

**Deanship of Graduate Studies
Al-Quds University**



Predictors of Stroke Rehabilitation Outcome

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MPT Thesis

Jerusalem - Palestine

1446/2025

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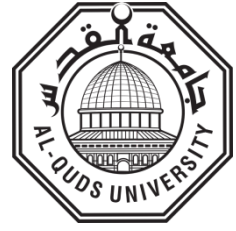
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**A thesis submitted in partial fulfillment of the
requirements for the degree of Master of
Physiotherapy - Deanship of Graduate Studies -Al-
Quds University**

1446/2025



Thesis Approval


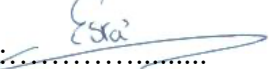

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Jerusalem- Palestine

1446/2025

Dedication

Firstly, I would like to thank Allah for granting me the strength, patience, and determination to reach this stage. I will always be grateful for every blessing You have bestowed upon me.

To my beloved homeland, Palestine.

To every inch of its land, to its steadfast people, and its unbreakable spirit.

To the martyrs of the West Bank, Gaza, Al-Quds, and the 1948 territories—your sacrifices will never be forgotten. May your enduring courage and resilience continue to inspire the pursuit of justice, dignity, and freedom.

To the steadfast prisoners in the occupation's prisons, your courage continues to inspire generations.

To the one who has stood by me with pride and unwavering support, my father, Ayed.

To the kindest soul whose prayers have always surrounded me with love, my beautiful mother, Nayfeh.

To my beloved siblings Shahd, Basel, Ahmed, and Hala, your love and support have been my greatest strength.

To my friends, thank you for standing by me, lifting me, and reminding me to keep going.

To Al-Quds University, for the opportunity to grow and pursue my academic journey.

To all the patients and their families who contributed to this research, your trust made this work possible.

To those who believed in me even when I doubted myself.

To every late night, quiet tear, and small victory that built this journey.

To the dreamer in me, you never gave up.

This thesis is for all the silent efforts that went unseen,
and the hope that never stopped whispering.


“Keep going — it will be worth it.”

Malak Ayed Wazwaz

Declaration

This thesis is submitted in partial fulfillment of the requirements for the Master's degree in Physiotherapy.

I hereby declare that the work presented in this thesis is original and has not been submitted, either in whole or in part, for the award of a higher degree at any other university or academic institution.

Signed: 

Name: Malak Ayed Wazwaz

Date: 27/06/2025

Acknowledgment

All praise and gratitude are due to Allah, whose grace and guidance gave me the strength to reach this point in my academic journey.

To my beloved father, mother, brothers, and sisters, thank you for your unwavering trust and for patiently waiting to celebrate this moment with me. Your love has been my anchor, and your belief in me has been my greatest motivation. From the depths of my heart, thank you for everything.

A heartfelt thank you to my exceptional supervisor, Dr. Akram Amro — your support, trust, and encouragement made this journey possible. Your guidance was a light during every difficult step, and I'm deeply grateful for your mentorship.

I extend my sincere appreciation to Al-Quds University, particularly the Physiotherapy Department, for providing a nurturing academic environment. Special thanks to the dedicated faculty members Dr. Akram Amro, Dr. Esraa Hamdan, Dr. Abed Al-Hammed Al-Zeer, and Dr. Hadeel Halawa. Your dedication, knowledge, and sincerity have left a lasting mark on my growth as a researcher and practitioner. I truly value your efforts.

Finally, a special thanks to all the participants and their families who took part in this study. Your cooperation and contribution were essential in bringing this research to life and helping me reach my goal of earning a Master's degree.

With deep appreciation and warm regards,

Thank you all

Malak Ayed Wazwaz

Abstract

Background:

Stroke is the second leading cause of mortality and mortality and Disability-Adjusted Life Year (DALY) loss globally, with over 30% struggling with instrumental ADLs. Rehabilitation improves functional outcomes and quality of life for stroke patients. Factors influencing recovery include clinical severity, comorbidities, demographic characteristics, socioeconomic status, and access to care. In Palestine, stroke rehabilitation faces structural limitations, with non-governmental organizations providing primary post-stroke therapy services.

Methods:

A prospective cohort study was conducted in Hebron, Palestine, involving 36 first-ever stroke patients recruited from hospitals, 32 participants completed both baseline and 3-month follow-up assessments. The mean age was 64.22 years, with equal gender distribution. Rehabilitation outcomes were assessed using standardized ICF-based tools: Fugl-Meyer Assessment and NIHSS (impairment level), ARAT and Barthel Index (Functional activity level), and Adapted Participation Questionnaire (participation level). Data on demographics, comorbidities, socioeconomic status, and rehabilitation service utilization across care settings were also collected.

Results:

A statistically significant improvement in impairment level was observed between baseline and three-month follow-up, as measured by the Fugl-Meyer Upper Extremity (FMUE) scores ($Z = -2.657$, $p = 0.008$). Key predictors of FMUE improvement included age, body mass index (BMI), stroke type and severity (NIHSS), presence of diabetes mellitus (DM), and the total amount of physical therapy received across home, hospital, and inpatient settings. Similarly, significant improvement was noted in the Fugl-Meyer Lower Extremity (FMLE) scores ($Z = -2.621$, $p = 0.009$), with improvement predicted by gender, smoking status, osteoarthritis (OA), coronary artery disease (CAD), and inpatient physical therapy.

At the functional activity level, the Barthel Index showed a significant increase ($Z = -4.787$, $p < 0.001$), with improvement predicted by the number of children, financial status,

stroke type, referral to rehabilitation, and receipt of physical, occupational, and psychological therapy in inpatient settings, as well as physical therapy at home. The Action Research Arm Test (ARAT) also demonstrated significant improvement ($Z = -3.521$, $p < 0.001$), with predictive factors including DM, HT, OA, financial status, stroke severity (NIHSS), employment status, physical therapy at home, and outpatient occupational therapy. Finally, at the participation level, no statistically significant improvement was observed, as measured by the Adapted Participation Questionnaire ($Z = -1.387$, $p = 0.07$).

Conclusion:

At three months post-stroke, rehabilitation was associated with statistically significant improvements in impairment and functional activity levels. However, no significant change was observed in the participation level.

Keywords:

Stroke, Predictors, The International Classification of Functioning, Disability and Health, Impairment level, functional activity level, participation level, use of care settings.

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Chapter one

Introduction

1.1 Introduction Statement

Stroke is the 2nd leading cause of mortality and the third greatest cause of DALY loss worldwide. Around twenty percent of those who have suffered strokes have difficulty with ADLs, and over 30% have trouble with instrumental ADLs. These numbers rise over time. Stroke is the third leading cause of death in Palestine, affecting 13% of 2018 deaths, and the main cause of adult disability.(WHO EMRO, n.d.-a) .

Enhancing the functional results and the quality of life of stroke patients requires rehabilitation. Research indicates that stroke survivors' functional recovery trajectories depend on the rehabilitation setting. After controlling for stroke severity and baseline functional status, a prospective longitudinal study found that inpatient rehabilitation facility (IRF) patients had better six-month functional outcomes than those in skilled nursing facilities (SNFs), outpatient therapy, or no rehabilitation(Chan et al., 2012).

Furthermore, a meta-analysis of rehabilitation interventions indicated that structured post-discharge transition programs led to significant increases in motor function, activities of daily living, walking speed, and carer load. (Saragih et al., 2024)

A quasi-experimental community-based rehabilitation program (CRAT) showed that structured community interventions significantly enhanced rehabilitation participation and enhanced motor function and daily activity performance, as measured by the Fugl-Meyer scale and Barthel Index, among various stroke populations (Ru et al., 2017). Functional recovery after stroke is influenced by various factors, including clinical severity, comorbidities, demographic attributes, socioeconomic status, and rehabilitation access. Stroke severity and baseline functional status are the strongest predictors of success, while comorbidities significantly affect rehabilitation outcomes. Socioeconomic determinants like education and income interact differently over time, with lower education leading to

decreased functional gains and lower income causing poorer motor recovery(Putman et al., 2007).

In the Palestinian context, however, stroke rehabilitation faces critical structural limitations. There are no designated stroke units; patients are typically admitted to general medical wards or ICUs based on clinical severity. Rehabilitation service access is often dictated by medical insurance eligibility, family financial capacity, and geographical availability, with more severe cases often receiving less structured follow-up care. Currently, non-governmental organizations remain the primary providers of post-stroke physical and occupational therapy services.(Rosenbloom & Leff, 2022)

1.2 Problem Statement

Stroke significantly impacts patients' functional, neurological, and participation outcomes. Worldwide predictors of improvement of different chronic diseases are well documented and studied with the intention of improving and accelerating healing and management of those diseases.

Yet limited research exists on stroke rehabilitation outcome predictors in Palestine. Differences in rehabilitation outcomes contributing factors between stroke patients remain unclear. Variations in rehabilitation service utilization and the influence of personal and socioeconomic factors on outcomes are also underexplored .

This study aims to compare rehabilitation outcomes between stroke patients, examine service usage, and identify predictors of recovery in Hebron to inform better rehabilitation strategies.

1.3 Study Questions:

1. What are the main personal and socioeconomic characteristics of stroke patients in Hebron, Palestine?
2. What are the main stroke rehabilitation services and settings in Hebron, Palestine?
3. What are the functional, neurological, and participation outcomes of stroke rehabilitation in Hebron, Palestine?
4. What are the main personal, socioeconomic, and rehabilitation predictors of stroke rehabilitation outcomes in Hebron, Palestine?

1.4 Study Objectives

1. Describe the key personal and socioeconomic characteristics of stroke patients receiving rehabilitation services in Hebron.
2. Identify the main types of stroke rehabilitation services and care settings utilized within the Hebron region.
3. Assess the functional, neurological, and participation-related outcomes among stroke patients following rehabilitation interventions.
4. Examine the personal, socioeconomic, and rehabilitation-related contributing factors that predict post-stroke rehabilitation outcomes in this population.

1.5 Study Hypothesis

1. Palestinian first-ever stroke patients show less improvement in functional, activity, and participation outcomes compared to stroke patients in developed countries.
2. There is a statistically significant difference in rehabilitation outcome upon different personal, socioeconomic, and stroke-related variables.
3. There is a positive relationship between frequency and intensity of rehabilitation and stroke rehabilitation outcomes.

1.6 Study Rationale

Based on clinical observations, there appears to be significant variation in the ultimate outcomes of stroke rehabilitation in Hebron, Palestine. It is essential to identify and address factors that hinder recovery potential, while simultaneously enhancing and prioritizing factors that contribute to improved outcomes throughout the different phases of rehabilitation.

1.7 Terminology

- ICF: International Classification of Functioning, Disability and Health
- PCBS: Palestinian Central Bureau of Statistics.
- DALY: Disability-Adjusted Life Year.
- FMA-UE: Fugl-Meyer Assessment for Upper Extremity.
- FMA-LE: Fugl-Meyer Assessment for Upper Extremity.
- NIHSS: National Institutes of Health Stroke Scale.
- ARAT: Action Research Arm Test.
- BI: Barthel Index.

- AAPQ: Adapted participation questionnaire.
- ADL: Activity of Daily Living.
- CBR: Community-based Rehabilitation.
- BL: Baseline.
- F.U.: Follow Up.
- PT: Physical Therapy.
- OT: Occupational Therapy.
- ST: Speech Therapy.
- Psych. Therapy: Psychological Therapy.
- BMI: Body Mass Index.
- DM: Diabetes mellitus.
- HT: Hyper Tension.
- CAD: Coronary Artery Disease.

Chapter Two

Review of literature

2.1 Background

2.1.1 Stroke Definition

Stroke, commonly known as a cerebrovascular accident (CVA), results from an abrupt disruption in cerebral blood flow, either due to vessel blockage (ischemic) or rupture (hemorrhagic), leading to neurological deficits (WHO., 2023). The American Stroke Association (ASA) classifies stroke into ischemic, hemorrhagic, and transient ischemic attack (TIA), with ischemic strokes being the most prevalent, accounting for nearly 85% of cases (Martin et al., 2024). Stroke continues to be a global health priority because of its high rates of disability and mortality. Prompt diagnosis and management are crucial, especially for ischemic stroke, where treatment options are time-sensitive.

2.1.2 Stroke Types

Strokes are generally categorized into three main types: ischemic stroke, hemorrhagic stroke, and transient ischemic attack (TIA). Ischemic stroke, the most common type, results from reduced blood flow to the brain due to a blocked artery, and it represents nearly 85% of all stroke cases worldwide (Benjamin, 2024). In contrast, hemorrhagic strokes are caused by the rupture of a blood vessel, leading to bleeding within or around the brain, and tend to be associated with more severe clinical outcomes (Feigin et al., 2021). TIAs, often referred to as "warning strokes" or "mini-strokes," involve temporary

disruptions in brain function without permanent damage but are important predictors of future ischemic events (Easton et al., 2009).

In the context of the Middle East and North Africa (MENA) region, ischemic strokes remain the predominant subtype, consistent with global trends. However, local variations in cardiovascular risk factors, such as high rates of hypertension and diabetes, may influence both the incidence and outcomes of different stroke types (Abuawad et al., 2025). Understanding these distinctions is crucial for guiding appropriate treatment decisions, such as thrombolytic therapy for ischemic stroke, and for shaping effective prevention and rehabilitation approaches based on stroke subtype.

2.1.3 Risk Factors for Stroke

Stroke is a multifactorial condition with both non-modifiable and modifiable risk factors contributing to its onset. Non-modifiable factors include age, sex, ethnicity, and genetic predisposition. The risk of stroke increases substantially with advancing age, particularly after the age of 55 (Feigin et al., 2021). Modifiable risk factors of significant relevance in public health and clinical contexts encompass hypertension, diabetes mellitus, dyslipidemia, atrial fibrillation, obesity, physical inactivity, smoking, and an unhealthy diet. Hypertension is consistently recognized as the most significant and prevalent risk factor for both ischemic and hemorrhagic strokes. Diabetes and obesity are significant factors, especially in the Middle East and North Africa (MENA), where the incidence of metabolic disorders is elevated. (Johnston et al., 2009).

In recent decades, growing attention has also been given to psychosocial stress, sleep disorders, and air pollution as emerging risk factors (Feigin et al., 2021). The INTERSTROKE study, a significant international research initiative, demonstrated that over 90% of the global burden of stroke is linked to modifiable behavioral and metabolic risk factors, emphasizing the essential requirement for initial prevention strategies. Comprehending these factors is crucial for both prevention and the development of rehabilitation after a stroke, and secondary prevention strategies that are customized to individual risk characteristics.

2.1.4 Tissue Plasminogen Activator (tPA) Administration in Stroke Patients

Tissue plasminogen activator (tPA) is a gold-standard thrombolytic treatment for acute ischemic stroke, administered to dissolve blood clots and restore cerebral perfusion. Its effectiveness is time-sensitive, with the highest benefit observed when administered within

a 4.5-hour window from symptom onset(Powers et al., 2019). When delivered promptly, tPA significantly improves functional outcomes and reduces long-term disability(Emberson et al., 2014; Hacke et al., 2008). Despite its proven efficacy, global data show that only a small proportion of eligible stroke patients receive tPA, often due to delayed hospital arrival, lack of stroke awareness, or insufficient emergency protocols(El Khoury et al., 2022) . In many low- and middle-income countries, including those in the MENA region, the utilization rate of tPA remains critically low, frequently under 10% due to limited stroke-ready facilities, lack of trained personnel, and prehospital delays. These challenges underscore the need for improved public education, emergency response systems, and stroke care infrastructure to expand tPA access and reduce preventable stroke-related disability and mortality.

2.1.5 Recovery after Stroke

Stroke recovery comprises both spontaneous recovery and learning-dependent processes(Cramer, 2008; Langhorne et al., 2011). Spontaneous recovery refers to the phenomenon by which most patients recover to some degree from their impairments within the first three months after a stroke (Cramer, 2008; Krakauer et al., 2012). Several cohort studies suggest that the improvement in body functions and activities observed in the first week post-stroke is predictable and that most non-severe patients will have recovered a fixed proportion of their maximal potential recovery from impairment by three months post-stroke (Buch et al., 2016; Prabhakaran et al., 2008; van der Vliet et al., 2020; Winters et al., 2015). The stability of the proportional recovery across studies and rehabilitation protocols has led to opinions that the extent of recovery does not depend on the rehabilitation treatment provided to patients and most probably reflects endogenous repair processes in the brain(Bruce H. Dobkin & Thomas S. Carmichael, 2005; Krakauer et al., 2012; Kwakkel et al., 2004). The implications of this statement are immense since it suggests that current rehabilitation therapies do not have an additional effect on recovery beyond that expected from spontaneous biological recovery. Nevertheless, all the reports regarding proportional recovery come from developed countries where at least minimal treatment is always provided. It is therefore unclear the extent to which proportional recovery depends on the baseline levels of rehabilitation therapies administered in the Western world during the subacute phase after stroke.

The recovery process reflects the extent to which body structure and functions as well as activities, have returned to their pre-stroke state (Bernhardt et al., 2017). The International Classification of Functioning, Disability, and Health (ICF) provide a conceptual framework for disability with different hierarchical levels: impairment, activity limitation, and participation restriction(*International Classification of Functioning, Disability and Health (ICF)*, n.d.-a). Improvement in any domain of the ICF can be viewed as a sign of ongoing recovery(Bernhardt et al., 2017; Levin et al., 2009). Nevertheless, assessments at the level of impairment should better distinguish between behavioral restitution (i.e., a return towards more normal patterns of motor control) and the use of compensation strategies (i.e., a patient's ability to accomplish a goal through substitution with a new approach rather than using his/her normal pre-stroke behavioral repertoire). This differentiation is of the utmost importance for understanding the mechanisms underlying motor recovery(Bernhardt et al., 2017). True motor recovery is best captured by clinical impairment scales and quantitative (e.g., kinematic and kinetic) measures of motor impairment(Krakauer et al., 2012; Kwakkel et al., 2004). Understanding the interaction between motor impairments and behavioral training is essential to interpreting neural repair processes during stroke recovery and directing interventions targeted to improve motor recovery.

2.1.6 Neuroplasticity and Stroke Recovery

Neuroplasticity, defined as the brain's ability to reorganize and establish new neural connections, is fundamental to the process of stroke recovery. After a cerebrovascular event, particularly in the early post-stroke phase, neuroplastic mechanisms are engaged to compensate for damaged regions and recover lost functions.(Langhorne & Ramachandra, 2020a). These processes underpin the efficacy of rehabilitation interventions such as task-specific training, constraint-induced movement therapy, and repetitive practice, which are designed to harness and reinforce adaptive neural reorganization (Boyd et al., 2017). Neuroplasticity is affected by various factors, such as age, lesion location, intensity of rehabilitation, and the timing of therapy beginning. Present developments in neurological imaging and brain stimulation that are not invasive have confirmed the dynamic nature of cortical changes and demonstrated potential for enhancing neuroplasticity in stroke survivors.(Yu et al., 2024). Understanding the principles of neuroplasticity is therefore critical for designing personalized rehabilitation protocols that maximize functional outcomes and promote long-term recovery.

2.1.7 Timing, intensity, and content of rehabilitation therapies

Preclinical studies in animals indicate that the timing of post-stroke therapy is crucial, suggesting a sensitive window of increased brain plasticity shortly after a stroke, during which significant recovery from impairment takes place. In this brief period, heightened responsiveness to training has been noted (Murata et al., 2008) (Nudo & Milliken, 1996); (Biernaskie & Corbett, 2001). Rats subjected to an enriched environment alongside daily reach training therapy exhibited notable improvements in reaching ability recovery when rehabilitation commenced 5-14 days post-stroke, but not at 30 days Biernaskie et al., 2004; Biernaskie & Corbett, 2001). In rodents, initiating upper extremity reaching training 5 days post-stroke resulted in qualitatively as well as quantitatively superior gains in reaching compared to therapy commenced later (i.e., 30 vs 14 days post-stroke) (Bernhardt et al., 2017)

The existence of a time-sensitive period for recovery is not clear in humans due to the lack of research on stroke patients who did not receive treatment during the subacute phase, regardless of their initial condition. The sensitivity window in humans is considered to commence within the initial 10 days following a stroke (Bernhardt et al., 2017) and extends to 3 and even 6 months post-stroke (Duncan et al., 1992; Kwakkel et al., 2003; Nakayama et al., 1994). To maximize the effectiveness of rehabilitation therapies after a stroke, it is critical to determine the time window during which the brain is most responsive (i.e., plastic) to post-injury sensorimotor experience and to focus rehabilitation efforts during this period. To the best of our knowledge, no study has directly compared the effects of starting training early following a stroke (i.e., 1-3 months) compared to a later time point (> 6 months).

Studies in non-human primates suggest that the possibility of recovery is enhanced by intervention practiced at a high dosage (i.e., time in rehabilitation and/or the number of repetitions) and a high intensity (i.e., dose per session) and that focuses on movement quality, especially when the intervention is initiated within days or weeks after injury (DARLING et al., 2011; Krakauer et al., 2012). Experiments with monkeys showed that after intensive behavioral training that included 600 pellet retrievals a day for 3–4 weeks, the animals regained full recovery of hand function (Nudo & Milliken, 1996). In a different study – one in a monkey with focal cortical ischemia – near-normal reaching performance was attained following training that emphasized accurate reaching (Herbert et al., 2015).

