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Executive dysfunction and its association with balance function in stroke patients attendant at CRP

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Contents

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Acronym

ADL: Activities of daily living

BHPI: Bangladesh Health Professions Institute

BBS: Berg Balance Scale

BMRC: Bangladesh Medical Research Council

CRP: Centre for the Rehabilitation of the Paralysed

CVA: Cerebrovascular accident

DALYs: Disability adjusted life years

ED: Executive dysfunction

EF: Executive function

HS: Hemorrhagic stroke

IS: Ischemic stroke

IRB: Institutional Review Board

MMSE: Mini-Mental State Examination

SPSS: Statistical Package for the Social Sciences

TMT: Trail Making Test

WHO: World Health Organization

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Abstract

Background: Executive dysfunction is a common but often under-recognized consequence of stroke that can impact various aspects of functional recovery, including mobility and balance. Impaired executive functions such as attention, planning, and cognitive flexibility may hinder a patient's ability to maintain postural control, increasing the risk of falls during rehabilitation. Despite its clinical relevance, the relationship between executive dysfunction and balance impairment in stroke survivors remains underexplored, particularly in the context of Bangladeshi rehabilitation settings. **Objectives:** The objectives of the study were to assess the level of executive dysfunction in stroke patients, to evaluate the balance function in the same population, and to investigate the association between executive dysfunction and balance function. **Methodology:** A cross-sectional study was conducted among 111 stroke patients attending the Neurology Unit at CRP. Participants were selected through convenience sampling based on inclusion and exclusion criteria. Executive function was assessed using the Trail Making Test (TMT-A and B), overall cognitive function was assessed by using the Mini-Mental State Examination (MMSE) scale, balance function was measured using the Berg Balance Scale (BBS), and risk of fall was measured by the Time Up and Go test (TUG test). Data were analyzed using SPSS software version 25. **Results:** The findings revealed that a significant proportion of the stroke patients exhibited mild to moderate executive dysfunction. This study found the prevalence of executive dysfunction was 42.3% (n=47), with severe cognitive impairment 22.5% (n=25), and mild cognitive impairment 19.8% (n=22). The BBS score indicated moderate balance impairment, with 73.9% walking with assistance and 26.1% Walking Independently. Statistical analysis showed a significant positive association between executive function and balance scores ($p < 0.05$), suggesting that poorer executive functioning was associated with greater balance deficits. **Discussion:** These findings highlight the importance of addressing cognitive, particularly executive, deficits alongside physical rehabilitation to improve balance and reduce fall risk in post-stroke patients.

Keywords: *Executive dysfunction, stroke, balance function.*

Chapter i: Introduction

1.1. Background

Stroke was described by the World Health Organisation in 1970 as "the rapid development of clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death, with no apparent cause other than of vascular origin (Coupland et al., 2017). A cerebrovascular accident (CVA), commonly referred to as a stroke, is a medical emergency that happens when blood flow to a portion of the brain has decreased or stopped, depriving the brain tissue of oxygen and nutrition. Either an ischaemic stroke (a blockage in the blood arteries supplying the brain) or a hemorrhagic stroke (a rupture of blood vessels causing bleeding into the brain) can cause this disruption in blood flow (Tsao et al., 2022).

In the world, stroke is the leading cause of disability and the second leading cause of death, accounting for 11.13% of all deaths. Ischemic stroke is the most frequent kind of stroke, affecting around 87% of all cases (Mozaffarian et al., 2015). In 2010, there were approximately 5.3 million cases of hemorrhagic stroke (HS) and 11.6 million cases of ischemic stroke (IS) worldwide. The majority of the IS (63%) and HS (80%) occurred in low and middle-income nations (Ornello et al., 2018). In 2016, there were 13.7 million new cases of stroke. Approximately 5.5 million individuals died from stroke globally in that same year, with 2.7 million deaths from IS and 2.8 million deaths from HS (Johnson et al., 2019).

In 2016, 80.1 million people worldwide experienced a stroke. There were 39.0 million men and 41.1 million women among them (Johnson et al., 2019). Approximately 7 million strokes occur in the US each year, with 3% of those 20 and older having experienced a stroke. Approximately 795,000 people in the US have a new or recurrent stroke each year, with nearly 610,000 of them having their first stroke event (Virani et al., 2020). In 2016, there were approximately 1,322 cases of stroke per 100,000 people worldwide, including 156 new cases per 100,000 people. In the United States, there were around 2,320 cases of stroke per 100,000 individuals, with about 184 new cases per 100,000 people (Johnson et al., 2019).

Several factors can raise your risk of stroke. There are two categories of these things: those that you can change and those that you cannot. Age, a history of stroke or other brain disorders, smoking, excessive alcohol consumption, inactivity, high blood pressure, high cholesterol, diabetes, heart problems, obesity, poor diet, and genetics are some of the major risk factors for stroke (Hopewell and Clarke, 2016). With almost 80% of patients reporting minor cognitive impairments after a stroke, cognitive impairment is a very common long-term stroke outcome. After a stroke, one of the main factors influencing the loss in performance of daily tasks is cognitive decline, in addition to motor impairments (Buvarp et al., 2021).

Executive function refers to cognitive skills that allow us to focus attention on related but different components of a task or problem, inhibit highly automatic responses to stimuli, and retain knowledge in working memory (Blair, 2017). According to Hayes, Donnellan, and Stokes., (2016), executive function is the collection of cognitive processes that control, direct, and guide cognitive, emotional, and behavioral functions when performing new tasks like setting priorities, organizing ideas and activities, making decisions, and effectively managing time. The cerebellum, basal ganglia, and prefrontal cortex are brain structures that are connected by white matter fibers in the brain and are responsible for controlling these activities (Povroznik et al., 2018; Friedman & Robbins, 2022).

A stroke can damage specific brain regions, which might impair a person's ability to think clearly and make judgments (Povroznik et al., 2018). According to reports, executive dysfunction restricts reintegration into society and results in a diminished capacity to carry out activities of daily living (ADL) (Ghaffari, Rostami, and Akbarfahimi, 2021). Executive dysfunction occurs in as much as 75% of stroke patients and poses a critical problem for the quality of life of these individuals (Povroznik et al., 2018).

Multiple areas, including attention, executive processes, memory, language, and visuo-perceptual abilities, are affected by post-stroke cognitive impairment, which is not a single diagnosis (Jokinen et al., 2015). Among stroke survivors, aphasia, executive dysfunction (initiation inhibition, mental flexibility), memory, orientation, language, and attention are the most prevalent cognitive impairments. High rates of morbidity and death, longer hospital stays, more admissions to rehabilitation facilities, dependence on ADLs, and worse functional outcomes are some of the effects of cognitive impairments (Mohd Zulkifly et al., 2016).

Hayes, Donnellan, and Stokes (2016) found that ED was independently related to decreased balance, mobility, and exercise endurance in chronic stroke patients. According to a longitudinal study, individuals with impaired EF three months and a year after a stroke experienced significantly poorer balance and reduced levels of physical activity compared to those without such impairment. Previous studies have discovered an association between stroke patients' difficulties with thinking, moving, balance, and walking (Hayes, Donnellan, and Stokes, 2016).

1.2. Justification:

Stroke is a common neurological condition, increasingly prevalent in developing countries. Its rising incidence highlights the need for comprehensive care beyond medical management. Physiotherapy plays a vital role in stroke rehabilitation, forming an essential component of the multidisciplinary team. It helps prevent complications and enhances independence in individuals with disabilities. Greater awareness of physiotherapy's importance can support its integration into hospitals, clinics, and institutions to meet patient needs. Executive dysfunction impairments in planning, organizing, and adapting behaviors are common in stroke patients and significantly affect their recovery, particularly balance function. Addressing executive function is crucial for effective rehabilitation and improving overall functional outcomes. This study aims to explore the relationship between executive dysfunction and balance function in stroke patients receiving physiotherapy at CRP. To the best of the researcher's knowledge, this is the first study of its kind at CRP, and its findings will offer valuable insights for healthcare professionals involved in stroke management and rehabilitation.

1.3. Research question:

What is the relationship between executive dysfunction and balance function in stroke patient attendants at CRP?

1.4. Objectives:

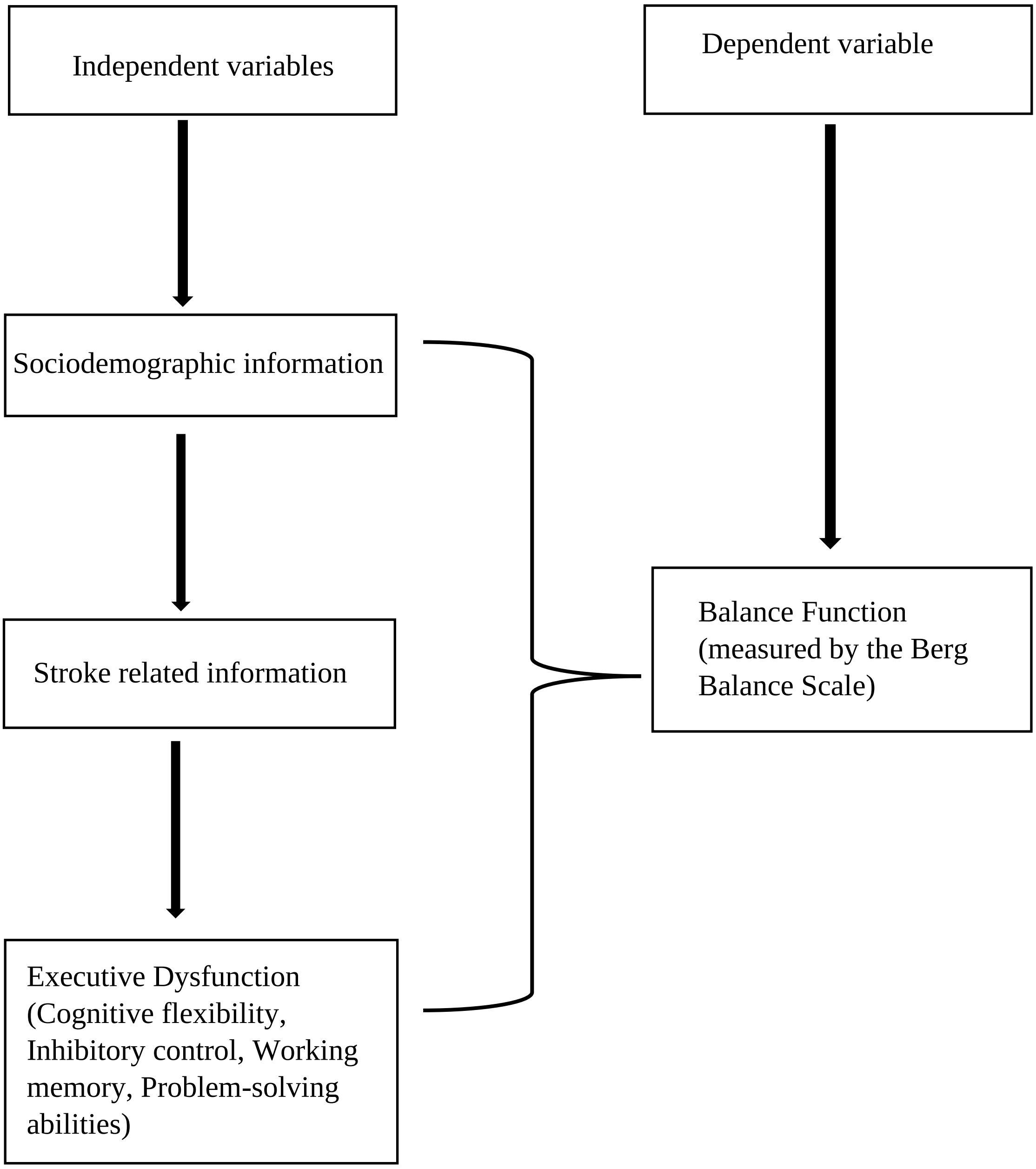
General Objective:

Evaluate the executive dysfunction and its association with balance function in stroke patients.

Specific Objective:

- Find out the socio-demographic information of the persons with stroke.
- Assess the executive dysfunction in stroke patients.
- Evaluate the balance function in the same population
- Investigate the association between executive dysfunction and balance function.

1.5. Conceptual Framework:



1.6. Operational definition:

Ischemic stroke (IS):

When blood supply to the brain is interrupted, brain cells die, leading to a potentially fatal condition known as an ischemic stroke.

Hemorrhagic stroke (HS):

A hemorrhagic stroke is a life-threatening emergency that occurs when a blood vessel in the brain ruptures and bleeds.

Impairment:

An impairment occurs when a person's physical or mental abilities are lost or deviated from normal.

Disability:

A disability can be defined as any physical or mental condition that limits an individual's capacity to engage in specific activities (activity limitation) and interact with their environment (participation restrictions).

Executive function (EF):

Executive function is a combination of mental processes that help people regulate their thoughts and behaviors to achieve their goals.

Executive dysfunction (ED):

Executive dysfunction is an interruption in the brain's ability to manage thoughts, emotions, and behaviors.

Activity of daily living (ADLs):

ADLs are basic, everyday tasks that people need to perform to maintain their independence and well-being, such as eating, bathing, dressing, and mobility.

Chapter ii: Literature Review

Definition of stroke:

A stroke, sometimes referred to as a cerebrovascular accident (CVA), is a medical emergency that happens when the blood supply to a portion of the brain is diminished or stopped, depriving the brain tissue of nutrition and oxygen. This disruption in blood flow may be caused by a hemorrhagic stroke, which occurs when blood leaks into the brain, or an ischemic stroke, which results from a blockage in the blood vessels supplying the brain (Tsao et al., 2022). Stroke was described by the World Health Organization in 1970 as "with no apparent cause other than of vascular origin, characterized by rapidly developed clinical signs of focal (or global) disturbance of cerebral function, lasting more than 24 hours or leading to death" (Coupland et al., 2017). According to Murphy and Werring (2020), stroke is a clinically defined syndrome of acute, localised neurological impairment caused by vascular injury (haemorrhage, infarction) of the central nervous system.

Types of stroke:

The World Health Organization (WHO) states that stroke is defined by the International Classification of Disease (ICD)-11 as cerebral ischaemic stroke, intracerebral haemorrhage, subarachnoid haemorrhage, and stroke that is not recognized as ischaemic or hemorrhagic and involves the presence of acute neurological dysfunction (Feigin et al., 2018). There are two types of strokes: ischaemic and hemorrhagic. A blockage or lack of blood flow in an artery supplying the brain is the cause of an ischaemic stroke, also known as a cerebral infarction, which accounts for 80% of all strokes. They may result from a thrombus, which blocks the blood vessel, or from plaque buildup, which is often triggered by artery cholesterol and causes the pathway to narrow, decreasing blood flow (Fahima, 2015). A hemorrhagic stroke occurs when a blood artery bursts, causing bleeding into the brain. Subarachnoid haemorrhage (SAH) and intracerebral haemorrhage (ICH) are two additional subtypes of hemorrhagic stroke. SAH is bleeding into the subarachnoid space, while ICH is bleeding into the brain parenchyma. High mortality and significant morbidity are linked to hemorrhagic stroke. Poorer results are linked to hemorrhagic stroke progression (Unnithan and Mehta, 2020).

Predisposing factors or risk factors:

There are many risk factors for stroke, including both non-modifiable risk factors (like age and race) and modifiable risk factors (such as diet and associated diseases). Furthermore, risk factors can also be categorised as intermediate-term risk factors (like hypertension and hyperlipidaemia), long-term risk factors for stroke (like sex and race), and short-term hazards or triggers (such as viral events, sepsis, and stress). Additionally, young patients' risk factors for stroke are probably different from those of older patients (Boehme, Esenwa, and Elkind, 2017). Diet, lack of exercise, smoking, substance abuse, and medical conditions such as cerebral aneurysms, arteriovenous malformations, high blood pressure, diabetes, atherosclerosis, cardiovascular disease, obesity, and transient ischaemic attacks (TIAs) are also preventable risk factors. Factors that cannot be changed include gender, age, race, and family history (Loh et al., 2022).

Prevalence:

In many nations, stroke is a leading cause of death and disability. In 2013, there were approximately 25.7 million stroke survivors worldwide, 6.5 million stroke-related deaths, 113 million stroke-related disability-adjusted life-years (DALYs), and 10.3 million new stroke cases (Venketasubramanian et al., 2017; Feigin et al., 2015). In recent years, there have been noticeable changes in the prevalence of stroke in the US. About 7.09 million people had a stroke as of 2019, and ischaemic strokes accounted for 82.7% of these instances (Renedo et al., 2024). With around 11 million strokes and over 6.5 million fatalities each year, stroke is the second largest cause of mortality globally. The majority of these strokes (86%) take place in low- and middle-income nations (Watkins, 2023). Siobhan et al. observed that over a 15-year follow-up, 262 (21%) of the 2625 people survived to be 15 years old, with 33.8% having mild impairment, 14.3% having substantial disability, and 15.0% having severe disability (Alim et al., 2024; Crichton et al., 2016).

Stroke is a major cause of severe long-term impairment and the second greatest cause of death globally. Stroke is the fourth greatest cause of death for women and the fifth leading cause of death overall in the United States, where there are around 800,000 strokes annually (George, 2017). While Canada sees about 62,000 new cases annually, the United Kingdom reports more than 100,000 new cases (Renedo et al., 2024). According to Rendo et al. (2024), ischaemic strokes accounted for 82.7% of the 7.09 million prevalent strokes that occurred in the United States in 2019. According to data from the European Registers of Stroke (EUROS) project, stroke has a major impact on Europe, with incidence rates differing significantly between countries and regions (Wafa et al., 2020). Every year in the UK, stroke kills thousands of people; according to the Stroke Association, there are over 100,000 new cases, or almost one every five minutes (Thayabaranathan et al., 2022). According to the Heart and Stroke Foundation of Canada, stroke is a significant health issue in Canada, where there are about 62,000 new cases reported each year (Li et al., 2020).

Globally, there are an estimated 17 million people who have had their first stroke, and there are 62 million stroke survivors. After heart disease, stroke is the second most common cause of mortality worldwide for adults over 60. Every year, stroke claims the lives of around six million people worldwide (Mosisa et al., 2023). In Asia, where over 60% of the world's population lives and many of its nations are "developing" economies, stroke is a particularly severe issue. Except for Japan, Asia has a higher stroke death rate than Western Europe, the Americas, or Australasia (Venketasubramanian et al., 2017). A major health concern in Asia is stroke, which has variable prevalence rates depending on socioeconomic and demographic factors. Stroke incidence rates in China are concerning, especially in areas with lower sociodemographic indices (SDI), according to the China Kadoorie Biobank (Mi et al., 2023). The Indian Council of Medical Research-India Stroke Registry has provided important insights into stroke risk factors, and the country is dealing with an increasing burden of non-communicable disorders (Pandian et al., 2023). According to the mortality rate and burden, Indonesia and Mongolia have the highest rates (4309.8 strokes per 100,000 people and 193.3 strokes per 100,000 people, respectively), while Singapore has the highest rate (804.2 strokes per 100,000 people) and Japan has the lowest rate (706.6 strokes per 100,000 people) (Turana et al., 2021).

In India, an estimated 1.5 million people have a stroke annually, and 500,000 more suffer from a stroke-related disability. The stroke incidence of 135 to 145 per 100,000 individuals per year and the early case death rate of 27% to 41% are the only assumptions made here. Stroke is anticipated to have significant long-term impacts on Indian families, especially those who reside in rural areas (Lindley et al. 2017). Pakistan's crude age and sex-adjusted stroke incidence from 2000 to 2016 was 95 per 100,000 people annually, with the highest incidence occurring in men and women aged 75 to 85 (584,000 of 650,000) (Khan et al. 2019).

Stroke is a serious medical condition that ranks third in terms of mortality and is the main cause of disability in Bangladesh. Bangladesh has the 84th highest stroke death rate globally, according to the World Health Organization (Alim et al., 2024). With a stroke prevalence of 11.39 per 1000 adult population, Bangladesh was significantly lower than high-income countries (26–80 per thousand) but higher than other low- and middle-income countries (5.36–10.40 per thousand) (Mondal et al., 2022). According to Suwanwela and Poungvarin (2016), the disability-adjusted life year (DALY) loss from stroke in Bangladesh is 888.1 per 100,000, with an age and sex-standardized death rate of 54.8 per 100,000. Stroke's high prevalence has long-term financial effects on people, families, and the country. Despite the large number of stroke survivors, no studies have examined how stroke affects quality of life (QoL) in Bangladesh (Islam et al., 2023).

According to the survey, 288 of the 25,287 participants had at least one stroke diagnosis in their lifetime, translating to a prevalence of 11.4 per 1000 people. Mymensingh division had the greatest stroke prevalence (14.71 per thousand), followed by Khulna (14.01), Barishal (13.41), Dhaka (12.27), Sylhet (11.88), Chattagram (11.04), Rangpur (8.96), and Rajshahi division (7.62 per thousand) (Mondal et al., 2022). People over 60 had the highest prevalence of stroke (30.10 per thousand), whereas those between 18 and 40 had the lowest frequency (4.60 per thousand). Between the ages of 41 and 50, the prevalence was 14.7 per thousand, and between the ages of 51 and 60, it was 25.2 per thousand. Stroke prevalence was 8.68 per thousand in women and 13.8 per thousand in men, which is about twice as high as in women. In urban regions, the prevalence of stroke was 11.07 per thousand, whereas in rural areas, it was 11.85 per thousand (Mondal et al., 2022). According to BIRDEM's stroke registry, 72% of cases were ischemic strokes, 68% of patients were male, and the average age of the patients was

60.6 years (Bhowmik et al., 2016). The most prevalent risk factor among stroke patients was hypertension (79.2%), which was followed by a dietary practice of not eating the recommended daily amounts of fruits and vegetables (67.3%). Diabetes (28.8%) was the most prevalent condition among stroke patients, followed by dyslipidaemia and smoking, including tobacco use (38.9% and 37.2%, respectively). Of stroke patients, 20.1% had a history of ischaemic heart disease (IHD), 13.9% had atrial fibrillation, and just 1% had valvular heart disease (Mondal et al., 2022).

Although the occurrence of stroke varies by region and population, it is nevertheless a significant global health issue. The World Health Organization (WHO) predicts that there are an amazing 15 million stroke cases worldwide each year, affecting millions of individuals (Feigin et al., 2022). Although their prevalence varies by region, higher rates have been seen in some areas, including Africa and Southeast Asia (Feigin et al., 2021). Given that the incidence of stroke increases with age and disproportionately impacts the elderly, age is a crucial determinant. Since men are more likely than women to have a stroke in many regions, gender differences are also important. However, because women tend to live longer, the occurrence of stroke is frequently higher in this demographic (Appelros and Åsberg, 2020). Moreover, there is a complicated relationship between the prevalence of stroke and modifiable risk factors such as diabetes, high blood pressure, obesity, smoking, and sedentary lifestyles. This emphasizes the importance of targeted treatments meant to address these causes and lessen the burden of stroke worldwide (Soto-Camara et al., 2020).

Symptoms of stroke:

The type and affected location of the brain might impact the symptoms of a stroke. Sudden numbness or weakness, disorientation, trouble speaking or understanding speech, vision issues, and difficulties walking, balancing, or coordinating are typical symptoms. A sudden, intense headache that has no apparent explanation could also be a sign of a stroke. To minimise brain injury and lower the chance of long-term consequences, prompt medical intervention is essential. Early intervention can lessen brain damage and lower the chance of long-term issues (Khan et al., 2020). Hemorrhagic strokes can present with a variety of clinical signs and symptoms, but the most common ones include abrupt headache, nausea, and sharp increases in blood pressure. These symptoms are accompanied by localised neurological indications within a few minutes of the stroke onset. Over several hours, the signs and symptoms of these people may start to appear gradually and range in intensity. The symptoms of an ischaemic stroke can include paresis, ataxia, paralysis, vomiting, and eye gazing, but where they manifest depends on the area of the brain that is supplied by damaged blood vessels (Ojaghihaghi et al. 2017). Patients indicated that the most common clinical symptom in 75.0% of instances was headache, which was followed by hemiparesis in 0.5% of cases and aphasia in 60.3% of cases. Most people who have an ischaemic stroke reported having aphasia (60.0%), facial palsy (58.3%), and headache (71.7%). Likewise, it was shown that the most common clinical signs in patients with hemorrhagic strokes were aphasia (60.7%), vomiting (57.1%), and headache (78.6%) (Fekadu, Chelkeba, and Kebede, 2019).

Stroke Rehabilitation:

With a focus on physical, cognitive, and emotional components, stroke rehabilitation provides a comprehensive approach to helping people recover after a stroke. Evidence-based therapies help stroke patients become more independent in their everyday tasks by improving their functional abilities, which include motor skills, balance, and activities of daily living (Ali et al., 2020). Restoring the capacity to walk and improving general mobility are made possible by focused rehabilitation techniques such as physical therapy and gait training (Selves, Stoquart, and Lejeune, 2020). Furthermore, by optimizing functional recovery and promoting community reintegration, rehabilitation initiatives greatly lower impairment and dependency, thereby enhancing quality of life (Teasell et al., 2020). Crucially, stroke rehabilitation promotes comprehensive recovery and well-being by treating cognitive deficits, emotional difficulties like depression and anxiety, and consequences, including pressure ulcers and muscle contractures (Aggarwal, Dua, and Sachdev, 2024).

Stroke-related cognitive impairment:

Over time, cognitive deficits might worsen, affecting mood and general health (Demeyere et al., 2021). According to Kusec et al. (2023), for example, cognitive impairments are present in 65.3% of long-term survivors, who also have notable rates of tiredness and sadness. Prior studies clearly demonstrated a correlation between older adults' cognitive and motor function. While poor memory is a common sign of neurodegeneration, particularly Alzheimer's disease, vascular pathology seems to be linked to executive dysfunction and motor impairments (Einstad et al., 2021; Beauchet et al., 2018). Global cognition, executive function, and memory have all been linked to gait performance after stroke (Sagnier et al., 2017; Ursin et al., 2015; Ben Assayag et al., 2015).

