.

Dear Chumki Akter,
Congratulations.
The Institutional Review Board (IRB) of SCMST has reviewed and discussed your application to conduct the dissertation mentioned above, with you, as the principal investigator. The following documents have been reviewed and approved:

Sr. No.	Name of the Documents
1	Dissertation Proposal
2	Close-ended Questionnaire (English & Bangla version)
3	Information sheet & consent form.

The purpose of the study is to measure the gait parameters and walking performance of stroke survivors. The study involves face-to-face interviews by using a close-ended questionnaire to assess the gait parameters and walking performance of stroke survivors in CRP-Savar and CRP-Mirpur. It may take 30 to 40 minutes to fill out the questionnaire and there is no likelihood of any harm to the participants. The members of the Ethics Committee have approved the study to be conducted in the presented form at the meeting held at 09.00 AM on 28th September 2023 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 by the Nuremberg Code 1947, the World Medical Association Declaration of Helsinki, 1964 - 2013, and other applicable regulations.

Best regards,
16.05.24
Dr. Abul Kasem Mohammad Enamul Haque
Principal, SCMST &Chairman, Institutional Review Board (IRB)
Saic College of Medical Science & Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh

CRP
Centre for the Rehabilitation of the Paralysed

পক্ষাঘাতগ্রস্তদের পুনর্বাসন কেন্দ্র (সিআরপি)
Centre for the Rehabilitation of the Paralysed (CRP)
a project of the Trust for the Rehabilitation of the Paralysed
Head Office: CRP Savar, Chapain, Savar, Dhaka-1343, Bangladesh
Tel: 02224445464-5, Fax: 02224445069, E-mail: contact@crp-bangladesh.org, Web: www.crp-bangladesh.org

CRP-ERC-R&E-0401-0458 15.07.2024

To

Chumki Akter
B.Sc. in Physiotherapy
Session: 2018-2019, Reg: 10416
Saic College of Medical Science and Technology (SCMST)
Mirpur-14, Dhaka-1216, Bangladesh
E-mail: chumkiakter502@gmail.com

Ref: *Study Title* ''Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study'.

Sub: Approval of documents for *Study Title* ''Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study'.
Dear author,

The CRP Ethics Committee reviewed and discussed your application to conduct the research entitled ''Assessing the gait parameters and walking performance of stroke survivors: A cross-sectional study'. Which was submitted on 25th June 2024.

The following documents were reviewed:

SL. No.	Documents	Version	*Dated*	*Copy*
1	Protocol	-		1

The following members of the ethics committee reviewed the protocol on 15.06.2024.

SL. No.	**Name**	**Role in EC**	**Affiliation with Institute (Yes/No) If yes, Specify.....**
1.	Prof. Dr. Mohammad Alamgir Kabir	Chair of CRPEC	No
2.	Md. Shaikhul Hasan	Member Secretary	Yes, Assist. Manager- Research, Monitoring & Evaluation.
3.	Nasirul Islam	Executive Member	Yes
4.	Dr. Mohammad Sohrab Hossain	Executive Member	Yes

CRP Mirpur, Dhaka. Mobile: 01768152922, E-mail: dgm-mirpur@crp-bangladesh.org, **CRP Ganakbari, Dhaka.** Telephone: 02 996689227, E-mail: ganakbari@crp-bangladesh.org, **CRP Manikganj.** Mobile: 01730059559, E-mail: manikganj@crp-bangladesh.org, **CRP Mymensingh - BAU Centre.** Mobile: 01730059510, E-mail: mymensingh@crp-bangladesh.org, **CRP Chattogram - A.K. Khan Centre.** Mobile: 01730059529, E-mail: chittagong@crp-bangladesh.org, **CRP Rajshahi - Afsar Hussain Centre.** Mobile: 01730059644, E-mail: rajshahi@crp-bangladesh.org, **CRP Pabna - Diabetic Shamity Centre.** Mobile: 01730059518, E-mail: pabna@crp-bangladesh.org, **CRP Barishal - CARSA Foundation Centre.** Mobile: 01730059643, E-mail: barisal@crp-bangladesh.org, **CRP Sylhet - Iskandar Shitara Centre.** Mobile: 01730059512, E-mail: sylhet@crp-bangladesh.org, **CRP Moulvibazar - Afsarul & Mata - Hajra Centre.** Mobile: 01730059525, E-mail: moulvibazar@crp-bangladesh.org, **CRP Gobindapur, Moulvibazar.** Mobile: 01730059542, E-mail: gobindapur@crp-bangladesh.org