In clinical practice, stroke patients are given far less practice time during rehabilitation than animal models. A typical outpatient treatment session lasts about 36 minutes, during which patients engage in a mean of only 32 arm movements per session (Lang et al., 2009). In addition, standard rehabilitation training often focuses on task accomplishment more than movement quality (Dobkin, 2005). There is a notable deficiency of human studies examining whether intense training shortly after a stroke can enhance spontaneous biological recovery, similar to findings in animal models.

2.1.8 Stroke rehabilitation in low and middle-income countries

For LMICs, meeting the inpatient and outpatient rehabilitation needs of stroke survivors with insufficient staff and facility resources is very challenging (Kwakkel & van Wegen, 2017). Although task shifting to family caregivers may appear to be an attractive solution for healthcare sustainability, results from the Family-led Rehabilitation after Stroke in India (ATTEND) trial do not support investment in new stroke rehabilitation services that promote such strategies (Lindley et al., 2017). The ATTEND trial was a large-scale randomized controlled trial (n = 1,250) that examined the impact of family-delivered, home-based rehabilitation interventions for stroke patients in a low- and middle-income country. The training program commenced in the hospital and was extended at home for a duration of up to two months. The findings indicated that incorporating family-led rehabilitation training into standard stroke unit care did not reduce mortality or dependency at six months post-stroke. The training did not affect any other physical, emotional, or quality of life outcomes. The results indicate that the ATTEND trial is neutral, showing no positive trends favoring family-delivered rehab services at home compared to no therapy or a minimal number of outpatient sessions. (Kwakkel & van Wegen, 2017). The findings align with a Cochrane review comprising six studies, which indicated no advantages of caregiver-mediated exercises in enhancing outcomes post-stroke. (Vloothuis et al., 2016). (Kayola et al., 2023). & (Gandhi et al., 2025) identified the main barriers in the Low and middle-income countries to access rehabilitation services, including financial reasons, health literacy, scarcity of number of rehabilitation specialists, and other reasons, that have contributed to the poor outcome of stroke rehabilitation, and other perspectives like poor economic status, or stroke mortality, and further burden on caregivers

2.1.9 Utilization of Rehabilitation Services and Care Settings

Patients experiencing a first stroke and those experiencing a second stroke use rehabilitation services in very different ways. Recuperation after a stroke is greatly aided

by acute care facilities, inpatient rehabilitation centers, and outpatient treatment programs. Recurrent stroke patients frequently lack access to specialized care owing to greater disability levels and financial limitations, in contrast to first-ever stroke patients, who are more likely to undergo extensive rehabilitation owing to a better functional prognosis. In low-resource contexts like Palestine, where rehabilitation services are few, socioeconomic and geographical factors amplify the impact of treatment utilization disparities.(Li et al., 2024).

2.1.10 Barriers to Rehabilitation Access and Utilization

Despite the well-established benefits of early and intensive rehabilitation following stroke, many patients face significant barriers to accessing these essential services. These barriers can be structural, socioeconomic, cultural, or health-system related. Geographic disparities, especially in low- and middle-income countries, often limit the availability of specialized rehabilitation centers, particularly in rural areas(Kamenov et al., 2019). Financial constraints, lack of insurance coverage, and transportation difficulties further hinder access, disproportionately affecting individuals from lower socioeconomic backgrounds (Okekunle et al., 2022). Cultural beliefs, sex stereotypes, and insufficient awareness regarding the importance of rehabilitation may contribute to its underutilization, particularly among elderly people and women. (Salhab et al., 2018). Research in the Middle East and North Africa (MENA) region indicates that fragmented care pathways and insufficient post-discharge planning are prevalent, resulting in inconsistent delivery of rehabilitation services. Furthermore, the lack of trained rehabilitation professionals, including occupational therapists and speech-language pathologists, presents a significant challenge in numerous Arab countries (Health Organisation, n.d.). It is essential to address these barriers to achieve equitable stroke recovery outcomes and maximize long-term functional improvements.

2.1.11 Role of Multidisciplinary Rehabilitation Teams

Multidisciplinary rehabilitation teams are essential in enhancing recovery outcomes post-stroke by addressing the complex and varied needs of patients. These teams typically include physiatrists, physical therapists, occupational therapists, speech-language pathologists, psychologists, nurses, and social workers, who work collaboratively to deliver individualized, holistic care. Recent evidence highlights that such coordinated rehabilitation significantly improves functional independence, reduces disability, and enhances quality of life for stroke survivors.(Chiu et al., 2021) The World Health

Organization (WHO,2023) emphasizes that early and continuous input from multiple specialists fosters better alignment between clinical goals and patient-centered outcomes. Furthermore, systematic reviews confirm that organized multidisciplinary stroke units are linked to lower mortality and reduced institutionalization compared with general medical care (Adeniji et al., 2023a; Langhorne & Ramachandra, 2020b). This collaborative model facilitates shared decision-making, ensures continuity across acute and post-acute phases, and is now considered a cornerstone of contemporary stroke care worldwide.

2.2 Similar studies:

A number of regionally relevant studies align with and support the findings of our investigation into predictors of rehabilitation outcomes among first-ever stroke patients. For instance, in Saudi Arabia, Abdul-Sattar & Godab (2013) evaluated 180 stroke patients undergoing inpatient rehabilitation and identified admission functional status (FIM score), stroke severity, cognitive impairment, and depression as independent predictors of functional gains, while age was not significant in multivariable analysis. Similarly,(Fouad et al., 2017) in Egypt reported that high NIHSS scores and comorbid cardiac disease predicted poorer 3-month outcomes on the modified Rankin Scale, although age lost significance in regression analysis.

Moreover, a prospective Italian multicenter cohort of older first-stroke patients (mean age ≥ 75 years) found that baseline FIM score and cognitive status were more powerful predictors of rehabilitation efficacy and home discharge than chronological age itself(Mutai et al., 2012). Across these contexts, key predictors consistently include baseline functional independence, stroke severity (NIHSS/FIM), cognitive status, and cardiovascular comorbidities—mirroring our results. These studies offer robust comparative frameworks and reinforce the external validity of our predictive models of upper-limb, lower-limb, and overall functional improvements post-stroke.

A study by Langhorne et al. (2011) examined the predictors of motor recovery in stroke patients undergoing rehabilitation. The study analyzed a cohort of 456 stroke patients and found that early rehabilitation was a key determinant of motor recovery, with those who began therapy within 48 hours of their stroke showing greater improvements in motor function. The study emphasized the role of neuroplasticity, noting that early intervention enhanced the brain's ability to reorganize and form new connections, thereby improving recovery potential. These findings highlight the critical window for intervention in stroke

rehabilitation and suggest that timely therapeutic engagement can significantly enhance functional outcomes.

The EPICA Study (Predictors of Neurological and Functional Recovery in Patients with Moderate to Severe Ischemic Stroke) by Lee et al. (2019) aimed to identify the key predictors of neurological and functional recovery in patients with moderate to severe ischemic stroke. This multicenter study included 1,212 ischemic stroke patients, with a focus on understanding factors that could predict the recovery of motor function and overall neurological outcomes.

A study by Dohle et al. (2018) conducted a systematic review and meta-analysis to investigate the predictors of upper limb recovery following stroke, analyzing data from over 50 studies with more than 5,000 stroke patients. The results revealed that the initial level of motor function was the strongest predictor of recovery. Patients who demonstrated even minimal voluntary movement of the affected upper limb within the first 72 hours had significantly better recovery outcomes. In contrast, patients with severe initial impairments showed limited improvements over time. The study highlights the importance of early detection of motor function and the initiation of rehabilitation to enhance upper limb recovery.

A study by Lee et al. (2022) in South Korea confirmed that first-ever stroke patients had better rehabilitation outcomes in terms of motor recovery and independence. Similarly, a comparative study in Turkey by Yildiz et al. (2021) showed that recurrent stroke patients had significantly longer rehabilitation stays but lower gains in mobility and participation.

A multicenter cohort study of 359 first-stroke patients aged ≥ 75 years found that admission functional status, measured by the Functional Independence Measure (FIM), was the strongest predictor of functional recovery and discharge home. Age contributed minimally beyond that, and comorbidities and cognitive status modestly influenced outcomes. FIM at admission explained most of the variance in rehabilitation efficacy. (Appelros et al., 2003; Suttiwong et al., 2018).

Simić-Panić et al., 2018a Conducted a prospective cohort study that linked a higher comorbidity burden (i.e., conditions like atrial fibrillation and prior myocardial infarction) to lower functional gains (i.e., as measured by the Barthel Index and Functional Independence Measure) in stroke patients.

A systematic review conducted by Ezekiel et al. (2019) and their colleagues of participation outcomes in community-dwelling stroke survivors identified mobility, cognitive function, and depression as the strongest correlates of participation. Exercise capacity and environmental barriers were less studied but emerged as important areas for intervention.

Chapter Three

Methods and Materials

3.1 Introduction

This chapter aims to present the sampling method, sample size, inclusion and exclusion criteria, besides the methodology of the research represented in the design, tools of data collection procedure, intervention, and statistical analysis, in addition to the ethical considerations of this research.

3.2 Research setting

This study was conducted in Hebron, at private clinics, and patients' homes. 3 hospitals in Hebron (namely Alia Governmental Hospital, Meezan Hospital, and Al-Ahli Hospital).

3.3 Sampling and Population

3.3.1 Sampling method

The convenience sampling method was used in this study. Convenience sampling is a non-probability sampling technique where participants are selected based on their availability and willingness to participate in the study. This method involves choosing individuals who are easy to access rather than randomly selecting from the entire population. Convenience sampling is not as statistically rigorous as probability sampling.

This sampling method helps to recruit the requested sample size in the shortest period.(Etikan et al., 2015)

3.3.2 Sample size

In this study, the sample size consisted of 36 stroke patients. This number was selected to meet the minimum requirements for conducting valid statistical analyses in observational cohort research. Previous methodological guidelines suggest that cohort studies generally require at least 30 participants per group to allow for meaningful estimates and maintain statistical validity, particularly in exploratory or feasibility designs (Hertzog, 2008; Julious, 2005). Accordingly, the inclusion of 36 participants in this study can be considered sufficient for the intended analyses.

3.3.3 Inclusion criteria

Participants were included in the study if they met all the criteria below:

1. Age 40-80 years.
2. Stroke, ischemic or hemorrhagic, that is radiologically verified.
3. First-ever stroke.
4. ≤ 7 days after stroke onset.
5. Willing to attend all study evaluations.

3.3.4 Exclusion criteria

1. Patients suffering from other neurological diseases
2. Recurrent, TIA.
3. Unwilling to sign a consent form first-degree caregiver
4. Expected inability to participate in the study due to illness, social, or geographic reasons.

Subjects will be excluded if they have any of these criteria.

3.4 Methodology

3.4.1 Study design

A prospective comparative cohort study was adopted because it allows for the investigation of patients' status over time, recording both independent and dependent variables. (Caruana et al., 2015; Stevens et al., 2015) This study is a type of observational research design where two or more groups of individuals (cohorts) are followed over time to observe differences in outcomes based on specific variables.

3.4.2 Study tools

3.4.2.1 Data collection sheet (Appendix 1)

Data collection sheet that included the following:

- Personal data: (Age, Gender, Socioeconomic status, marital status, financial status, employment, number of children)
- Smoking history
- BMI
- Previous comorbidities.
- Use of care (settings, services, intensity, frequency, personal and family involvement in therapeutic activities)

3.4.3 Outcome measures

outcomes were classified according to ICF as participation, impairment, and Functional activity levels outcomes.

3.4.3.1 Participation Outcome Measure

Including the Adapted Palestinian Participation Questionnaire (APPQ)

3.4.3.1.1 Adapted Palestinian Participation Questionnaire (Appendix 2)

The Adapted Participation Questionnaire (AAPQ) is a culturally sensitive tool developed to assess participation among elderly individuals in Arab communities, aligning with the International Classification of Functioning, Disability, and Health (ICF) framework. It consists of 10 items that measure participation across social, familial, religious, and leisure domains—before and after age 60 or a significant health event. Each item is rated on a 3-point scale (0 = no participation, 5 = occasional, 10 = frequent), yielding a total score out of 100. The AAPQ demonstrated strong psychometric properties: test–retest reliability was excellent ($r = 0.971$, $p < .001$), interrater reliability was also high ($r = 0.916$, $p < .001$), and internal consistency was acceptable (Cronbach’s $\alpha = 0.742$). Face and content validity were established through expert panel reviews and culturally grounded focus groups in Palestine. Its simplicity, cultural alignment, and adaptability make it a valid and reliable instrument for measuring participation outcomes in both clinical and community rehabilitation settings across Arab populations.

3.4.3.2 Impairment Outcome Measures

Including the NIHSS questionnaire and the Fugl-Meyer assessment for the upper and lower extremities

3.4.3.2.1 NIHSS (National Institutes of Health Stroke Scale) (Appendix 3)

The NIHSS is a validated and reliable tool for evaluating the severity of neurological impairments in stroke patients. It provides a comprehensive assessment of neurological function, with high sensitivity (85% to 90%) for detecting stroke severity and early neurological changes. It also shows high specificity (>80%) in distinguishing stroke patients from those with other conditions. (Ramachandran et al., 2022)

It consists of 11 items that evaluate various aspects of neurological function:

1. Level of Consciousness (0–3 points)
2. Best Gaze (0–2 points)
3. Visual Fields (0–3 points)
4. Facial Palsy (0–3 points)
5. Motor Arm (0–4 points per arm)
6. Motor Leg (0–4 points per leg)
7. Limb Ataxia (0–2 points)
8. Sensory (0–2 points)
9. Best Language (0–3 points)
10. Dysarthria (0–2 points)
11. Extinction and Inattention (0–2 points)

The total NIHSS score ranges from 0 to 42, with a score of 42 indicating the most severe neurological impairment and a score of 0 signifying no impairment. (*International Classification of Functioning, Disability and Health (ICF)*, n.d.-b; Kasner et al., 1999)

Each item is rated on the severity of neurological impairment, with scores ranging from 0 (no deficit) to 3 or 4 (severe deficit). The total NIHSS score helps categorize stroke severity:

- 0: No neurological deficit
- 1–4: Minor stroke
- 5–15: Moderate stroke
- 16–20: Moderate-to-severe stroke
- 21–42: Severe stroke

3.4.3.2.2 Fugl-Meyer Assessment for Upper Extremity (FMA-UE) (Appendix 4)

It is a widely validated tool for assessing motor, sensory, and coordination functions in stroke patients. It has excellent validity for measuring recovery in patients with hemiparesis or hemiplegia and shows high inter-rater and test-retest reliability, ensuring consistent and stable results across different clinicians. The FMA also has a high sensitivity to detect small changes in motor function, making it ideal for tracking recovery, and high specificity, accurately distinguishing true functional improvements from other factors.(Gladstone, Danells, & Black, 2002a, 2002b)

It consists of several subtests that assess:

- Motor Function: Focuses on the movement of the upper limb, including the shoulder, elbow, wrist, and hand function.
- Sensory Function: Assesses the sensory abilities of the affected limb.
- Coordination: Tests the ability to perform coordinated movements with the upper extremity.

Each item within the FMA is scored on a 3-point scale (0 to 2), where:

- 0: No movement or function
- 1: Partial movement or function
- 2: Full movement or function

The scores from each subtest are summed to give a total score.

- 0–12 points: Severe impairment
- 13–30 points: Moderate impairment
- 31–60 points: Mild impairment
- 61–66 points: Minimal impairment or normal function.

3.4.3.2.3 Fugl-Meyer Assessment for Lower Extremity (FMA-LE) (Appendix 5)

It is a modified version of the original FMA, specifically designed to assess the motor function, sensory function, and coordination of the lower extremities in stroke patients. It is an essential tool for evaluating lower limb recovery. It demonstrates strong validity and reliability, with both inter-rater and test-retest consistency, with high sensitivity to detect small changes in lower extremity function, making it ideal for tracking recovery and strong specificity.(Gladstone, Danells, & Black, 2002c)

It consists of several subtests that assess:

- Motor Function: Includes tests of hip, knee, ankle, and foot movements, focusing on both voluntary movements and postural control.
- Sensory Function: Assesses sensory perception in the lower extremity, including light touch, pain, and proprioception.
- Coordination: Evaluates coordination of the lower limbs during functional movements

Each item is scored on a 3-point scale (0 to 2):

- 0: No movement or function
- 1: Partial movement or function
- 2: Full movement or function

The scores from each subtest are summed to give a total score.

- 0–10 points: Severe impairment
- 11–20 points: Moderate impairment
- 21–30 points: Mild impairment
- 31–34 points: Minimal impairment or normal function

3.4.3.3 Functional Activity Outcome Measures

Including the Action Arm Test and Barthel Index.

3.4.3.3.1 Action Research Arm Test (ARAT) (Appendix 6)

The Action Research Arm Test (ARAT) is a standardized observational assessment used to evaluate upper-limb motor function after a stroke. It is made up of 19 items organised into four subscales: grasp, grip, pinch, and general movement. Each item is rated on a 4-point ordinal scale from 0 (no movement) to 3 (normal performance), giving a total scoring range of 0 to 57, with higher scores indicating better upper limb function.(Lyle, 1981).There is no clear cut-off value for categorizing impairment severity, however change scores of ≥ 5.7 points are often regarded clinically relevant.(J. H. Van Der Lee et al., 2001) The ARAT has excellent reliability (inter-rater reliability ICC = 0.99) and validity in stroke populations, with strong correlations to other motor function assessments such as the Fugl-Meyer Evaluation and the Wolf Motor Function Test. Its ability to respond to change gradually makes it appropriate for use in both research and clinical settings to assess upper limb healing.(Yozbatiran et al., 2008)

3.4.3.3.2 Barthel Index (Appendix 7)

The Barthel Index is a widely used tool for assessing functional independence in activities of daily living (ADLs) among stroke patients. It consists of 10 items evaluating self-care and mobility activities such as feeding, bathing, grooming, dressing, bowel and bladder control, toilet use, transfers, mobility, and stair climbing. Each activity is rated based on the level of independence, with scores ranging from 0 (completely dependent) to a maximum of 100, indicating full independence. The scoring system categorizes dependency levels as total (0-20), severe (21-60), moderate (61-90), slight (91-99), and full independence (100). Cut-off values distinguish functional limitations, with scores below 60 indicating severe limitations and scores above 90 suggesting minimal limitations. The Barthel Index has strong construct, concurrent, and predictive validity, and has demonstrated excellent inter-rater and test-retest reliability across various evaluators and repeated assessments. It exhibits high sensitivity in detecting functional improvements, particularly in the early rehabilitation phase, and high specificity in differentiating functional dependency levels. (Collin et al., 1988)

3.4.4 Data collection procedures

Patients were screened for eligibility during hospital admission. Those meeting the inclusion criteria were asked to participate and given written informed consent before the initial assessment. The baseline assessment occurred within the initial week following the stroke, during the acute phase, to assess participants' functional status, neurological impairment, and participation levels through standardized assessment tools. A follow-up assessment was performed three months after the stroke, a period identified as crucial for neurological recovery. Prior studies indicate that the most significant improvements in motor and functional outcomes generally take place within the initial three months post-stroke, after which rates of recuperation tend to stabilize. This guided the study's emphasis on prompt and continuous rehabilitation throughout this period of increased neuroplastic potential. (Dromerick et al., 2021; *In Stroke Recovery, the First Three Months Are Key - Charlesgate*, n.d.)

3.5 Statistical Analysis

Data analysis was performed using IBM SPSS Statistics (Version 2023). Descriptive statistics were utilized to summarize the characteristics of the study sample, with means,

standard deviations, minimums, and maximums reported for continuous variables, while frequencies and percentages were used for nominal variables. Ordinal variables were described using medians. To evaluate changes in rehabilitation outcomes between baseline and the three-month follow-up, the Wilcoxon signed-rank test was employed. The Mann-Whitney U test was applied to assess differences in outcome measures between independent groups. Furthermore, Spearman's rank-order correlation was used to explore the relationships between ordinal or continuous personal variables and the degree of improvement. Multivariate regression analysis was also conducted to identify significant predictors of stroke rehabilitation outcomes.

3.6 Ethical Consideration

Ethical approval was obtained from the Ethical Committee of Al-Quds University Health Committee (Appendix 8), and all ethical guidelines were strictly adhered to throughout the research process. Participants were provided with an information sheet (Appendix 9) outlining the study's objectives, assessment tools, and any potential risks. Informed consent (Appendix 10) was obtained from each participant before their inclusion in the study. Participants were informed of their right to withdraw from the study at any point without any impact on their care or rights. Anonymity and confidentiality were rigorously maintained, and no personally identifiable information was disclosed. All data were securely stored in a locked cabinet accessible only to the researcher and were used exclusively for scientific purposes.