Executive function:

The phrase "executive functions" describes a group of mental skills that support and motivate flexible, goal-oriented behaviour. These include the capacity to think and think flexibly, to mentally update and manipulate information, to minimise information that is not relevant to present objectives, to self-monitor, and to plan and modify behaviour according to the situation at the moment (Rabinovici, Stephens, and Possin, 2015). According to Skidmore, Eskes, and Brodtmann (2023), executive function is a higher brain function that includes risk-taking, planning, decision-making, working memory, inhibitory control, and cognitive flexibility (speed, error-processing, and attention). These are regulated by the prefrontal cortex, cerebellum, and basal ganglia, which are linked by cerebral white matter fibers (Friedman & Robbins, 2022; Povroznik et al., 2018). Executive impairment is caused by direct or indirect injury to these areas in stroke patients (Povroznik et al., 2018). They discovered that compared to stroke patients, those with frontal lobe lesions showed worse executive function. Between 25% and 75% of stroke patients experience executive dysfunction as a result of these brain regions being impacted (Skidmore, Eskes, and Brodtmann, 2023; Hayes, Donnellan, and Stokes, 2016).

Executive dysfunction and balance function:

According to reports, executive dysfunction restricts reintegration into society and results in a diminished capacity to carry out activities of daily living (ADL) (Ghaffari, Rostami, and Akbarfahimi, 2021). Prior research has demonstrated a correlation between executive dysfunction and walking and balancing abilities in stroke patients (Hayes, Donnellan, and Stokes, 2016). Balance function in stroke patients has been linked to executive impairment (Hayes, Donnellan, and Stokes, 2016). Sakai, Hosoi, and Harada (2023) investigated executive dysfunction and assessed balance function in community-dwelling older persons following a moderate stroke. They found that the balancing function was linked to executive impairment. Using cluster analysis, Sakai, Hosoi, and Harada (2023) divided executive dysfunction into three groups: mild, moderate, and severe. They then looked into whether balance function, as determined by the timed up and go test (TUGT), varied depending on the severity of executive dysfunction in stroke patients. The degree of executive dysfunction was found to have an impact on balancing function. In chronic stroke patients, ED was found to be independently associated with reduced mobility, balance, and exercise endurance (Hayes, Donnellan, and Stokes, 2016).

Trail Making Test (TMT):

The Mini-Mental State Examination (MMSE) and TMT sections A and B were used to evaluate executive and cognitive skills. While TMT part B has frequently been used to evaluate executive function, TMT part A represents motor speed and attentional function. Participants in TMT component A had to link the circled numbers (1–25) in the correct order as fast as they could. TMT component B required participants to connect letters and numbers in a sequential order as quickly as they could (Sakia et al., 2024).

Mini-Mental State Examination (MMSE):

The MMSE is a popular cognitive screening exam, and results between 24 and 30 are regarded as normal. Tasks cover orientation, memory, recall, attention, item naming, writing a phrase, duplicating a figure, following written and spoken instructions, and more (Trzepacz et al., 2015).

Berg Balance Scale (BBS):

Berg, Wood-Dauphinee, and Williams (1995) found that the BBS is capable of measuring the ability to sustain a balance function. Each of the 14 items on the test has a score between 0 and 4, for a total of 56 points. The BBS includes fundamental motions like turning, standing up, and one-leg standing. A better balancing function is indicated by higher scores (Sakai et al., 2024).

Time Up and Go Test (TUGT):

The TUGT is a tool used to evaluate walking and dynamic balance. The subject was sat on a chair that measured 40 cm. The individual was directed to stand up from the chair, walk to a cone 3 meters away, circle it towards their nonparalytic side, return to the chair, and sit down. The assessor used a stopwatch to measure the time after telling the participant to get out of the chair at the "ready to go" cue. Participants were permitted to utilize orthotics and walking aids that they typically use regularly (Sakai et al., 2024).

Chapter iii: Methodology

3.1. Study design: A cross-sectional study design was selected to conduct this study. A cross-sectional study is one kind of observational study design, which examines data from a population at a single point in time. In a cross-sectional study, the researcher simultaneously examines the study population's exposures and results. Typically, they are inexpensive and simple to perform. They help establish initial evidence for organizing a future advanced study. A cross-sectional study can investigate the relationships between various exposures and outcomes and is the most effective method of determining prevalence (Wang & Cheng, 2020). This makes a cross-sectional design appropriate for the study due to its ability to effectively identify the association between executive dysfunction and balance function in stroke patients. For this reason, the researcher chose a cross-sectional study design to conduct this study.

3.2. Study site: The researcher collected data from the Neurology unit of the Centre for the Rehabilitation of Paralyzed (CRP), Savar-Dhaka, for conducting the study.

3.3. Study duration: The study was conducted from 1st June 2024 to 31st May 2025, and the duration of data collection from 1st January 2025 to 31 March 2025 approximately 3 months, from initial recruitment through to the final dissemination of results.

3.4. Study population: In this study, the study populations are stroke patients who received treatment at CRP.

3.5. Inclusion criteria-

- Age more than 18 years and less than 95 years (Sakia et al., 2024).
- Presence of hemiplegia (Sakia et al., 2024).
- No orthopedic disease (Sakia et al., 2024).
- Both sexes are incorporated.
- Both ischaemic and hemorrhagic strokes will be included.
- Patients with stroke who are treated by a physiotherapist in the CRP Neurology unit and who willingly participate in this study.

3.6. Exclusion criteria-

- Did not have a formal diagnosis of stroke (Hayes et al., 2016).
- Patient diagnosed with severe dementia and Alzheimer's disease (Sakia et al., 2024).
- Patient diagnosed with higher brain dysfunction (e.g., unilateral spatial neglect, aphasia, and apraxia) (Sakia et al., 2024).
- Patients who are unable to perform TMT or TUGT (Sakia et al., 2024).
- A patient who has other types of neurological disorders.
- A patient who has a visual impairment that would have hindered participation in the assessment (Hayes et al., 2016).
- Patient who has a diagnosis of pre-stroke vascular dementia or cognitive impairment (Hayes et al., 2016).

3.7. Sample size:

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

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

$$= \frac{1.96^2 \times 0.3 \times 0.7}{0.05^2}$$

$$= 322.694 = 323$$

here,

n= sample size

z=Confidence level. A 95% confidence level gives us Z values of 1.96.

d = the desired level of precision (i.e., the margin of error).5% = 0.05

p =expected prevalence, which is 0.3 (Rahman et al., 2024)

q = 1-p = (1-0.3) = 0.7

The intended sample size was n=323, but only 111 participants were recruited due to a limited data collection period.

3.8. Sampling technique: A convenience sampling technique was used by the researcher to draw out the sample from the population. Convenience sampling is a form of nonprobability sampling usually used for population and clinical research. Convenience sampling is popular because it is inexpensive, not as time-consuming as other sampling strategies, and easy to conduct (Stratton, 2021).

3.9. Method of data collection:

Written consent was taken from the patients before collecting data. A Questionnaire was used to accumulate data through face-to-face conversations. To assess executive dysfunction Trail Making Test (TMT) was used. The Mini-Mental State Examination (MMSE) was used to evaluate cognitive impairment. Berg Balance scale (BBS) and Time up and go test (TUGT) were used to assess balance function and risk of fall. A combination of structured and semi-structured formats was used to obtain participant data.

3.10. Data collection tools: The researcher used a consent form and a standard questionnaire form as data collection tools.

3.10.1. Questionnaire: Following certain parameters, the researcher created the questionnaire with the supervisor's approval and advice. It was designed to gather information related to executive dysfunction, cognitive impairment, balance function, and personal information of stroke patients. The key areas it covered include-

I. Socio-demographic information of stroke patients:

Usually, it relates to the participants' basic social and personal traits, such as their age, gender, marital status, degree of education, job status, occupation, and place of residence.

II. Stroke-related information:

The researcher collected information about the stroke type, date of onset, affected side, time since stroke, previous medical history, medication use, etc., in this area.

This data made it easier for the researcher to comprehend each participant's stroke severity and clinical features.

III. Executive dysfunction status:

The Trail Making Test (TMT) was used by the researcher for the assessment of executive dysfunction.

IV. Cognitive impairment status:

Mini-Mental State Examination (MMSE) was used for the assessment of cognitive impairment level after stroke.

V. Berg Balance Scale (BBS):

The Berg Balance Scale (BBS) with fourteen (14) closed-ended questions was used to assess balance function in individuals through various tasks.

VI. Time Up and Go Test (TUGT):

The Time Up and Go test was used to assess the mobility of the participants and to understand how the participants executed the task.

3.11. Outcome measurement tools:

3.11.1.Trail Making test (TMT):

It is a simple tool used to assess executive dysfunction. Both parts of the Trail Making Test consist of 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the patient should draw lines to connect the numbers in ascending order. In Part B, the circles include both numbers (1 – 13) and letters (A – L); as in Part A, the patient draws lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.).

3.11.2.Mini-Mental State Examination (MMSE):

The Mini-Mental State Examination (MMSE) is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment.

3.11.3.Berg Balance scale (BBS):

The Berg Balance Scale (or BBS) is a widely used clinical test of a person's static balance. The BBS is a 14-item scale that quantitatively assesses balance. The items are scored from 0 to 4, with a score of 0 representing an inability to complete the task and a score of 4 representing independent item achievement. A global score is calculated out of 56 possible points.

3.11.4.Time up and go test (TUGT):

Time up and go test (TUGT) was used to assess mobility and understand how patients execute the task.

3.12. Data analysis:

A scientific calculator, Microsoft Excel, and SPSS software for Windows (version 25) will be used for statistical analysis. Following the completion of the first data collection, each response was double-checked to identify any errors or ambiguities. The acquired data was analyzed by inserting it into SPSS version 25. A statistical analysis that is both descriptive and inferential will be carried out. The mean and standard deviation were used in the descriptive section of parametric data to show the central tendency and the measure of dispersion. With the use of several visualization techniques, including a pie chart and a bar chart, the categorical data was displayed as frequency and percentage of proportion. To determine the association between executive dysfunction, balancing function, stroke-related data, and sociodemographic characteristics using the Pearson chi-square test. The Chi-Square (x2) test is the most often used method for assessing discrete data hypotheses. It is a nonparametric statistical significance test for tabular analysis that is bivariate and includes a contingency table. The Chi-Square test assists in the analysis of data that is presented as counts. Nominal or categorical data that cannot be examined using the ranking technique might be subjected to this test.

3.13. Ethical consideration:

- The researcher will follow the Institutional Review Board (IRB) guidelines.
- The researcher will follow the WHO guidelines and the Bangladesh Medical Research Council (BMRC) guidelines.
- Strictly maintain confidentiality.
- Informed consent will be taken.

- All participants will be informed about the aim and objectives of the study before participation.
- Participants' rights and privileges will be ensured.
- No harmful act will be taken, and the participant can withdraw themselves at any time.

3.14. Informed consent: Participants were selected for this study according to selection criteria and informed properly by using a consent form. The patient and researcher signed willingly and voluntarily into the project. Participants were informed that they were completely free to decline to answer any question during the study and free to withdraw their agreement and participation at any time from the study. They were also told that confidentiality would be maintained, and the benefits of the study to future subjects and therapists were explained.

Chapter iv:	Result

Below is a summarized and visual representation of the patient's data, focusing on stroke-related sociodemographic characteristics as well as assessments of executive dysfunction, balance function, and mobility. These descriptive statistics offer essential insights into the study population and establish a foundation for exploring the relationship between executive dysfunction and balance function.

4.1. Sociodemographic information

4.1.1. Age of the participants:

Among the 111 participants in this study, the mean age was 54.09 years with a standard deviation of 11.73. This indicates that the average age of the participants centered around 54 years, with most individuals' ages typically varying by approximately 11.73 years from the mean.

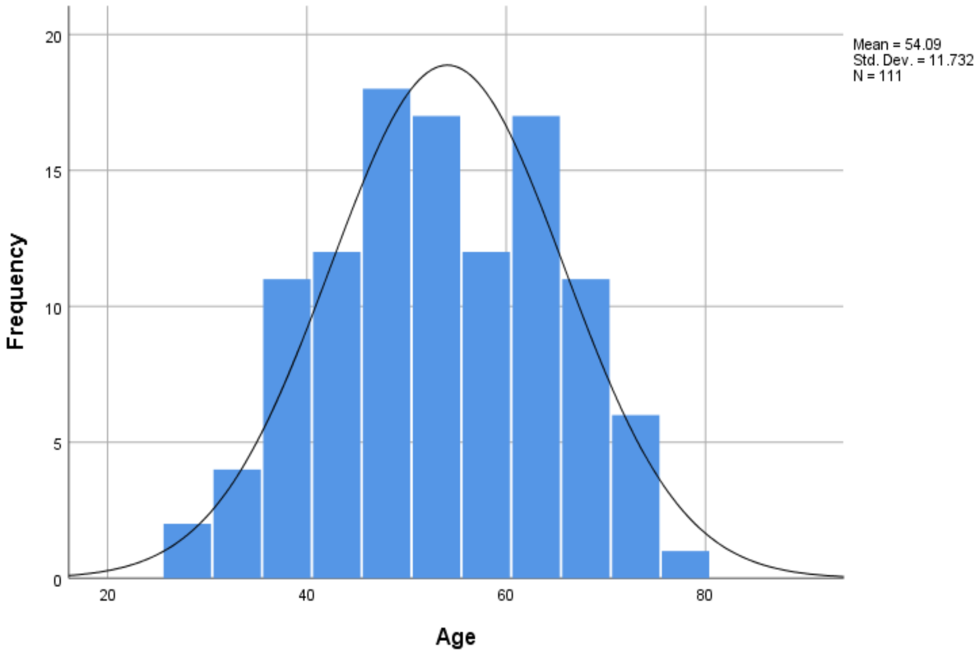


Figure 1: Age of the participants

4.1.2. Gender of the participants:

Out of the total 111 participants, 75 are male, accounting for 67.6% of the sample, while 36 are female, making up 32.4%.

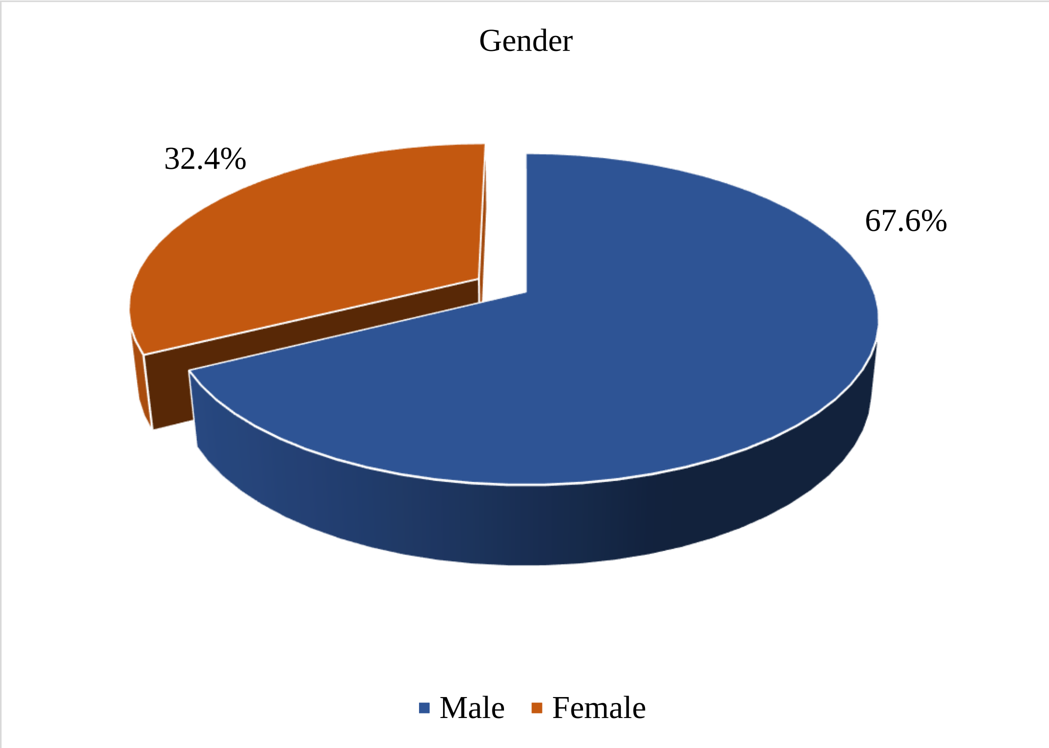


Figure 2: Gender of the participants

4.1.3. Marital status:

Among the participants, 94.6% (n=105) were married, making them the overwhelming majority in the study. A small proportion of the sample, 4.5% (n=5), were widowed, while only 0.9% (n=1) were unmarried.

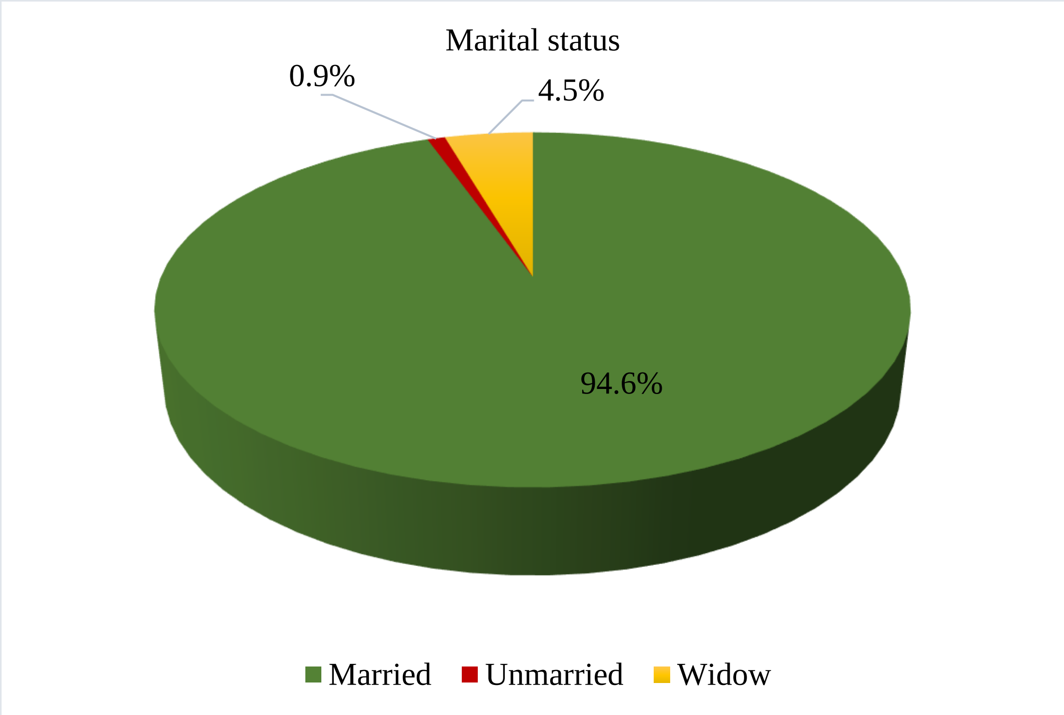


Figure 3: Marital status of the participants

4.1.4. Educational level:

Among the participants, the highest proportion had attained a secondary level of education, accounting for 29.7% (n=33) of the sample. This was followed by 18.9% (n=21) who were graduates and 16.2% (n=18) with a primary education. Additionally, 14.4% (n=16) had completed higher secondary education, while 12.6% (n=14) reported having no formal education. A smaller portion, 8.1% (n=9), had achieved postgraduate qualifications.

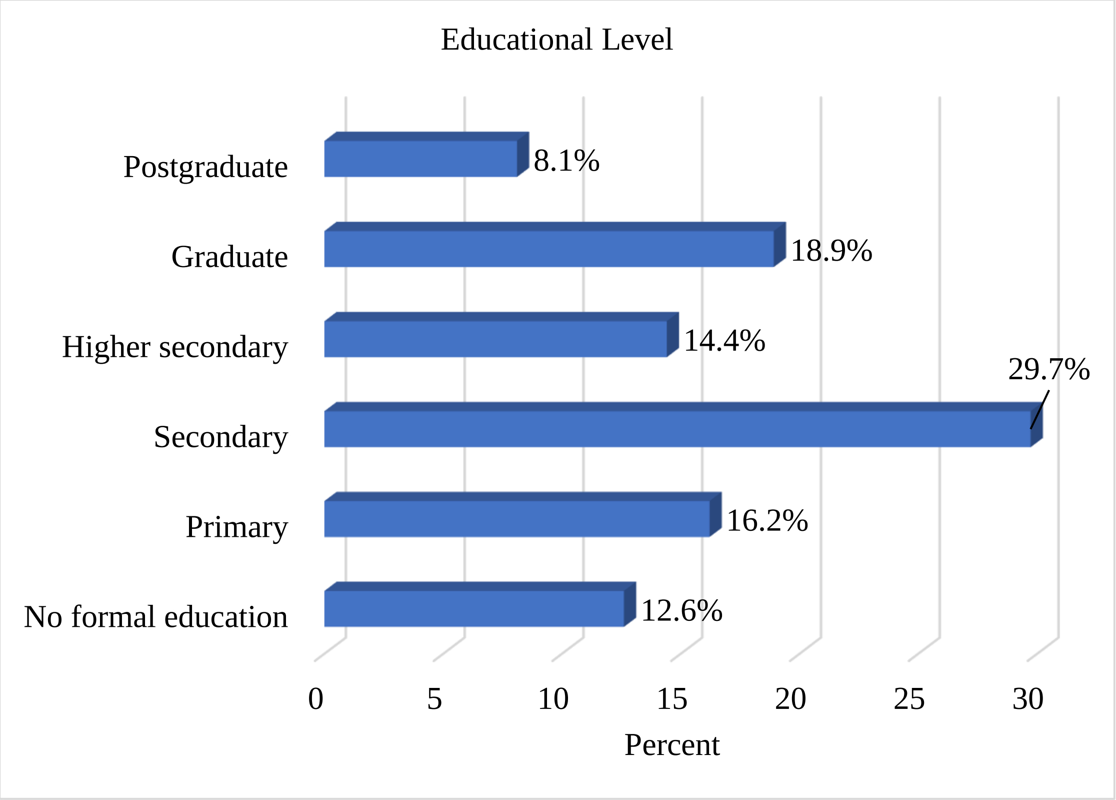


Figure 4: Educational level of the participants

4.1.5. Occupation:

Among the participants, 33.3% (n=37) reported being engaged in other forms of employment, while 31.5% (n=35) identified as housewives, making these the two largest occupational groups. Businessmen made up 16.2% (n=18) of the sample, followed by service holders at 9.9% (n=11). Farmers accounted for 5.4% (n=6), and shopkeepers represented 2.7% (n=3). Only 0.9% (n=1) of the participants were unemployed.

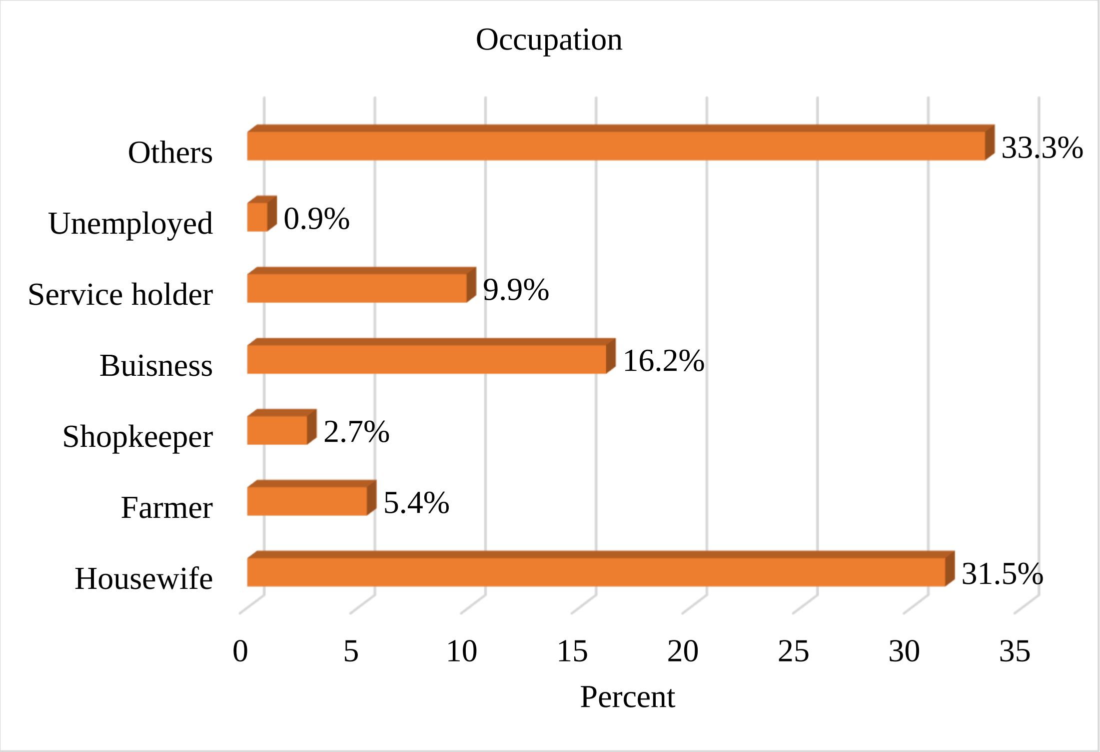


Figure 5: Occupational status of the participants

4.1.6: Monthly cost:

Among 111 participants, their median value of the monthly income was 30000.

4.1.7. Financial status:

Among the participants, the largest portion—40.5% (n=45)—identified as belonging to the middle class. This was followed by 25.2% (n=28) who reported being part of the upper middle class and 18.9% (n=21) from the upper class. A smaller group, 15.3% (n=17), identified as lower middle class.