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CRP
Centre for the Rehabilitation of the Paralysed

পক্ষাঘাতগ্রস্তদের পুনর্বাসন কেন্দ্র (সিআরপি)
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CRP-ERC-R&E-0401-0458

5.	Mohammad Anwar Hossain	Executive Member	Yes, Head of Physiotherapy Department, CRP.
6.	Tauhidul Islam	Executive Member	Yes, Acting Head of Occupational Therapy Department.
7.	Tahamina Sultana	Executive Member	Yes, Head of Speech and Language Therapy Department (Acting).
7.	Md Obaidur Rahman	Executive Member	No
8.	Md. Mizanur Rahnan	Executive Member	Yes, Assist. Professor, BHPI.

We confirm that neither you nor your study team members participated in the deliberations of the Ethics Committee & did not vote on the proposal for this study. He/She promised to CRP Research department, she/he will follow every rule and regulation of CRP and research policy. This Ethical Clearance only for those who will take/collect data from CRP.

We approve the research to be conducted in its presented form at Centre for the Rehabilitation of the Paralysed (CRP).

The CRP Ethics Committee expects to be informed about the progress of the study, any Serious Adverse Effects (SAE) occurring in the course of the study, any changes in the protocol and participant's information / informed consent and asks to be provided a copy of the final report.

Please submit to the Ethical Committee (EC) the published article of the study as per EC Standard Operating Protocol (SOP)'s.

The EC is organized & operates according to the requirements of Declaration of Helsinki and *ICH-GCP, local regulatory requirements* and guidelines.

Yours sincerely,

Md. Shaikhul Hasan
Assistant Manager- Research, Monitoring & Evaluation,
And Member Secretary of CRP-ERC, CRP.

CRP Mirpur, Dhaka. Mobile: 01768152922, E-mail: dgm-mirpur@crp-bangladesh.org, **CRP Ganakbari, Dhaka.** Telephone: 02 996689227, E-mail: ganakbari@crp-bangladesh.org, **CRP Manikganj.** Mobile: 01730059559, E-mail: manikganj@crp-bangladesh.org, **CRP Mymensingh - BAU Centre.** Mobile: 01730059510, E-mail: mymensingh@crp-bangladesh.org, **CRP Chattogram - A.K. Khan Centre.** Mobile: 01730059529, E-mail: chittagong@crp-bangladesh.org, **CRP Rajshahi - Afsar Hussain Centre.** Mobile: 01730059644, E-mail: rajshahi@crp-bangladesh.org, **CRP Pabna - Diabetic Shamity Centre.** Mobile: 01730059518, E-mail: pabna@crp-bangladesh.org, **CRP Barishal - CARSA Foundation Centre.** Mobile: 01730059643, E-mail: barisal@crp-bangladesh.org, **CRP Sylhet - Iskandar Shitara Centre.** Mobile: 01730059512, E-mail: sylhet@crp-bangladesh.org, **CRP Moulvibazar - Afsarul & Akbaral Hague Centre.** Mobile: 01730059628, E-mail: moulvibazar@crp-bangladesh.org, **CRP Gobindapur, Moulvibazar.** Mobile: 01730059542, E-mail: gobindapur@crp-bangladesh.org

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APPENDIX: D

Gant Chart

Activities/ months	Sep 23	Oct 23	Nov 23	Dec 23	Jan 24	Feb 24	Mar 24	Apr 24	May 24	June 24	July 24	Aug 24
Proposal presentation												
Introduction												
Literature review												
Methodology												
Data collection												
Data Analysis												
Result												
1st progress presentation												
Discussion												
Conclusion And Recommendation												
2nd progress presentation												
Communication with supervisor												
Final submission												