Chapter Four

Result Presentation

4.1 Result presentation and analysis

4.1.1 Recruitment and Follow-up Process

A total of 135 stroke patients were screened for eligibility across three hospitals in Hebron: Al-Ahli Hospital, Alia Governmental Hospital, and Al-Mezan Hospital. Of these, 81 patients were excluded due to recurrent stroke, transient ischemic attack (TIA), or other neurological conditions, and 18 declined participations by refusing to sign the consent form. The remaining 36 eligible patients were recruited at baseline. During the three-month follow-up period, two participants passed away and two withdrew for personal reasons. Ultimately, 32 patients completed follow-up and were included in the outcome analysis (Figure 4.1)

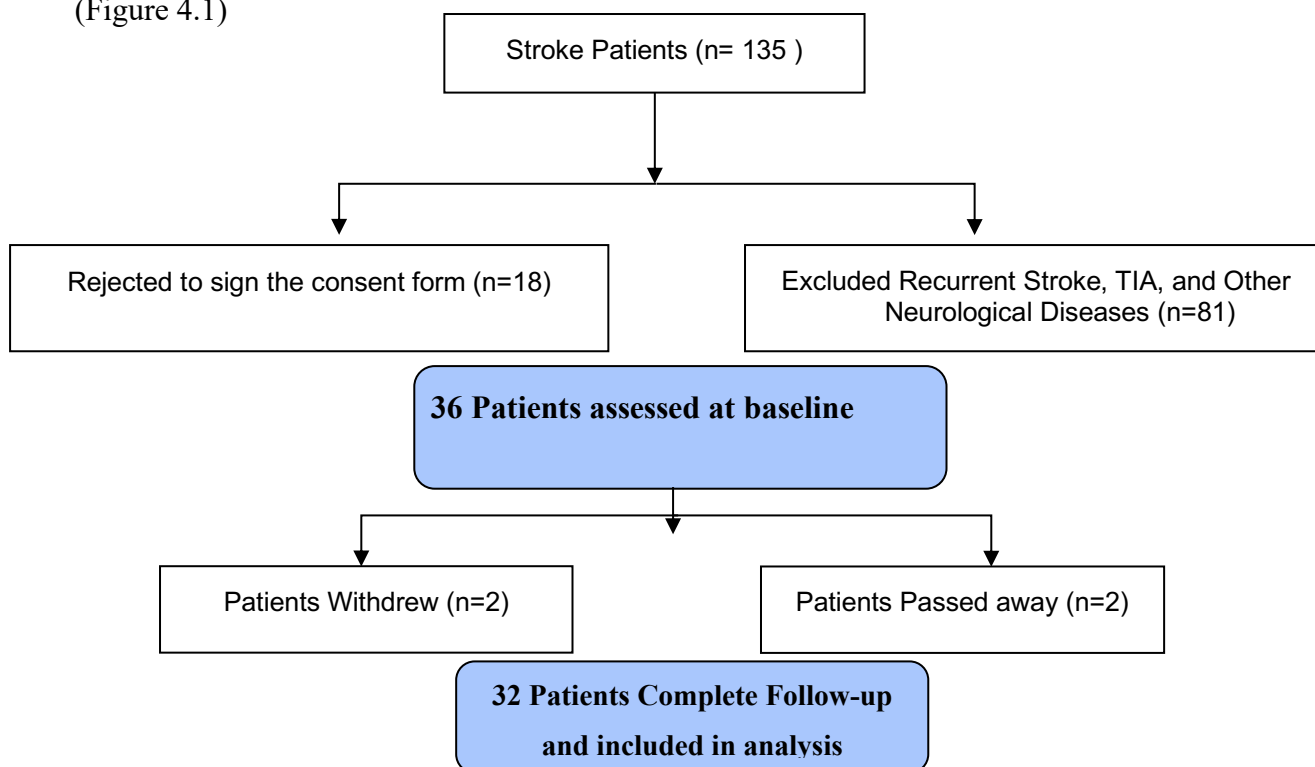


FIGURE 4. 18 RECRUITMENT AND FOLLOW-UP

4.1.2 Descriptive statistics of variables

4.1.2.1 Age of Participants

Table 4.1 showed that participants had a mean age of 64.22 years (SD = 10.16). The median (65 years) and mode (64 years) were closely aligned with the mean, suggesting a roughly normal age distribution across the sample, with ages ranging from 46 to 78 years.

TABLE 4. 1 AGE OF PARTICIPANTS

	Mean of Age	Median	Mode	Minimum	Maximum	Std. Deviation
Age Of Participants	64.22	65	64	46	78	10.156

4.1.2.2 Gender of Participants

Figure 4.2 illustrates that the sample comprised an equal distribution of male and female participants, each contributing to 50% of the overall study population.

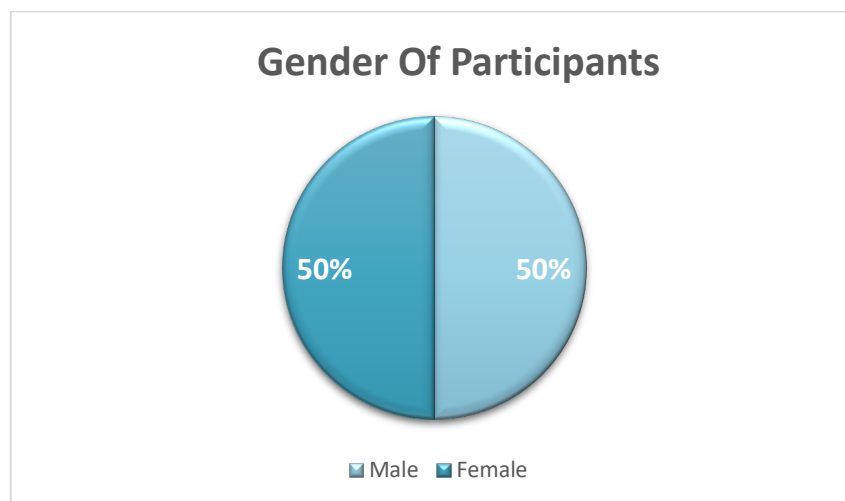


FIGURE 4. 19 GENDER OF PARTICIPANTS

4.1.2.3 BMI of Participants

Table 4.2 below shows the mean Body Mass Index (BMI) of participants was 29.63 kg/m² (SD = 6.45), indicating that, on average, participants were in the overweight to obese range. The median BMI was 28.04 kg/m², with a mode of 31.25 kg/m². BMI values ranged from 22.49 kg/m² (normal weight) to 46.88 kg/m² (severe obesity), reflecting considerable variability in participants' body composition.

TABLE 4. 2 BMI OF PARTICIPANTS

	Mean	Median	Mode	Minimum	Maximum	Std. Deviation
Body Mass Index	29.6281	28.04	31.25	22.49	46.88	6.45411

4.1.2.4 Number of Children

Table 4.3 shows that the participants had an average of 6.06 children (SD = 3.09), with a median and mode of 6 children. The number of children ranged from 1 to 15, indicating considerable variability in family size among the sample.

TABLE 4. 3 NUMBER OF CHILDREN

	Mean	Median	Mode	Minimum	Maximum	Std. Deviation
Number Of Child	6.06	6	6	1	15	3.089

4.1.2.5 Co-morbidities

Figure 4.3 illustrates the distribution of participants according to their co-morbidities. The most common conditions were diabetes mellitus (DM) and hypertension (HT), each reported by 61.1% of participants. Coronary artery disease (CAD) was reported by 55.6% of participants. A smaller proportion had renal or cardiac failure (16.7%) or osteoarthritis (OA) (16.7%). None of the participants reported having atrial fibrillation (AF).

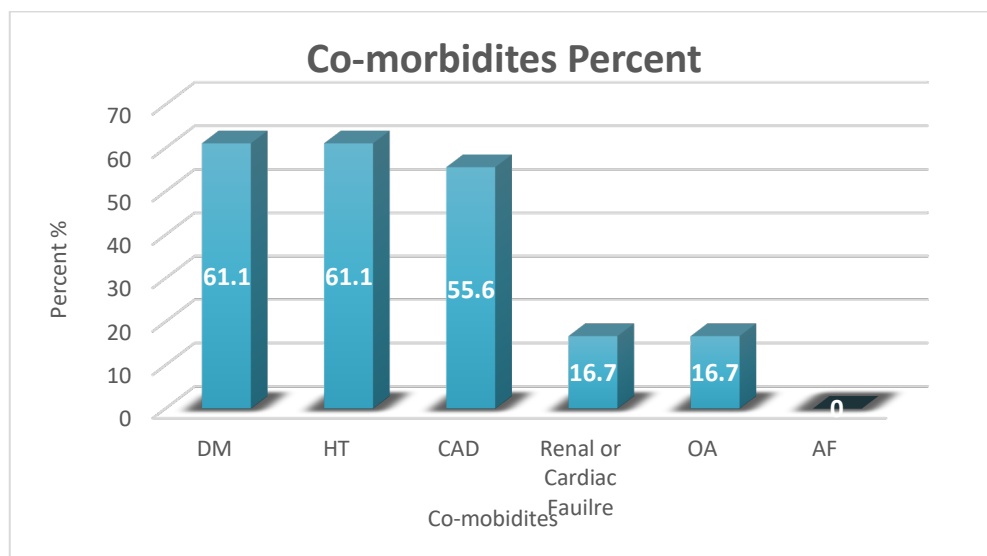


FIGURE 4. 20 CO-MORBIDITIES PERCENT

4.1.2.6 Smoking Status

Figure 4.4 shows the distribution of participants according to their smoking status. About 22.2% of participants reported that they smoke, while the majority (77.8%) reported that they do not smoke.

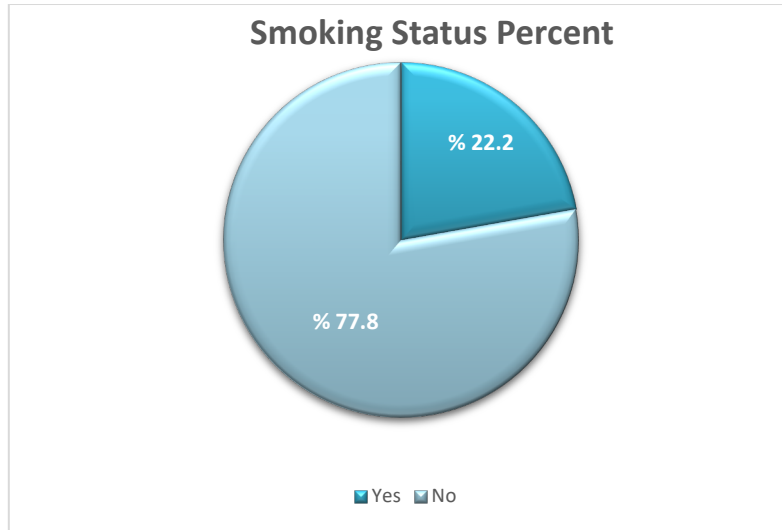


FIGURE 4. 21 SMOKING STATUS PERCENT

4.1.2.7 Financial status

Figure 4.5 shows the distribution of participants according to their financial status. The highest percentage reported a good financial status (38.9%), followed by fair (36.1%) and poor (19.4%). Only a small proportion of participants (5.6%) reported having a very good financial status.

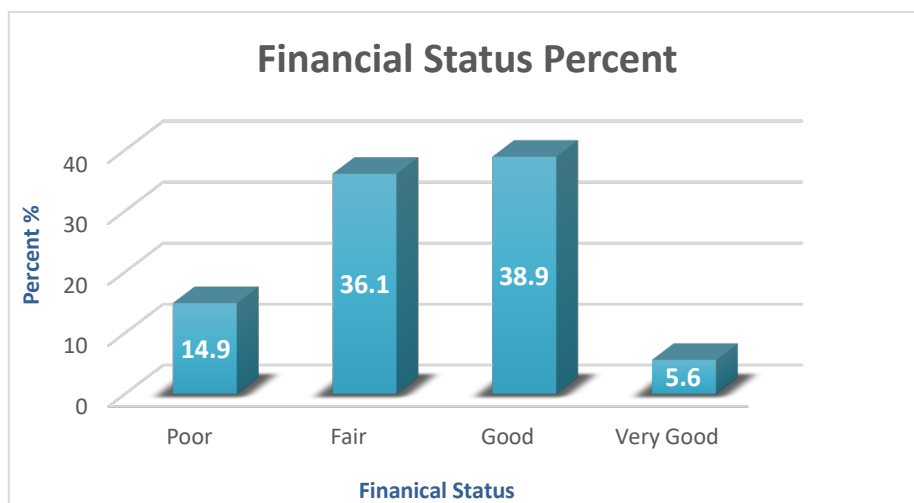


FIGURE 4. 22 FINANCIAL STATUS

4.6.2.9 Employment Status

Figure 4.6 demonstrates the distribution of participants based on their current employment situation. Over half of the individuals were unemployed (55.6%), whereas 44.4% indicated they were employed.

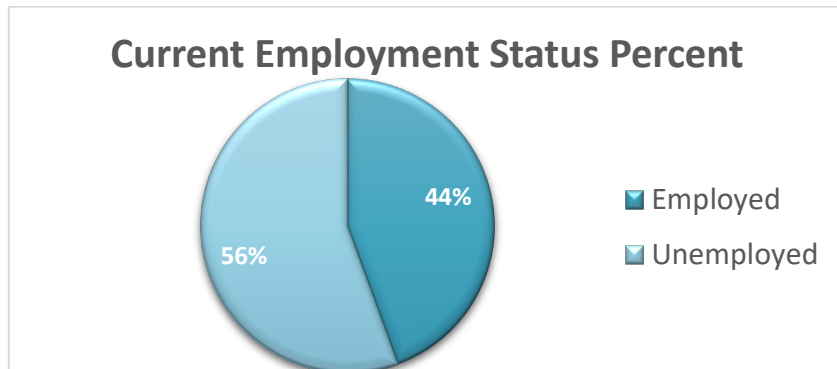


FIGURE 4. 23 CURRENT EMPLOYMENT STATUS

4.6.2.9 Type of Stroke

Figure 4.7 presents the distribution of participants according to the type of stroke. The majority of participants (88.9%) had an ischemic stroke, while only 11.1% experienced a hemorrhagic stroke.

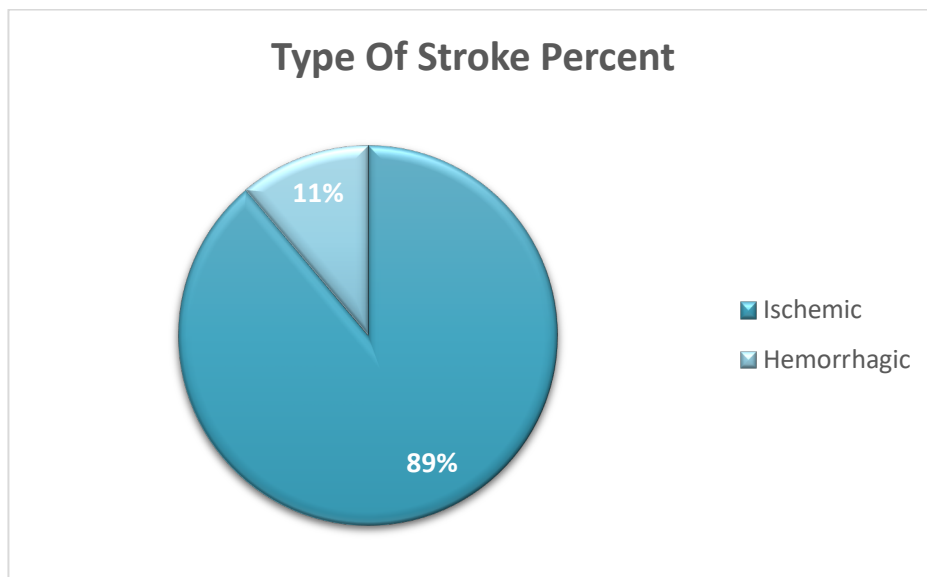


FIGURE 4. 24 TYPE OF STROKE

4.1.2.10 Side of stroke

As shown in Figure 4.8, the distribution of participants according to the side of the stroke. Just over half of the participants (53%) had a stroke on the left side, while 47 % experienced a stroke on the right side.

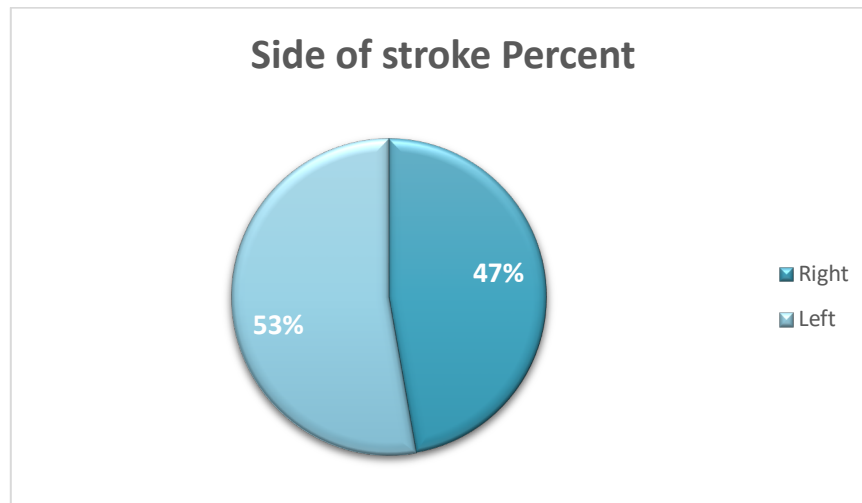


FIGURE 4. 25 SIDE OF STROKE

4.1.2.11 Administration of tissue plasminogen activator (tPA)

As shown in Figure 4.9, the distribution of participants according to whether they received tissue plasminogen activator (tPA) indicates that only 16.7% of participants received tPA, while the majority (83.3%) did not receive it.

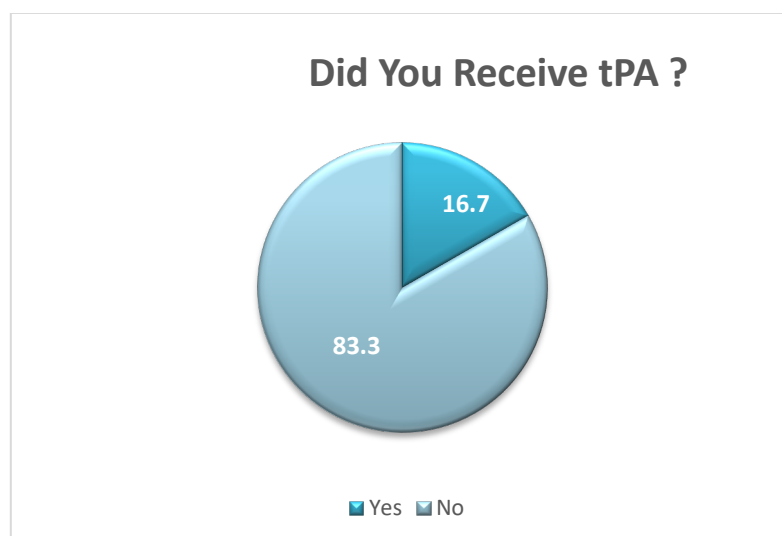


FIGURE 4. 26 ADMINISTRATION OF TPA

4.1.2.12 Referral to a Rehabilitation

Figure 4.10 illustrates the distribution of participants based on their referral to rehabilitation by their doctor to a facility. More than half of the participants (55.6%) were referred, while 44.4% were not.

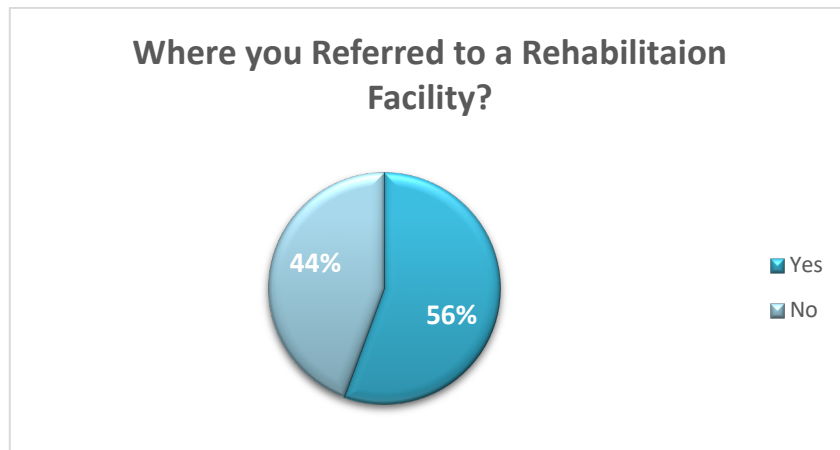


FIGURE 4. 27 REFERRED TO A REHABILITATION FACILITY

4.1.2.13 Use of Care Setting

As illustrated in Figure 4.11, the reported percentages reflect the proportion of patients who received specific rehabilitation services within each care setting, with each setting treated as a distinct subgroup (i.e., 100% per setting). Among patients managed in hospital settings, 37.5% received physical therapy (PT), while 25% received PT at home, 31.3% in outpatient clinics, and 43.8% in inpatient facilities. Occupational therapy (OT) was predominantly delivered in inpatient settings (40.6%), with minimal use in outpatient clinics (6.3%) and no reported utilization in hospital or home settings. Speech therapy and psychotherapy were provided exclusively in inpatient settings, received by 12.5% and 6.3% of patients.