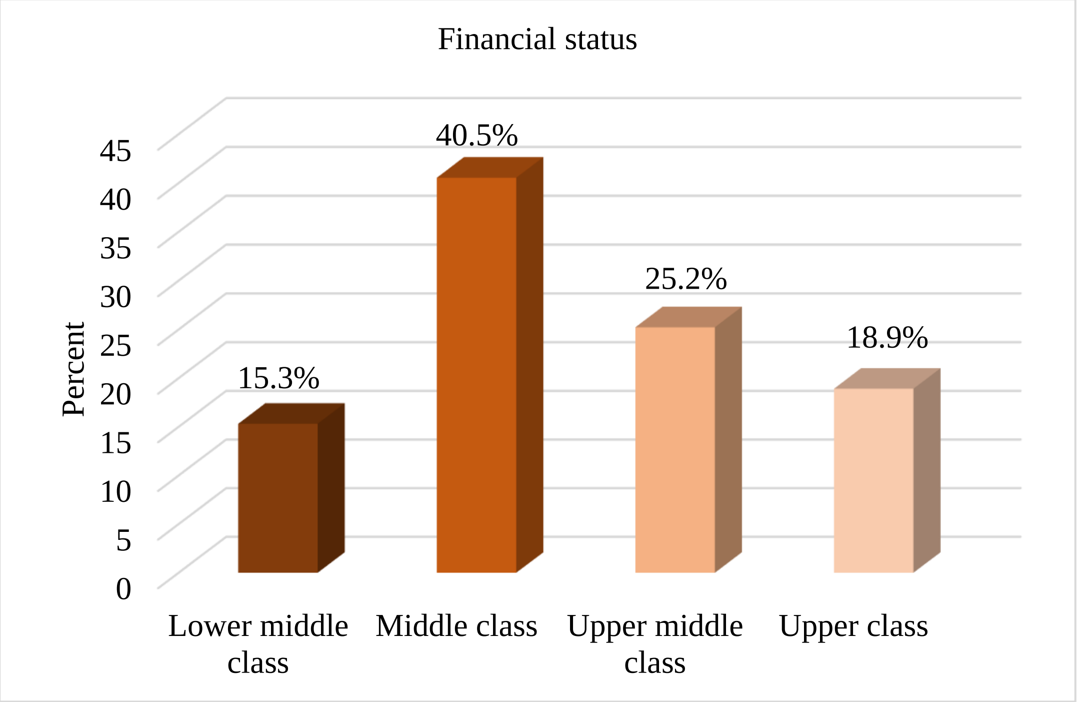


Figure 6: Financial status of the participants

4.1.8. Living area:

Among the participants, the majority—44.1% (n=49)—resided in semi-urban areas. Rural and urban residents were equally represented, each accounting for 27.9% (n=31) of the sample.

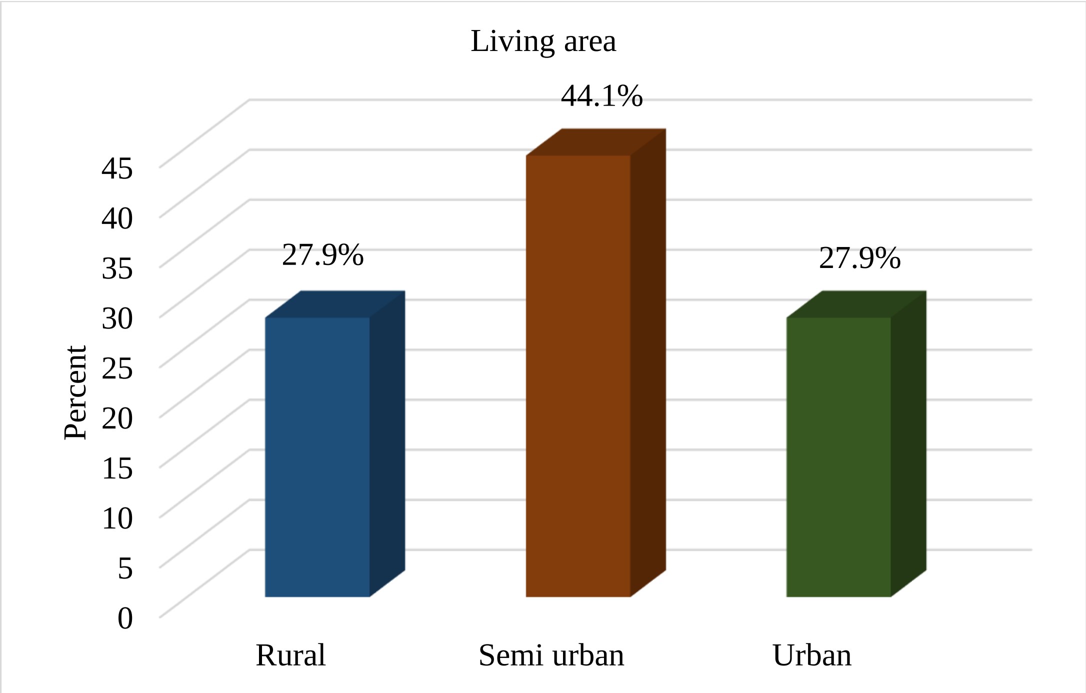


Figure 7: Living area of the participants

4.1.9: Family history of stroke:

Among the participants, 32.4% (n=36) reported having a family history of stroke, while 67.6% (n=75) did not. This suggests that nearly one-third of the individuals may have a genetic or familial predisposition to stroke.

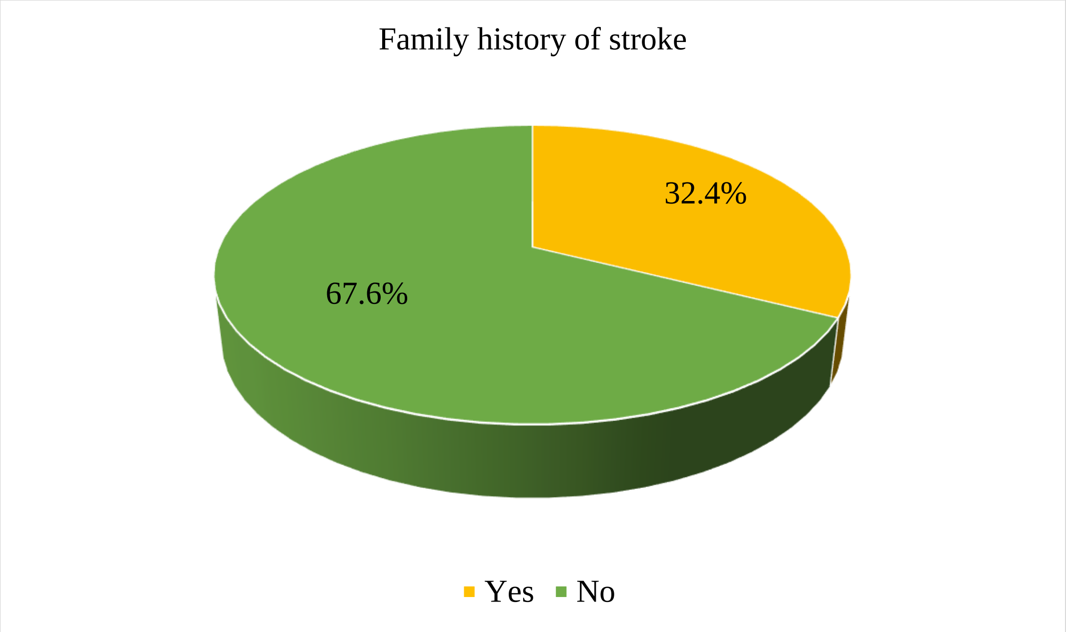


Figure 8: Family history of stroke

4.1.10. Habit of smoking:

Among the 111 participants, 24.3% (n=27) reported that they smoke, while the majority, 75.7% (n=84), indicated that they do not. This suggests that approximately one in four participants are smokers.

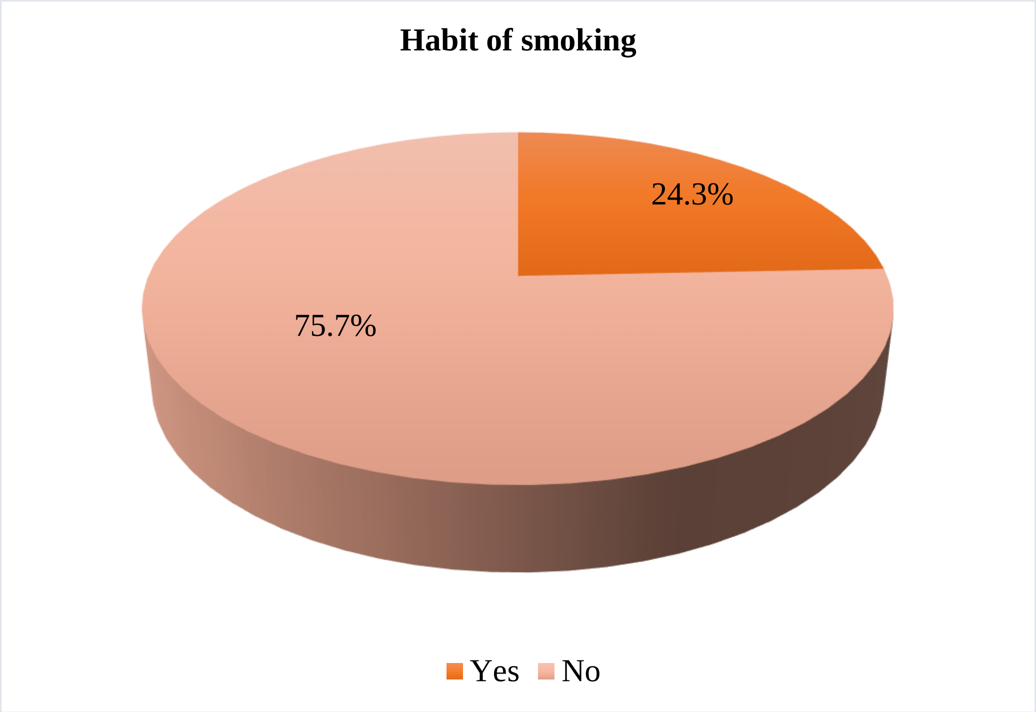


Figure 9: Smoking habits of the participants

4.1.11: Weight of the participants:

The median weight of the participants is 65.00 kg, which means that half of the individuals in the study weigh less than or equal to 65 kg, while the other half weigh more.

4.1.12: Comorbidities:

Among the participants, 41.4% (n=46) reported having hypertension alone, making it the most common comorbidity. A significant portion, 27.0% (n=30), had both hypertension and diabetes. Additionally, 9.0% (n=10) had a combination of hypertension, diabetes, and heart disease. Smaller groups reported more complex combinations: 5.4% (n=6) had hypertension along with other conditions; 4.5% (n=5) had hypertension, diabetes, and other unspecified conditions; and 3.6% (n=4) had both hypertension and lung disease. Another 2.7% (n=3) reported hypertension, diabetes, and lung disease, and a separate 2.7% (n=3) had hypertension and heart disease. Less commonly, 1.8% (n=2) experienced hypertension, diabetes, heart disease, and other conditions, and 0.9% (n=1) each reported either hypertension, lung disease, and others or hypertension, diabetes, lung disease, and others.

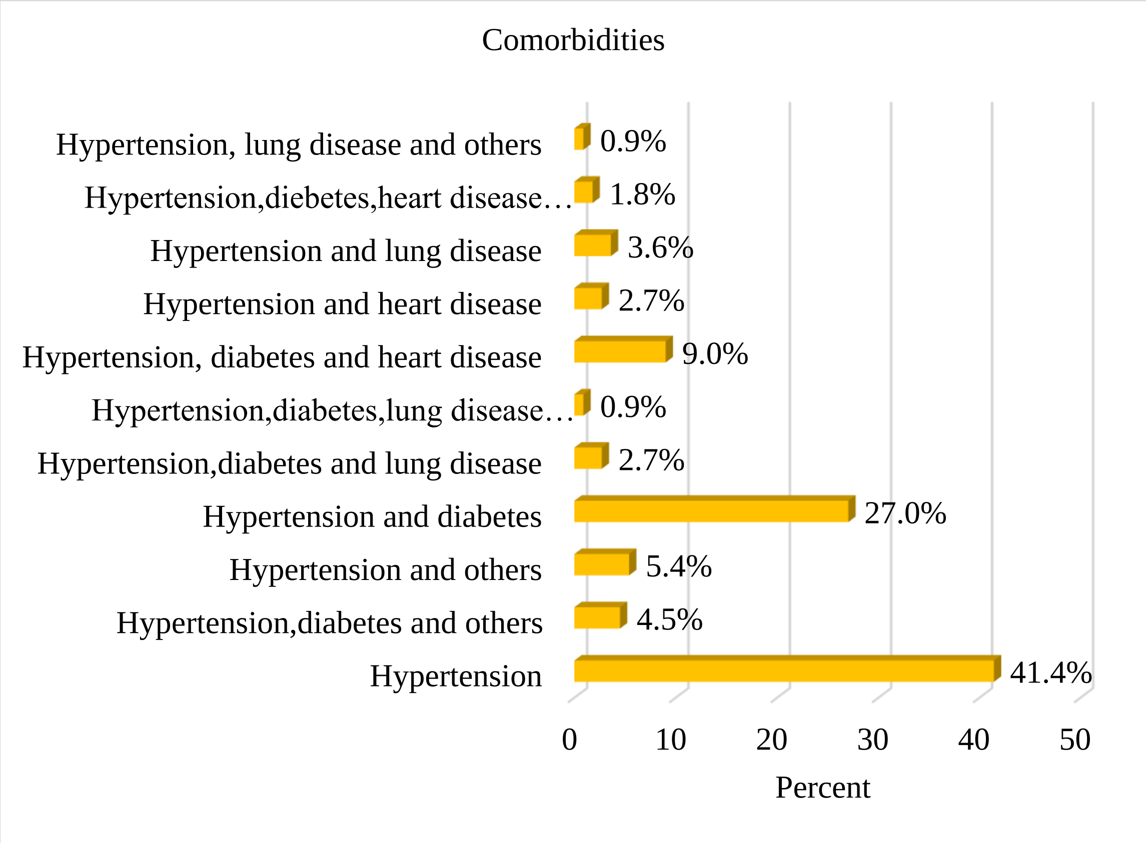


Figure 10: Comorbid conditions of the participants

4.1.13. Number of comorbidities:

Among the 111 participants, 58.6% (n=65) had multiple comorbidities, while 41.4% (n=46) reported only a single comorbidity. This indicates that more than half of the study population experienced more than one coexisting medical condition, highlighting a notable burden of multimorbidity among the participants.

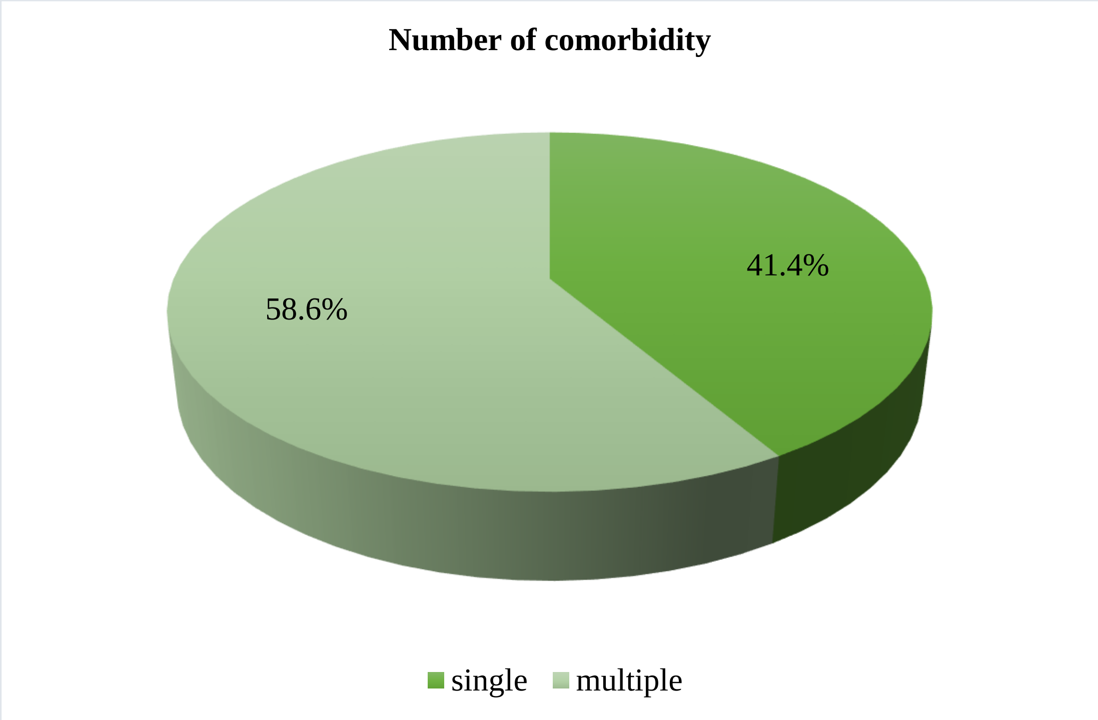


Figure 11: Number of comorbidities among the participants

Table 1: Sociodemographic information of the participants

Variable	Mean/SD	Median	Frequency (n)/percentage (%)
Age	54.09 /11.732	-	-
Gender	-	-	Male- 75 (67.6 %) Female- 36 (32.4 %)
Marital status	-	-	Married- 105 (94.6%) Unmarried- 1 (0.9%) Widow- 5 (4.5%)
Educational level	-	-	No formal education-14 (12.6%) Primary- 18 (16.2%) Secondary- 33 (29.7%) Higher secondary- 16 (14.4%) Graduate- 21 (18.9%) Post-graduate- 9 (8.1%)
Occupation	-	-	Housewife- 35 (31.5%) Farmer- 6 (5.4%) Shopkeeper- 3 (2.7%) Business- 18 (16.2%) Service holder- 11 (9.9%) Unemployed- 1 (0.9%) Other- 37 (33.3%)
Monthly cost	-	30000.00	-
Financial status	-	-	Lower middle class- 17 (15.3%) Middle class- 45 (40.5%) Upper middle class- 28 (25.2%) Upper class- 21 (18.9%)
Living area	-	-	Rural- 31 (27.9%) Semi urban- 49 (44.1%) Urban- 31 (27.9%)

Family history of stroke	-	-	Yes- 36 (32.4%) No 75 (67.6%)
Habit of smoking	-	-	Yes- 27 (24.3%) No 84 (75.7%)
Weight	-	65.00	-
Comorbidities	-	-	Hypertension: 46 (41.4%) Hypertension, diabetes, and others: 5 (4.5%) Hypertension and others: 6 (5.4%) Hypertension and diabetes: 30 (27.0%) Hypertension, diabetes, and lung disease: 3 (2.7%) Hypertension, diabetes, lung disease, and others: 1 (0.9%) Hypertension, diabetes, and heart disease: 10 (9.0%) Hypertension and heart disease: 3 (2.7%) Hypertension and lung disease: 4 (3.6%) Hypertension, diabetes, heart disease, and others: 2 (1,8%) Hypertension, lung disease, and others: 1 (0.9%)
Number of Comorbidities	-	-	Single-46 (41.4%) Multiple-65 (58.6%)

**Median value was considered in case of non-normally distributed continuous data.

4.2. Stroke-related information

4.2.1. Type of stroke:

Among the 111 participants, 81.1% (n=90) experienced an ischemic stroke, while 18.9% (n=21) had a hemorrhagic stroke. This distribution indicates that ischemic stroke was the predominant type among the study population, accounting for more than four out of every five cases.

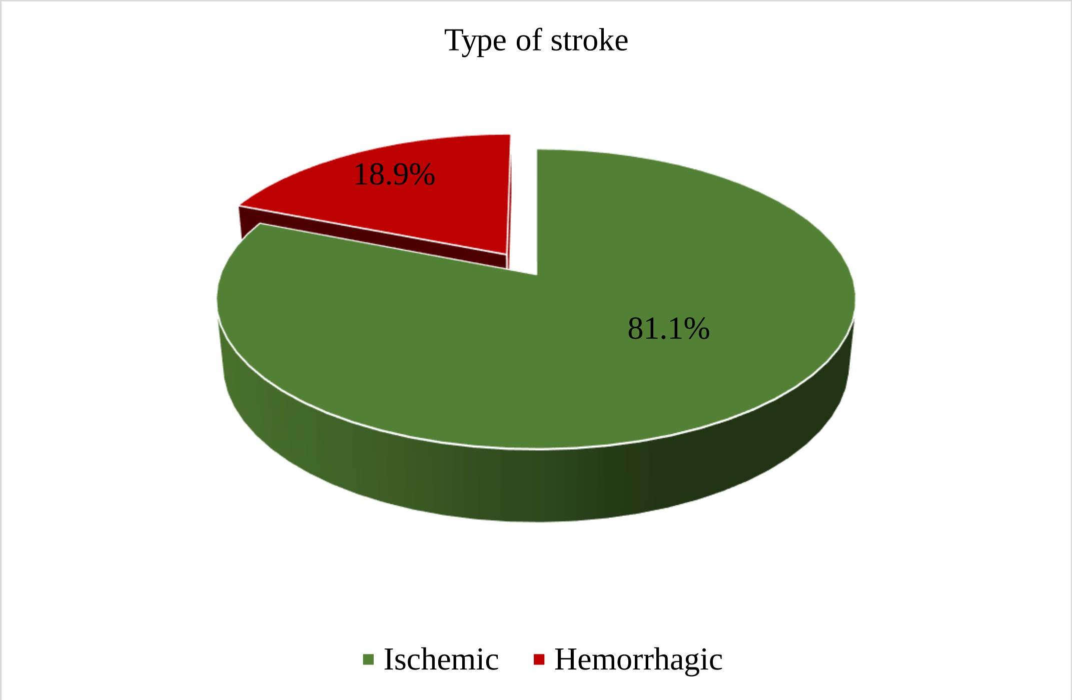


Figure 12: Types of stroke among the participants

4.2.2: Duration of stroke:

Among 111 participants, the median duration of stroke was 150 days.

4.2.3. Stage of stroke:

Among the 111 participants, 44.1% (n=49) were in the chronic stage of stroke, 29.7% (n=33) were in the acute stage, and 26.1% (n=29) were in the subacute stage. This indicates that the largest proportion of participants were living with chronic stroke.

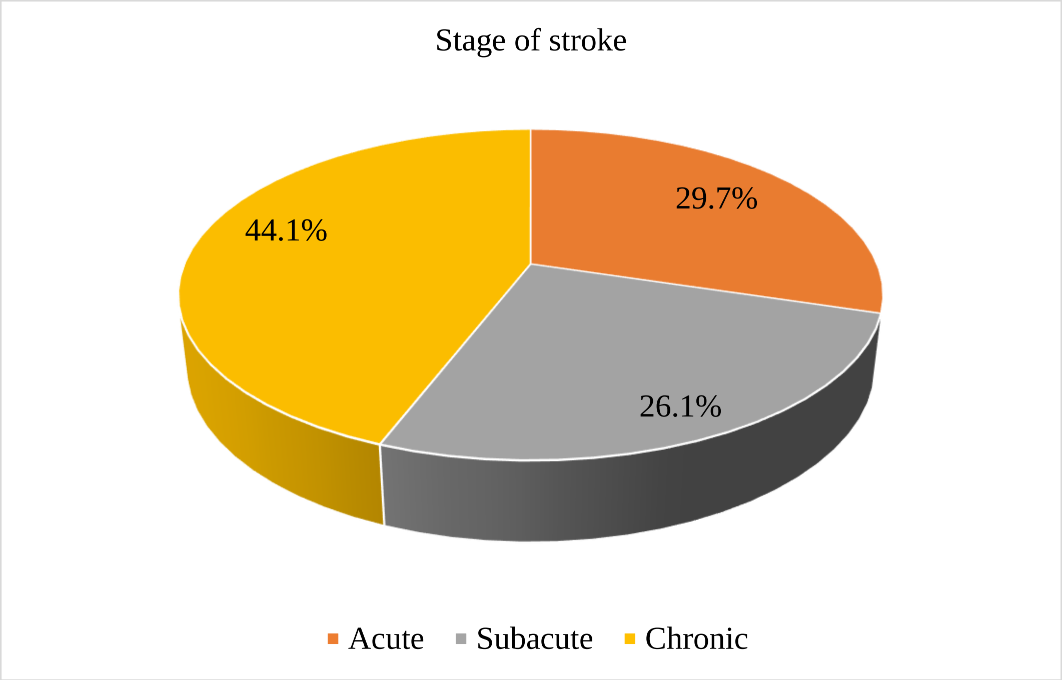


Figure 13: Stage of stroke of the participants

4.2.4. Number of strokes:

Among the 111 participants, the majority (81.1%, n=90) had experienced a single stroke. Additionally, 13.5% (n=15) reported having had two strokes, while a smaller proportion, 5.4% (n=6), had experienced more than two strokes.

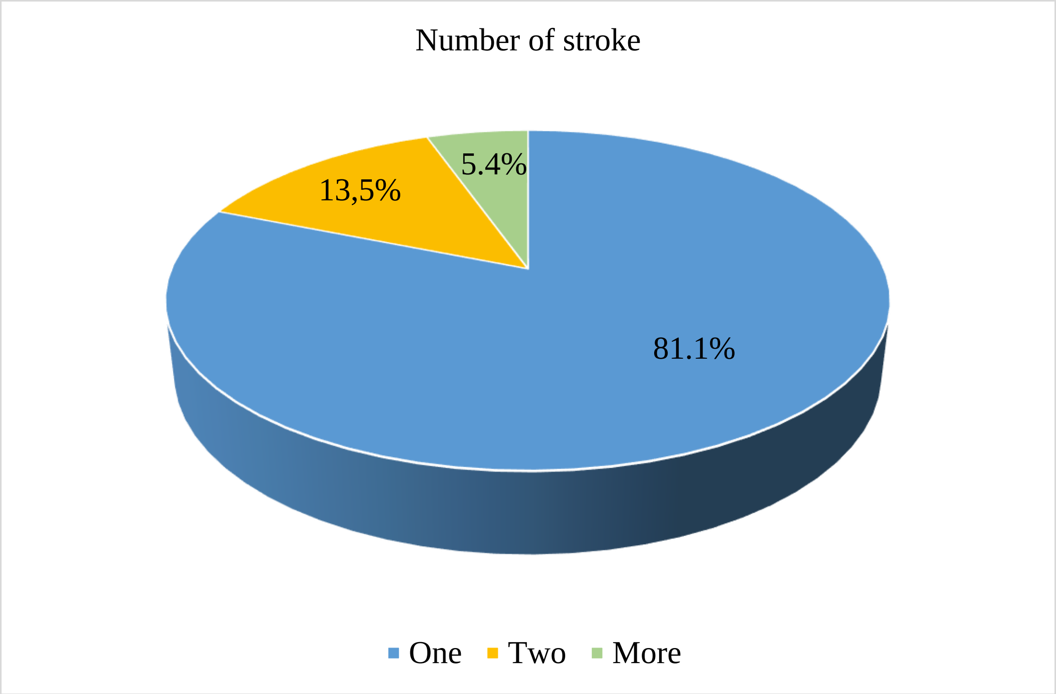


Figure 14: Number of strokes among the participants

4.2.5. Affected side:

Among the 111 participants, 51.4% (n=57) had the right side of their body affected by the stroke, while 48.6% (n=54) had left-sided involvement. This shows a nearly even distribution between right and left-sided impairments, with a slightly higher occurrence of right-sided stroke effects in the study population.

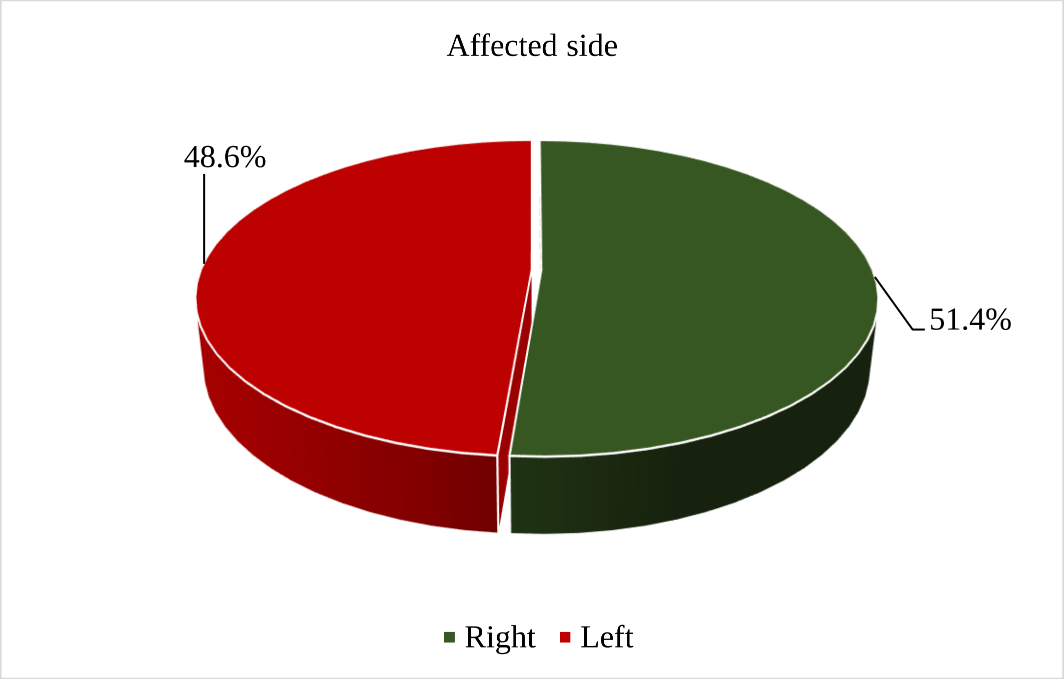


Figure 15: Affected side of the participants

4.2.6. Duration of rehabilitation:

The median duration of rehabilitation among the 111 participants was 60 days.

4.2.7. Referred by rehabilitation by whom:

Among the 111 participants, the majority (70.3%, n=78) were referred for rehabilitation by individuals categorized as "others," which may include family members, caregivers, or non-physician healthcare workers. A smaller portion, 27.9% (n=31), were referred by physicians, while only 1.8% (n=2) sought rehabilitation on their initiative.

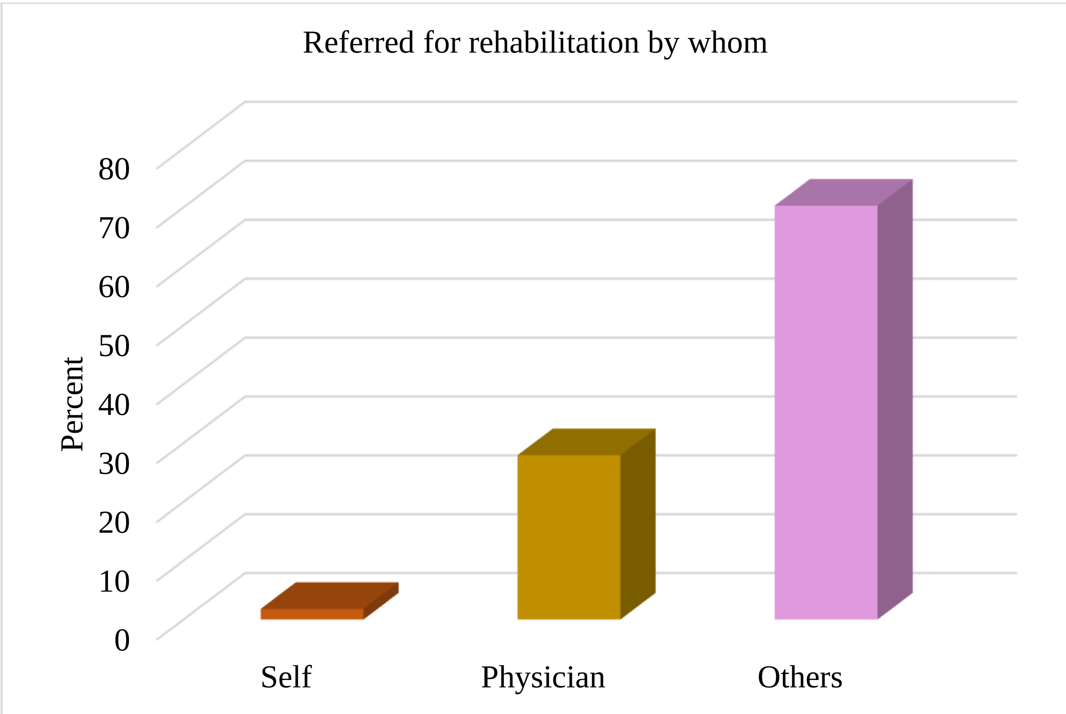


Figure 16: Referring to rehabilitation by whom

Table 2: Stroke-related information of the participants

Variable	Mean/SD	Median	Frequency (n)/percentage (%)
Type of stroke	-	-	Ischemic-90 (81.1%) Hemorrhagic-21 (18.9%)
Duration of stroke	-	150.00	-
Stage of stroke	-	-	Acute-33 (29.7%) Subacute-29 (26.1%) Chronic-49 (44.1%)
Number of strokes	-	-	One-90 (81.1%) Two-15 (13.5%) More-6 (5.4%)
Affected side	-	-	Right-57 (51.4%) Left-54 (48.6%)
Duration of rehabilitation	-	60.00	-
Referred for rehabilitation by whom	-	-	Self-2 (1.8%) Physician-31 (27.9%) Others- 78 (70.3%)

**Median value was considered in case of non-normally distributed continuous data.

4.3. Executive dysfunction:

Among the 111 participants, 42.3% (n=47) were found to have executive dysfunction, while 57.7% (n=64) did not exhibit signs of this condition. This suggests that a significant proportion of the individuals experienced difficulties with cognitive processes such as planning, decision-making, problem-solving, or attention control.

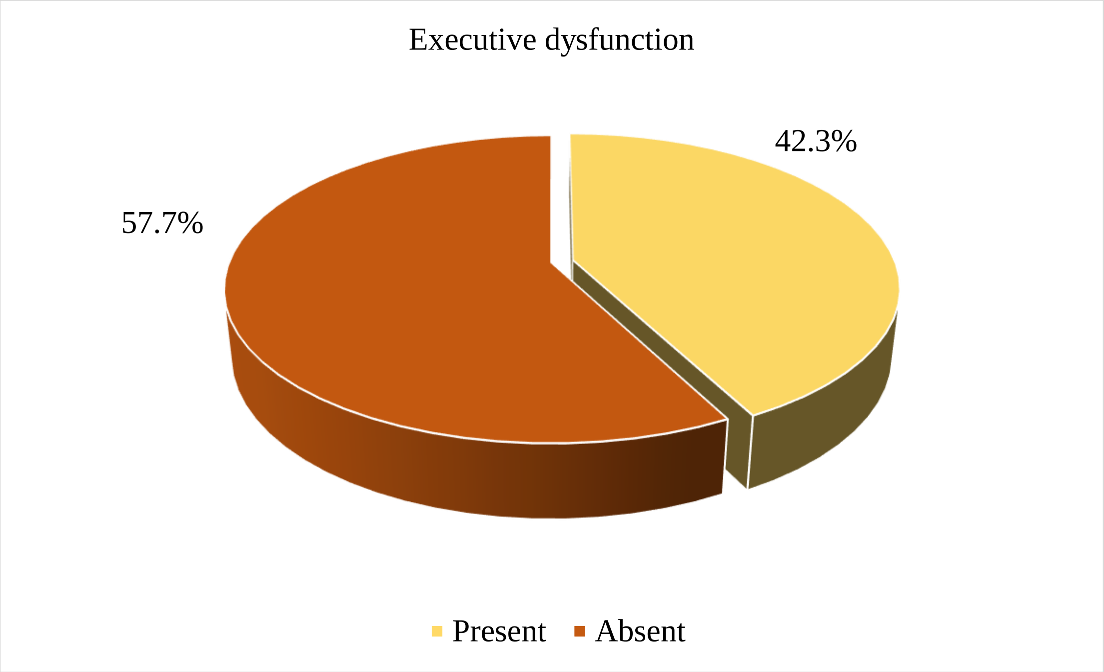


Figure 17: Executive dysfunction status of the participants

4.4. Trail making test part A (TMT part A)

4.4.1. TMT part A hand used:

Among the 111 participants, 51.4% (n=57) completed the Trail Making Test Part A (TMT-A) using their non-dominant hand, while 48.6% (n=54) used their dominant hand.

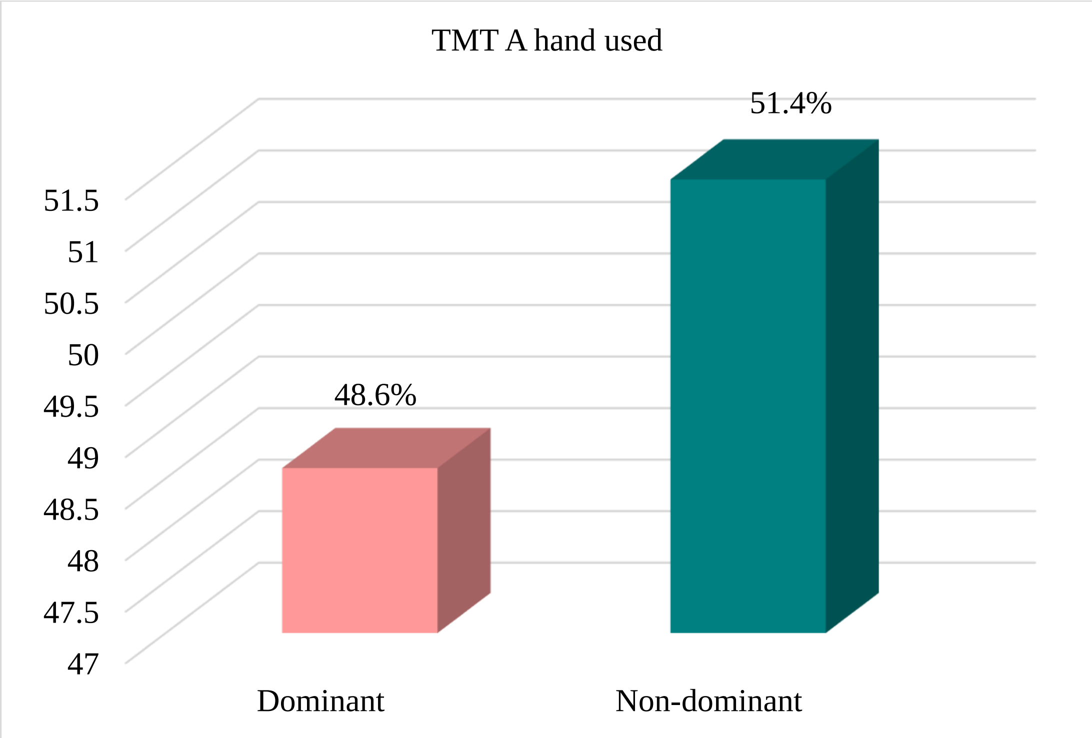


Figure 18: TMT part A hand used

4.4.2. TMT part A time and number of errors:

The median time taken to complete the Trail Making Test Part A (TMT-A) among the 111 participants was 20 seconds. The median number of errors made during the Trail Making Test Part A (TMT-A) among the 111 participants was 1.

4.4.3 TMT part A category:

Among the 111 participants, 57.7% (n=64) demonstrated normal executive function, with scores of 29 or below, while 42.3% (n=47) exhibited mild executive dysfunction, indicated by scores ranging from 30 to 78.

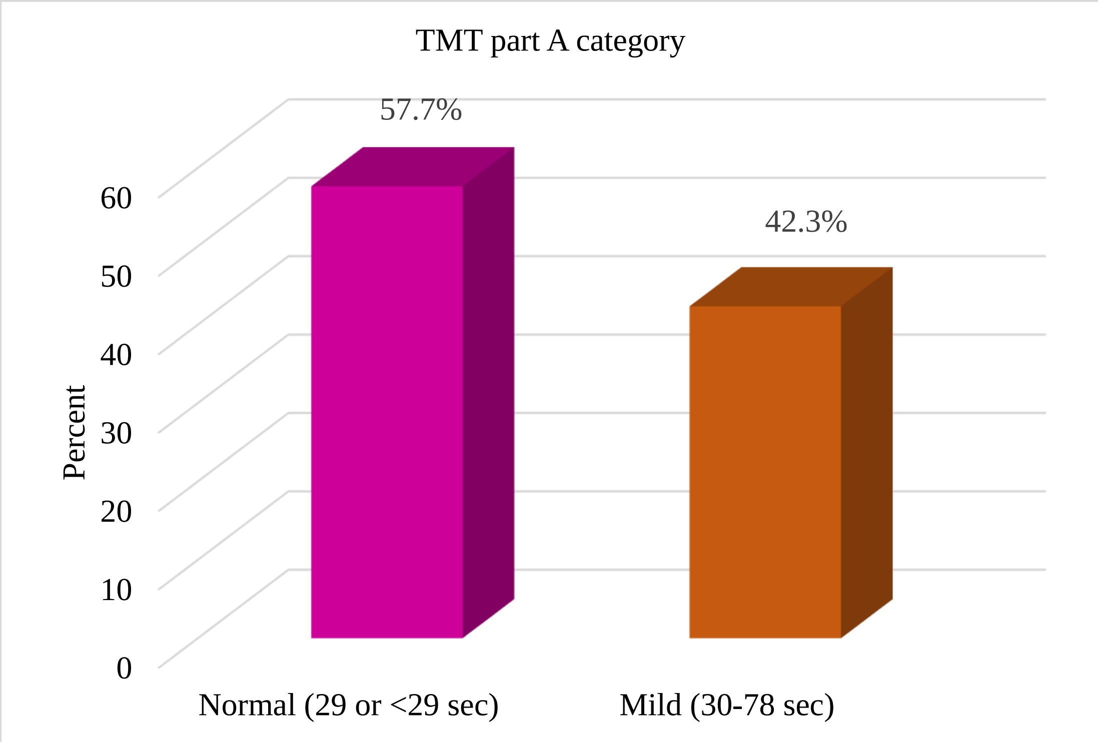


Figure 19: TMT part A category of the participants

4.5. Trail making test part B (TMT part B)

4.5.1. TMT part B hand used:

Among the 111 participants, 51.4% (n=57) completed the Trail Making Test Part B (TMT-B) using their non-dominant hand, while 48.6% (n=54) used their dominant hand.

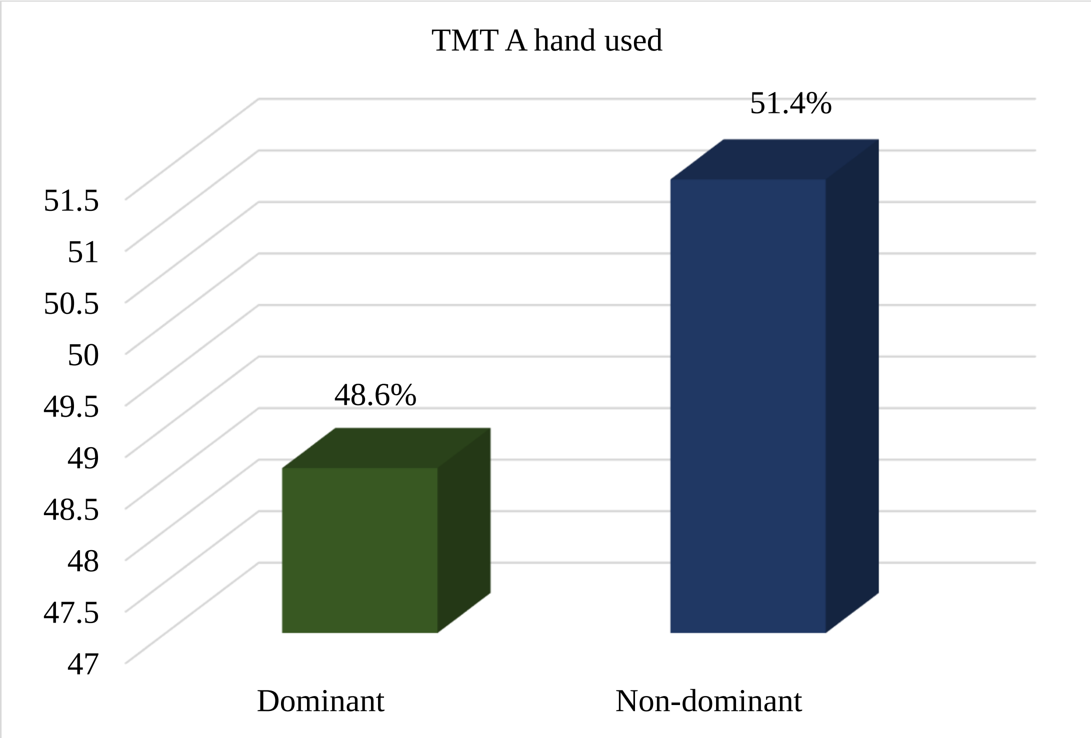


Figure 20: TMT part B hand used

4.5.2. TMT part B time and number of errors:

The median time among the 111 participants to complete the Trail Making Test Part B (TMT-B) was 35 seconds, and the median number of errors made during the Trail Making Test Part B (TMT-B) among the 111 participants was 1.

4.5.3. TMT part B category:

Among the 111 participants, 57.7% (n=64) completed the Trail Making Test Part B (TMT-B) in 75 seconds or less, placing them in the "normal" category. The remaining 42.3% (n=47) took between 76 and 273 seconds, indicating mild executive dysfunction.

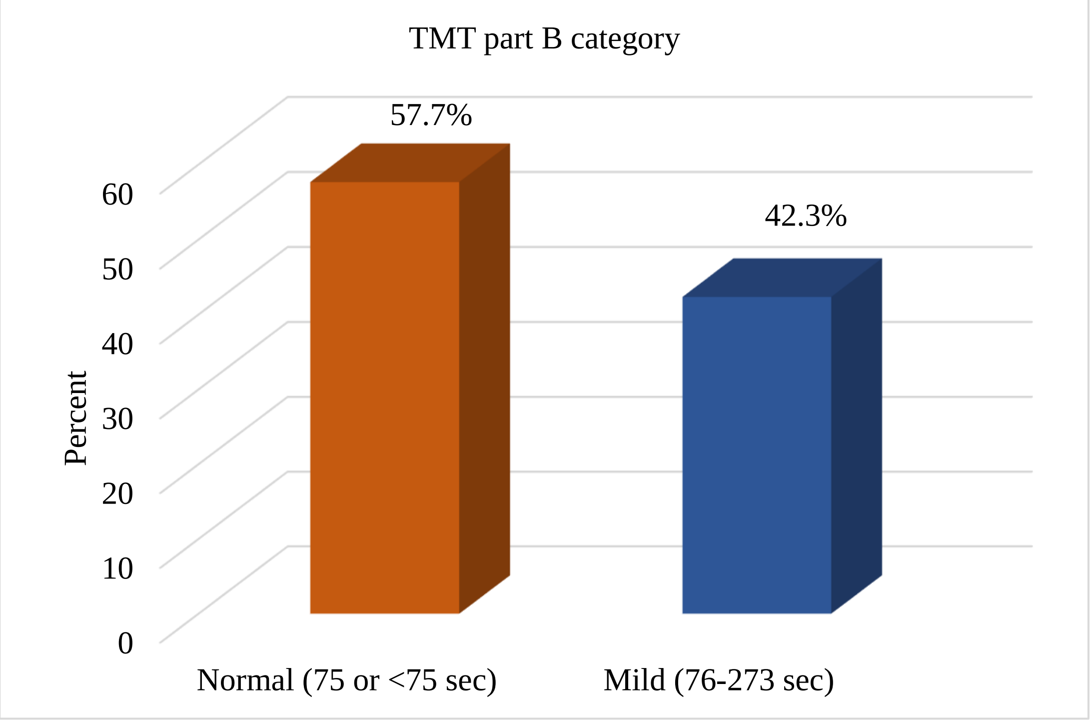


Figure 21: TMT part B category of the participants

4.6. MMSE total score:

Among the participants, 22.5% (n=25) had severe cognitive impairment (MMSE score 0–17), 19.8% (n=22) had mild cognitive impairment (MMSE score 18–23), and the majority, 57.7% (n=64), showed no cognitive impairment (MMSE score 24–30).

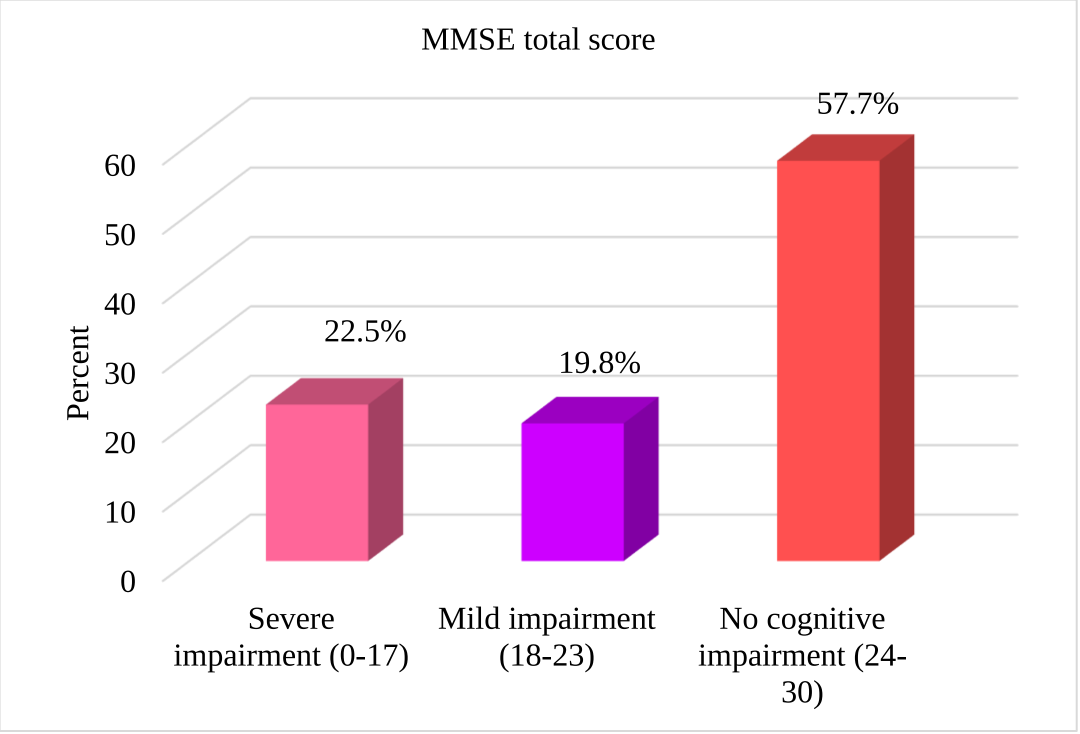


Figure 22: MMSE total score of the participants

4.7. BBS total score:

Among the 111 participants, the majority, 73.9% (n=82), were categorized as walking with assistance, based on a BBS (Berg Balance Scale) score between 21 and 40. In contrast, 26.1% (n=29) were classified as walking independently, with BBS scores ranging from 41 to 56.

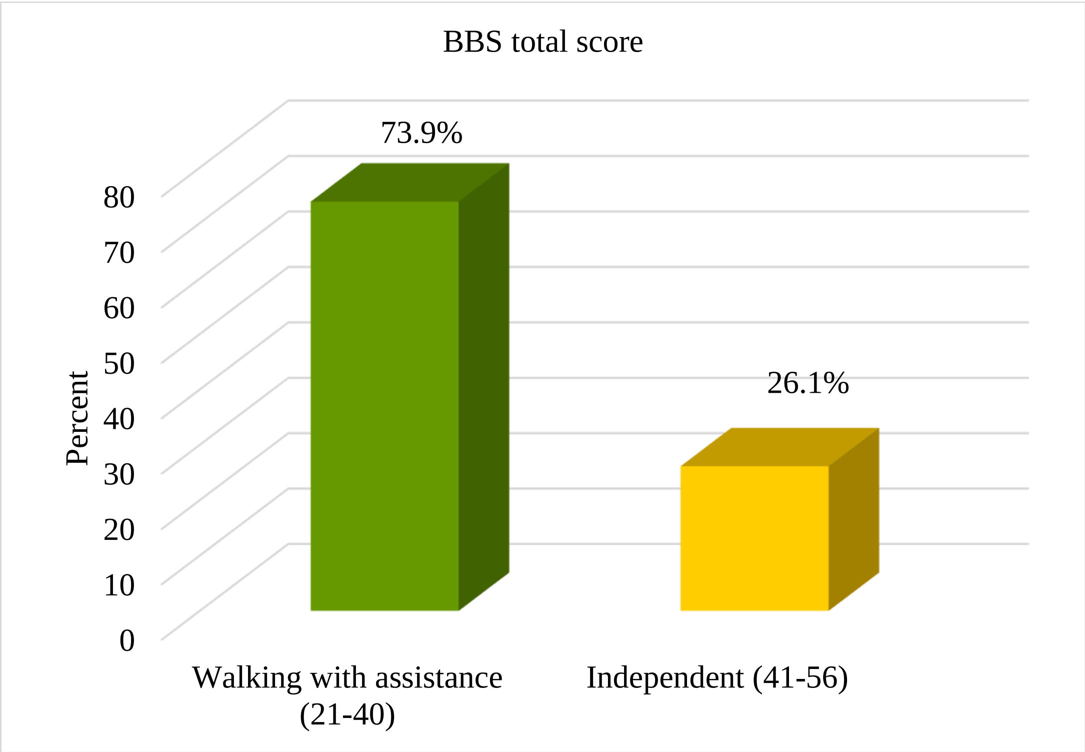


Figure 23: BBS total score of the participants

4.8. Mobility and risk of fall:

Among the 111 participants, 8.1% (n=9) demonstrated normal mobility (TUG time ≤10 seconds), while 18.0% (n=20) showed good mobility and were able to walk without a gait aid (TUG time ≤20 seconds). Additionally, 36.0% (n=40) had potential mobility limitations and required a walking aid (TUG time ≤30 seconds), and the largest group, 37.8% (n=42), were at high risk of falling and required assistance (TUG time >30 seconds).