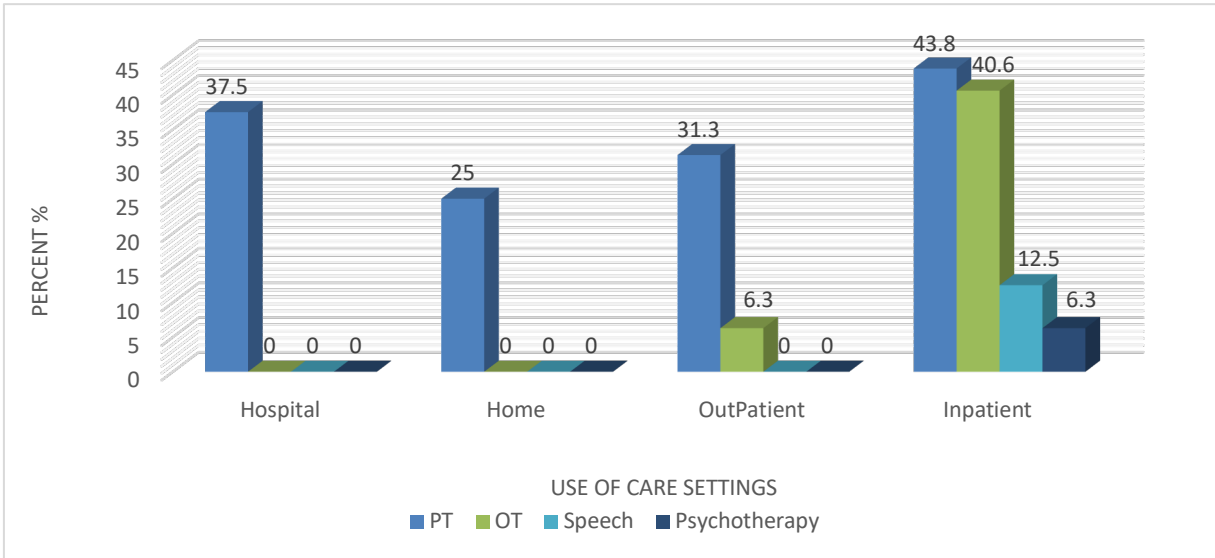


FIGURE 4. 28 USE OF CARE SETTINGS

4.2.11.14 Reasons for Not Receiving Rehabilitation at Home

Figure 4.11 presents the reasons reported by participants for not receiving rehabilitation at home. Financial reasons (25%) and the perception that it would make no difference (25%) were the most common responses, followed by difficulty in reaching services (16.7%) and lack of awareness (16.7%). A smaller proportion of participants reported no perceived need for rehabilitation (8.3%) or cited other reasons (8.3%).

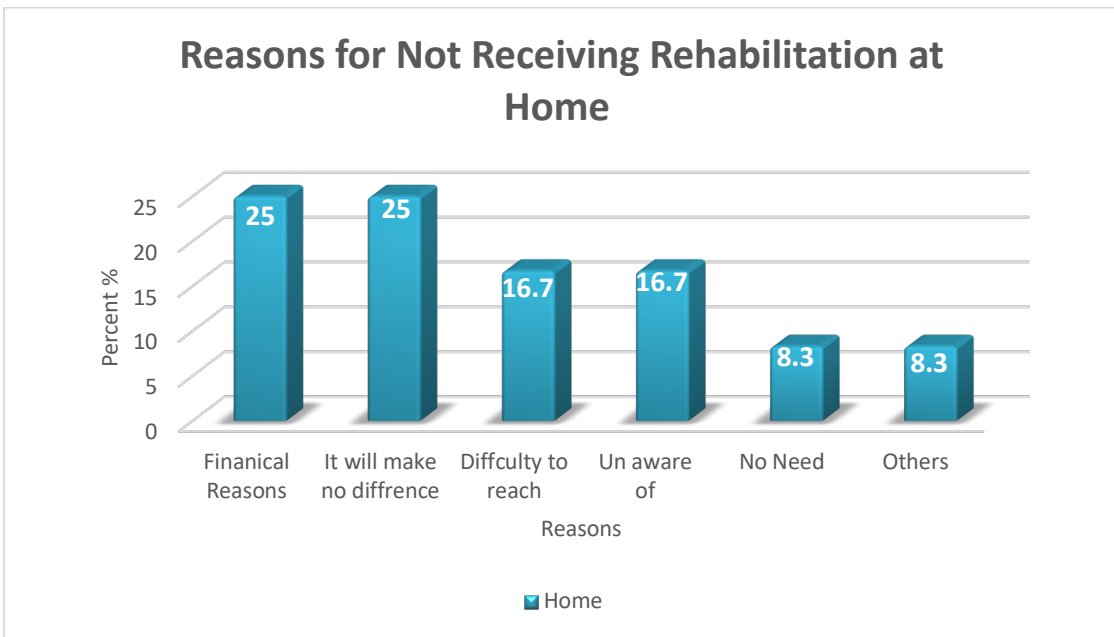


FIGURE 4. 29 REASONS FOR NOT RECEIVING REHABILITATION AT HOME

4.2.11.15 Reasons for Not Receiving Rehabilitation at Outpatient Clinic

Figure 4.12 shows that the most commonly cited reason for not attending outpatient rehabilitation was the perception that it would make no difference (36.4%). This was followed by difficulty in reaching services (27.3%) and financial status (18.2%) as limiting factors. An additional 18.2% reported other reasons.

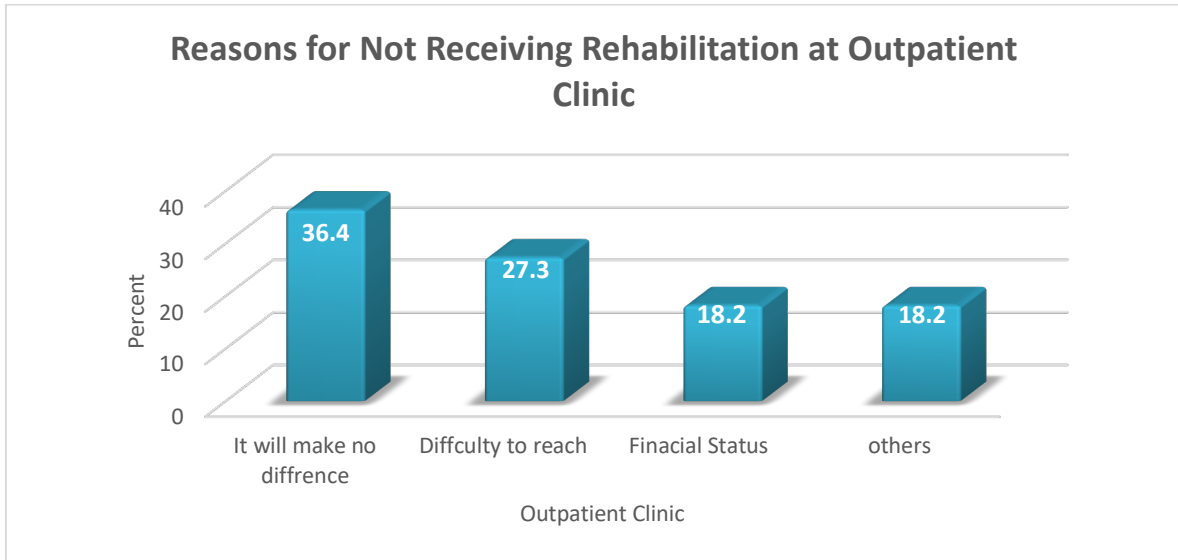


FIGURE 4.12: REASONS FOR NOT RECEIVING REHABILITATION AT OUTPATIENT CLINIC

4.2.11.16 Reasons for Not Receiving Rehabilitation at an Inpatient Facility

Figure 4.13 presents the reasons reported by participants for not receiving rehabilitation in an Inpatient setting. Financial reasons were the most common (57.1%), followed by difficulty reaching services (28.6%) and other reasons (14.3%).

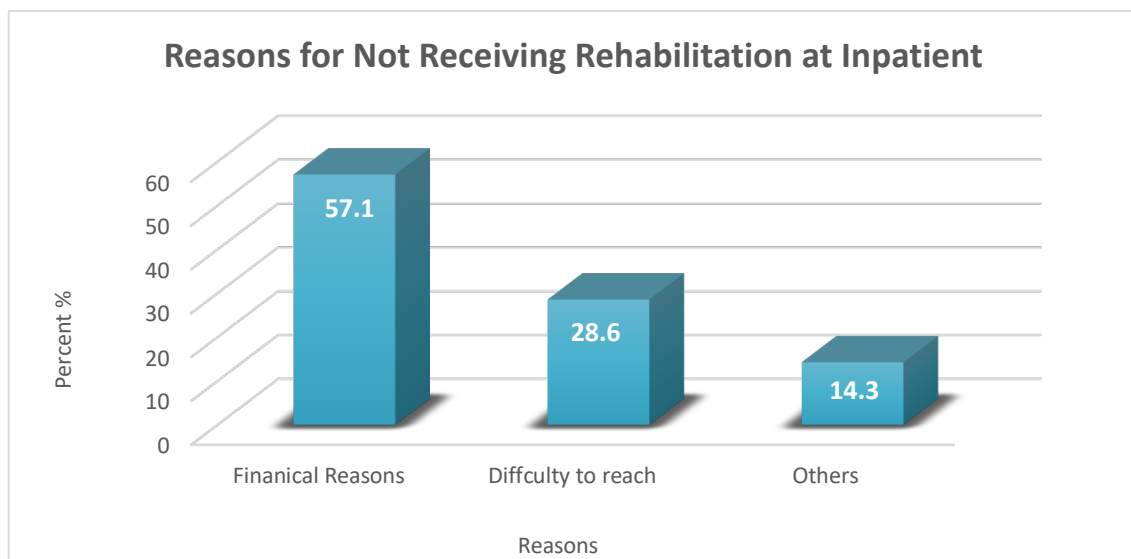


FIGURE 4. 30 REASONS FOR NOT RECEIVING REHABILITATION AT THE INPATIENT FACILITY

4.1.3 Normality test of study Variables

The normality of the study variables among participants was assessed before data processing. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to determine whether the variables were parametric ($p > 0.05$) or non-parametric ($p < 0.05$). Table 4.3 below presents the outcomes of the normality test for the study variables.

TABLE 4. 4 RESULTS OF THE NORMALITY TEST OF IMPROVEMENT OF OUTCOME MEASURES

Study Variables	Kolmogorov-Smirnova		Sig.	Shapiro-Wilk		Sig.
	Statistic	df		Statistic	df	
Improvement in Barthel Index	0.143	36	0.062	0.907	36	0.005
Improvement in Fugl-Meyer Upper Extremity	0.191	36	0.002	0.854	36	0
Improvement in Fugl-Meyer Lower Extremity	0.222	36	0	0.774	36	0
Improvement in ARAT	0.253	36	0	0.844	36	0
Amro Adapted Participation Questionnaire Percent	0.121	36	.200*	0.965	36	0.298
National Institutes of Health Stroke Scale	0.215	36	0	0.905	36	0.005
* This is a lower bound of the true significance.						
a Lilliefors Significance Correction						

Results indicated that most variables, including Improvement in Barthel Index, Improvement in Fugl-Meyer Upper Extremity, Improvement in Fugl-Meyer Lower Extremity, Improvement in ARAT, and National Institutes of Health Stroke Scale, showed significant deviation from normality (Shapiro-Wilk $p < 0.05$). In contrast, Adapted Participation Questionnaire Percent was the only variable that demonstrated a normal distribution ($p = 0.298$). Although Improvement in the Barthel Index was not significant in Kolmogorov-Smirnov ($p = 0.062$), the Shapiro-Wilk result ($p = 0.005$) suggested mild non-normality. Given these findings, the majority of the outcome variables did not meet the assumptions of normality; thus, non-parametric statistical methods were appropriately applied in the subsequent analyses.

4.1.4 Inferential Statistical Analysis for Improvement in Outcome Measures according to the ICF Framework

4.1.4.1 Impairment Level Outcome Measures

4.1.4.1.1 National Institutes of Health Stroke Scale (NIHSS) Scores

4.1.4.1.1.1 Descriptive Statistics for National Institutes of Health Stroke Scale (NIHSS) Scores

The National Institutes of Health Stroke Scale (NIHSS) was administered at baseline to evaluate stroke severity for all participants (n = 36). Scores ranged from 2 to 26, with a mean of 14.89 (SD = 7.05). The distribution showed slight positive skewness (0.31) and a mild platykurtic tendency (kurtosis = -0.88), indicating that stroke severity was approximately symmetrically distributed in this sample (as shown in Table 4.8)

TABLE 4. 5 DESCRIPTIVE STATISTICS FOR (NIHSS)

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
National Institutes of Health Stroke Scale	36	2	26	14.89	7.05	0.314	-0.876

4.1.4.1.1.2 Differences in Mean NIHSS Scores According to Study Nominal Variables

Table 4.6 illustrates that stroke severity, measured by the National Institutes of Health Stroke Scale (NIHSS), showed meaningful variation across several patient factors. Overall, higher NIHSS scores — indicating more severe strokes — Females showed a significantly higher mean score (18.44 ± 6.49) compared to males (11.33 ± 5.78), indicating a notable gender difference ($U = 58, p = 0.001$). Similarly, participants with hemorrhagic stroke had significantly greater mean scores (23.00 ± 2.31) than those with ischemic stroke (13.88 ± 6.79), suggesting stroke subtype influences the outcome ($U = 22, p = 0.034$). The presence of coronary artery disease (CAD) was also associated with higher mean scores (21.8 ± 5.04) compared to those without CAD (13.00 ± 6.42) ($U = 32, p = 0.001$). Furthermore, individuals with renal or cardiac comorbidities exhibited significantly elevated scores (21.00 ± 6.99) relative to those without these conditions (13.67 ± 6.50) ($U = 36, p = 0.021$). Lastly, smokers had higher mean scores (19.50 ± 4.31) than non-smokers (13.57 ± 7.72), indicating smoking status as a significant factor ($U = 50, p = 0.017$). Conversely, other variables—including side of stroke, employment status, hypertension, diabetes, and significant differences in mean NIHSS scores ($p > 0.05$).

TABLE 4. 6 DIFFERENCES IN MEAN NIHSS SCORES ACCORDING TO STUDY NOMINAL VARIABLES

Variables		Percent	Mean (SD)	Mean Difference	Mann-Whitney	Sig
Gender	Male	50%	11.33 (5.780)	7.11	58	0.001
	Female	50%	18.44 (6.492)			
Type of stroke	Ischemic	88.90%	13.88 (6.786)	9.12	22	0.034
	Hemorrhage	11.10%	23 (2.309)			
CAD	Yes	22.20%	21.8 (5.043)	8.8	32	0.001
	No	77.80%	13 (6.418)			
Renal or Cardiac	Yes	16.70%	21 (6.986)	7.33	36	0.021
	No	83.30%	13.67 (6.504)			
Smoking	Yes	22.20%	19.5 (4.309)	5.93	50	0.017
	No	77.80%	13.57 (7.7177)			

4.1.4.1.1.3 Association between NIHSS score at baseline and Study ordinal and continuous Variables

The current findings, as presented in Table 4.7, demonstrate that higher stroke severity, as measured by the NIHSS, is significantly associated with poorer financial status ($r = 0.428$, $p = 0.009$). This suggests that individuals with lower financial standing tend to experience more severe strokes. No statistically significant correlations were found between NIHSS and age ($r = 0.1$, $p = 0.56$), body mass index ($r = -0.176$, $p = 0.305$), or number of children ($r = 0.201$, $p = 0.239$), indicating that these variables were not meaningfully associated with stroke severity in this study.

TABLE 4. 7 ASSOCIATION BETWEEN NIHSS AND STUDY ORDINAL AND CONTINUOUS VARIABLES

	NIHSS & Spearman Correlation	Sig. (2-tailed)
Age Of Patient	0.1	0.56
Financial Status	.428**	0.009
Body Mass Index	-0.176	0.305

4.1.4.1.2 Fugl-Meyer Assessment for Upper Extremity

4.1.4.1.2.1 Difference of mean Fugl Mayer Upper Extremity in Baseline Assessment and after 3-month follow-up

As shown in Table 4.8 and visually represented in Figure 4.14, there was a statistically significant improvement in upper extremity motor function over the 3-month follow-up period. The mean Fugl-Meyer Upper Extremity (FMU) score increased from 18 (SD = 21.95) at baseline to 36.5 (SD = 25.35) at follow-up, reflecting a mean difference of 18.5 points. This improvement was statistically significant, as demonstrated by the Wilcoxon signed-rank test ($Z = -2.657$, $p = 0.008$). The bar chart in Figure 4.13 further illustrates this positive trend.

TABLE 4. 8 DIFFERENCE OF MEAN FMUE IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

Outcome Measure	Baseline Mean (SD)	Follow-up Mean (SD)	Mean Difference	Wilcoxon Z	p-value
Fugl-Meyer Upper Extremity	18 (21.949)	36.5 (25.346)	18.5	-2.657b	0.008

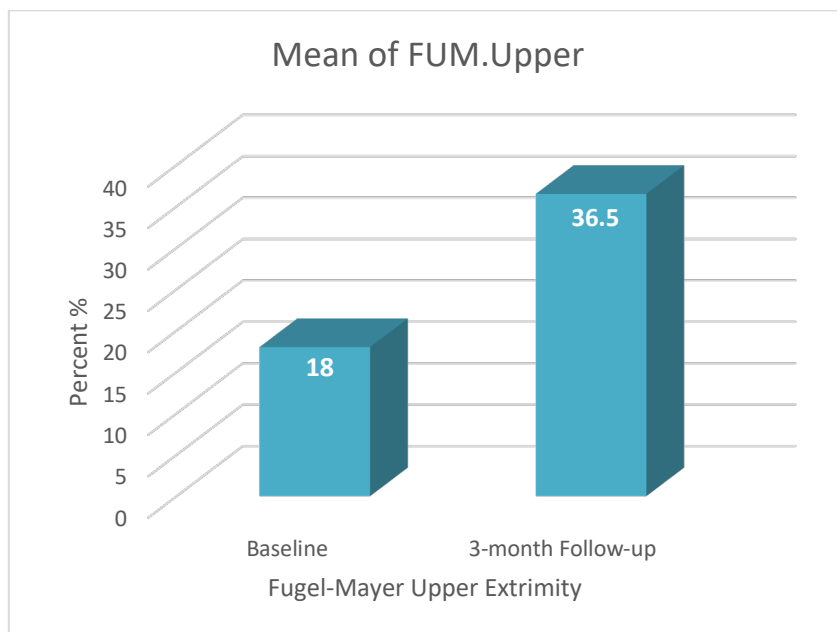


FIGURE 4. 31 DIFFERENCE OF MEAN FMUE IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

4.1.4.1.2.2 Difference of mean Fugl Mayer Upper Extremity Improvement according to study nominal variables

The comparison of Fugl-Meyer Upper Extremity (FMUE) improvement across nominal variables, as shown in Table 4.9, revealed that most demographic and clinical factors—including gender, type and side of stroke, employment status, hypertension, coronary artery disease, osteoarthritis, renal or cardiac conditions, and receipt of occupational therapy, speech therapy, or psychological services—were not significantly associated with FMUE improvement ($p > 0.05$).

However, significant differences in FMUE improvement were observed concerning several variables. Patients without diabetes mellitus showed significantly greater motor recovery compared to those with diabetes ($p = 0.001$). Similarly, patients who received thrombolytic therapy (tPA) demonstrated significantly higher improvement scores than those who did not ($p = 0.026$). Additionally, patients who were referred to rehabilitation services ($p = 0.023$) and those who received physical therapy at an outpatient clinic ($p = 0.012$) exhibited significantly greater gains in FMUE scores.

TABLE 4. 9 DIFFERENCE OF MEAN FUGL MAYER UPPER EXTREMITY IMPROVEMENT ACCORDING TO STUDY NOMINAL VARIABLES

Variables		Percent	Mean (SD)	Mean Difference	Mann-Whitney	Sig
Diabetes mellites	Yes	56.30%	2.857 (14.39)	23.58	32	0.001
	No	43.80%	26.44 (22.6)			
tPA	Yes	18.80%	43 (30.98)	36.15	32	0.026
	No	81.30%	6.84 (16.69)			
Referred To Rehab	Yes	50%	24.62 (26.28)	22	86	0.023
	No	50%	2.62 (16.14)			
PT at Outpatient	Yes	31.30%	21.27 (23.6)	24.47	48	0.012
	No	68.80%	3.2 (16.06)			

4.1.4.1.2.3 Association between Fugl-Meyer Upper Extremity Improvement and Study ordinal and continuous Variables

As shown in Table 4.10, FMUE improvement was strongly correlated with ARAT improvement ($\rho = 0.645$, $p < 0.001$) and moderately correlated with FMLE gains ($\rho = 0.413$, $p = 0.021$). A significant moderate correlation was also found with the total number of outpatient physical therapy sessions ($\rho = 0.457$, $p = 0.009$).

Conversely, no statistically significant associations were identified between FMUE improvement and several other variables, including sociodemographic factors (e.g., age, BMI, financial status, number of children), baseline clinical measures (e.g., NIH Stroke Scale, Barthel Index at baseline and follow-up), participation outcomes (Adapted Participation Questionnaire), and most therapy-related exposures such as physical, occupational, speech, and psychotherapy sessions administered across hospital, home, or inpatient settings ($p > 0.05$).