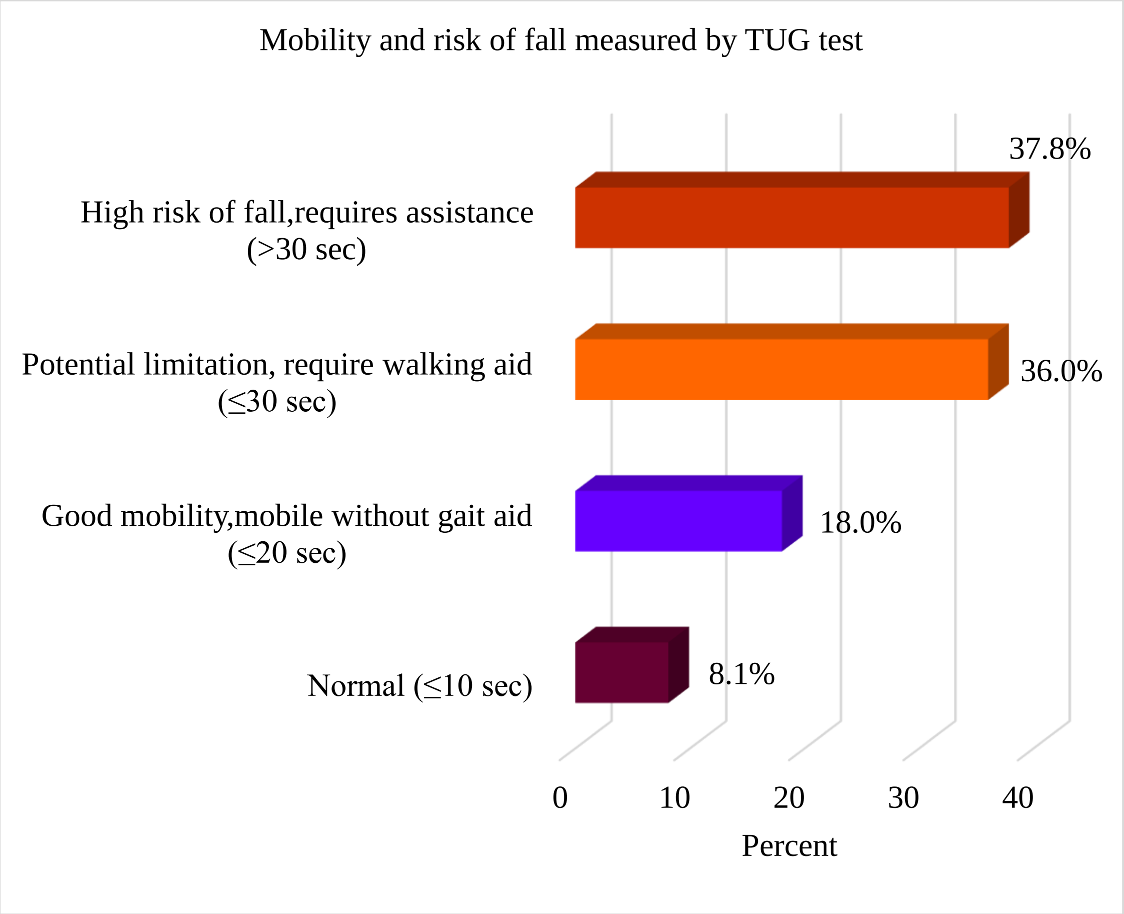


Figure 24: Mobility and risk of falls of the participants

Table 3: Functional parameters of the participants

Variables	Mean/SD	Median	Frequency (n)/ Percentage (%)
TMT A hand used	-	-	Dominant- 54 (48.6%) Non-dominant- 57 (51.4%)
TMT A time (sec)	-	20.00	-
TMT A number of errors	-	1.00	-
TMT A category	-	-	Normal (29 or <29 sec): 64 (57.7%) Mild (30-78 sec): 47 (42.3%)
TMT B hand used	-	-	Dominant: 54 (48.6%) Non-dominant: 57 (51.4%)
TMT B time (sec)	-	35.00	-
TMT B number of errors	-	1.00	-
TMT B category	-	-	Normal (75 or <75 sec): 64 (57.7%) Mild (76-273 sec): 47 (42.3%)
Executive dysfunction	-	-	Present: 47(42.3%) Absent: 64 (57.7%)
MMSE total score	-	-	Severe impairment (0-17): 25 (22.5%) Mild impairment (18-23): 22 (19.8%) No cognitive impairment (24-30): 64 (57.7%)

BBS total score	-	-	Walking with assistance (21-40): 82 (73.9%) Independent (41-56): 29 (26.1%)
TUG test score	-	-	Normal (≤10 sec): 9 (8.1%) Good mobility, mobile without gait aid (≤20 sec): 20 (18.0%) Potential limitation: requires walking aid (≤30 sec): 40 (36.0%) High risk of fall, requires assistance (>30 sec): 42 (37.8%)

**Median value was considered in case of non-normally distributed continuous data.

4.9. Inferential statistical analysis:

Typically, inferential statistical analysis involves drawing inferences about a population based on data describing a sample. In this study, associations were analyzed between executive dysfunction and balance function in stroke patients. Specifically, relationships were examined between the presence of executive dysfunction and variables such as age, gender, type and side of stroke, time since stroke onset, and level of physical activity. Additionally, associations between balance function scores and executive function test results were assessed.

Test assumption:

Pearson chi-square,

1. Two categorical variables, including two or more subcategories.
2. 0-1 cells (0%-20%) have expected count less than 5.

Level of significance (α value < 0.05)

Table 4: Association between sociodemographic characteristics such as gender, educational level, occupation, financial status, living area, family history of stroke, and number of comorbidities with executive dysfunction.

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Executive dysfunction	Gender	5.581	0.018	1	Significant
	Educational level	6.461	0.264	5	Not significant
	Occupation	7.641	0.266	6	Not significant
	Financial status	2.751	0.432	3	Not significant
	Living area	1.886	0.389	2	Not significant
	Family history of stroke	1.280	0.258	1	Not significant
	Number of comorbidities	10.928	0.001	1	Significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table indicates no significant link between executive dysfunction and education, occupation, finances, living area, or stroke family history. However, gender and number of comorbidities showed significant associations, suggesting they may influence the presence of executive dysfunction in stroke patients.

Additionally, the Phi value between executive dysfunction and gender was -0.224, with a p-value of 0.018, showing a weak negative association. This means that as gender changes, there is a slight change in the likelihood of executive dysfunction. Similarly, the Phi value between executive dysfunction and the number of comorbidities was -0.314, with a p-value of 0.001, indicating a moderate negative association. This suggests that as the number of comorbidities increases, executive dysfunction becomes more likely.

The bar chart (4A) shows the relationship between gender and the presence of executive dysfunction. It illustrates that a higher number of males had no executive dysfunction compared to females, while more females had executive dysfunction present. This suggests that executive dysfunction was more common among female participants.

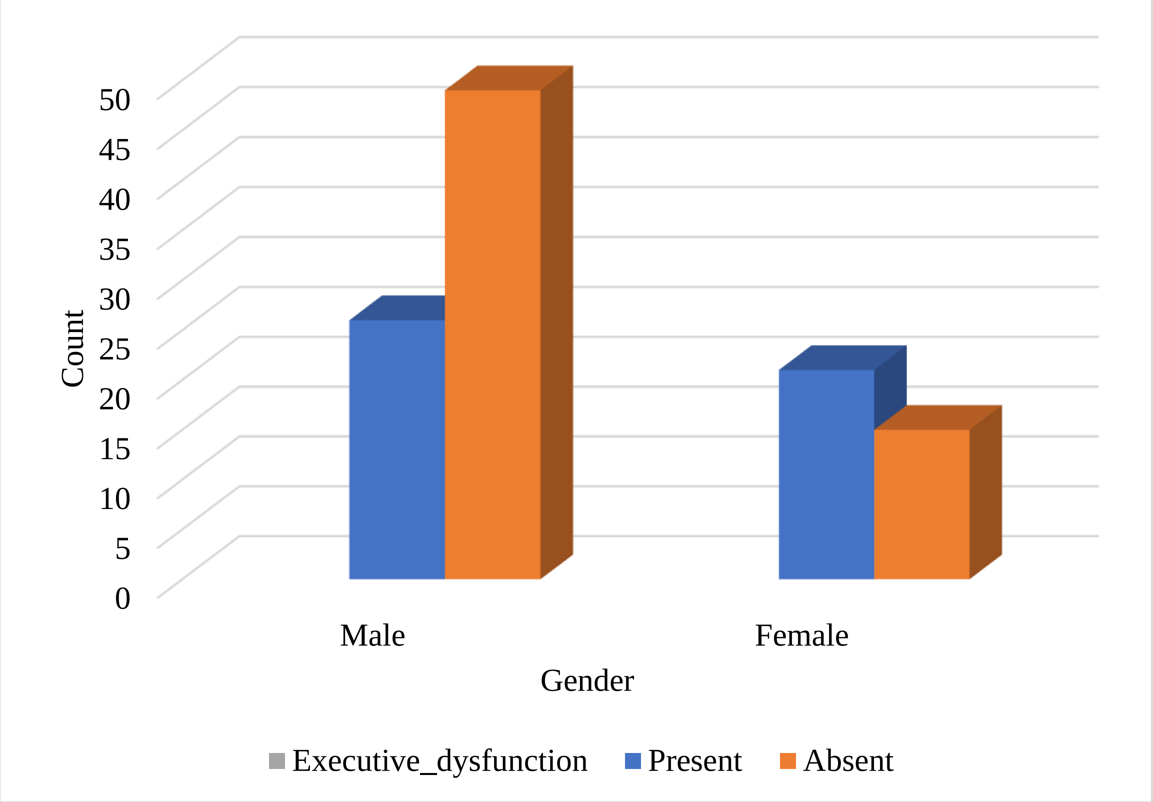


Figure 4 (A): Association between executive dysfunction and gender

The bar chart (4B) shows that executive dysfunction is more common in individuals with multiple comorbidities, while those with a single comorbidity are more likely to have no executive dysfunction.

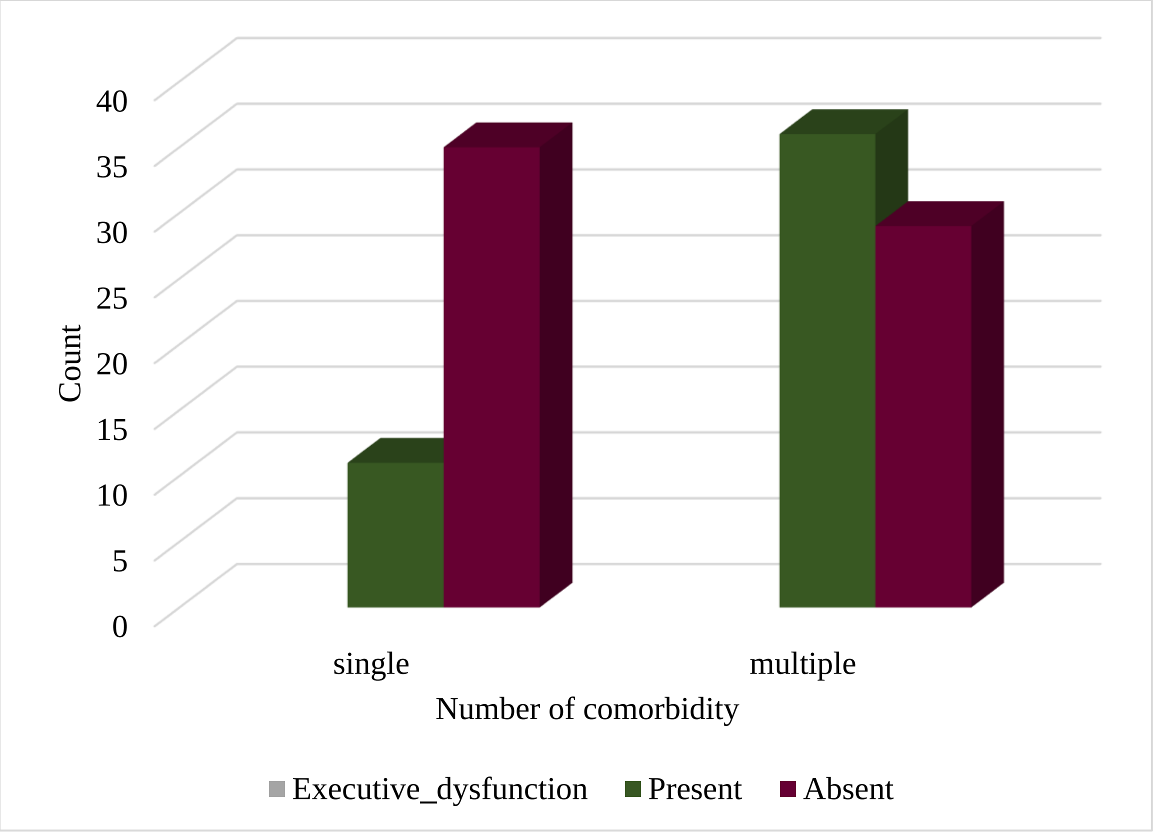


Figure 4 (B): Association between executive dysfunction and number of comorbidities

Table 5: Association between stroke-related factors such as type of stroke, stage of stroke, number of strokes, and affected side with executive dysfunction:

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Executive dysfunction	Type of stroke	0.295	0.587	1	Not significant
	Stage of stroke	0.120	0.942	2	Not significant
	Number of strokes	1.817	0.403	2	Not significant
	Affected side	0.003	0.959	1	Not significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table above shows the results of the association between executive dysfunction and stroke-related variables such as type of stroke, stage of stroke, number of strokes, and affected side. There was no significant association found between executive dysfunction and any of these variables, indicating that these stroke-related factors did not have a noticeable impact on the presence of executive dysfunction.

Table 6: Association between sociodemographic factors such as gender, educational level, occupation, financial status, living area, family history of stroke, and number of comorbidities with the BBS total score:

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Berg Balance Scale score	Gender	6.224	0.013	1	Significant
	Educational level	9.748	0.083	5	Not significant
	Occupation	8.006	0.238	6	Not significant
	Financial status	0.956	0.812	3	Not significant
	Living area	0.342	0.843	2	Not significant
	Family history of stroke	0.035	0.852	1	Not significant
	Number of comorbidities	9.377	0.002	1	Significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table presents the association between sociodemographic factors and balance function, measured by the Berg Balance Scale (BBS). Gender and number of comorbidities showed significant associations with BBS scores (p = 0.013 and 0.002, respectively). This indicates that balance performance varied by gender and comorbidity burden. Other factors—education, occupation, financial status, living area, and stroke family history—showed no significant association. A weak negative correlation was found between BBS and gender (Phi = -0.237), while a moderate negative correlation was observed with comorbidities (Phi = -0.291), suggesting that more comorbidities are linked to lower balance scores in stroke patients.

The bar chart (6A) illustrates the distribution of male and female participants based on their level of balance and mobility as categorized by the Berg Balance Scale (BBS). Participants were grouped into two categories: those requiring assistance with walking (BBS scores between 21–40) and those considered independent walkers (BBS scores between 41–56). Among males, a higher proportion (n = 50) required walking assistance, while a smaller group (n = 25) was classified as independent. A similar pattern was observed among females, with 32 participants needing assistance and only a few (n = 5) able to walk independently. Overall, the chart demonstrates that the majority of participants, regardless of gender, fell into the category of walking with assistance, with fewer individuals achieving independent mobility. Additionally, the number of independent walkers was noticeably lower among females compared to males.

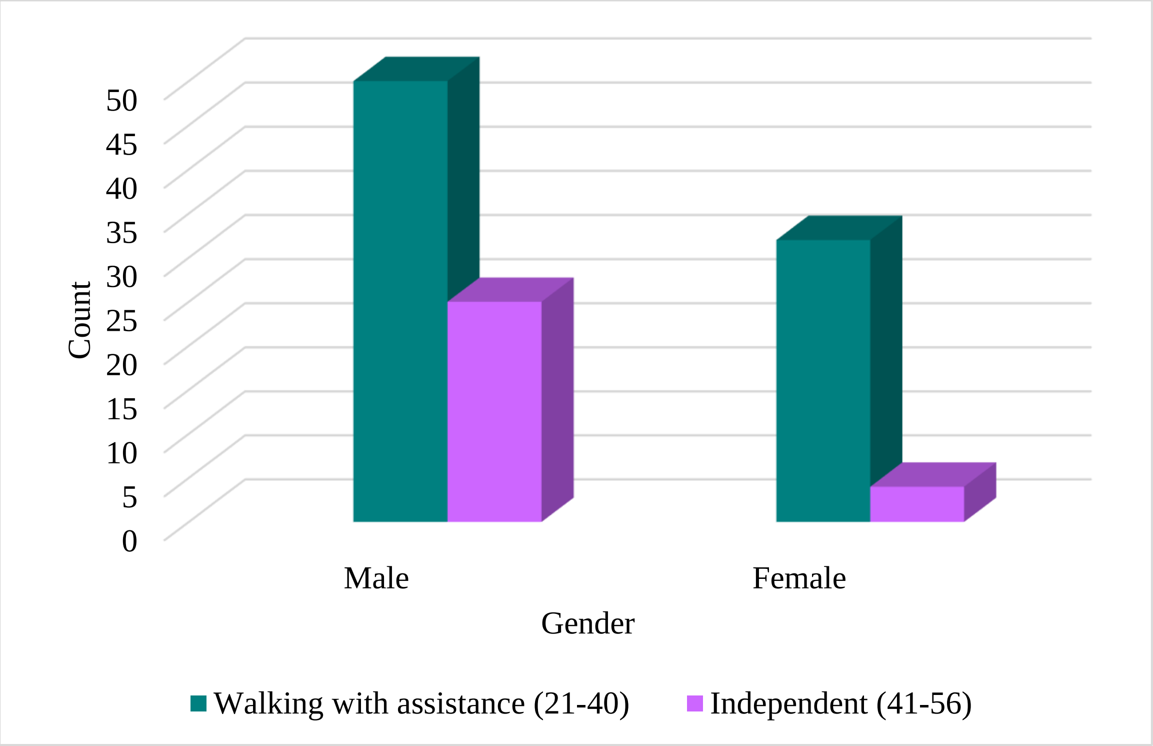


Figure 6 (A): Association between BBS score and gender

The bar chart (6B) displays the relationship between the number of comorbidities and mobility status, as measured by the Berg Balance Scale (BBS). Participants were grouped based on whether they had a single comorbidity or multiple comorbidities, and further classified by their BBS scores into two categories: walking with assistance (scores 21–40) and independent (scores 41–56). Among individuals with a single comorbidity, 27 required assistance with walking, while 19 were able to walk independently. In contrast, among those with multiple comorbidities, the majority (55) needed assistance, and only 10 were classified as independent. These results suggest that having multiple comorbidities is associated with greater impairment in balance and mobility.

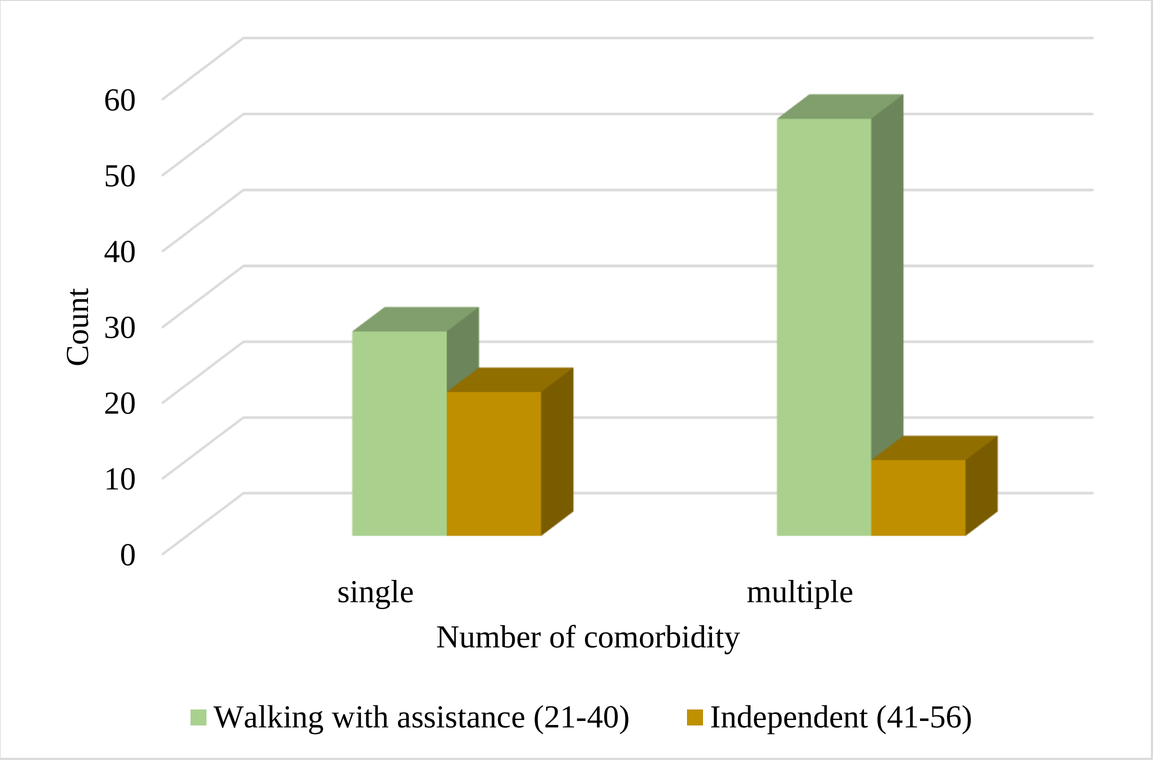


Figure 6 (B): Association between BBS score and number of comorbidities

Table 7: Association between stroke-related factors such as type of stroke, stage of stroke, number of strokes, and affected side with the BBS total score:

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Berg Balance Scale score	Type of stroke	0.072	0.788	1	Not significant
	Stage of stroke	1.400	0.497	2	Not significant
	Number of strokes	0.467	0.792	2	Not significant
	Affected side	0.002	0.963	1	Not significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table presents the association between stroke-related factors, such as type of stroke, stage of stroke, number of strokes, and affected side, and balance performance as measured by the BBS (Berg Balance Scale) total score. The Chi-Square analysis showed that none of these variables had a statistically significant association with the BBS total score, as all p-values were well above the 0.05 significance level. This suggests that variations in stroke type, stage, frequency, or the side of the body affected do not have a meaningful impact on balance function in the participants assessed.

Table 8: Association between MMSE total score, BBS total score, and risk of fall with executive dysfunction (measured by TMT part A and part B):

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Executive dysfunction	MMSE total score	111.000	0.000	2	Significant
	BBS total score	28.829	0.000	1	Significant
	Risk of fall (TUG test)	93.080	0.000	3	Significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table shows significant associations between executive dysfunction (assessed by Trail Making Test A and B) and cognitive and physical functions, including MMSE score, BBS score, and fall risk (TUG test). Executive dysfunction was strongly linked to lower cognitive performance (Chi-Square = 111.000, p = 0.000) and poorer balance (Chi-Square = 28.829, p = 0.000). Additionally, individuals with executive dysfunction had a higher risk of falling (Chi-Square = 93.080, p = 0.000). These findings emphasize the strong connection between executive dysfunction and reduced cognitive ability, impaired balance, and increased fall risk in stroke patients.

Additionally, the Phi value for executive dysfunction and MMSE score is 1.000 (p = 0.000), showing a perfect positive association. For executive dysfunction and BBS score, the Phi value is 0.510 (p = 0.000), indicating a strong positive relationship. The Phi value between executive dysfunction and risk of fall is 0.916 (p = 0.000), showing a very strong association. All associations are statistically significant.

The bar chart (8A) shows that executive dysfunction is more prevalent among individuals with greater cognitive impairment, while those with no cognitive impairment predominantly do not exhibit executive dysfunction.

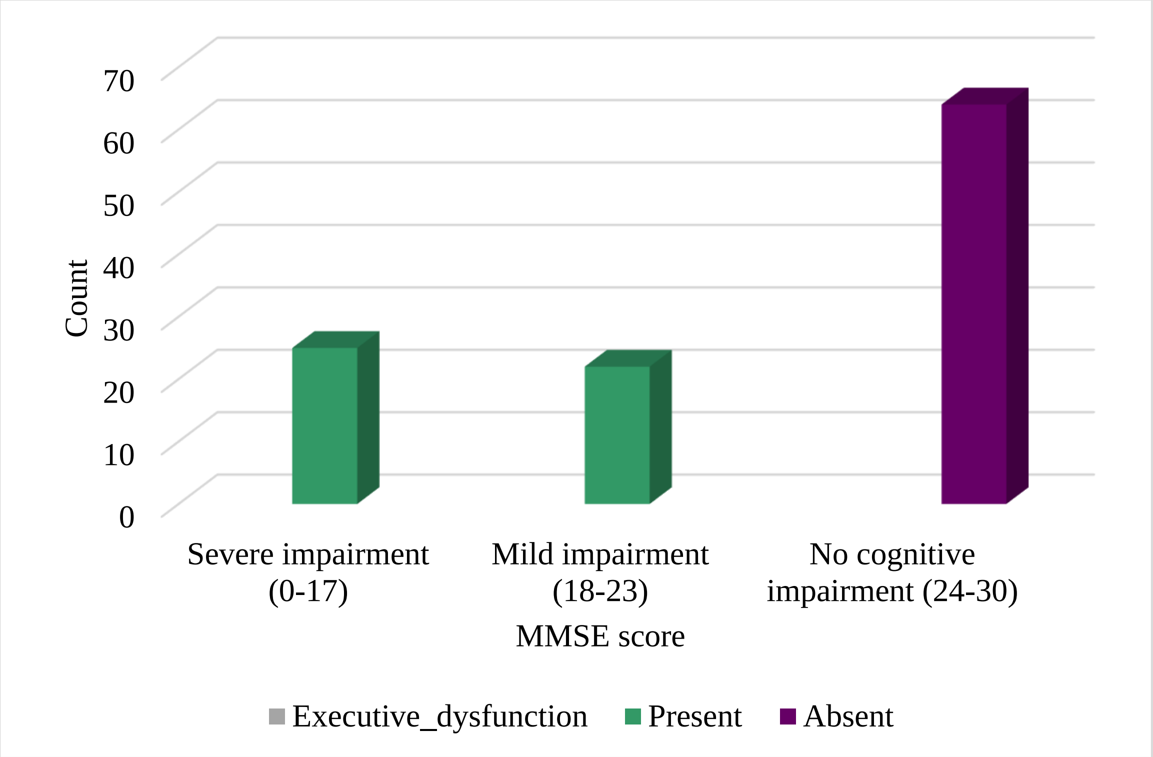


Figure 8 (A): Association between executive dysfunction and MMSE score

The bar chart (8B) indicates that executive dysfunction is more prevalent among individuals who require assistance with walking (BBS score 21–40). In contrast, individuals who are independent in walking (BBS score 41–56) predominantly do not exhibit executive dysfunction.