TABLE 4. 10 ASSOCIATION BETWEEN FUGL-MEYER UPPER EXTREMITY IMPROVEMENT AND STUDY ORDINAL AND CONTINUOUS VARIABLES

	Improvement in FMUE (Spearman Correlation)	Sig. (2-tailed)
Improvement in Fugl-Meyer Lower Extremity	.413*	0.021
Improvement in ARAT	.645**	0.001
Total Of Physical Therapy At Outpatient	.457**	0.009

4.1.4.1.2.4 Predictors of Fugl-Meyer Upper Extremity Improvement

Stepwise multivariate linear regression was conducted to identify independent predictors of improvement in Fugl-Meyer Upper Extremity (FMUE) scores. Variables entered sequentially based on statistical criteria, with the final model explaining 96.0% of the variance in FMUE improvement ($R^2 = 0.960$, Adjusted $R^2 = 0.946$, $p < 0.001$). The strongest predictor was diabetes mellitus status, followed by the total number of physical therapy sessions conducted at home, in the hospital, and inpatient. Additional significant predictors included stroke severity (NIHSS), patient age, body mass index, and type of stroke. Each variable significantly improved the model fit and independently contributed to explaining the variation in FMUE improvement. According to tables 4.11,4.12,4.13

TABLE 4. 11 MODEL SUMMARY FOR PREDICTORS OF FMUE IMPROVEMENT

Model Summary ⁱ					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
8	.980h	0.96	0.946	5.6032	

TABLE 4. 12 ANOVA FOR FMUE IMPROVEMENT PREDICTORS

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
8	Regression	17421.403	8	2177.675	69.363	.000i
	Residual	722.097	23	31.396		
	Total	18143.5	31			

TABLE 4. 13 COEFFICIENTS OF FMUE IMPROVEMENT'S PREDICTORS

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
8	(Constant)	47.648	12.512		3.808	0.001
	Do You Have Diabetes Mellitus ?	-24.343	2.61	-0.507	-9.326	0
	Total Of Physical Therapy At Home	0.993	0.083	0.591	11.926	0
	Total Of Physical Therapy At Hospital	109.884	8.592	0.612	12.789	0
	National Institutes of Health Stroke Scale	-0.845	0.193	-0.228	-4.366	0
	Total Of Physical Therapy At an Inpatient Facility	0.529	0.088	0.323	5.996	0
	Age Of Patient	-0.716	0.119	-0.31	-6.028	0
	Body Mass Index	1.279	0.24	0.269	5.335	0
	Type Of Stroke	18.95	3.818	0.263	4.963	0

a Dependent Variable: Improvement in Fugl-Meyer Upper Extremity

4.1.4.1.3 Fugl-Meyer Assessment for Lower Extremity

4.1.4.1.3.1 Difference of mean Fugl Mayer Lower Extremity in Baseline Assessment and after 3-month follow-up

The Wilcoxon Signed-Rank Test demonstrated a statistically significant improvement in the Fugl-Meyer Lower Extremity (FMLE) scores between baseline and the 3-month follow-up ($Z = -2.621$, $p = 0.009$). Specifically, the mean FMLE score increased from 19 (SD = 14.07) at baseline to 29 (SD = 17.62) at follow-up, reflecting an average improvement of 10 points. The positive trend is further illustrated in the bar chart presented in Figure 4.15.

TABLE 4. 14 DIFFERENCE OF MEAN FMLE IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

Outcome Measure	Baseline Mean (SD)	Follow Up Mean (SD)	Mean Difference	Wilcoxon Z	p-value
Fugl-Meyer Lower Extremity	19 (14.066)	29 (17.617)	10	-2.621b	0.009

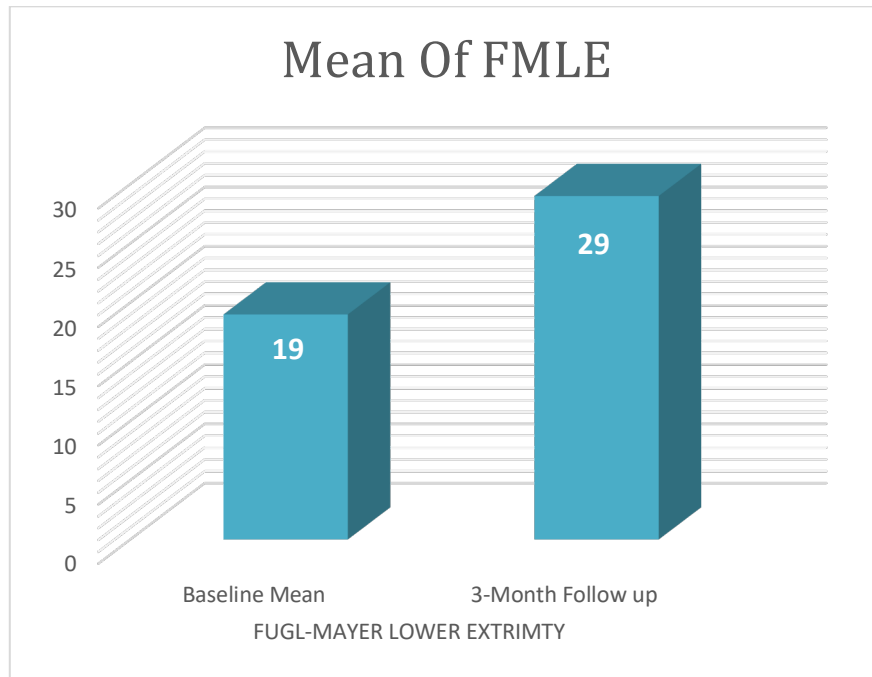


FIGURE 4. 32 DIFFERENCE OF MEAN FMLE IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

4.1.4.1.3.2 Difference of mean Fugl Mayer Lower Extremity Improvement according to study nominal variables

As shown in Table 4.15, the difference in FMLE improvement was compared across various nominal demographic and clinical characteristics using the Mann–Whitney U test. The analysis revealed statistically significant differences in FMLE improvement based on the side of stroke, PT at hospital, OT at inpatient, OT at outpatient, ST at inpatient, and psychotherapy at inpatient. Patients with left-sided strokes showed significantly greater improvement in lower extremity motor function (Mean = 11.83, SD = 9.59) compared to those with right-sided strokes (Mean = 4.21, SD = 12.98), with a significant difference (U = 52.5, p = 0.005). This suggests a potential lateralization effect in recovery response.

Similarly, those who received physical therapy (PT) at the hospital demonstrated significantly better FMLE improvement (Mean = 11.16, SD = 9.5) compared to those who did not (Mean = 0.67, SD = 13.73; $p = 0.028$).

Significant differences were also found in participants who received occupational therapy (OT) in inpatient settings, where the mean improvement was 12.67 (SD = 10.26) compared to 1.85 (SD = 10.6) for those who did not ($U = 42.5$, $p = 0.003$). Similar trends were observed for OT at outpatient clinics (Mean = 17.00, $p = 0.019$), although with a small sample size (6.3%).

Furthermore, those who underwent speech therapy (ST) during inpatient care showed significantly greater improvements (Mean = 14.5, SD = 2.88) than those who did not (Mean = 9.7, SD = 10.12; $p = 0.001$). Patients who received inpatient psychotherapy also showed higher FMLE improvements (Mean = 12.00) compared to those who did not (Mean = 7.86, SD = 11.94), with statistical significance ($p = 0.044$).

No statistically significant differences were found in FMLE improvement across gender, stroke type, employment status, comorbidities (hypertension, diabetes mellitus, CAD, renal or cardiac conditions), smoking status, tPA administration, or home/outpatient therapy interventions ($p > 0.05$).

TABLE 4. 15 DIFFERENCE OF MEAN FUGL MAYER LOWER EXTREMITY IMPROVEMENT ACCORDING TO STUDY NOMINAL VARIABLES

Variables		Percent	Mean (SD)	Mean Difference	Mann-Whitney	Sig
Side of stroke	Right	40.60%	4.21, (12.98)	7.62	52.5	0.005
	Left	59.40%	11.83(9.59)			
PT at Hospital	Yes	37.50%	11.16(9.5)	10.49	60	0.028
	No	62.50%	0.67 (13.73)			
OT at Outpatient	Yes	6.30%	17 (0)	8.21	0	0.019
	No	93.80%	8.21(11.21)			
ST at Inpatient	Yes	12.50%	14.5 (2.88)	4.80	0	0.001
	No	87.50%	9.7(10.12)			
Psych at Inpatient	Yes	6.30%	12 (0)	5.86	4	0.044
	No	93.80%	7.86(11.94)			

4.1.4.1.3.3 Association between Fugl-Meyer Lower Extremity Improvement and Study ordinal and continuous Variables

As presented in Table 4.16, several variables showed statistically significant associations with improvement in Fugl-Meyer Lower Extremity (FMLE) scores. A moderate negative correlation was observed with the age of the patient ($\rho = -0.561$, $p = 0.001$). In contrast, functional outcomes such as improvement in the Barthel Index ($\rho = 0.615$, $p < 0.001$), ARAT improvement ($\rho = 0.651$, $p < 0.001$). Additionally, a moderate positive correlation was observed between FMLE improvement and Fugl-Meyer Upper Extremity (FMUE) improvement ($\rho = 0.413$, $p = 0.021$), Regarding Use of Care Settings, significant positive correlations were identified for the total amount of physical therapy at hospital ($\rho = 0.355$, $p = 0.05$), and physical therapy at inpatient facilities ($\rho = 0.368$, $p = 0.042$).

occupational therapy at outpatient ($\rho = 0.427$, $p = 0.017$), occupational therapy at inpatient facilities ($\rho = 0.460$, $p = 0.009$), speech therapy at inpatient facilities ($\rho = 0.579$, $p = 0.001$).

On the other hand, several variables did not show significant associations with FMLE improvement. These included financial status, body mass index, number of children, National Institutes of Health Stroke Scale (NIHSS) score, and the total amount of physical or occupational therapy received in outpatient or home settings.

TABLE 4. 16 ASSOCIATION BETWEEN FUGL-MEYER LOWER EXTREMITY IMPROVEMENT AND STUDY ORDINAL AND CONTINUOUS VARIABLES

Variable	Improvement in FMLE (Spearman Correlation)	p-value
Age Of Patient	-0.561**	0.001
Improvement in Barthel Index	0.615**	0.001
Improvement in Fugl-Meyer Upper Extremity	0.413*	0.021
Improvement in ARAT	0.651**	0.001
Total of Physical Therapy at Hospital	0.355	0.05
Total of Occupational Therapy at Outpatient	0.427*	0.017
Total of Occupational Therapy at Inpatient Facility	0.460**	0.009
Total of Speech Therapy at Inpatient Facility	0.579**	0.001
Total of Physiotherapy at Inpatient Facility	0.368*	0.042

4.1.4.1.3.4 Predictors of Fugl-Meyer Lower Extremity Improvement

As shown in Tables 4.17, 4.18, and 4.19, stepwise multiple linear regression analysis was performed to identify significant predictors of improvement in Fugl-Meyer Lower Extremity (FMLE) scores. The final model included five variables: total physical therapy received at an inpatient facility, patient gender, smoking status, presence of osteoarthritis, and coronary artery disease. This model explained 75.7% of the variance in FMLE improvement ($R^2 = 0.757$, adjusted $R^2 = 0.708$), indicating a strong predictive ability ($F(5,25) = 15.55$, $p < 0.001$). Each additional predictor contributed significantly to the model, improving the accuracy of predicting lower extremity motor recovery.

TABLE 4. 17 MODEL SUMMARY FOR PREDICTORS OF FMLE IMPROVEMENT

Model Summary ^f				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
5	.870e	0.757	0.708	6.785

TABLE 4. 18 ANOVA FOR FMLE IMPROVEMENT PREDICTORS

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	3578.516	5	715.703	15.545	.000f
	Residual	1151.032	25	46.041		
	Total	4729.548	30			

TABLE 4. 19 COEFFICIENTS OF FMLE IMPROVEMENT'S PREDICTORS

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	23.229	8.308		2.796	0.01
	Total Of Physical Therapy At an Inpatient Facility	0.435	0.074	0.604	5.913	0
	Gender Of Patient	10.758	3.043	0.43	3.536	0.002
	Do You Smoke?	-13.468	3.917	-0.477	-3.439	0.002
	Do You Have Osteoarthritis?	-10.962	3.865	-0.298	-2.836	0.009
	Do You Have Coronary Artery Disease ?	-8.532	3.917	-0.302	-2.178	0.039

a Dependent Variable: Improvement in Fugl-Meyer Lower Extremity

4.1.4.2 Functional Level Outcome Measures

4.1.4.2.1 Barthel Index

4.1.4.2.1.1 Difference of mean Barthel Index in Baseline Assessment and after 3-month follow-up

Descriptive statistics revealed that the mean Barthel Index score increased from 25.28 (SD = 30.77) at baseline to 58.44 (SD = 36.88) at the 3-month follow-up. The range of scores also expanded, with baseline scores varying between 0 and 85, and follow-up scores ranging from 0 to 100, indicating improvement in participants' functional independence over time.

A Wilcoxon Signed-Rank test was conducted to determine if this observed increase was statistically significant. The test indicated a significant improvement in Barthel Index scores from baseline to 3 months post-assessment ($Z = -4.787$, $p < .000$). This positive trend is further illustrated in Figure 4.16 which visually depicts the mean difference in Barthel Index scores between the Baseline and follow-up period

TABLE 4. 20 DIFFERENCE OF MEAN BARTHEL INDEX AT BASELINE AND AFTER 3-MONTH FOLLOW-UP

Outcome Measure	Baseline Mean (SD)	Follow-up Mean (SD)	Mean Difference	Wilcoxon Z	p-value
Barthel Index	25.28 (30.77)	58.44 (36.88)	33.16	-4.787	< .000

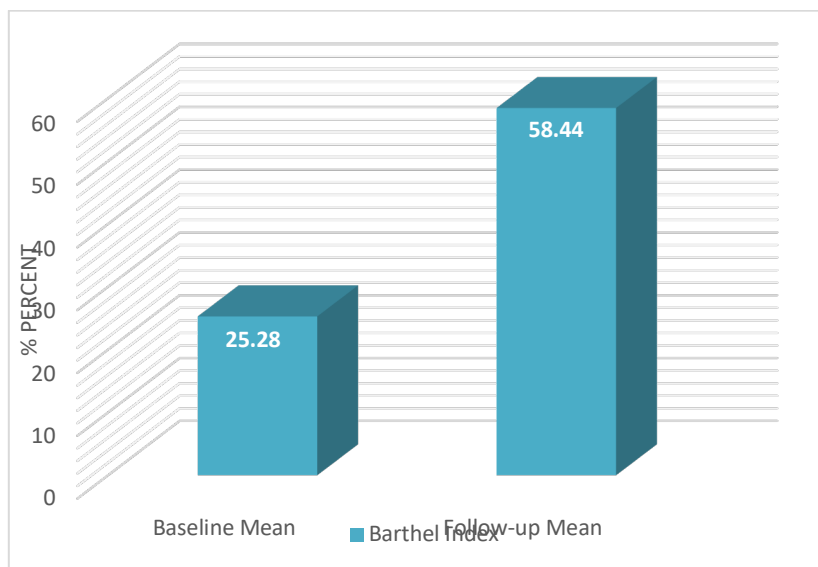


FIGURE 4. 33 DIFFERENCE OF MEAN BARTHEL INDEX IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

4.1.4.2.1.2 Difference of mean Barthel Index Improvement according to study nominal variables

As illustrated in Table 4.21, a statistically significant difference in Barthel Index improvement was found between participants with right-sided and left-sided strokes. Individuals with left-sided strokes demonstrated a significantly greater mean improvement ($M = 49.74$, $SD = 24.35$) compared to those with right-sided strokes ($M = 23.46$, $SD = 25.19$), $p = 0.008$. Additionally, participants who received physiotherapy at the hospital showed greater improvement ($M = 48.00$, $SD = 26.28$) than those who did not ($M = 24.17$, $SD = 23.63$), $p = 0.019$.

All other demographic, clinical, and service utilization variables—including gender, type of stroke, employment status, presence of hypertension, diabetes mellitus, coronary artery disease, osteoarthritis, renal or cardiac comorbidities, smoking status, thrombolytic therapy (tPA), rehabilitation referral, and receipt of physiotherapy, occupational therapy, or speech/psychological therapy in other settings—did not demonstrate statistically significant differences in Barthel Index improvement ($p > 0.05$).

TABLE 4. 21 DIFFERENCE OF BARTHEL INDEX IMPROVEMENT ACCORDING TO STUDY VARIABLES

Variables		Percent	Mean (SD)	Mean Difference	Mann-Whitney	Sig
Side of stroke	Right	40.6%	23.46 (25.19)	26.28	54.5	0.008
	Left	59.4%	49.74 (24.351)			
PT at Hospital	Yes	37.5%	48 (26.278)	23.83	60	0.019
	No	62.5%	24.17 (23.629)			

4.1.4.2.1.3 Association between Barthel Index Improvement and Study ordinal and continuous Variables

As shown in Tables 4.22 and related analyses, significant positive correlations were found between Barthel Index (BI) improvement and several motor and rehabilitation-related variables. Notably, BI improvement was significantly associated with Fugl-Meyer Upper Extremity scores at baseline ($\rho = 0.518$, $p = 0.002$) and follow-up ($\rho = 0.419$, $p = 0.017$), as well as with improvement in Fugl-Meyer Lower Extremity ($\rho = 0.615$, $p < 0.001$) and ARAT scores ($\rho = 0.487$, $p = 0.005$.) Significant associations were also found with rehabilitation service utilization; particularly, total speech therapy ($\rho = 0.500$, $p = 0.004$) and physical therapy sessions at inpatient facilities ($\rho = 0.421$, $p = 0.016$) were moderately and positively correlated with functional gains. Total physical therapy at the hospital also showed a significant but weaker positive correlation ($\rho = 0.379$, $p = 0.032$).

Conversely, other demographic and clinical variables—including age, body mass index, comorbidities, and several other rehabilitation service variables—were tested but did not demonstrate statistically significant relationships with BI improvement ($p > 0.05$).

TABLE 4. 22 CORRELATION BETWEEN BARTHEL INDEX IMPROVEMENT AND STUDY ORDINAL AND CONTINUOUS VARIABLES

Variables	Improvement in Barthel Index (Spearman Correlation)	Sig. (2-tailed)
Fugl-Meyer Upper Extremity BL	0.518**	0.002
Fugl-Meyer Upper Extremity FU	0.419*	0.017
Improvement in Fugl-Meyer Lower Extremity	0.615**	0.001
Improvement in ARAT	0.487**	0.005
Total Of Physical Therapy At Hospital	0.379*	0.032
Total Of Speech Therapy At an Inpatient Facility	0.500**	0.004
Total Of Physical Therapy At an Inpatient Facility	0.421*	0.016

4.1.4.2.1.4 Predictors of Barthel Index Scale Improvement

A stepwise multiple regression analysis in Table 4.23,4.24,4.25 was conducted to identify significant predictors of improvement in the Barthel Index, with various therapy-related, demographic, and clinical variables entered sequentially. The model-building process began with total speech therapy sessions at an inpatient facility and progressively incorporated additional predictors, including physical therapy, occupational therapy, financial status, stroke type, coronary artery disease, psychotherapy, number of children, renal or cardiac failure history, referral to a rehabilitation facility, and physical therapy at home.

The ANOVA results across successive models indicate a statistically significant increase in explained variance, with F-statistics ranging from 8.836 ($p = 0.006$) in the initial model to 74.844 ($p < 0.001$) in the final model, demonstrating that the inclusion of these variables significantly improves model fit. Residual variance decreased accordingly, indicating enhanced predictive accuracy.

TABLE 4. 23 MODEL SUMMARY FOR PREDICTORS OF BARTHEL INDEX IMPROVEMENT

Model Summary n				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
13	.984m	0.968	0.955	5.827

TABLE 4. 24 ANOVA FOR BARTHEL INDEX IMPROVEMENT PREDICTORS

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
13	Regression	22874.769	9	2541.641	74.844	.000n
	Residual	747.106	22	33.959		
	Total	23621.875	31			

TABLE 4. 25 COEFFICIENTS OF BARTHEL INDEX IMPROVEMENT PREDICTORS

Coefficients ^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
13		B	Std. Error	Beta		
	(Constant)	-179.056	13.103		-13.665	0
	Total Of Physical Therapy At an Inpatient Facility	1.814	0.102	1.432	17.778	0
	Total Of Occupational Therapy At an Inpatient Facility	1.688	0.086	1.489	19.539	0
	Financial Status	21.151	1.457	0.667	14.52	0
	Type Of Stroke	52.641	4.244	0.641	12.403	0
	Total Of Psychotherapy At an Inpatient Facility	1.329	0.102	0.711	13.055	0
	Number Of Child	-1.626	0.392	-0.168	-4.146	0
	Do You Have History of Renal or cardiac Failure?	-43.33	3.544	-0.622	-12.227	0
	Where you referred to a Rehabilitation Facility?	14.32	2.67	0.264	5.363	0
	Total Of Physical Therapy At Home	0.331	0.08	0.173	4.155	0

^a a Dependent Variable: Improvement in Barthel Index

4.1.4.2.2 Action Research Arm Test (ARAT)

4.1.4.2.2.1 Difference of mean ARAT in Baseline Assessment and after 3-month follow-up

As illustrated in Figure 4.17, there was a substantial improvement in upper limb motor function measured by the Action Research Arm Test (ARAT). The mean ARAT score increased from 5.5 (SD = 13.82) at baseline to 21.38 (SD = 22.92) after 3 months, yielding a mean difference of 15.88 points. This improvement was statistically significant, as determined by the Wilcoxon Signed-Rank Test ($Z = -3.521$, $p < .001$), as detailed in Table 4.26.