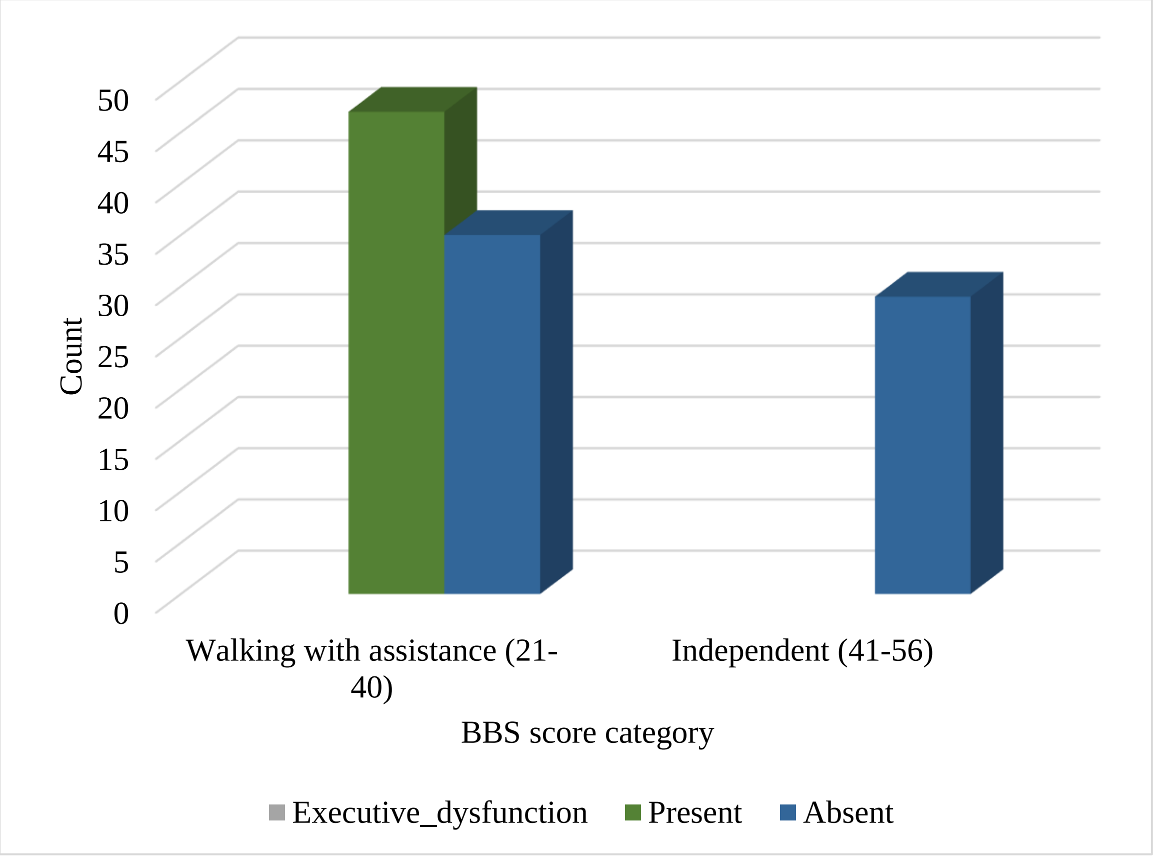


Figure 8 (B): Association between executive dysfunction and BBS score

The bar chart (8C) illustrates that executive dysfunction is more common among individuals with poor mobility and a high risk of falls (TUG time >30 sec). Conversely, those with better mobility (shorter TUG times) are more likely to be free of executive dysfunction. This suggests a strong association between executive dysfunction and reduced physical performance.

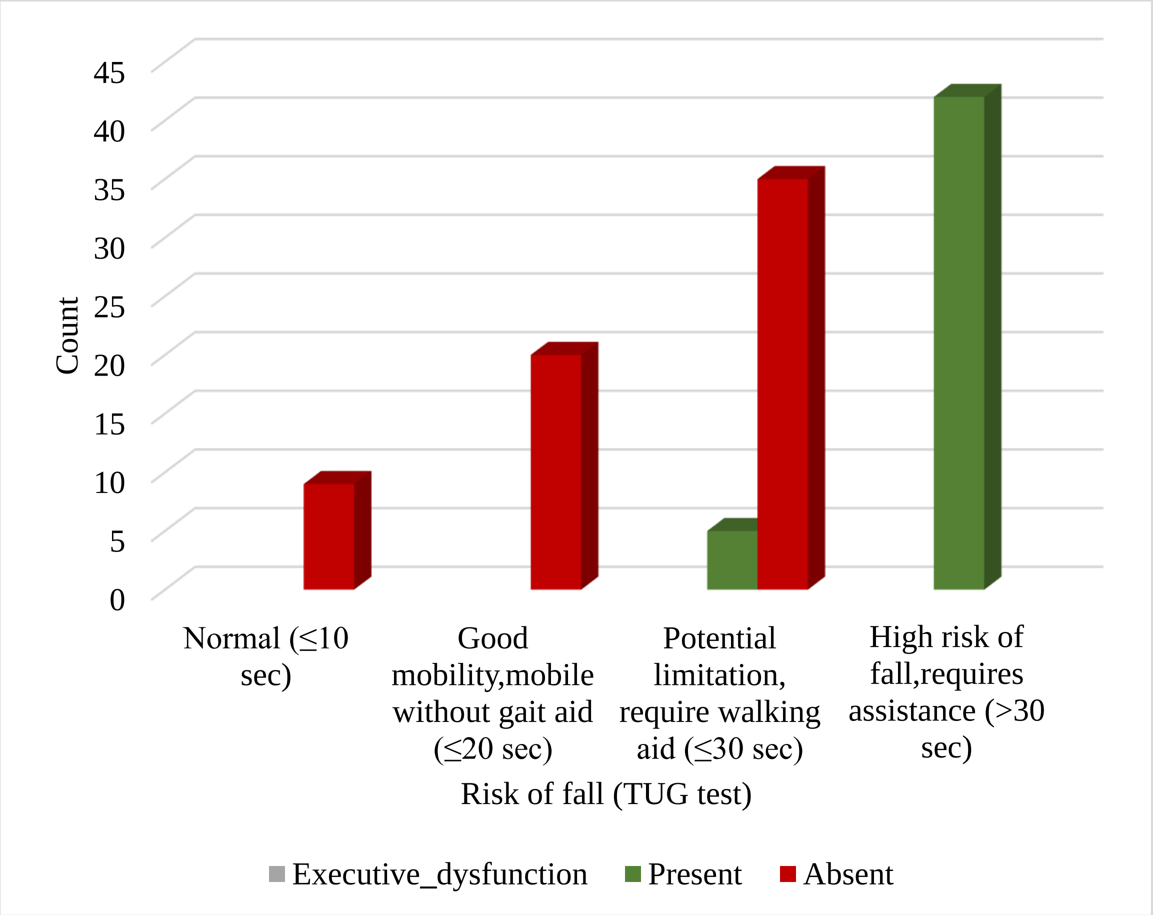


Figure 8 (C): Association between executive dysfunction and risk of fall (TUG test)

Table 9: Association between risk of fall (TUG test) with BBS total score:

Variable 1	Variable 2	Chi-Square value (X^2)	P value	df	Comment
Berg Balance Scale score	Risk of fall (TUG test)	111.000	0.000	3	Significant

** α value is 0.05. P-value is statistically significant if it is less than the α value.

The table shows that the association between the Berg Balance Scale (BBS) total score and the risk of fall measured by the Timed Up and Go (TUG) test is statistically significant, with a Chi-Square value of 111.000 and a p-value of 0.000. This indicates a strong relationship between balance function and fall risk in the studied participants. In simpler terms, as balance ability decreases (lower BBS scores), the risk of falling (as measured by the TUG test) increases significantly.

The Phi value is 1.000 (p = 0.000), indicating a perfect and very strong positive association between BBS score and risk of falls. This means they are exactly related—when one changes, the other does too.

This bar chart (9A) shows how individuals are distributed across different BBS (Berg Balance Scale) categories and their corresponding TUG (Timed Up and Go) performance levels, revealing a clear link between balance and mobility. Most people in the "Walking with assistance (21–40)" BBS category fall into the TUG categories of "Potential limitation, requires walking aid (≤30 sec)" or "High risk of fall, requires assistance (>30 sec)." In contrast, those classified as "Independent (41–56)" on the BBS are primarily in the TUG categories of "Normal (≤10 sec)" or "Good mobility, mobile without gait aid (≤20 sec)." This suggests that individuals with better balance tend to demonstrate higher levels of mobility.

Figure 9 (A): Association between BBS score and risk of fall (TUG test)

Chapter v: Discussion

Stroke is a leading cause of long-term disability worldwide, often resulting in both cognitive and motor impairments. Among stroke survivors, executive dysfunction is frequently observed, impacting their ability to plan, organize, and execute tasks. These cognitive deficits can have a profound effect on physical functions, particularly balance, which is critical for mobility and preventing falls. Balance impairments are common post-stroke due to the disruption of sensorimotor pathways, and recent evidence suggests that cognitive processes—especially executive functions—play a key role in maintaining postural control. Understanding the relationship between executive dysfunction and balance is crucial in optimizing rehabilitation strategies for stroke patients.

This study examined the link between executive dysfunction and balance in stroke patients at CRP using a self-structured questionnaire. Descriptive statistics summarized categorical data as percentages (via charts and tables) and continuous data as means and standard deviations. Chi-square tests assessed associations between executive dysfunction and balance-related variables. Results suggest that executive dysfunction is associated with impaired balance, with demographic and clinical profiles providing important context.

In this study, the mean age of participants was 54.09 years (SD = 11.73), indicating that the sample primarily consisted of middle-aged individuals. Age plays a significant role in stroke occurrence and recovery, as older adults are generally more susceptible to stroke, while younger individuals may be more proactive in seeking rehabilitation services (Patterson, 2018). The majority of the participants were male (n = 75, 67.6%), with females comprising 32.4% (n = 36), reflecting a notable gender disparity. This imbalance may have implications for both executive function and balance outcomes following stroke. Similar trends have been reported in previous studies; for example, Mondal et al. (2022) found that the prevalence of stroke was 13.8 per thousand in men compared to 8.68 per thousand in women, nearly twice as high in men, highlighting a consistent pattern of higher stroke incidence among males.

Most participants in this study were married (94.6%, n = 105), with only a few reporting being widowed (4.5%, n = 5) or unmarried (0.9%, n = 1). The educational background of the participants varied widely: 12.6% (n = 14) had no formal education, while 16.2% (n = 18) had completed primary education, 29.7% (n = 33) had secondary education, 14.4% (n = 16) completed higher secondary, 18.9% (n = 21) were graduates, and 8.1% (n = 9) held postgraduate degrees. These findings are consistent with the study by Bonner et al. (2016), which reported that approximately 70% of participants had completed at least a high school level of education. In terms of socioeconomic status, 15.3% (n = 17) of participants were from lower middle-class backgrounds, 40.5% (n = 45) were middle class, 25.2% (n = 28) were upper middle class, and 18.9% (n = 21) were from the upper class. These results reflect a wide socioeconomic range among participants. This aligns with the findings of Watkins (2023), who reported that the majority of strokes (around 86%) occur in low- and middle-income countries.

In this study, occupational distribution revealed that the majority of participants were either housewives (31.5%) or engaged in various unspecified occupations categorized as "Other" (33.3%). A smaller proportion of participants were involved in business (16.2%), followed by service holders (9.9%), farmers (5.4%), and shopkeepers (2.7%). Only one participant (0.9%) was unemployed. This occupational spread reflects a diverse socio-economic background among stroke patients attending CRP and may influence both their access to rehabilitation resources and their functional recovery outcomes, including balance and cognitive functions.

In this study, a large proportion of participants (58.6%, n = 65) had multiple comorbid conditions, while 41.4% (n = 46) had only one. Hypertension was the most common health issue, present either on its own (41.4%, n = 46) or in combination with other conditions. Common combinations included hypertension with diabetes (27.0%, n = 30) and hypertension with both diabetes and heart disease (9.0%, n = 10). More complex patterns involving lung disease and other conditions were also observed in smaller numbers. Additionally, 24.3% (n = 27) of participants were smokers, while the majority (75.7%, n = 84) were non-smokers. These findings are consistent with those reported by Mondal et al. (2022), who found hypertension to be the most prevalent risk factor among stroke patients (79.2%), followed by poor dietary habits (67.3%), diabetes (28.8%), dyslipidaemia (38.9%), and smoking or tobacco use (37.2%).

In this study, most participants had experienced an ischemic stroke (81.1%, n = 90), while a smaller number had a hemorrhagic stroke (18.9%, n = 21). These findings are consistent with previous research, which shows that ischemic stroke is the most common type, accounting for approximately 87% of all stroke cases (Mozaffarian et al., 2015). Globally, in 2010, there were an estimated 11.6 million cases of ischemic stroke and 5.3 million cases of hemorrhagic stroke (Johnson et al., 2019), further supporting the prevalence patterns observed in this study. In this study, the researcher found that 29.7% (n = 33) were in the acute stage, 26.1% (n = 29) in the subacute stage, and 44.1% (n = 49) in the chronic stage. The side of the body affected by stroke was nearly evenly distributed, with 51.4% (n = 57) having right-sided impairment and 48.6% (n = 54) left-sided.

In this study, the researcher found that 42.3% of participants were classified as having executive dysfunction (ED). This group showed significantly lower scores on both the TMT Part A and MMSE compared to those without ED. These findings align with previous research, which reported similar prevalence rates of ED among stroke patients 47% in the study by Hayes, Donnellan, and Stokes (2016), and 51.4% in the study by Sakai et al. (2024). TMT Part B is a well-established tool for identifying executive dysfunction (Sakai et al., 2024). In this study, the researcher used TMT Part B to define and classify executive dysfunction, following the method used by Sakai et al. (2024), and found a prevalence of 42.3%. This result is similar to findings from previous studies.

In this study, MMSE results showed that 57.7% of participants had no cognitive impairment, while 19.8% had mild and 22.5% had severe cognitive deficits. These findings highlight the high prevalence of cognitive impairment following stroke, consistent with previous reports indicating that up to 80% of stroke survivors experience some degree of cognitive decline. Beyond motor impairments, cognitive dysfunction is recognized as a major contributor to reduced ability to perform daily activities after stroke (Buvarp et al., 2021).

Balance function in this study was evaluated using both the Berg Balance Scale (BBS) and the Timed Up and Go (TUG) test. According to BBS results, 73.9% of participants required assistance with walking, and only 26.1% were able to walk independently.

Similarly, TUG results showed that nearly 74% of participants had mobility limitations, with 37.8% classified as being at high risk of falling. These findings point to a high level of balance dysfunction in the sample. This is consistent with previous research showing that impaired balance and gait are common after stroke and are key contributors to reduced independence in daily activities (Yu et al., 2021). Falls are a frequent and serious complication in stroke survivors, with around 60% experiencing at least one fall during hospitalization and up to 73% falling within the first six months post-stroke. Our findings highlight a similar risk pattern, reinforcing the importance of early balance assessment and fall prevention strategies in stroke rehabilitation.

In the present study, no significant association was observed between executive dysfunction (ED) and the stage of stroke, as indicated by the chi-square test ($\chi^2 = 0.120$, $p = 0.942$). This suggests that the presence of ED did not vary meaningfully across different stroke stages within the study population. But the prior research has reported a relatively high prevalence of ED among patients in the early stage of stroke (within <3 months), highlighting it as a frequent post-stroke cognitive impairment that negatively impacts functional independence in daily living (Laakso et al., 2019; Yu et al., 2021).

In this study, the Chi-square analysis revealed significant associations between executive dysfunction and several key clinical measures. There was a highly significant relationship between executive dysfunction and MMSE total scores ($\chi^2 = 111.000$, $p < 0.001$), indicating that individuals with executive dysfunction also tended to have lower global cognitive function. This supports the view that executive function is an important component of overall cognitive health and that deficits in executive functioning are closely linked with broader cognitive impairment.

In this study, a significant association was observed between executive dysfunction and balance performance, as measured by the Berg Balance Scale (BBS) ($\chi^2 = 28.829$, $p < 0.001$). Participants with executive dysfunction exhibited poorer balance and reduced functional mobility compared to those without executive dysfunction. This finding is consistent with prior research suggesting that impairments in executive functioning, particularly in areas such as attention, planning, and cognitive flexibility, can negatively impact postural control and increase physical instability (Hayes, Donnellan, and Stokes, 2016).

Similarly, a strong association was found between executive dysfunction and fall risk, as evaluated by the Timed Up and Go (TUG) test ($\chi^2 = 93.080$, $p < 0.001$). Participants classified as having executive dysfunction were significantly more likely to be at higher risk of falling. These results reinforce the notion that executive functions are essential for complex motor tasks requiring planning, sequencing, and divided attention—key components of safe and effective mobility. The ED group in this study demonstrated slower TUG performance and lower BBS scores than the non-executive dysfunction (NED) group, highlighting the functional impact of cognitive deficits on physical outcomes. These findings align closely with those of Sakai, Hosoi, and Harada (2023), who reported that TUG performance varied significantly with the degree of executive dysfunction in stroke patients. Similarly, Yu et al. (2021) found a strong correlation between executive dysfunction and TUG scores, supporting the link between impaired cognitive control and increased fall risk. Hayes, Donnellan, and Stokes (2016) also identified balance function, as measured by the BBS, as a factor associated with executive dysfunction in stroke survivors.

Executive functions encompass goal setting, task execution, flexible thinking, and working memory (Sakai, Hosoi, and Tanabe, 2024; Skidmore, Eskes, and Brodtmann, 2023). Both the TUG and BBS tests involve the application of these functions. For example, TUG requires individuals to stand from a seated position, walk, turn around a cone, and return to sit, all of which demand planning, task initiation, and continuous attention (Sakai et al., 2024). Similarly, the BBS involves a series of balance tasks that require individuals to follow instructions, sequence actions, and self-correct all behaviors that rely on intact executive control. While Yu et al. (2021) found significant differences in Berg Balance Scale (BBS) scores between stroke patients with and without executive dysfunction during the first year post-stroke, the current study did not observe a significant association between the duration or stage of stroke and either executive dysfunction or BBS scores.

Taken together, these findings and those of prior studies provide strong evidence that executive dysfunction is closely linked to balance impairments and increased fall risk. This underscores the importance of incorporating executive function assessments into post-stroke rehabilitation to better identify patients at risk of mobility limitations and falls, and to develop more targeted, interdisciplinary intervention strategies.

This study aimed to explore the potential relationship between cognitive impairments, particularly executive dysfunction, and balance issues among stroke patients. Although exploratory, the findings offer valuable insights into the cognitive and functional challenges faced by stroke survivors, highlighting the importance of addressing both domains during rehabilitation. The study design allows for modification in future research to include longitudinal elements or intervention-based assessments.

Limitation

This study has various limitations that should be considered. The sample size was small, and it only included stroke patients at the Centre for the Rehabilitation of the Paralysed (CRP) in Savar; thus, the results may not be applicable to all stroke survivors in Bangladesh. The study solely examined the relationship between executive dysfunction and balance; it did not examine other variables that might have influenced the findings, such as medication or the quantity and kind of rehabilitation sessions. The brief study period restricted the number of participants and the duration of their follow-up. Also, the research was conducted by an undergraduate student with insufficient expertise, which may have resulted in some errors. Future research should include more participants, last longer, and investigate a wider range of issues.

Chapter vi: Conclusion and Recommendation

Conclusion

Stroke is a primary cause of long-term impairment, frequently impairing both physical and cognitive abilities. This study found a significant association between executive dysfunction and impaired balance function in stroke patients. Participants with executive dysfunction demonstrated lower Berg Balance Scale scores and slower Timed Up and Go performance, indicating reduced postural stability and an increased risk of falls. These findings suggest that cognitive deficits, particularly in executive functions, may contribute to poor balance outcomes after stroke.

Recommendation

Based on this study on executive dysfunction and balance function in stroke patients at CRP, it is recommended that routine cognitive assessments, particularly for executive function, be integrated into stroke rehabilitation programs. Early identification of cognitive impairments can help guide more personalized and effective interventions targeting both mental and physical recovery. Rehabilitation professionals should receive training to recognize and address executive dysfunction. Future studies should involve larger, more diverse samples and explore the long-term effects of cognitive impairments on balance and fall risk. Use mixed methods, both qualitative and quantitative, for richer insights. Incorporating combined cognitive and physical therapies may enhance functional outcomes and patient independence.

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Appendix

BANGLADESH HEALTH PROFESSIONS INSTITUTE

বাংলাদেশ হেলথ্ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)

Bangladesh Health Professions Institute (BHPI)

(The Academic Institute of CRP)

Ref: CRP-BHPI/IRB/12/2024/1018 Date: 15/12/2024

To
Mahmuda Akter Akhi
4th Year B.Sc. in Physiotherapy
Session: 2019-2020, Student ID: 112190486
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

Subject: Approval of the thesis proposal "Executive dysfunction and its association with balance function in stroke patients attendant at CRP" by the ethics committee.

Dear Mahmuda Akter Akhi,

Congratulations.

The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with you, as the principal investigator and Asma Islam, Associate Professor, Department of Physiotherapy, BHPI as thesis supervisor. The following documents have been reviewed and approved:

Sl. No.	Name of the Documents
1	Research Proposal
2	Questionnaire (English version)
3	Information sheet & consent form.

The purpose of the study is to determine the association between executive dysfunction and balance function in stroke patients. The study involves the use of a Trail Making Test (TMT), Mini-Mental State Examination (MMSE), Berg Balance Scale (BBS), and Time Up and Go Test (TUGT) questionnaire to explore the relationship between executive dysfunction and balance function in stroke patients that may take 20 to 30 minutes to fill in the questionnaire any instruction or precaution for collection of specimen. There is no likelihood of any harm to the participants and participation in the study may benefit the participants or other stakeholders by knowing the association between executive dysfunction and balance function as this study helps to develop an effective rehabilitation program and create awareness among patients about physiotherapy treatment. The members of the Ethics Committee have approved the study to be conducted in the presented form at the meeting held at **9 AM on 15 July 2024 at BHPI (44th IRB Meeting).**

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

Best regards,

MillatHossain

Muhammad Millat Hossain,
Associate Professor & Course Coordinator, MRS
Member Secretary, Institutional Review Board (IRB)
BHPI, CRP, Savar, Dhaka-1343, Bangladesh.

সিআরপি-চাপাইন, সাভার, ঢাকা-১৩৪৩, বাংলাদেশ। ফোন: +৮৮ ০২ ২২৪৪৪৫৪৬৪-৫, +৮৮ ০২ ২২৪৪৪১৪০৪, মোবাইল: +৮৮ ০১৭৩০ ০৫৯৬৪৭
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E-mail : principal-bhpi@crp-bangladesh.org, Web: bhpi.edu.bd

Permission Latter

Date: 29 December,2024

Head

Department of Physiotherapy

Centre for the Rehabilitation of the Paralysed (CRP)

Chapain, Savar, Dhaka-1343.

Through: Head, Department of Physiotherapy, BHPI.

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

Sir,

With due respect and humble submission to state that I am Mahmuda Akter Akhi, a student in 4th year B.Sc. in physiotherapy at Bangladesh Health Professions Institute (BHPI). The Ethical committee has approved my research project entitled: "Executive Dysfunction and its Association with Balance Function in Stroke Patients Attendant at CRP" under the supervision of Asma Islam, Associate Professor, Department of Physiotherapy, BHPI. I want to collect data for my research project from the Department of Physiotherapy at CRP. So, I need permission for data collection from the Neurology Unit of the Physiotherapy Department at CRP-Savar, Dhaka-1343. I want to assure you that anything in the study will not be harmful to the participants and the Department itself.

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

Yours faithfully,

Mahmuda

Mahmuda Akter Akhi

4th Year; B.Sc. in Physiotherapy

Class Roll: 11; Session: 2019-2020

Bangladesh Health Professions Institute (BHPI)

(An academic Institution of CRP)

CRP-Chapain, Savar, Dhaka-1343.

Forewarded to HOD(PT, BHPI)

11/01/2025

Forwarded and Recommended for your kind approval.

Dr. Shazal Kumar Das, PhD
Assistant Professor and Head
Department of Physiotherapy
BHPI, CRP, Savar, Dhaka-1343.