TABLE 4. 26 DIFFERENCE OF MEAN ARAT IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

Outcome Measure	Baseline Mean (SD)	Follow Up Mean (SD)	Mean Difference	Wilcoxon Z	p-value
Action Research Arm Test	5.5 (13.816)	21.38 (22.92)	15.88	-3.521b	0.001

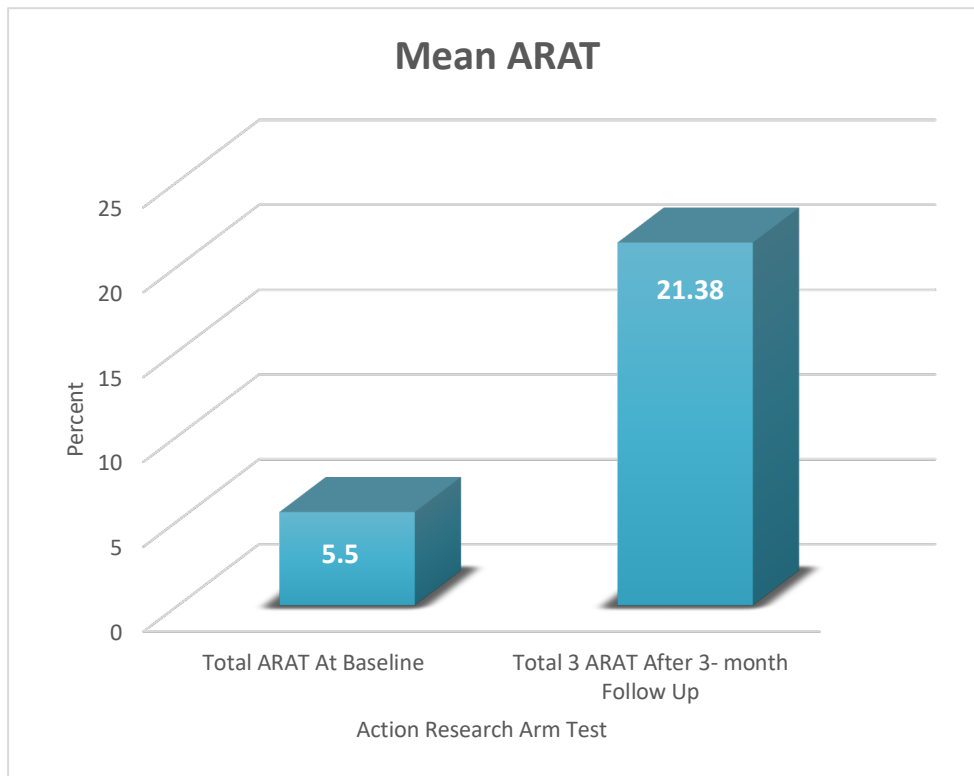


FIGURE 4. 34 DIFFERENCE OF MEAN ARAT IN BASELINE ASSESSMENT AND AFTER 3-MONTH FOLLOW-UP

4.1.4.2.2.2 Difference of mean ARAT Improvement according to study nominal variables

An analysis of mean differences in ARAT improvement across various nominal variables revealed several notable patterns, as shown in Table 4.27. Employment status emerged as a significant factor, with employed participants showing greater improvement in upper limb function (Mean = 21.14, SD = 18.24) compared to their unemployed counterparts (Mean = 10.69, SD = 14.50), reaching statistical significance ($p = 0.041$). Administration of thrombolytic therapy (tPA) was also significantly associated with ARAT gains, as those who received tPA had higher improvements ($p = 0.039$).

Among rehabilitation interventions, patients who received occupational therapy in inpatient settings showed significantly greater ARAT improvement (Mean = 19.58, SD = 17.14) compared to those who did not (Mean = 8.96, SD = 14.71; $p = 0.004$). Interestingly, those receiving physical therapy at the hospital also showed statistically significant differences ($p = 0.006$), favoring those who received such intervention. Although not statistically significant, a trend toward higher ARAT improvement was observed among participants without diabetes, without osteoarthritis, and those who did not smoke.

Other sociodemographic and clinical variables—including gender, type or side of stroke, hypertension, coronary artery disease (CAD), renal or cardiac comorbidities, referral to rehabilitation, and receiving inpatient speech or psychotherapy—did not show statistically significant associations with ARAT improvement ($p > 0.05$).

TABLE 4. 27 DIFFERENCE OF MEAN ARAT IMPROVEMENT ACCORDING TO STUDY'S NOMINAL VARIABLES

Variables		Percent	Mean (SD)	Mean Difference	t-test	Sig
Employment Status	Employed	43.80%	21.14(18.24)	10.45	72	0.041
	Unemployed	56.30%	10.69(14.5)			
tPA	Yes	18.80%	12.92(13.8)	2.89	38	0.039
	No	81.30%	15.81(17.62)			
PT at Hospital	Yes	37.50%	18.78(17.26)	9.38	54	0.006
	No	62.50%	9.4(14.87)			
OT at Inpatient	Yes	40.60%	19.58(17.14)	10.62	53.5	0.004
	No	59.40%	8.96(14.71)			

4.1.4.2.2.3 Association between ARAT Improvement and Study ordinal and continuous Variables

Analysis of Spearman correlations revealed significant positive associations between ARAT improvement and several clinical and rehabilitation variables. Notably, ARAT improvement was moderately to strongly correlated with improvements in the Barthel Index ($\rho = 0.487, p = 0.005$), Fugl-Meyer Upper Extremity ($\rho = 0.645, p = 0.001$), Fugl-Meyer Lower Extremity ($\rho = 0.651, p = 0.001$), and 10-Meter Walk Test performance ($\rho = 0.648, p = 0.001$). Additionally, higher ARAT improvement was significantly associated with greater exposure to inpatient physical therapy ($\rho = 0.517, p = 0.002$), occupational therapy ($\rho = 0.525, p = 0.002$), and speech therapy ($\rho = 0.350, p = 0.050$). No significant correlations were found with age, BMI, or number of children.

TABLE 4. 28 ASSOCIATION BETWEEN ARAT IMPROVEMENT AND STUDY ORDINAL AND CONTINUOUS VARIABLES

	Improvement in ARAT (Spearman Correlation)	Sig. (2-tailed)
Improvement in Barthel Index	.487**	0.005
Improvement in Fugl-Meyer Upper Extremity	0.645**	0.001
Improvement in Fugl-Meyer Lower Extremity	.651**	0.001
Total Of Physical Therapy at Hospital	0.517**	0.002
Total Of Occupational Therapy at an Inpatient Facility	0.525**	0.002
Total Of Speech Therapy at an Inpatient Facility	0.350*	0.05

4.1.4.2.2.4 Predictors of ARAT Improvement

A series of hierarchical multiple regression models was conducted on Table 4.29,4.30,4.31 to identify the most significant predictors of improvement in Action Research Arm Test (ARAT) scores over the 3-month follow-up period. The final model (Model 9) demonstrated a very strong predictive capacity, explaining 93.0% of the variance in ARAT improvement ($R^2 = 0.930$, Adjusted $R^2 = 0.901$, $p < .001$). The stepwise inclusion of predictors progressively enhanced the model's explanatory power, beginning with "Total Occupational Therapy at an Inpatient Facility" as the sole predictor in Model 1 ($R^2 = 0.327$, $p = .001$), and culminating in Model 9 with the inclusion of variables such as diabetes status, NIH Stroke Scale, financial status, hypertension, osteoarthritis, physical therapy at home, renal or cardiac history, and employment status. The improvement in model fit, as indicated by decreasing standard error of the estimate (from 17.33 in Model 1 to 6.53 in Model 9), underscores the cumulative value of these clinical and sociodemographic predictors. The final model ($F(9,22) = 32.504$, $p < .001$) suggests that rehabilitation intensity—particularly inpatient occupational therapy—combined with stroke severity indicators and comorbid conditions, significantly influences upper limb functional recovery post-stroke.

TABLE 4. 29 MODEL SUMMARY FOR PREDICTORS OF ARAT IMPROVEMENT

Model Summaryj					
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	
9	.964i	0.93	0.901	6.526	

TABLE 4. 30 ANOVA FOR ARAT IMPROVEMENT PREDICTORS

ANOVAa						
Model		Sum of Squares	df	Mean Square	F	Sig.
9	Regression	12458.549	9	1384.283	32.504	.000j
	Residual	936.951	22	42.589		
	Total	13395.5	31			

TABLE 4. 31 COEFFICIENTS ARAT IMPROVEMENT PREDICTORS

Coefficientsa						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
9	(Constant)	48.097	11.162		4.309	0
	Total Of Occupational Therapy at an Inpatient Facility	0.55	0.068	0.644	8.084	0
	Do You Have Diabetes Mellitus?	-18.348	2.808	-0.445	-6.533	0
	National Institutes of Health Stroke Scale	-1.498	0.256	-0.47	-5.844	0
	Financial Status	11.748	2.037	0.492	5.767	0
	Do You Have Hypertension?	8.411	3.291	0.199	2.556	0.018
	Do You Have Osteoarthritis?	-20.244	4.11	-0.327	-4.925	0
	Total Of Physical Therapy At Home	0.251	0.095	0.174	2.631	0.015
	Do You Have History of Renal or cardiac Failure?	18.365	4.529	0.35	4.055	0.001
	Current Employment status	-11.849	3.69	-0.287	-3.211	0.004

a Dependent Variable: Improvement in ARAT

4.1.4.3 Participation level Outcome measure

4.1.4.3.1 Adapted Participation Questionnaire

4.1.4.3.1.1 Descriptive Statistics for Adapted Participation Questionnaire (Before, After, and Percent)

The participation level of stroke patients was assessed using the Adapted Palestinian Participation Questionnaire (APPQ). A statistically significant decline in participation was observed when comparing the period before the stroke and the baseline assessment shortly after the stroke (Wilcoxon signed-rank test, $Z = -4.370$, $p = 0.001$). Following three months of rehabilitation, there was a slight increase in participation scores between baseline and follow-up; however, this improvement was minimal—less than 20% on average—and not statistically significant ($Z = -1.387$, $p = 0.07$). These findings are summarized in Table 4.32.

TABLE 4. 32 DESCRIPTIVE STATISTICS FOR AMRO ADAPTED PARTICIPATION QUESTIONNAIRE

	Mean Before (SD)	Mean After (SD)	Mean Difference	Wilcoxon Z	P-Value
Adapted Participation Questionnaire Before Stroke	67.78 (18.5)	9.44 (5.04)	58.33	-4.37	0.001
Adapted Participation Questionnaire At 3-month Follow up	9.44 (5.04)	26.74 (10.2)	17.3	-1.387	0.07

Result Discussion

In the current study, the mean age of participants was 64.22 years (SD = 10.16), with a range of 46 to 78 years and a median of 65 years (Table 4.1). This finding is comparable to previous research conducted in Palestine. For example, a case-control study by (Amro et al., 2018) in Hebron reported a slightly higher mean age of 66.39 years and a median age of 69 years among first-ever stroke patients. Regionally, the current findings fall within the range reported in studies across the Middle East and North Africa (MENA) region. A systematic review by (Alhazzani et al., 2018) and (El-Hajj et al., 2016) found that the mean age at first-ever stroke typically ranges from 59 to 71 years, placing this study well within expected regional norms. Additionally, a hospital-based study in Aseer, Saudi Arabia, reported a similar mean age of 62.6 years (Rukn et al., 2019). In contrast, studies from Qatar and central Saudi Arabia have documented slightly younger mean ages, typically

between 56.9 and 58 years, suggesting possible differences in population demographics, lifestyle, or healthcare systems.

The decline in age observed in the present study compared to earlier local data may be partly explained by the deteriorating socioeconomic and public health conditions in Palestine, particularly over the past two years. The ongoing political conflict and humanitarian crisis have led to chronic stress, reduced access to preventive healthcare, medication shortages, and disruption of essential services, all of which may contribute to the earlier onset of stroke, particularly among middle-aged adults. The accumulation of untreated or poorly controlled risk factors such as hypertension, diabetes, and dyslipidemia under such strained conditions could be driving this trend. This finding indicated the importance of national preventive plans to decrease the incidence and prevalence of stroke in Palestine.

The results indicate a nearly balanced distribution of male and female stroke patients, supported by a retrospective study examining gender disparities and risk factors associated with acute ischaemic stroke conducted in the Palestinian territories of Palestine. (khraiwesh et al., 2025)also reported notable gender-specific differences in risk profiles but found relatively balanced stroke incidence between men and women. That study highlighted that although men and women experienced strokes at similar rates, the nature of their risk factors differed, with men more frequently exhibiting smoking and hyperlipidemia, while women had a higher prevalence of hypertension and diabetes. Additionally, the West Bank study pointed to disparities in acute stroke management and outcomes, showing that women were less likely to receive timely intervention and had worse functional recovery compared to men. This aligns with broader global findings that equal incidence does not necessarily translate into equity in care or outcomes. Several studies have documented that despite similar rates of stroke occurrence between men and women, women often experience delays in acute treatment, receive less aggressive interventions, and have poorer functional recovery after stroke(Appelros et al., 2009; Reeves et al., 2008). Disparities may arise from biological variants, sociocultural factors, and biases within the healthcare system, highlighting the necessity for gender-sensitive strategies in stroke management. The alignment of our study with the research conducted in the West Bank underscores the necessity of gender-sensitive approaches in stroke mitigation, acute care, and rehabilitation, specifically adapted to the Palestinian context, where socioeconomic variables and healthcare accessibility affect risk exposure and treatment options.

The average BMI among the participants was 29.63 kg/m² (SD = 6.45), categorizing the typical individual as overweight according to the WHO classification, and approaching the threshold for Class I obesity. (Report of a WHO Consultation, n.d.). This finding demonstrates a significant incidence of excess body weight in stroke patients within our cohort. Regional studies have indicated that elevated BMI is an independent and adjustable risk factor for stroke. A population-based investigation in the Gaza Strip indicated that roughly 48 percent of adults were classified as obese, with a higher prevalence of diabetes, hypertension, and hypercholesterolemia—conditions that are closely linked to a heightened risk of stroke. (Damiri et al., 2019; Shahwan et al., 2019). The elevated BMI observed in our sample may reflect Palestinian sociodemographic and environmental factors. Overweight and obesity have skyrocketed due to diets high in sugar, processed carbs, and saturated fats, and insufficient physical activity. Urbanization, limited living spaces, and persistent stress from uncertainty in politics and occupation reduce physical exercise and encourage emotional eating. Lack of preventive healthcare, integrated public health programs for weight control, and insufficient health literacy may delay the diagnosis and treatment of obesity and accompanying comorbidities.

The findings show that Palestine needs specialized dietary consultation techniques for stroke prevention and rehabilitation. Public health measures should support a healthy diet, frequent exercise, and better weight-related screening and counselling in health care facilities and hospitals. Stroke survivors must address overweight and obesity to prevent recurrence and improve recovery.

Hypertension and diabetes mellitus were both widespread, with 61.1% of stroke patients having either of them. In numerous regional and global studies, hypertension is more prevalent than diabetes within stroke populations. This concurrent prevalence is somewhat atypical. Comprehensive systematic research of 13 Middle Eastern countries revealed that 62.1% of stroke patients had hypertension, while only 33.1% were diagnosed with diabetes. A recent study conducted in Egypt across different centres revealed that 69% of stroke patients had hypertension, whereas 40.2% were diagnosed with diabetes. (Basamed, 2022).

The comparisons indicate that the hypertension prevalence in our cohort closely aligns with regional statistics; however, the diabetes prevalence is significantly elevated. This may indicate an increasing prevalence of a metabolic syndrome associated with lifestyle

factors risk factors among the local community.(Tran et al., 2010). Consistent with a prior hospital-based study conducted in Nablus, Palestine, the data show that 66 percent of stroke patients had hypertension, 45.8 percent had diabetes, and 33.9 percent had renal issues. (Sweileh et al., n.d.). Even while hypertension rates don't appear to be changing, the reality that more individuals in this group are diabetic suggests that urbanization, changes in diet, and decreased physical activity have become bigger issues in public health. Conversely, renal impairment was seen in 16.7% of the present population. This variation may be attributable to patient demographics, care settings, diagnostic thresholds, or improved management of chronic diseases.

Smoking was reported by 22.2% of the current cohort, while 77.8% of the participants in the cohort did not smoke. Consistent with earlier Palestinian hospital-based statistics, the prevalence is 19.6%, with nearly all of the smokers being male. The study included ischemic stroke patients from Nablus. (Zabadi et al., 2018). This implies that stroke patients in Palestine have moderate but ongoing smoking exposure.

In the broader Palestinian context, the national adult smoking prevalence was approximately 22.5% in 2010, with marked gender disparity, with 37.6% of men and only 2.6% of women smoking (Mizher et al., 2018). Our findings are consistent with the national trend: a moderate overall prevalence of tobacco use among stroke patients, which is likely due to the predominance of males in this population. Stroke risk was significantly greater in cigarette smokers (total stroke OR = 2.79; ischemic stroke OR = 2.59) and particularly in waterpipe smokers (OR = 4.99) according to a case-control study in Lebanon. (El-Hajj et al., 2019). The proven substantial relationship with stroke risk is meaningful even though smoking seems to be less widespread in our population compared to that Lebanese study.

More than half of the participants (55.6%) were unemployed at the time of stroke, and only a small proportion reported a very good financial status (5.6%), with most describing their situation as good (38.9%). Additionally, participants reported a mean of 6.06 children, suggesting large household sizes and potentially high family-related responsibilities, which is one of the variables studied to reflect the number of potential caregivers that would be an asset for family contribution to rehabilitation. When compared to general labor market data, this unemployment rate is considerably higher than the national average in Palestine, where unemployment stood at 24.4% (PCBS,2023). This disparity implies that those who

are unemployed or economically vulnerable may be at greater risk of stroke, likely due to compounded effects of chronic stress, poor nutrition, limited healthcare access, and lower engagement in preventive health services. And it is worth mentioning that this average age is retirement age in Palestine (>60), so it is predicted that the majority may not be working at this stage of life. Similar findings were reported in Jordan, where stroke patients were more likely to be unemployed and belong to lower socioeconomic strata than the general population (Barakat et al., 2022). Global research indicates that socioeconomic hardship before a stroke correlates with both a heightened incidence of strokes and poorer outcomes, characterized by extended recovery durations and elevated impairment levels. (Addo et al., 2012). In large families—such as those in our cohort—financial strain may escalate after a stroke, particularly if the impacted member is the primary earner. Furthermore, while a greater number of children may provide an expanded caregiving network, it may also indicate restricted access to family planning and inadequate financial means, both of which are associated with social determinants of health.

These findings emphasize the multifaceted influence of socioeconomic position on stroke susceptibility and recovery, underscoring the necessity of including social screening, financial assistance, and family-oriented rehabilitation strategies in stroke care in Palestine. 88.9% of individuals suffered ischemic strokes, whereas 11.1% received hemorrhagic strokes, a pattern that aligns with both regional and global statistics. A recent study from Jordan indicated ischemic stroke prevalence of 86.2% and hemorrhagic strokes at 13.8%, precisely in line with our findings. (*Ischaemic Stroke in Jordan: A 2-Year Hospital-Based Study of Subtypes and Risk Factors*, n.d.). Similarly, a hospital-based study in Nablus, Palestine, found that 82.3% of stroke cases were ischemic (Sawalha, 2009). The partially elevated incidence of ischaemic strokes in our sample may be ascribed to enhanced survival rates of less severe ischaemic events or the underdiagnosis of hemorrhagic strokes resulting from pre-hospital fatalities or restricted imaging availability. In terms of stroke lateralisation, 53% of strokes affected the left hemisphere, whilst 47% were right-sided, consistent with outcomes from population studies like the Rotterdam Study, which observed a minor left-sided predominance. (Palm et al., 2012). One plausible explanation is that left-sided strokes often manifest with speech and motor deficits that are more easily recognized and more likely to prompt hospital admission, whereas right-sided strokes, associated with non-dominant hemisphere deficits like neglect or visual-spatial dysfunction, may go unnoticed initially.