Approved

21/1/25

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

সম্মতি পত্র (বাাংলা)

(অংশগ্রহণকারীকে পড়েশোনাতে হবে)

আসসালামুয়ালাইকুম\ নমস্কার, আমার নাম মাহমুদা আক্তার আঁখি,আমি বাংলাদেশ হেল্থ প্রফেশনস ইনস্টিটিউট (বি এইচ পি আই)- এ ফিজিওথেরাপি কোর্সের এক জন ছাত্রী। আমার গবেষণার কাজের জন্য আমি স্ট্রোক রোগীদের উপর একটি গবেষণা পরিচালনা করছি এবং আমার অধ্যয়ন শিরোনাম **"নির্বাহী কর্মহীনতা এবং সিআরপি-তে চিকিৎসারত স্ট্রোক রোগীদের ব্যালেন্স ফাংশনের সাথে এর যোগসূত্র"**।এক্ষেত্রে আমি আপনার এবং স্ট্রোক সম্পর্কে আনুষঙ্গিক কিছু তথ্য জানতে চাচ্ছি। যা প্রায় ২০-৩০ মিনিট সময় লাগবে। এটি শিক্ষাগত গবেষণা এবং অন্য কোন উদ্দেশ্যে ব্যবহার করা হবে না।গবেষক সরাসরি নিউরোলজি ইউনিট এর সাথে সম্পর্কিত নয়, তাই গবেষণায় আপনার অংশগ্রহণ নিউরোলজি ইউনিটে আপনার বর্তমান বা ভবিষ্যতে চিকিৎসায় কোনো প্রভাব ফেলবে না। গবেষক গবেষণা চলাকালীন প্রতিটি ধাপে গোপনীয়তা বজায় রাখবেন। আপনার তথ্য আপনার অনুমতি ছাড়া ব্যবহার করা হবে না। এই গবেষণায় আপনার অংশগ্রহণ ইচ্ছা অনুযায়ী এবং এই অধ্যয়নের যে কোন সময়ে নিজেকে প্রত্যাহার করতে পারবেন।

আপনি একজন অংশগহণকারী হিসেবে অধ্যয়ন সম্পর্কে কোনো প্রশ্ন থাকে তাহলে আপনি আমাকে অথবা আসমা ইসলাম, ফিজিওথেরাপি বিভাগের সহকারী অধ্যাপক, বি এইচ পি আই, সিআরপি, সাভার, ঢাকা, ম্যামের সঙ্গে যোগাযোগ করতে পারেন।

আমি আপনার আনুমতি নিয়ে এই সাক্ষাৎকার শুরু করতে যাচ্ছি?

☐ হ্যাঁ ☐ না

অংশগ্রহণকারীর স্বাক্ষর ____________________ তারিখ ______________

সাক্ষাৎকারীর স্বাক্ষর ____________________ তারিখ ______________

Verbal Consent Statement

(Please read out to the participants.)

Assalamualaikum, my name is Mahmuda Akter Akhi; I am conducting this study as a part of my academic work for a B. Sc. in Physiotherapy under Bangladesh Health Professions Institute (BHPI), which is affiliated with the University of Dhaka. My study title is **"Executive dysfunction and its association with balance function in stroke patients attendant at CRP"**. I would like to know about some personal and other related information. You will need to answer some questions mentioned in this form. It will take approximately 20-30 minutes.

I want to inform you that this is a purely academic study and will not be used for any other purpose. All information provided by you will be kept in a locker as confidential, and in the event of any report or publication, it will be ensured that the source of information remains anonymous, and all information will be destroyed after completion of the study.

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

If you have any queries about the study or your rights as a participant, you may contact me and/or my supervisor, Asma Islam, Associate Professor, Department of Physiotherapy, Bangladesh Health Professions Institute (BHPI), CRP, Savar, Dhaka.

Do you have any questions before I start? Yes / No

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

☐ Yes

☐ No

Signature of the Participant ___________________________ Date:

Signature of the Interviewer __________________________ Date:

প্রশ্নপত্র বাংলা

সনাক্তকরণ নম্বর:

উত্তরদাতার নাম:

ঠিকানা:

ফোন নম্বর:

সাক্ষাৎকারের তারিখ:

পর্ব–১: সামাজিক জনসংখ্যা সংক্রান্ত তথ্য

প্রশ্ন নং	প্রশ্ন	উত্তর
১	বয়স	বছর
২	লিঙ্গ	০=পুরুষ ১=মহিলা
৩	বৈবাহিক অবস্থা	০=বিবাহিত ১=অবিবাহিত ২=বিধবা/বিপত্নীক ৩=বিবাহ বিচ্ছিন্ন
৪	শিক্ষাগত অবস্থা	০=কোন প্রাতিষ্ঠানিক শিক্ষা নাই ১=প্রাথমিক শিক্ষা ২=মাধ্যমিক শিক্ষা ৩=উচ্চ মাধ্যমিক শিক্ষা ৪=স্নাতকডিগ্রী ৫=মাস্টার বা তার উপরে ৬=অনন্যা
৫	পেশা	০=গৃহিণী ১=কৃষক ২=দোকানদার ৩=ব্যবসা ৪=চাকরিজীবী ৫=দিনমজুরি ৬=ছাত্র ৭=বেকার ৮=অনন্যা

৬	মাসিক খরচ	
৭	স্ট্রোকের কারণে পেশার ক্ষতি	০=হ্যাঁ ১=না
৮	আর্থিক অবস্থা	০=নিম্ন শ্রেণী ১=নিম্ন মধ্যবিত্ত শ্রেণী ২=মধ্যবিত্ত শ্রেণী ৩=উচ্চ মধ্যবিত্ত শ্রেণী ৪=উচ্চ শ্রেণী
৯	বসবাসের এলাকা	০=গ্রাম ১=উপশহর ২=শহর
১০	শুশ্রুষাকারীর পরিচয়	০=আত্নীয় ১=অনাত্নীয়
১১	পরিবারে স্ট্রোকের ইতিহাস	০=হ্যাঁ ১=না
১২	আপনি কি ধূমপান করেন?	০=হ্যাঁ ১=না
১৩	ওজন	
১৪	রোগের হার	০=উচ্চ রক্ত চাপ ১=ডায়াবেটিস ২=হৃদরোগ ৩=ফুসফুসের রোগ ৪=অন্যান্য

পর্ব-২: স্ট্রোকএবং চিকিৎসা সম্পর্কিত তথ্য

১	ঘটনার তারিখ	
২	স্ট্রোকের ধরণ	০=ইসচেমিক ১=হেমোরেজিক
৩	স্ট্রোকের সময়কাল	
৪	স্ট্রোকের ধাপ	০=অ্যাকিউট ১=সাবঅ্যাকিউট ২=ক্রনিক

৫	আপনি কতবার স্ট্রোক করেছেন?	০=এক ১=দুই ২=অধিক
৬	আক্রান্ত পাশ	০=ডান ১=বাম
৭	স্ট্রোক এবং পুর্নবাসন শুরুর মধ্যকার সময় (দিন/মাস/বছর)	
৮	পুর্নবাসনের স্থায়িত্ব (দিন/সপ্তাহ/মাস/বছর)	
৯	কাদের মাধ্যমে পুর্নবাসনের জন্য রেফার্ড করা হয়	০=নিজে ১=চিকিৎসক ২=ফিজিওথেরাপিষ্ট ৩=অন্যান্য

পর্ব-৩: নির্বাহী কর্মহীনতা

নির্দেশনা: **ট্রেইল মেকিং টেস্টের** উভয় অংশে 25টি বৃত্ত রয়েছে যা কাগজের শীটে বিতরণ করা হয়েছে। অংশ A-তে, বৃত্তগুলিকে 1 - 25 নম্বর দেওয়া হয় এবং রোগীকে আরোহী ক্রমে সংখ্যাগুলিকে সংযুক্ত করার জন্য লাইন আঁকতে হবে। B অংশে, বৃত্ত গুলোতে উভয় সংখ্যা (1 - 13) এবং অক্ষর (A - L) অন্তর্ভুক্ত রয়েছে; পার্ট A এর মতো, রোগী একটি আরোহী প্যাটার্নে বৃত্তগুলিকে সংযুক্ত করার জন্য লাইন আঁকেন, কিন্তু সংখ্যা এবং অক্ষরগুলির মধ্যে (যেমন, 1-A-2-B-3-C, ইত্যাদি) পরিবর্তন করার মাধ্যমে বৃত্ত গুলো মিলাবে। রোগীকে কাগজ থেকে কলম বা পেন্সিল না তুলে যত তাড়াতাড়ি সম্ভব বৃত্তগুলিকে সংযুক্ত করতে নির্দেশ দেওয়া উচিত। রোগীকে সময় দিন যখন সে সংযোগ করে "লেজ"। রোগী যদি কোনো ভুল করে তাহলে তা অবিলম্বে নির্দেশ করুন এবং রোগীকে তা সংশোধন করার অনুমতি দিন। ত্রুটিগুলি শুধুমাত্র রোগীর স্কোরকে প্রভাবিত করে যে ত্রুটির সংশোধন টাস্কের সমাপ্তির সময় অন্তর্ভুক্ত করা হয়। পাঁচ মিনিট অতিবাহিত হওয়ার পর রোগীর উভয় অংশ সম্পূর্ণ না হলে পরীক্ষা চালিয়ে যাওয়া অপ্রয়োজনীয়।

ধাপ 1: রোগীকে ট্রেল মেকিং টেস্ট পার্ট A ওয়ার্কশীটের একটি অনুলিপি এবং একটি কলম বা পেন্সিল দিন।

ধাপ 2: নমুনা শীট (ট্রেল মেকিং পার্ট A) ব্যবহার করে রোগীর কাছে পরীক্ষাটি প্রদর্শন করুন।

ধাপ 3: রোগীকে সময় দিন যখন সে পরীক্ষায় নম্বর দ্বারা তৈরি "লেখা" অনুসরণ করে।

ধাপ 4: সময় রেকর্ড করুন।

ধাপ 5: ট্রেল মেকিং টেস্ট পার্ট B এর পদ্ধতিটি পুনরাবৃত্তি করুন।

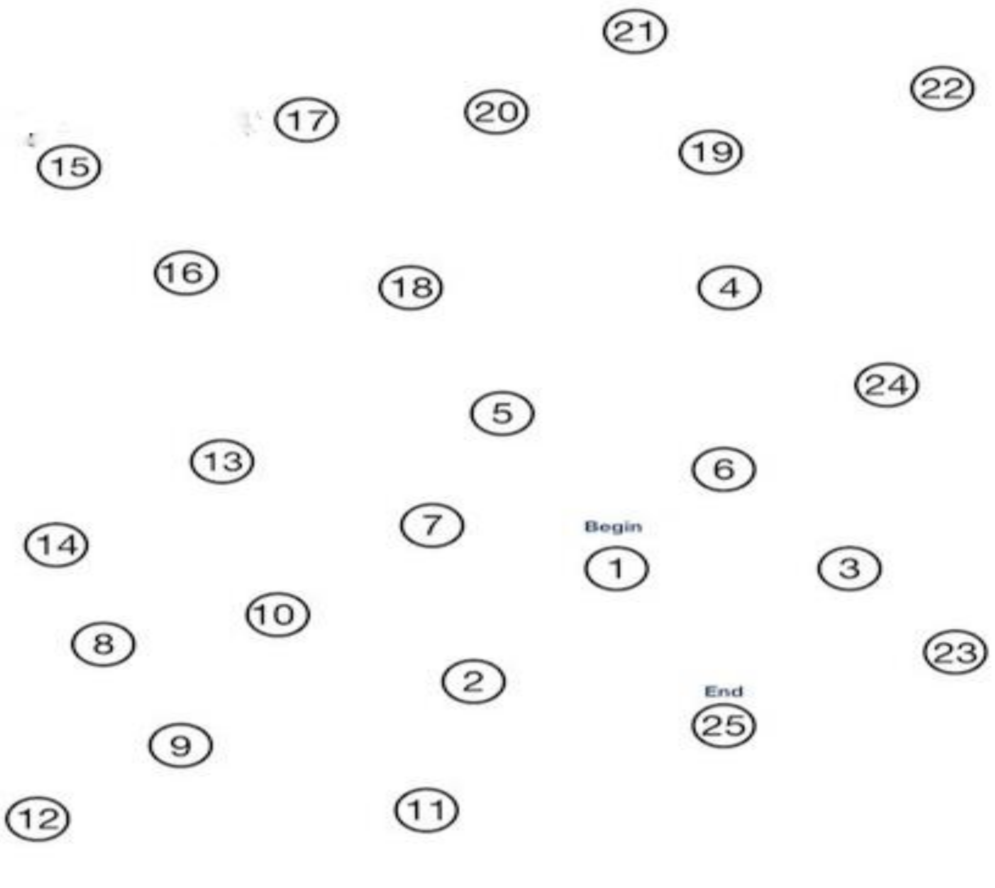
স্কোরিং:

ট্রেল মেকিং পার্ট A এবং B উভয়ের ফলাফলই কাজটি সম্পূর্ণ করার জন্য প্রয়োজনীয় সেকেন্ডের সংখ্যা হিসাবে রিপোর্ট করা হয়; অতএব, উচ্চ স্কোর বৃহত্তর বৈকল্য প্রকাশ

গড়	ঘাটতি	চলতি পদ্ধতি
ট্রেল মেকিং পার্ট A ২৯ সেকেন্ড	>৭৮ সেকেন্ড	90 সেকেন্ডের মধ্যে সবচেয়ে বেশি
ট্রেল মেকিং পার্ট B ৭৫ সেকেন্ড	>২৭৩ সেকেন্ড	সর্বাধিক 3 মিনিটে

ট্রেল মেকিং টেস্ট (টিএমটি) পার্ট A

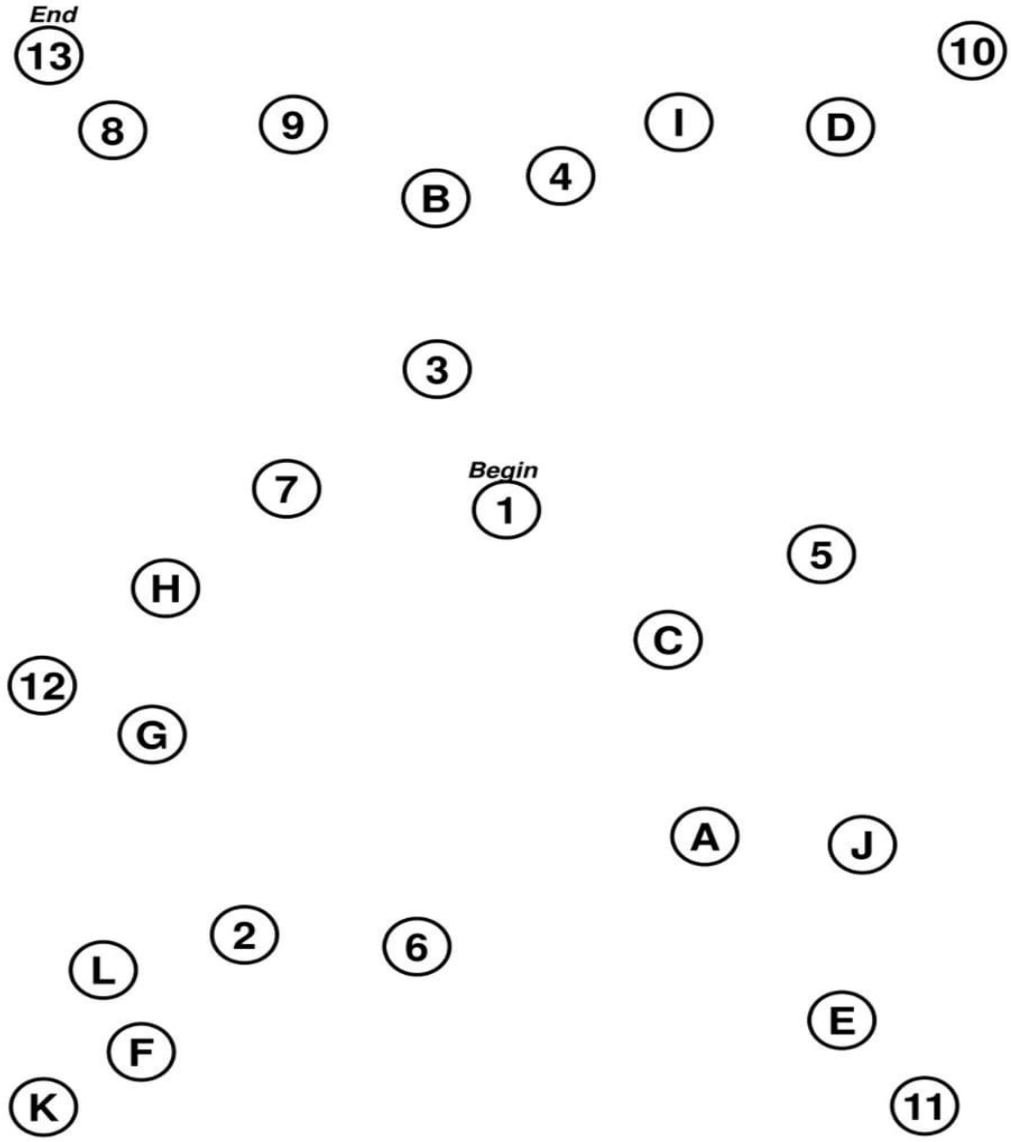
ব্যবহৃত হাত (একটি চেক): ☐ প্রভাবশালী ☐ অ-প্রধান



সময় (সেকেন্ড)	
ত্রুটির সংখ্যা	

ট্রেল মেকিং টেস্ট (টিএমটি) পার্ট B

ব্যবহৃত হাত (একটি চেক): ☐ প্রভাবশালী ☐ অ-প্রধান



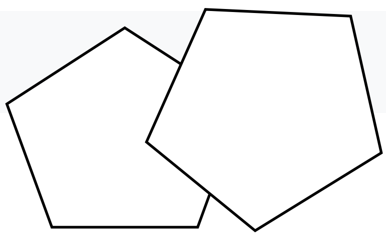
সময় (সেকেন্ড)	
ত্রুটির সংখ্যা	

কার্যনির্বাহী কর্মহীনতা: ☐ উপস্থিতি ☐ অনুপস্থিত

পর্ব-৪: জ্ঞানীয় দুর্বলতার মূল্যায়ন

মিনি-মেন্টাল স্টেট এক্সামিনেশন (MMSE) হল একটি টুল যা পদ্ধতিগতভাবে এবং পুঙ্খানুপুঙ্খভাবে মানসিক অবস্থা মূল্যায়ন করতে ব্যবহার করা যেতে পারে। এটি একটি 11-প্রশ্নের পরিমাপ যা জ্ঞানীয় ফাংশনের পাঁচটি ক্ষেত্র পরীক্ষা করে: অভিযোজন, নিবন্ধন, মনোযোগ এবং গণনা, প্রত্যাহার এবং ভাষা। সর্বাধিক স্কোর হল 30। 23 বা তার কম স্কোর হল জ্ঞানীয় দুর্বলতার নির্দেশক। এমএমএসই পরিচালনা করতে মাত্র 5-10 মিনিট সময় নেয় এবং তাই বারবার এবং নিয়মিত ব্যবহার করা হয়ে থাকে।

প্রশ্ন	সর্বাধিক নম্বর	প্রাপ্ত নম্বর
ওরিয়েন্টেশন (বছর) (ঋতু) (তারিখ) (দিন) (মাস) কি? কোথায় আমরা (রাষ্ট্র) (দেশ) (শহর) (হাসপাতাল) (তলা)?	৫ ৫	
নিবন্ধন 3টি বস্তুর নাম দিন: প্রতিটি বলতে 1 সেকেন্ড। তারপরে রোগীকে 3টি বলার পরে জিজ্ঞাসা করুন। প্রতিটি সঠিক উত্তরের জন্য 1 পয়েন্ট দিন। তারপরে সেগুলিকে পুনরাবৃত্তি করুন যতক্ষণ না সে সব শিখছে।	৩	
মনোযোগ এবং গণনা সিরিয়াল 7 এর। প্রতিটি সঠিক উত্তরের জন্য 1 পয়েন্ট। 5 উত্তর পরে থামুন। বিকল্পভাবে, "বিশ্ব" বানান পিছিয়ে।	৫	
স্মরণ করুন উপরে পুনরাবৃত্তি করা 3টি বস্তুর নাম জিজ্ঞাসা করুন। প্রতিটি সঠিক উত্তরের জন্য 1 পয়েন্ট দিন।	৩	

ভাষা (ঘড়ি দেখিয়ে) এটা কি? (কলম দেখিয়ে) এটা কি? আমি এখন যা বলব তা শুনুন এবং বলুন। শুনুনঃএক মাঘে শীত যায় না। বলুন। একটি 3-পর্যায়ের আদেশ অনুসরণ করুন: "আপনার হাতে একটি কাগজের টুকরো নিন, এটি অর্ধেক ভাঁজ করুন এবং মেঝেতে রাখুন।" নিম্নলিখিত পড়ুন এবং মেনে চলুন: আপনার চোখ বন্ধ করুন একটি বাক্য লিখুন (আশেপাশের বস্তু দেখে)।	২ ১ ৩ ১ ১	
দেখানো নকশা কপি করুন 	১	
মোট স্কোর	৩০	

ব্যাখ্যা: ২৪-৩০,কোন জ্ঞানীয় প্রতিবন্ধকতা নেই; ১৮-২৩,সামান্য জ্ঞানীয় প্রতিবন্ধকতা;

০-১৭,গুরুতর জ্ঞানীয় প্রতিবন্ধকতা।

পর্ব-৫: ভারসাম্য মূল্যায়ন

এই প্রশ্নাবলী স্ট্রোক রোগীদের স্ট্যাটিক এবং গতিশীল ভারসাম্য মূল্যায়নের জন্য ডিজাইন করা হয়েছে. **বার্গ ব্যালেন্স স্কেল (বিবিএস)** হল একজন ব্যক্তির স্ট্যাটিক `(বার্গ এট আল।, 1989) এর বহুল ব্যবহৃত ক্লিনিকাল পরীক্ষা।বিবিএস হল একটি 14-আইটেম স্কেল যা পরিমাণগতভাবে ভারসাম্য মূল্যায়ন করে। আইটেমগুলি 0 থেকে 4 পর্যন্ত স্কোর করা হয়, 0 এর স্কোর টাস্ক সম্পূর্ণ করতে অক্ষমতা এবং 4 স্কোর স্বাধীন আইটেম অর্জনের প্রতিনিধিত্ব করে। একটি বিশ্বব্যাপী স্কোর 56 সম্ভাব্য পয়েন্টের মধ্যে গণনা করা হয়। প্রশ্নাবলীর এই অংশটি ফিজিওথেরাপিস্ট একটি পেন্সিল ব্যবহার করে পূরণ করবেন।

নং	**পরীক্ষা**	**প্রাপ্ত নম্বর**
১।	**বসা থেকে দাঁড়ানো:** (দয়া করে উঠে দাঁড়ান।সাহায্যর জন্য আপনার হাত ব্যবহার না করার চেষ্টা করুন) (৪)হাত ব্যবহার না করে দাঁড়াতে এবং স্বাধীনভাবে স্থিতিশীল হতে সক্ষম (৩) হাত ব্যবহার করে স্বাধীনভাবে দাঁড়াতে সক্ষম (২) অনেক চেষ্টা করার পর হাত ব্যবহার করে দাঁড়াতে সক্ষম (১) দাঁড়ানো বা স্থিতিশীল করার জন্য ন্যূনতম সহায়তা প্রয়োজন (০) দাঁড়ানোর জন্য মাঝারি বা সর্বাধিক সহায়তা প্রয়োজন	
২	**সাহায্য ছাড়াদাঁড়ানো:** (অনুগ্রহ করে দুই মিনিট না ধরে দাঁড়ান) (৪) ২ মিনিটের জন্য নিরাপদে দাঁড়াতে সক্ষম (৩) তত্বাবধানে ২ মিনিট দাঁড়াতে সক্ষম	

	(২) সাহায্য ছাড়া ৩০ সেকেন্ড দাঁড়াতে সক্ষম (১) বেশ কয়েকটি চেষ্টার পর ৩০ সেকেন্ড দাঁড়াতে সক্ষম (০) ৩০ সেকেন্ডের জন্য দাঁড়াতে অক্ষম	
৩।	**পিঠের সাহায্য ছাড়া বসবে কিন্তু পা থাকবে মেঝে বা টুলের উপরে:** (অনুগ্রহ করে 2 মিনিটের জন্য বাহু ভাঁজ করে বসুন) (৪) ২ মিনিটের জন্য নিরাপদে বসতে সক্ষম (৩) তত্বাবধানে ২ মিনিট বসতে সক্ষম (২) ৩০ সেকেন্ড বসতে সক্ষম (১) ১০ সেকেন্ডের জন্য বসতে সক্ষম (০) ১০ সেকেন্ডের জন্য সমর্থন ছাড়া বসতে অক্ষম	
৪।	**দাঁড়ানো থেকে বসা:** (দয়া করে বসুন) (৪) হাতের ন্যূনতম ব্যবহারে নিরাপদে বসতে পারে (৩) হাত ব্যবহার করে পরে যাওয়া নিয়ন্ত্র করতে পারে (২) পায়ের পিছন দিক ব্যবহার করে নিচে পরে যাওয়া নিয়ন্ত্রণ করতে পারে। (১) স্বাধীনভাবে বসতে পারে কিন্তু পরে যাওয়া নিয়ন্ত্রিত করতে পারে না (০) বসতে সহায়তা প্রয়োজন।	
৫।	**স্থানান্তর:** (স্থানান্তরের জন্য একটি চেয়ারের ব্যবস্থা করুন। আপনি একটি বিছানা এবং একটি চেয়ার ব্যবহার করতে পারেন) (৪) হাতের সামান্য ব্যবহারে নিরাপদে স্থানান্তর করতে সক্ষম	

	(৩)হাতের যথাযথ ব্যবহার করে নিরাপদে স্থানান্তর করতে সক্ষম (২) মৌখিক ইঙ্গিত অথবা তত্ত্বাবধানে স্থানান্তর করতে সক্ষম (১) সহায়তা করার জন্য একজন ব্যক্তির প্রয়োজন (০) নিরাপদ থাকার জন্য দুজন লোকের সহায়তা বা তত্ত্বাবধানের প্রয়োজন	
৬।	**সাহায্য ছাড়া চোখ বন্ধ করে দাঁড়ানো:** (দয়া করে আপনার চোখ বন্ধ করুন এবং ১০ সেকেন্ডের জন্য স্থির থাকুন) (৪) নিরাপদে ১০ সেকেন্ডের জন্য দাঁড়াতে সক্ষম (৩) তত্ত্বাবধানে ১০ সেকেন্ডের জন্য দাঁড়াতে সক্ষম (২) ৩ সেকেন্ড দাঁড়াতে সক্ষম (১) ৩ সেকেন্ড চোখ বন্ধ রাখতে না পারলেও নিরাপদে দাড়াতে পারে (০) পতন থেকে রক্ষা পেতে সাহায্য প্রয়োজন	
৭।	**একসাথে পা দিয়ে সাহায্য ছাড়া দাঁড়িয়ে থাকা:** (আপনার পা একসাথে রাখুন এবং না ধরে রেখে দাঁড়ান) (৪) স্বাধীনভাবে পা একসাথে রাখতে এবং ১ মিনিট নিরাপদে দাঁড়াতে সক্ষম (৩) স্বাধীনভাবে পা একসাথে রাখতে এবং তত্ত্বাবধানে ১ মিনিট দাঁড়াতে সক্ষম (২) স্বাধীনভাবে পা একসাথে রাখতে সক্ষম কিন্তু ৩০ সেকেন্ড ধরে রাখতে অক্ষম (১) অবস্থান ঠিক রাখার জন্য সাহায্য প্রয়োজন কিন্তু ১৫ সেকেন্ড পা একসাথে করে দাঁড়াতে সক্ষম	

	(০) অবস্থান ঠিক রাখার জন্য সাহায্যের প্রয়োজন এবং 15 সেকেন্ড ধরে রাখতে অক্ষম	
৮।	**দাঁড়িয়ে থাকা অবস্থায় প্রসারিত বাহু সামনে নাওয়া:** (বাহু ৯০ ডিগ্রিতে তুলুন। আপনার আঙ্গুলগুলি প্রসারিত করুন এবং যতদূর পারেন সামনের দিকে পৌঁছান।) (৪) আত্মবিশ্বাসের সাথে ২৫ সেমি (১০ ইঞ্চি) এগিয়ে যেতে পারে (৩) ১২ সেমি (৫ ইঞ্চি) এগিয়ে যেতে পারে (২) ৫ সেমি (২ ইঞ্চি) সামনে পৌঁছতে পারে (১) সামনে পৌঁছায় কিন্তু তত্ত্বাবধানের প্রয়োজন (০) চেষ্টা করার সময় ভারসাম্য হারায়/বাহ্যিক সহায়তার প্রয়োজন	
৯।	**দাঁড়ানো অবস্থায় মেঝে থেকে বস্তু তুলে নিন:** (আপনার পায়ের সামনে রাখা জুতাটি তুলে নিন) (৪) নিরাপদে এবং সহজে জুতা তুলতে সক্ষম (৩) জুতা তুলতে সক্ষম কিন্তু তত্ত্বাবধানের প্রয়োজন (২) তুলতে অক্ষম কিন্তু স্লিপার থেকে ২-৫ সেমি পর্যন্ত পৌঁছায় এবং স্বাধীনভাবে ভারসাম্য বজায় রাখে (১) নিতে অক্ষম এবং চেষ্টা করার সময় তত্ত্বাবধানের প্রয়োজন (০)চেষ্টা করতে অক্ষম/ভারসাম্য হারানো বা পড়ে যাওয়া থেকে রক্ষা করার জন্য সাহায্যের প্রয়োজন	
১০।	**দাঁড়ানো অবস্থায় বাম এবং ডান কাঁধের পিছনে ঘুরে তাকান:** (বাম কাঁধের দিকে সরাসরি আপনার পিছনে তাকাতে ঘুরুন। ডানদিকে পুনরাবৃত্তি করুন।)	

	(৪) উভয় দিক থেকে পিছনে তাকাতে পারে এবং ওজন ভালভাবে বিনিময় হয় (৩) এক পাশ পিছনে তাকাতে পারে , অন্য দিকে কম ওজন বিনিময় হয় (২) শুধুমাত্র পাশে বাঁক হতে পারবে কিন্তু ভারসাম্য বজায় রাখতে হবে (১)ঘুরার সময় সাহায্য বা তত্বাবধান প্রয়োজন (০) ভারসাম্য হারানো বা পড়ে যাওয়া থেকে রক্ষা করার জন্য সহায়তা প্রয়োজন	
১১।	**৩৬০ ডিগ্রী ঘুরা:** (একটি পূর্ণ বৃত্তে সম্পূর্ণভাবে ঘুরুন। বিরতি দিন,তারপরে পূর্ণ বৃত্ততিতে অন্য দিকে ঘুরুন) (৪)৪ সেকেন্ড বা তার কম সময়ে নিরাপদে ৩৬০ ডিগ্রি ঘুরতে সক্ষম (৩)মাত্র ৪ সেকেন্ড বা তার কম সময়ে একপাশে নিরাপদে ৩৬০ ডিগ্রি ঘুরতে সক্ষম (২)নিরাপদে কিন্তু ধীরে ধীরে ৩৬০ ডিগ্রি ঘুরতে সক্ষম (১)ঘনিষ্ঠ তত্বাবধান বা মৌখিক সংকেত প্রয়োজন (০)ঘুরার সময় সহায়তা প্রয়োজন	
১২।	**সাহায্য ছাড়া দাঁড়িয়ে থাকার সময় স্টেপ বা টুলের উপর বিকল্প পা রাখুন:** (প্রতিটি পা পর্যায়ক্রমে স্টেপ/স্টুলের উপর রাখুন। প্রতিটি পা স্টেপ/স্টুলকে চারবার স্পর্শ না করা পর্যন্ত চালিয়ে যান) (৪) স্বাধীনভাবে এবং নিরাপদে দাঁড়াতে এবং ২০ সেকেন্ডে ৮টি ধাপ সম্পূর্ণ করতে সক্ষম (৩) স্বাধীনভাবে দাঁড়াতে এবং ২০ সেকেন্ডের বেশি সময়ে ৮টি ধাপ সম্পূর্ণ করতে সক্ষম	

	(২) তত্বাবধানে সাহায্য ছাড়াই ৪টি ধাপ সম্পূর্ণ করতে সক্ষম (১)ন্যূনতম সহায়তা নিয়ে 2টির কম পদকক্ষেপ দিতে সক্ষম (০)পড়ে যাওয়া থেকে রক্ষা করার জন্য সহায়তা প্রয়োজন / চেষ্টা করতে অক্ষম	
১৩।	**এক পা সামনে নিয়ে সাহায্য ব্যতীত দাঁড়িয়ে থাকা:** (এক পা সরাসরি সামনে এগিয়ে রাখুন। আপনি যদি মনে করেন যে আপনি আপনার পা সরাসরি সামনে রাখতে পারবেন না, তাহলে এতটা এগিয়ে যাওয়ার চেষ্টা করুন যে আপনার সামনের পায়ের গোড়ালি অন্য পায়ের আঙ্গুলের চেয়ে এগিয়ে আছে।) (৪) স্বাধীনভাবে এক পা সামনে এগিয়ে স্থাপন করতে এবং ৩০ সেকেন্ড ধরে রাখতে সক্ষম (৩) স্বাধীনভাবে পা এগিয়ে রাখতে এবং ৩০ সেকেন্ড ধরে রাখতে সক্ষম (২) স্বাধীনভাবে ছোট পদক্ষেপ নিতে এবং ৩০ সেকেন্ড ধরে রাখতে সক্ষম (১) পদক্ষেপ নিতে সাহায্যের প্রয়োজন কিন্তু ১৫ সেকেন্ড ধরে রাখতে পারে (০) পদক্ষেপ বা দাঁড়ানোর সময় ভারসাম্য হারায়	
১৪।	**এক পায়ে দাঁড়িয়ে থাকা:** (এক পায়ে যতক্ষণ না ধরে দাঁড়ানো যায়) (৪) স্বাধীনভাবে পা তুলতে এবং ১০ সেকেন্ড> ধরে রাখতে সক্ষম (৩) স্বাধীনভাবে পা তুলতে এবং ৫-১০ সেকেন্ড ধরে রাখতে সক্ষম	

	(২) স্বাধীনভাবে পা তুলতে এবং ≥ ৩ সেকেন্ড ধরে রাখতে সক্ষম (১)পা তুলে ৩ সেকেন্ড ধরে রাখতে অক্ষম কিন্তু স্বাধীনভাবে দাঁড়িয়ে থাকতে সক্ষম (০) চেষ্টা করতে অক্ষম বা পড়ে যাওয়া প্রতিরোধে সহায়তার প্রয়োজন।	
	মোট স্কোর	

ব্যাখ্যা: ০-২০,হুইলচেয়ার আবদ্ধ;২১-৪০, সাহায্য নিয়ে হাঁটা; ৪১-৫৬, স্বাধীন।

টাইম আপ এবং গো পরীক্ষা

সাধারণ নির্দেশ:

উদ্দেশ্য - গতিশীলতা মূল্যায়ন করা।

সরঞ্জাম- স্টপওয়াচ

দিকনির্দেশ- রোগী তাদের নিয়মিত জুতা পরবেন এবং প্রয়োজন হলে হাঁটার সরঞ্জামের সাহায্য নিতে পারেন।রোগীকে একটি যথাযথ স্থানে বসিয়ে ১০ ফিট দূর পর্যন্ত মেঝেতে লাইন সনাক্ত করার মাধ্যমে শুরু করুন।

একজন প্রাপ্তবয়স্ক যিনি এটি সম্পূর্ণ করতে >/১২ সেকেন্ড সময় নেন তাদের পড়ে যাওয়ার ঝুঁকি থাকে।

1. রোগীকে নির্দেশ দিন

যখন আমি বলি "যাও", আমি আপনার থাকে চাইবো যে:

• চেয়ার থেকে উঠে দাঁড়ান।

• আপনার স্বাভাবিক গতিতে মেঝেতে লাইনে হাঁটুন।

• ঘুরে জাবেন।

• ঘুরে আবার আপনার স্বাভাবিক গতিতে চেয়ারে ফিরে যান।

• আবার বসুন।

2. "যাও" শব্দে সময় শুরু করুন।

3. রোগী ফিরে বসার পরে সময় বন্ধ করুন।

4. সময় রেকর্ড করুন।

নং	**সময় (সেকেন্ড)**
১।	
মোট সময়	

Questionnaire (English)

Patient's ID: **Date of interview:**

Patient's name: **Patient's Mobile No:**

Patient's address:

Part 1: Socio-Demographic Information

(Tick which is appropriate)

No	Question	Response
1.	Age (in years)	…..
2.	Gender	0. Male 1. Female
3.	Marital status	0. Married 1. Unmarried 2. Widow 3. Divorced
4.	Education level	0.No formal education 1. Primary 2. Secondary 3. Higher Secondary 4. Graduate 5. Postgraduate 6. Others
5.	Occupation	0. Housewife 1. Farmer 2. Shopkeeper 3. Business 4. Service holder 5. Day labor 6. Student 7. Unemployed 8. Other
6.	Monthly cost	

7.	Loss of occupation due to stroke?	0=Yes 1=No
8.	Financial status	0. Lower class 1. Lower middle class 2. Middle class 3. Upper middle class 4. Upper class
9.	Living area	0=Rural 1=Semi Urban 2=Urban
10.	Identify caregiver	0. Relative 1. Non-relative
11.	Family history of stroke	0. Yes 1. No
12.	Do you smoke?	0. Yes 1. No
13.	Weight	
14.	Comorbidity	0. Hypertension 1. Diabetes mellitus 2. Heart disease 3. Lung disease 4. Other

Part 2: Stroke and treatment-related information

No	Question	Response
1.	Date of incidence	
2.	Type of stroke?	0. Ischemic 1. Hemorrhagic
3.	Duration of stroke	
4.	Stage of stroke	0. Acute 1. Subacute

		2. Chronic
5.	Number of strokes	0. One 1. Two 2. More
6.	Affected side	0. Right 1. Left
7.	Time between stroke and starting of rehabilitation (days/months/years)	
8.	Time of rehabilitation/ Duration of Rehabilitation (Day/Week/months /year	
9.	Referred for Rehabilitation by whom	0. Self 1. Physician 2. Physiotherapist 3. Other

Part 3: Executive Dysfunction

Instructions: Both parts of the **Trail Making Test** consist of 25 circles distributed over a sheet of paper. In Part A, the circles are numbered 1 – 25, and the patient should draw lines to connect the numbers in ascending order. In Part B, the circles include both numbers (1 – 13) and letters (A – L); as in Part A, the patient draws lines to connect the circles in an ascending pattern, but with the added task of alternating between the numbers and letters (i.e., 1-A-2-B-3-C, etc.). The patient should be instructed to connect the circles as quickly as possible, without lifting the pen or pencil from the paper. Time the patient as he or she connects the "trail." If the patient makes an error, point it out immediately and allow the patient to correct it. Errors affect the patient's score only in that the correction of errors is included in the completion time for the task. It is unnecessary to continue the test if the patient has not completed both parts after five minutes have elapsed.

Step 1: Give the patient a copy of the Trail Making Test Part A worksheet and a pen or pencil.

Step 2: Demonstrate the test to the patient using the sample sheet (Trail Making Part A –SAMPLE).

Step 3: Time the patient as he or she follows the “trail” made by the numbers on the test.

Step 4: Record the time.

Step 5: Repeat the procedure for Trail Making Test Part B.

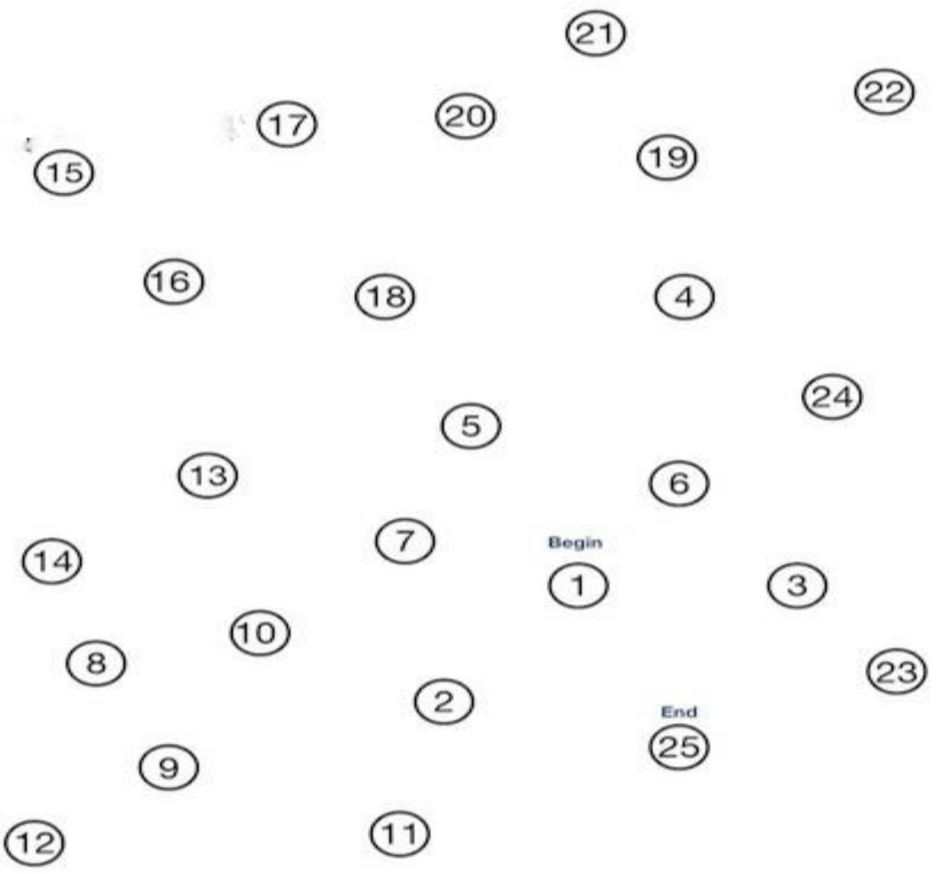
Scoring:

Results for both TMT A and B are reported as the number of seconds required to complete the task; therefore, higher scores reveal greater impairment.

Average	Deficient	Rule of Thumb
Trail A 29 seconds	> 78 seconds	Most in 90 seconds
Trail B 75 seconds	> 273 seconds	Most in 3 minutes

Trail Making Test (TMT) Part A

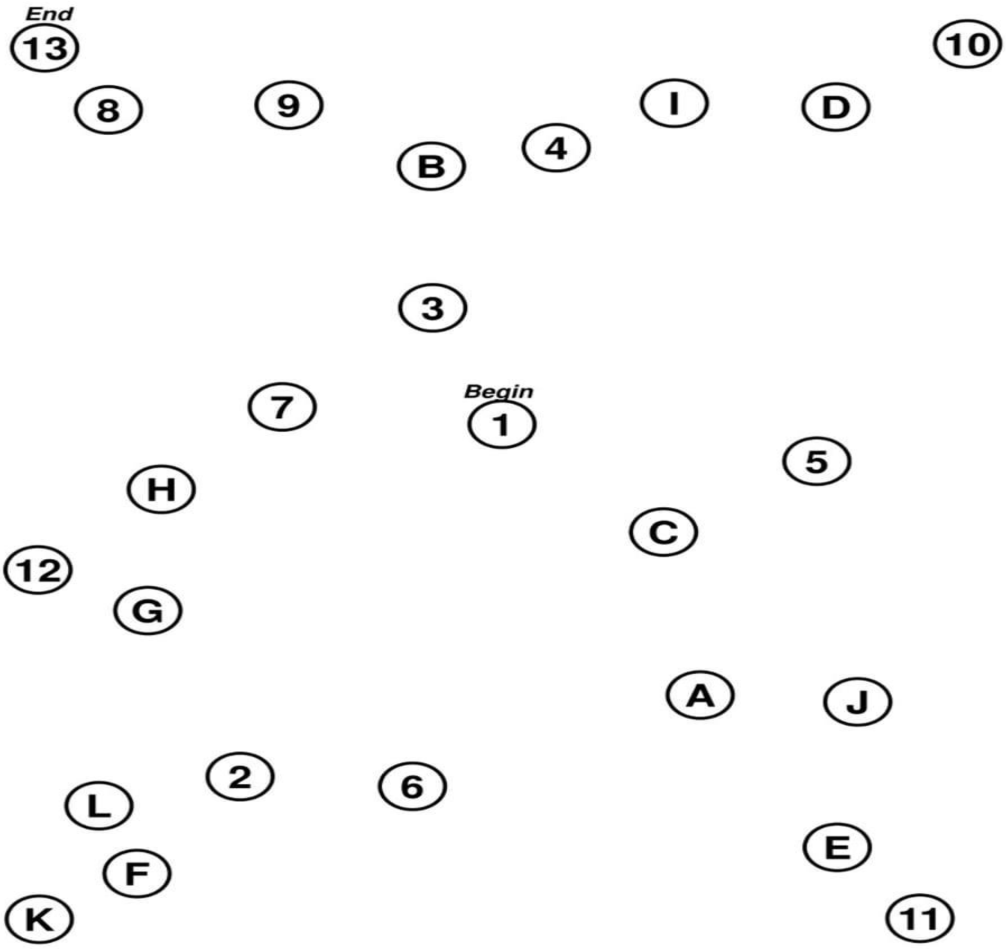
Hand used (check one): ☐ Dominant ☐ Non-Dominant



Time (sec)	
Number of errors	

Trail Making Test (TMT) Part B

Hand used (check one): ☐ Dominant ☐ Non-Dominant

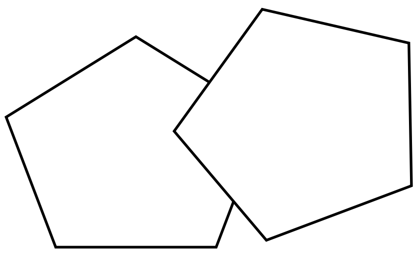


Time (sec)	
Number of errors	

Executive dysfunction: ☐ Present ☐ Absent

Part 4: Assessment of cognitive impairment

The **Mini-Mental State Examination (MMSE)** is a tool that can be used to systematically and thoroughly assess mental status. It is an 11-question measure that tests five areas of cognitive function: orientation, registration, attention and calculation, recall, and language. The maximum score is 30. A score of 23 or lower is indicative of cognitive impairment. The MMSE takes only 5-10 minutes to administer and is therefore practical to use repeatedly and routinely.

Questions	Maximum score	Patient's score
Orientation What is the (year) (season) (date) (day) (month)? Where are we (state) (country) (town) (hospital) (floor)?	5 5	
Registration Name 3 objects: 1 second to say each. Then ask the patient all 3 after you have said them. Give 1 point for each correct answer. Then repeat them until he/she learns all 3. Count trials and record. Trials ____________	3	
Attention and Calculation Serial 7's. 1 point for each correct answer. Stop after 5 answers. Alternatively, spell "world" backward.	5	
Recall Ask for the 3 objects repeated above. Give 1 point for each correct answer.	3	
Language Name a pencil and a watch. Repeat the following "No ifs, ands, or buts" Follow a 3-stage command: "Take a piece of paper in your hand, fold it in half, and put it on the floor." Read and obey the following: CLOSE YOUR EYES Write a sentence.	2 1 3 1 1	
Copy the design shown. 	1	
Total score:	30	

Interpretation: 24-30, no cognitive impairment; 18-23, mild impairment; 0-17, severe impairment.

Part 5: Assessment of balance

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

No	Test	Score
1.	**SITTING TO STANDING:***(Please stand up. Try not to use your hand for support.)* (4) able to stand without using hands and stabilize independently (3) able to stand independently using hands (2) able to stand using hands after several tries (1) needs minimal aid to stand or stabilize (0) needs moderate or maximal assistance to stand	
2.	**STANDING UNSUPPORTED:** *(Please stand for two minutes without holding on)* (4) able to stand safely for 2 minutes (3) able to stand for 2 minutes with supervision (2) able to stand 30 seconds unsupported (1) needs several tries to stand 30 seconds unsupported (0) unable to stand for 30 seconds unsupported	
3.	**SITTING WITH BACK UNSUPPORTED BUT FEET SUPPORTED ON FLOOR OR A STOOL:***(Please sit with arms folded for 2 minutes)* (4) able to sit safely and securely for 2 minutes (3) able to sit for 2 minutes under supervision (2) able to sit 30 seconds (1) able to sit for 10 seconds (0) unable to sit without support for 10 seconds	
4.	**STANDING TO SITTING:** *(Please sit down)* (4) sits safely with minimal use of hands (3) controls descent by using hands (2) uses the back of the legs against the chair to control the descent (1) sits independently but has uncontrolled descent (0) needs assist to sit	
5.	**TRANSFERS:** *(Arrange a chair for pivot transfer. Ask the subject to transfer one way toward a seat with armrests and one way toward a seat without armrests. You may use a bed and a chair.)* (4) able to transfer safely with minor use of hands (3) able to transfer safely definite need of hands (2) able to transfer with verbal cueing and/or supervision	

	(1) needs one person to assist (0) needs two people to assist or supervise to be safe	
6.	**STANDING UNSUPPORTED WITH EYES CLOSED:** *(Please close your eyes and stand still for 10 seconds)* (4) able to stand for 10 seconds safely (3) able to stand for 10 seconds with supervision (2) able to stand 3 seconds (1) unable to keep eyes closed 3 seconds but stays safely (0) needs help to keep from falling	
7.	**STANDING UNSUPPORTED WITH FEET TOGETHER:** *(Place your feet together and stand without holding on.)* (4) able to place feet together independently and stand 1 minute safely (3) able to place feet together independently and stand 1 minute with supervision (2) able to place feet together independently but unable to hold for 30 seconds (1) needs help to attain position but able to stand 15 seconds feet together (0) needs help to attain position and is unable to hold for 15 seconds	
8.	**REACHING FORWARD WITH OUTSTRETCHED ARM WHILE STANDING:** *(Lift arm to 90 degrees. Stretch out your fingers and reach forward as far as you can. Ask the subject to use both arms when reaching to avoid rotation of the trunk.)* (4) can reach forward confidently 25 cm (10 inches) (3) can reach forward 12 cm (5 inches) (2) can reach forward 5 cm (2 inches) (1) reaches forward but needs supervision (0) loses balance while trying/requires external support	
9.	**PICK UP OBJECT FROM THE FLOOR FROM A STANDING POSITION:** *(Pick up the shoe/slipper, which is placed in front of your feet)* (4) able to pick up slippers safely and easily (3) able to pick up slippers but needs supervision (2) unable to pick up but reaches 2-5 cm from slipper and keeps balance independently (1) unable to pick up and needs supervision while trying (0) unable to try/need assistance to keep from losing balance or falling	
10.	**TURNING TO LOOK BEHIND OVER LEFT AND RIGHT SHOULDERS WHILE STANDING:** *(Turn to look directly behind you over toward the left shoulder. Repeat to the right. The Examiner may pick an object to look*	

	at directly behind the subject to encourage a better twist turn.) (4) looks behind from both sides, and the weight shifts well (3) looks behind one side, only the other side shows less weight shift (2) turns sideways only, but maintains balance (1) needs supervision when turning (0) needs assistance to keep from losing balance or falling	
11.	**TURN 360 DEGREES:** *(Turn completely around in a full circle. Pause. Then turn a full circle in the other direction)* (4) able to turn 360 degrees safely in 4 seconds or less (3) able to turn 360 degrees safely on one side in only 4 seconds or less (2) able to turn 360 degrees safely but slowly (1) needs close supervision or verbal cueing (0) needs assistance while turning	
12.	**PLACE ALTERNATE FOOT ON STEP OR STOOL WHILE STANDING UNSUPPORTED:** *(Place each foot alternately on the step/stool. Continue until each foot has touched the step/stool four times)* (4) able to stand independently and safely and complete 8 steps in 20 seconds (3) able to stand independently and complete 8 steps in > 20 seconds (2) able to complete 4 steps without aid with supervision (1) able to complete > 2 steps, need minimal assist (0) needs assistance to keep from falling / unable to try	
13.	**STANDING UNSUPPORTED ONE FOOT IN FRONT:** *(Place one foot directly in front of the other. If you feel that you cannot place your foot directly in front, try to step far enough ahead that the heel of your forward foot is ahead of the toes of the other foot. To score 3 points, the length of the step should exceed the length of the other foot and the width of the stance should approximate the subject's normal stride width)* (4) able to place foot tandem independently and hold for 30 seconds (3) able to place foot ahead independently and hold for 30 seconds (2) able to take small steps independently and hold 30 seconds (1) needs help to step, but can hold for 15 seconds (0) loses balance while stepping or standing	
14.	**STANDING ON ONE LEG:** *(Stand on one leg as long as you can without holding on)* (4) able to lift leg independently and hold > 10 seconds (3) able to lift leg independently and hold for 5-10 seconds (2) able to lift leg independently and hold ≥ 3 seconds	

	(1) tries to lift leg unable to hold 3 seconds, but remains standing independently (0) unable to try or needs assistance to prevent a fall	
	Total Berg Balance Score	

Interpretation: 0-20, wheelchair bound; 21-40, walking with assistance; 41-56, independent.

Time Up and Go test (TUG):

General instruction:

Purpose: To assess mobility.

Equipment- Stopwatch

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

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

1. Instruct the patient

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

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

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

3. Stop timing after the patient sits back down.

4. Record Time

No	**Time (second)**
1.	
Total time	