Only 16.7% of stroke patients were administered tissue plasminogen activator (tPA), but the predominant majority (83.3%) did not get this evidence-based emergency treatment. This low rate is not surprising, as tPA must be administered **within 4.5 hours from stroke onset** to be effective. Delayed hospital arrival, insufficient public awareness of stroke symptoms, geographic barriers, and lack of round-the-clock neuroimaging and stroke teams contribute to underutilization (Habib, 2022). Furthermore, only 55.6% of patients in our cohort received referrals for rehabilitation, leaving 44.4% without access to structured inpatient rehabilitation services. Furthermore, only 55.6% received referrals for rehabilitation, resulting in 44.4% lacking access to official inpatient rehabilitation services. These findings underscore substantial deficiencies in the stroke care spectrum within the Palestinian system of healthcare. Regional data substantiate this apprehension: research conducted by Khatib et al. (2018), conducted across hospitals in the West Bank, reported no tPA administration among ischemic stroke patients during two years, mainly due to late arrival, lack of imaging, or inadequate triage systems. Rehabilitation access also remains low; the same study found that fewer than 20% of hospitalized stroke patients received a physical therapy evaluation. In contrast, developed healthcare systems such as those in Canada and parts of Europe report rehabilitation referral rates exceeding 70–80%, and tPA administration rates up to 25–30% in eligible patients (Adeniji et al., 2023b).

The low tPA rate in our cohort may indicate various systemic issues, including delays in recognizing stroke symptoms, inadequate public awareness regarding the time-sensitive nature of tPA, geographic barriers, and insufficient availability of neuroimaging and stroke teams at all hours. Underutilization of rehabilitation can be attributed to a lack of inpatient rehab units, brief hospital stays, and financial limitations, especially in situations where services are not universally covered. The results indicate significant implications: in the absence of timely reperfusion therapy and organized rehabilitation, stroke survivors face an increased likelihood of long-term disability, diminished quality of life, and elevated healthcare expenses. The findings highlight the necessity of enhancing the stroke care pathway in Palestine, encompassing public education on early stroke recognition and emergency response, in-hospital thrombolysis protocols, and the establishment of community-based rehabilitation networks.

Future research should investigate the obstacles to tPA access and rehabilitation uptake in Palestine, with a focus on qualitative studies that include patients, carers, and healthcare providers. This may inform the development of specific interventions and policy reforms intended to decrease stroke-related disability as well as mortality in resource-limited

environments. The findings regarding the procedure for the referral of stroke patients to rehabilitation underscore the necessity of educating patients about their rehabilitation services.

A clear disparity in the thorough application of rehabilitation services following a stroke is brought to light in the present study. With 43.8% of participants reporting PT during inpatient care and 37.5% during hospital admission, physical therapy (PT) was the most commonly used service. However, utilization fell dramatically in community-based settings, with only 25% receiving PT at home and 31.3% in outpatient clinics. While almost no patients received occupational therapy (OT) while receiving treatment in an outpatient or home environment, 40.6% did so while undergoing inpatient rehabilitation. Another example of the inadequate integration of multidisciplinary treatments outside of hospital settings is the fact that speech therapy and psychotherapy were only offered in inpatient settings to a tiny proportion of patients (Keptner et al., 2019).

This tendency is indicative of a more widespread problem in post-acute stroke rehabilitation in LMICs, where funding and organization are frequently lacking. Just 28.2% of Jordanian patients received physical therapy after discharge, and even fewer (20%) received occupational therapy or speech therapy. Although inpatient rehabilitation facilities are accessible, a systematic study spanning thirteen Middle Eastern nations indicated that community-based follow-up is not consistently applied, leading to less-than-ideal long-term recovery results (Khazaei et al., 2015). The inpatient physical therapy utilization in this study is somewhat in line with these regional data; however, the poor utilization of outpatient services, especially occupational therapy and speech therapy, highlights a systemic deficit in post-stroke rehabilitation care.

The lack of organized interdisciplinary cooperation and convergence limits rehabilitation, according to this study's findings. Financial hardship, ignorance, inaccessibility, transportation issues, and the perception that rehabilitation would not be beneficial were among the obstacles that participants described, along with clear inequalities and shortcomings in the administration of post-acute stroke care. Stroke survivors may be at increased risk for long-term impairment and reduced quality of life if accessible, comprehensive rehabilitation methods are not available to them. This finding has crucial implications. Health care planners and policymakers should make it a top priority to address the issues of accessibility, knowledge, and affordability by creating community-

based, multidisciplinary stroke rehabilitation programs that go beyond traditional inpatient settings to include outpatient and home-based options.

The therapeutic outcomes, cost-effectiveness, and practicality of establishing interdisciplinary stroke rehabilitation teams within the Palestinian healthcare system need more investigation. We need further research on how to tailor these models to local infrastructure and sociocultural factors so that we can fill the gaps in care that are now there.

This study revealed NIHSS scores among patients ranging from 2 to 26, with a mean score of 14.89 (SD = 7.05), signifying a prevalence of moderate-to-severe stroke presentations. This mean surpasses those documented in regional cohorts; for example, a recent investigation from Jordan demonstrated a mean NIHSS of roughly 12.5 (SD = 8.5) among ischemic stroke patients. (Alawneh et al., 2022a), while other reports in the region cite means around 11–14. This elevated severity may reflect delayed hospital presentation, comorbid burden, or limited acute interventions such as tPA in our setting.

The NIHSS scale categorizes scores of 5–15 as moderate stroke and 16–20 as moderate-to-severe; thus, our average score is firmly within the moderate range, approaching the upper limit, indicating that numerous individuals presented with considerable deficits at admission. Elevated baseline NIHSS scores are recognized as robust indicators of adverse clinical outcomes, encompassing heightened mortality risk, prolonged hospitalizations, increased impairment, and protracted recovery. (Kobeissi et al., 2023; Wouters et al., 2018). Thus, the severity distribution within this group emphasizes the need to address systemic delays and ensure that stroke patients have access to early reperfusion and stroke unit treatment to improve their chances of a full recovery. There was a lack of a socialized stroke unit, which had been linked to better stroke management as shown by lower impairment levels and better functional rehabilitation outcomes in the long run, and only 16% of patients received tPA during acute management, both of which may have contributed to the more severe strokes seen in this group of patients. The pressing necessity to improve Palestine's early stroke detection, referral networks, and acute intervention capabilities is highlighted by the high mean NIHSS. It also implies that in order for patients to obtain functional gains, they might need post-acute support and more intense rehabilitation.

Researchers in the future should look into factors, including prehospital delay, awareness, and health system responsiveness, that determine the baseline severity of stroke in this group. To better assist stroke survivors in the area, it is important to understand these trajectories so that preventative programs and rehabilitation treatments may be customized.

Stroke severity, as measured by NIHSS, varied meaningfully across several patient characteristics. Female participants recorded significantly higher mean scores (≈ 18.4) compared to males (≈ 11.3), reflecting greater initial neurological burden. This aligns with a large individual-participant meta-analysis, which found that women had approximately 20% higher adjusted risk of severe ischemic stroke than men, which may be attributed to a combination of biological, clinical, and social factors. Women tend to be older at the time of stroke onset and often have poorer pre-stroke functional status, which contributes to more severe outcomes (Gall et al., 2010). Postmenopausal hormonal changes, particularly reduced estrogen levels, increase vascular stiffness and thrombotic risk, further elevating stroke severity (Brass, 2004). Additionally, women are more likely to live alone and may experience delays in seeking emergency care, leading to missed opportunities for timely interventions such as thrombolysis (Phan et al., 2019). These factors collectively contribute to the heightened stroke severity seen in women across various populations.

Hemorrhagic stroke cases in our cohort had markedly higher mean NIHSS scores (≈ 23.0 vs. ≈ 13.9), which can be attributed to distinct pathophysiological mechanisms attributable to differing pathophysiological processes. Intracranial hemorrhage results in increased intracranial pressure, extensive tissue injury, and rapid neurological deterioration. In contrast to ischemic strokes, which may benefit from prompt reperfusion therapy, hemorrhagic strokes have limited acute intervention options. Our study indicates that higher NIHSS scores are associated with patients experiencing hemorrhagic stroke. Evidence from international research, including the systematic review by Sheth (2022), confirms that intracerebral hemorrhage carries a higher case fatality and poorer functional outcomes. Similarly, (Jibril et al., 2025) emphasized the aggressive and unpredictable nature of spontaneous hemorrhagic events. These findings highlight the need for earlier detection, targeted interventions, and stronger post-acute care strategies to mitigate the impact of hemorrhagic strokes, particularly in resource-limited settings.

Patients with coronary artery disease (CAD) or renal/cardiac comorbidities demonstrated markedly increased NIHSS scores (about 21 compared to around 13.0). Recent investigations have strengthened the correlation between systemic cardiovascular problems and heightened stroke severity. Patients with CAD frequently have more severe strokes resulting from significant vascular disease, such as large-vessel stenosis and plaque instability, which increase their susceptibility to bigger infarcts and diminished brain perfusion. This is compounded by (Hemmati et al., 2025) A number of additional risk factors include hypertension and atrial fibrillation. A study indicated that CAD was independently linked to increased initial stroke severity and poorer long-term outcomes.

Similarly, individuals with renal failure exhibit heightened stroke severity, likely due to chronic inflammation, endothelial dysfunction, and impaired cerebral autoregulation. These factors contribute to an increased risk of embolic events and larger infarcts. A study by Hemmati et al. (2025) reported that chronic renal function impairment increases the risk of acute ischemic stroke, greater stroke severity, and post-stroke mortality.

Patients with heart failure experience heightened stroke severity due to factors including diminished cardiac output, increased thromboembolic risk, and compromised cerebral perfusion. Research by Hu et al. (2025) demonstrated that heart failure is an independent risk factor for severe stroke outcomes, with patients displaying elevated NIHSS scores and reduced functional recovery.

Smokers in our sample had higher NIHSS scores (≈ 19.5 vs. ~ 13.6), aligning with current evidence linking smoking to increased stroke burden. Smoking contributes to vascular injury, promotes atherosclerosis, and increases blood coagulability, all of which elevate the risk of large-vessel occlusion and more severe stroke presentations. Recent studies, such as those (Luo et al. (2022) and Zhao et al. (2020)), affirm that cardiovascular events, such as large-artery strokes or cardioembolic strokes, are more common in smokers and are associated with worse neurological impairments. Prevention of strokes and post-stroke care, especially for high-risk individuals, should incorporate smoking cessation measures, as our findings show.

Lower financial status was significantly correlated with higher stroke severity (NIHSS scores; $r = 0.428$, $p = 0.009$), suggesting that individuals with poorer economic standing tend to suffer more severe strokes. Recent international research corroborates this

association: a hospital-based analysis in Jakarta found that patients with indicators of lower SES—such as lower education, unemployment, and out-of-pocket payment—had higher odds of presenting with moderate-to-severe strokes (NIHSS > 4) compared to those with higher SES (adjusted OR \approx 1.5–1.7). (Yamanie et al., 2023) In addition, regardless of the kind of stroke, a meta-analysis and systematic review of more than 150,000 stroke survivors showed that people with low income had a higher chance of experiencing disability and poor functional outcomes (pooled odds ratio of about 1.36 for low income vs. high income). (Nguyen et al., 2024).

Stroke severity and insurance status were not the only factors that predicted a poor prognosis for low-income individuals in South China. (adjusted OR \sim 1.84) (Wang et al., 2019)

Financially disadvantaged people may have less access to preventative care, delayed acute care owing to cost or transportation, and lower health literacy. Socioeconomic issues may lead to poorly regulated vascular risk factors and delayed management, worsening neurological impairment at presentation. The findings are significant. They emphasize social determinants of health in stroke care programs, especially in low- and middle-income countries like Palestine. Subsidized or universal health access, community-based screening, and educational outreach could reduce stroke severity and outcome disparities.

Upper extremity motor function exhibited a statistically significant enhancement over three months, with the mean FMUE score increasing from 18 at baseline to 36.5 at follow-up, reflecting a clinically significant increase of 18.5 points. The recovery trajectory corresponds closely with findings from recent extensive observational data: a systematic review and meta-analysis conducted in 2024 indicated that stroke survivors receiving standard care generally exhibit an improvement of about 12 points on the Fugl-Meyer Upper Extremity scale within 12 weeks, and up to 16 points by 24 weeks. (Kolmos et al., 2025a; Xue et al., 2022). Three-month robotic-assisted training research demonstrated median improvements of 9.6 points in upper limb Fugl-Meyer scores, with more significant enhancements observed in proximal (shoulder/elbow) function, indicating potential for early motor recovery. These comparisons indicate that, even in environments with constrained rehabilitation resources, patients can attain upper extremity improvements comparable to worldwide standards when afforded persistent follow-up and functional care. The noted enhancement verifies that early subacute therapies, whether traditional or

augmented by task-specific practice, are efficacious in facilitating significant motor advancements.(Pila et al., 2017)

Even in settings with limited resources, such as Palestine, it is crucial to maintain rehabilitative continuity beyond the acute phase, as these findings demonstrate. They stress the importance of early and ongoing assistance for the healing of the upper limbs and provide evidence that task-oriented, repeated practice (including community-based or low-cost modalities) may be beneficial.

Multiple key factors affect upper extremity motor recovery after stroke, as indicated by variations in Fugl-Meyer Upper Extremity (FMUE) scores. Individuals with stroke without diabetes mellitus exhibited significantly greater enhancements in FMUE scores compared to their counterparts with diabetes ($p = 0.001$). This aligns with findings from (Yang et al., 2021), Diabetes has been shown to adversely affect motor recovery, likely due to compromised neuroplasticity and microvascular dysfunction that disrupt central nervous system repair processes. Hyperglycemia correlates with increased infarct sizes and greater white matter damage, potentially restricting functional recovery.

Secondly, patients who received thrombolytic therapy (tPA) demonstrated significantly greater improvement in the upper limb ($p = 0.026$). Early reperfusion with tPA enhances recovery by minimizing infarct size and preserving the functional integrity of cortical and subcortical motor pathways. Research by Fan et al. (2025) confirms that tPA administration within the therapeutic window is associated with improved long-term outcomes, including motor recovery, due to better preservation of neural tissue.

FMUE outcomes were also enhanced by referral to rehabilitation services ($p = 0.023$) and outpatient physical therapy ($p = 0.012$). Structured, repetitive, task-oriented rehabilitation programs, more popular in outpatient settings, promote cortical reorganisation and functional gains. This matches a systematic review. by Gladstone, Danells, Black, et al. (2002), which validated the Fugl-Meyer Assessment as a responsive and reliable tool for capturing changes in motor function after targeted rehabilitation. Additionally, a more recent study by Coupar et al., 2(012) drove recovery of the upper limbs following a stroke by emphasising the significance of extensive, interdisciplinary therapy. Taken as a whole, these results stress the significance of medical treatment (such as thrombolysis), the negative consequences of co-morbid diseases (such as diabetes), and the benefit of organised rehabilitation in determining the paths to recovery after a stroke. Based on these findings, it is critical to identify patients at high risk and develop individualised

rehabilitation plans to help them recover as quickly as possible. Stroke survivors with diabetes and those with little therapy exposure should be the focus of future studies aimed at improving rehabilitation availability and efficacy.

Improvements in upper limb motor function, measured by the FMUE, showed robust and significant correlations with a range of functional and rehabilitation-related outcomes. Firstly, FMUE gains were very strongly linked to gait velocity improvement ($\rho = 0.799$, $p = 0.001$), illustrating the interdependence of upper and lower limb recovery and overall mobility enhancement post-stroke. This is supported by findings that gait speed improvements often reflect broader neuroplastic recovery in motor networks, especially when coordinated therapy targets both upper and lower limb function (Physical therapy for stroke rehabilitation)(Řasová et al., 2024). A strong positive correlation with ARAT improvement ($\rho = 0.645$, $p < 0.001$) confirms the concurrent validity of FMUE as a sensitive measure of upper limb recovery, consistent with systematic assessments demonstrating similar trajectories between ARAT and FMUE in detecting functional change over time (Valladares et al., 2024; Wolf et al., 2021).

Finally, FMUE improvement moderately correlated with the number of outpatient physical therapy sessions ($\rho = 0.457$, $p = 0.009$), reinforcing the concept of a dose–response relationship in stroke rehabilitation, where increased therapy frequency leads to better motor outcomes (Kolmos et al., 2025b).

Collectively, these correlations underscore the holistic nature of neurorecovery; upper limb function does not improve in isolation but reflects interconnected progress across multiple domains. These data emphasize the need for integrated rehabilitation programs that optimize therapy dosage, target both upper and lower extremities, and monitor progress using validated tools such as the FMUE and ARAT.

The multivariate regression model explained a remarkable 96% of the variance in FMUE improvement ($R^2 = 0.960$, Adjusted $R^2 = 0.946$, $p < 0.001$), highlighting several key predictors:

- Diabetes Mellitus emerged as the strongest negative predictor ($B = -24.343$, $p < 0.001$). This finding is consistent with systematic reviews indicating that diabetes impairs post-stroke neuroplasticity, limits functional gains, and is associated with slower recovery trajectories largely due to chronic inflammation, microvascular

dysfunction, and reduced cortical reorganization capacity (Mosenzon et al., 2023; Sweetnam et al., 2012).

- The total of Physical Therapy, both at home and in the hospital, was strongly associated with better FMUE outcomes. Meta-analyses show that greater therapy dose and higher training intensity significantly enhance motor recovery in both upper and lower limbs. Additionally, inpatient psychotherapy sessions contributed positively to FMUE improvement, reflecting how addressing emotional health and motivation facilitates engagement in physical rehabilitation and improves functional outcomes (Hodgson et al., 2025).
- The severity of stroke, assessed using the NIHSS, was another notable predictor. Elevated beginning severity scores correlated with diminished FMUE gains, aligning with the results of (Zhang et al., 2024), which indicated an inverse relationship between baseline NIHSS scores and upper limb recovery trajectories.
- Motor recovery is significantly inversely related to patient age. This result supports (Millot et al., 2024) who found that neuroplasticity and rehabilitative responsiveness are typically better in younger persons. Patients with a higher body mass index (BMI) had better functional results following a stroke, according to FMUE, which found a positive correlation between BMI and FMUE gains. Potential factors include improved nutritional status and rehabilitation tolerance in patients with higher BMI; however, the exact mechanisms are still up for debate. After a stroke, a person's body mass index (BMI) should be taken into account while making plans for rehabilitation due to the complex function it may play in the healing process (Becerril-Gaitan et al., 2023). Further investigation is needed to justify and explain this finding of a positive association between improvement and BMI
- Stroke type appeared as a significant predictor, with patients with ischemic stroke exhibiting superior recovery in FMUE compared to those with hemorrhagic stroke. This could be justified by the fact that both ischemic and hemorrhagic strokes will result in varying levels of ischemia; meanwhile, in hemorrhagic stroke, we have additional disabled components, represented in the pressures of the hematoma, which may affect even non-vasculopathy components (Girgenti et al., 2024).

Our results indicate a statistically significant enhancement in Fugl-Meyer Lower Extremity (FMLE) scores, increasing from a mean of 19 at baseline to 29 at the three-month follow-

up, reflecting an average improvement of 10 points. This level of recovery corresponds with the minimally clinically important difference (MCID) of 6 points, as determined in chronic stroke populations (Hiragami et al., 2019), and is significantly higher than the standard test–retest measurement error of approximately 1.8 points (Sullivan et al., 2011). Recent prospective data from the Korean Stroke Cohort, which examined over 1,000 patients, indicated that lower extremity recovery rates at three months average 67% of maximal potential based on initial impairment, reinforcing the notion that early motor recovery typically transpires rapidly and uniformly during this post-acute phase (H. H. Lee et al., 2022). A thorough meta-analysis of motor imagery therapies revealed an average FMA-LE gain of 4.9 points (95% CI: 4.3–5.4) in subacute to chronic stroke patients, indicating that well-structured rehabilitative techniques can consistently facilitate lower limb improvements of this magnitude. (Liu et al., 2023), The observed 10-point FMLE gain in our cohort aligns with the generally recognized range of recovery trajectories and underscores the therapeutic significance of the improvement. The therapies and care pathway implemented were deemed suitable and aligned with effective rehabilitation practices.

Our research indicates that early and systematic rehabilitation—specifically physical therapy (PT) and occupational therapy (OT) during hospitalization and inpatient rehabilitation—correlates significantly with improved lower extremity motor recovery, as assessed by FMLE scores. This is consistent with international stroke care guidelines, which advocate for early mobilization and specific task training (Winstein et al., 2016a). Additional evidence is provided by outcome studies indicating that heightened intensity and specialized therapy during function-focused sessions result in enhanced functional improvements in mobility (Bode et al., 2004). Moreover, while the uptake of OT in outpatient settings was lower, those who received such care nonetheless showed favorable recovery trajectories—supporting the value of continuity of therapy beyond discharge. Though speech therapy (ST) primarily addresses communication and swallowing, inpatient access to ST was also linked to better FMLE outcomes, potentially due to enhanced cognitive engagement and motivation, which have been shown to support motor rehabilitation as part of a multidisciplinary approach (Mulhern, 2023). The analysis revealed that, alongside the utilization of rehabilitation services, various demographic and clinical variables were significantly correlated with enhancements in lower extremity motor function. Stroke lateralization proved to be a significant factor: patients with left

hemispheric strokes exhibited greater FMLE improvement than those with right-sided lesions. This may indicate lateralized disparities in motor planning and recovery potential, as previous studies suggest that left hemisphere strokes—particularly in right-handed individuals—may maintain attention and spatial processing functions critical for motor relearning.(Sahyoun et al., 2004; Verheyden et al., 2008)

Spearman correlation analysis demonstrated multiple statistically significant correlations with enhancements in Fugl-Meyer Lower Extremity (FMLE) scores. Age exhibited a moderate negative correlation, signifying diminished motor recovery with increasing age. Conversely, robust positive correlations were noted with functional outcomes, such as the Barthel Index, ARAT, indicating simultaneous enhancements in motor and functional capabilities.

Furthermore, FMUE enhancement exhibited a moderate positive correlation with FMLE advancements, underscoring the synchronized recovery of upper and lower limbs. In terms of service utilization, inpatient rehabilitation therapies such as physical therapy, occupational therapy, speech therapy, and psychotherapy exhibited a positive correlation with FMLE enhancement, underscoring the significance of comprehensive, multidisciplinary inpatient care.(Veerbeek et al., 2014)

Multivariate regression analysis revealed that gender, smoking status, osteoarthritis, and coronary artery disease (CAD) are significant independent predictors of enhancement in Fugl-Meyer Lower Extremity (FMLE) scores. Although gender exhibited a slight effect, aligning with recent studies that suggest negligible Gender differences in motor recovery post-stroke(Phan et al., 2018), smoking emerged as a significant negative predictor, underscoring its detrimental influence on vascular integrity and neuroplasticity.(Liang et al., 2021) Osteoarthritis independently forecasted diminished motor recovery, presumably due to constraints in joint mobility and pain that hinder effective engagement in rehabilitation programs(Musa & Keegan, 2018). Likewise, CAD was linked to reduced FMLE improvement, highlighting the cumulative impact of cardiovascular comorbidity on stroke rehabilitation results.(Cuccurullo et al., 2024)

These findings underscore the necessity of addressing comorbidities such as smoking, osteoarthritis, and coronary artery disease in individualized stroke rehabilitation strategies to enhance lower limb motor recovery.

Participants demonstrated a significant progress in Barthel Index (BI) scores during the 3-month follow-up, increasing from a mean of 25.28 to 58.44, with the range expanding from 0–85 at baseline to 0–100 at follow-up. The increase was statistically significant, indicating notable improvements in independence regarding activities of daily living. This is consistent with findings from a regional study in Malaysia, which reported an increase in BI scores from 35.1 at discharge to 71.5 at three months, reflecting a significant improvement that highlights the swift functional recovery commonly observed in the critical post-stroke period (Mandić, 2012). Research in the Jordan context demonstrates significant contrary correlations between baseline NIHSS and subsequently BI scores, suggesting that increased neurological severity is associated with diminished functional gains, a finding that aligns with our results (Alawneh et al., 2022b).

Analysis indicated that patients with left-sided strokes demonstrated significantly greater enhancements in Barthel Index (BI) scores relative to those with right-sided lesions. This finding aligns with results from a prospective cohort study conducted in Serbia, which indicated that patients with left-hemiparesis exhibited greater improvements in self-care and mobility compared to those with right-sided stroke, and were more likely to regain independence. (Mandić, 2012) Furthermore, participants who underwent physiotherapy during hospital admission exhibited significantly improved BI recovery, highlighting the significance of early, structured rehabilitation. This effect has been similarly evidenced in randomized trials, which indicated that early physical therapy resulted in quicker functional enhancements (Fang et al., 2003).

Multivariate analysis revealed several key predictors that are significantly associated with improvements in Barthel Index (BI) scores among stroke survivors. A greater number of total sessions of physical therapy (PT) and occupational therapy (OT) during inpatient rehabilitation was significantly associated with improved functional independence. This is consistent with the AVERT trial (Bernhardt et al., 2015), which showed that early, intensive, and task-specific rehabilitation significantly enhances activities of daily living (ADL) outcomes. Additionally, psychotherapy delivered in inpatient environments emerged as a positive predictor, likely indicating the significance of addressing emotional and cognitive factors that affect motivation and engagement in recovery (Ayerbe et al., 2013).

Socioeconomic factors, particularly financial status, demonstrated a significant positive impact on BI improvement, aligning with regional studies that suggest access to resources and support systems enhances rehabilitation adherence and outcomes(Al-Jadid, 2014).

Stroke type significantly affected recovery trajectories, with ischemic stroke patients typically showing greater gains in the Barthel Index compared to those with hemorrhagic strokes. This supports findings that ischemic strokes tend to facilitate more predictable neuroplastic adaptation(Shida et al., 2023). The presence of renal or cardiac failure was linked to diminished functional gains, highlighting the influence of comorbidities on rehabilitation outcomes.

Referral to rehabilitation facilities and receiving physical therapy at home were significant predictors, highlighting the importance of ongoing and comprehensive post-discharge rehabilitation services, as outlined in the AHA/ASA stroke rehabilitation guidelines. (Winstein et al., 2016c).

The number of children predicted the Barthel Index score improvement, suggesting that family support is crucial to stroke recovery. Having additional children can boost patient motivation, emotional support, and practical assistance throughout rehabilitation. Training family members, especially children, in basic rehabilitation and care behaviors is essential for maintaining therapeutic gains beyond formal settings. Community-based rehabilitation (CBR) programs, which integrate family carers and local resources, increase functional outcomes by improving continuity of treatment, patient adherence, and hospital readmissions

(Saadatnia et al., 2020; Walker et al., 2013). In locations with limited access to specialized rehabilitation facilities, family empowerment via education and support is essential to comprehensive stroke rehabilitation.

The Action Research Arm Test (ARAT) showed a 15.88-point increase in upper limb motor performance from 5.5 at baseline to 21.38 at the 3-month follow-up. Previous upper limb rehabilitation trials found similar recovery(Simić-Panić et al., 2018). found that constraint-induced mobility therapy improved stroke patients' ARAT by 17 points over 3 months. These findings emphasize comprehensive upper limb rehabilitation in the subacute phase post-stroke. Conversely, comorbidities including diabetes mellitus, hypertension, osteoarthritis, and renal or cardiac failure were linked to diminished upper limb recovery. Chronic conditions likely contribute to systemic inflammation, diminished muscle performance, and restricted tolerance to intensive rehabilitation, collectively impeding

motor outcomes(Simić-Panić et al., 2018b). Moreover, patients exhibiting greater baseline stroke severity, as indicated by NIHSS scores, showed diminished ARAT gains, underlying the prognostic significance of initial neurological impairment on recovery potential.

Financial and employment status were identified as socioeconomic determinants; individuals with higher income or current employment demonstrated significantly greater improvement, likely attributable to enhanced access to follow-up services, transportation, and home support. This highlights the significance of social determinants in stroke rehabilitation, indicating that functional recovery encompasses both biological and social dimensions.

According to participation, it seems less rational to examine participation level in the first week of stroke, especially since some patients stay in the hospital, and it's the researcher's advice to test participation one week after discharge from the hospital to examine the effect of stroke on participation level

4.2 Study Limitations

1. The sample size was relatively small because of time and financial restrictions; a bigger sample size could have drawn a better picture of the variation in outcomes between patients.
2. Convenience sampling was employed, which may introduce selection bias and limit the generalizability of the findings to the wider stroke population.
3. The content of rehabilitation sessions was not documented, limiting the ability to assess the quality and nature of care within the rehabilitation services and settings.
4. Access to thrombolytic therapy (tPA) is limited in Palestine due to infrastructural and logistical barriers, which may have influenced the baseline severity and recovery trajectory of the patients included in this study.
5. Patents were tested using new kinematic assessment tools, using a laptop camera, and for functional tasks (Appendix 10), we could not use this data due to the restriction on software access for financial reasons. Otherwise, the task's performance could have been tracked in terms of angle, velocity, time, and distance to the object to complete the functional task that represented shoulder, elbow, wrist synergists (Appendix 11)
6. Travel restrictions and roadblocks due to regional instability and conflict created challenges in reaching or inviting participants for follow-up, especially in border or

high-conflict zones, which made us decide on a three-month follow-up instead of 6 months or more, where the patient could be more stable and the ultimate rehabilitation outcome could be documented.

Chapter Five

Conclusion and Recommendation

5.1 Conclusion:

This cohort study was conducted in Hebron to investigate stroke rehabilitation outcomes, using tools that reflect the three levels of ICF at baseline and follow-up (3 months)

The key findings are summarized as follows:

The socioeconomic profile of the participants revealed that over half of the stroke patients reported fair to poor socioeconomic status, with an equal distribution between males and females. Nearly half of the participants were not referred to rehabilitation services after hospital discharge. Furthermore, two-thirds of the patients did not receive any rehabilitation services in hospitals, inpatient units, or outpatient clinics, and only one-quarter received physical therapy at home. While physiotherapy was the most accessible service across settings, occupational therapy, speech therapy, and psychological support were mainly limited to inpatient care, indicating a substantial gap in comprehensive rehabilitation service provision.

In terms of comorbidities, the most prevalent conditions were hypertension, diabetes mellitus, and coronary artery disease. Notably, the prevalence of diabetes in this cohort was nearly double that reported in similar studies from the Middle East. Overweight was also a major characteristic among the participants.

At the impairment level, statistically significant improvements were observed in both upper and lower extremity function, as measured by the Fugl-Meyer Assessment. Improvement in upper extremity function (FMUE) was significantly associated with age,

body mass index (BMI), type and severity of stroke (NIHSS), presence of diabetes mellitus, and the total amount of physical therapy received across home, hospital, and inpatient settings. Similarly, lower extremity improvement (FMLE) was predicted by gender, smoking status, osteoarthritis (OA), coronary artery disease (CAD), and inpatient physical therapy.

Regarding functional activity, both the Barthel Index and Action Research Arm Test (ARAT) demonstrated significant improvements. Predictors of better Barthel Index scores included number of children, financial status, stroke type, referral to rehabilitation, and receipt of physical, occupational, and psychological therapy in inpatient settings, as well as physical therapy at home. ARAT improvements were associated with diabetes mellitus, hypertension, OA, financial status, stroke severity, employment status, physical therapy at home, and outpatient occupational therapy.

However, despite improvements in impairment and activity levels, no statistically significant improvement was observed in participation level at the three-month follow-up, as measured by the Adapted Participation Questionnaire, highlighting a gap in post-stroke social reintegration.

5.2 Recommendations

Based on the results and discussion presented in the previous sections, the research recommends the following:

5.2.1 For the researcher

1. To make the follow-up for research, the researcher recommended conducting a follow-up of patients at 6 months or even one year if it was possible, because it gives a better stable view of the change between baseline and follow-up.
2. Researchers are encouraged to document the content and structure of rehabilitation sessions (e.g., gait training, trunk control, task-specific therapy) to enable more detailed evaluation of treatment effectiveness.
3. To adopt an RCT that incorporates evidence-based and clinical guidelines of rehabilitation in one group and compare it with the results of the common current standard rehabilitation
4. Recommend the use of digital and objective outcome measures to assess improvement, such as GATE-LAB, myometers, and functional MRI.

5.2.2 For the clinician and Health worker

1. Proper patient and care governance concerning available rehabilitation options and suitable referral pathways during hospital discharge planning should be emphasized, as they represent a big part of the reasons behind not using rehabilitation and settings.
2. Based on the results of affordability and accessibility of rehabilitation services to promote the possibility of community-based rehabilitation (CBR) initiatives as a culturally relevant, sustainable approach to enhance accessibility and results.
3. To encourage and enable a period of inpatient rehabilitation, as results showed that frequency and intensity of rehabilitation services in these settings were associated with multidisciplinary rehabilitation and services, and better impairment and functional rehabilitation outcomes.
4. Stress the importance of incorporating multidisciplinary rehabilitation services in outpatient and home settings.
5. Clinicians must proactively identify and address modifiable risk factors, including obesity, hypertension, and diabetes, in the context of stroke recovery planning.

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Appendixes

Appendix 1: Data Collection Sheet



Faculty of Health Professions

Physiotherapy & Rehabilitation Department

Jerusalem – Abu Dies

Master of Physiotherapy (MPT)

“Predictors of Stroke Rehabilitation Outcome”

Participant Name: _____

Participant Code: _____

Date of Signature: _____

1. Personal Data:

1.	Name:	
2.	Age:	
3.	Gender:	
4.	Marital Status:	
5.	Address:	
6.	Employment Status:	
7.	Financial Status:	
8.	BMI:	
9.	Weight:	
10.	Height:	
11.	No. children	
12.	Phone Number:	

2. Medical History:

1.	Date of Stroke:	
2.	Type of Stroke:	
3.	Recurrent / first stroke	
4.	Location:	
5.	Comorbidities	
6.	Side of stroke	

3. Rehabilitation Services:

3.1 Hospital:

Type of treatment	Did you receive (yes/no)	Frequency (Hours per week)	Intensity (Average of session)	Duration of the Whole rehabilitation	Average H/w family involvement	Average H/w personal involving
PT						
OT						
Speech						
Psych						

3.2 Home:

Type of treatment	Did you receive (yes/no)	Frequency (Hours per week)	Intensity (Average of session)	Duration of the Whole rehabilitation	Average H/w family involvement	Average H/w personal involving
PT						
OT						
Speech						
Psych						

3.3 Outpatient

Type of treatment	Did you receive (yes/no)	Frequency (Hours per week)	Intensity (Average of session)	Duration of the Whole rehabilitation	Average H/w family involvement	Average H/w personal involving
PT						
OT						
Speech						
Psych						

3.4 Inpatient

Type of treatment	Did you receive (yes/no)	Frequency (Hours per week)	Intensity (Average of session)	Duration of the Whole rehabilitation	Average H/w family involvement	Average H/w personal involving
PT						
OT						
Speech						
Psych						

4. Outcome Measures:

	Outcome Measures	Baseline	3-month Follow Up
1.	Adapted Palestinian participation questionnaire		
2.	NIHSS		
3.	Fugl Mayer's upper limbs		
4.	Fugl Mayer's lower limbs		
5.	Barthel Index		
6.	10 MWT		
7.	ARAT		

Appendix 2: Adapted Palestinian Questionnaire

Adapted Participation Questionnaire (AAPQ)

Based on the participation survey and focus groups

AAPQ is an Arab community adapted participation items questionnaire, which is a culturally adapted general, social, religious, and leisure participation activities, as part of the ICF related to Arab community elderly Participation practices and behavior based on the elderly community survey and focus groups.

To assess the participation, before and after the age of 65(As Aging impact) or before and after a disease or injury (As participation impact post a disease or injury). At each item, give (0) for a completely negative answer, score 5 for occasional, and 10 for frequent or as regularly as possible.

NO	Item of participation	Participation Before	Participation After
1.	Visiting friends or relatives		
2.	Visited by friends or relatives		
3.	Manage your own financial issues		
4.	Going to paid work		
5.	Voluntary activities (union, societies, charity, political)		
6.	Public Social Gatherings (Clubs attendance, mosques or churches)		
7.	Practices any physical hobbies (gardening, sport, walking)		
8.	Takes care of family in any way (cooking, shopping, fixing objects)		
9.	Participation in social events (congratulations ceremonies and condolences for family or friends)		
10.	Spends passive leisure time during the day (newspaper, TV, cinema, computer, and social media)		
Total participation Before and after		A. Total ____ / 100	B. Total ____ / 100

Participation Impact percent (%) = A – B _____%

Developed by Dr. Akram Amro. 2017

Appendix 3: National Institutes of Health Stroke Scale (NIHSS)

NIH STROKE SCALE

Patient Identification. _____ - _____ - _____

Pt. Date of Birth ____/____/____

Hospital _____ (____ - ____)

Date of Exam ____/____/____

Interval: Baseline 2 hours post treatment 24 hours post onset of symptoms \pm 20 minutes 7-10 days
 3 months Other _____ (____)

Time: ____:____ []am []pm

Person Administering Scale _____

Administer stroke scale items in the order listed. Record performance in each category after each subscale exam. Do not go back and change scores. Follow directions provided for each exam technique. Scores should reflect what the patient does, not what the clinician thinks the patient can do. The clinician should record answers while administering the exam and work quickly. Except where indicated, the patient should not be coached (i.e., repeated requests to patient to make a special effort).

Instructions	Scale Definition	Score
<p>1a. Level of Consciousness: The investigator must choose a response if a full evaluation is prevented by such obstacles as an endotracheal tube, language barrier, orotracheal trauma/bandages. A 3 is scored only if the patient makes no movement (other than reflexive posturing) in response to noxious stimulation.</p>	<p>0 = Alert; keenly responsive. 1 = Not alert; but arousable by minor stimulation to obey, answer, or respond. 2 = Not alert; requires repeated stimulation to attend, or is obtunded and requires strong or painful stimulation to make movements (not stereotyped). 3 = Responds only with reflex motor or autonomic effects or totally unresponsive, flaccid, and areflexic.</p>	_____
<p>1b. LOC Questions: The patient is asked the month and his/her age. The answer must be correct - there is no partial credit for being close. Aphasic and stuporous patients who do not comprehend the questions will score 2. Patients unable to speak because of endotracheal intubation, orotracheal trauma, severe dysarthria from any cause, language barrier, or any other problem not secondary to aphasia are given a 1. It is important that only the initial answer be graded and that the examiner not "help" the patient with verbal or non-verbal cues.</p>	<p>0 = Answers both questions correctly. 1 = Answers one question correctly. 2 = Answers neither question correctly.</p>	_____
<p>1c. LOC Commands: The patient is asked to open and close the eyes and then to grip and release the non-paretic hand. Substitute another one step command if the hands cannot be used. Credit is given if an unequivocal attempt is made but not completed due to weakness. If the patient does not respond to command, the task should be demonstrated to him or her (pantomime), and the result scored (i.e., follows none, one or two commands). Patients with trauma, amputation, or other physical impediments should be given suitable one-step commands. Only the first attempt is scored.</p>	<p>0 = Performs both tasks correctly. 1 = Performs one task correctly. 2 = Performs neither task correctly.</p>	_____
<p>2. Best Gaze: Only horizontal eye movements will be tested. Voluntary or reflexive (oculocephalic) eye movements will be scored, but caloric testing is not done. If the patient has a conjugate deviation of the eyes that can be overcome by voluntary or reflexive activity, the score will be 1. If a patient has an isolated peripheral nerve palsy (CN III, IV or VI), score a 1. Gaze is testable in all aphasic patients. Patients with ocular trauma, bandages, pre-existing blindness, or other disorder of visual acuity or fields should be tested with reflexive movements, and a choice made by the investigator. Establishing eye contact and then moving about the patient from side to side will occasionally clarify the presence of a partial gaze palsy.</p>	<p>0 = Normal. 1 = Partial gaze palsy; gaze is abnormal in one or both eyes, but forced deviation or total gaze paresis is not present. 2 = Forced deviation, or total gaze paresis not overcome by the oculocephalic maneuver.</p>	_____

Rev 10/1/2003

N I H STROKE SCALE

Patient Identification. _____ - _____ - _____

Pt. Date of Birth ____/____/____

Hospital _____ (____ - ____)

Date of Exam ____/____/____

Interval: Baseline 2 hours post treatment 24 hours post onset of symptoms ±20 minutes 7-10 days
 3 months Other _____ (____)

<p>7. Limb Ataxia: This item is aimed at finding evidence of a unilateral cerebellar lesion. Test with eyes open. In case of visual defect, ensure testing is done in intact visual field. The finger-nose-finger and heel-shin tests are performed on both sides, and ataxia is scored only if present out of proportion to weakness. Ataxia is absent in the patient who cannot understand or is paralyzed. Only in the case of amputation or joint fusion, the examiner should record the score as untestable (UN), and clearly write the explanation for this choice. In case of blindness, test by having the patient touch nose from extended arm position.</p>	<p>0 = Absent. 1 = Present in one limb. 2 = Present in two limbs. UN = Amputation or joint fusion, explain: _____</p>	<p>_____</p>
<p>8. Sensory: Sensation or grimace to pinprick when tested, or withdrawal from noxious stimulus in the obtunded or aphasic patient. Only sensory loss attributed to stroke is scored as abnormal and the examiner should test as many body areas (arms [not hands], legs, trunk, face) as needed to accurately check for hemisensory loss. A score of 2, "severe or total sensory loss," should only be given when a severe or total loss of sensation can be clearly demonstrated. Stuporous and aphasic patients will, therefore, probably score 1 or 0. The patient with brainstem stroke who has bilateral loss of sensation is scored 2. If the patient does not respond and is quadriplegic, score 2. Patients in a coma (item 1a=3) are automatically given a 2 on this item.</p>	<p>0 = Normal; no sensory loss. 1 = Mild-to-moderate sensory loss; patient feels pinprick is less sharp or is dull on the affected side; or there is a loss of superficial pain with pinprick, but patient is aware of being touched. 2 = Severe to total sensory loss; patient is not aware of being touched in the face, arm, and leg.</p>	<p>_____</p>
<p>9. Best Language: A great deal of information about comprehension will be obtained during the preceding sections of the examination. For this scale item, the patient is asked to describe what is happening in the attached picture, to name the items on the attached naming sheet and to read from the attached list of sentences. Comprehension is judged from responses here, as well as to all of the commands in the preceding general neurological exam. If visual loss interferes with the tests, ask the patient to identify objects placed in the hand, repeat, and produce speech. The intubated patient should be asked to write. The patient in a coma (item 1a=3) will automatically score 3 on this item. The examiner must choose a score for the patient with stupor or limited cooperation, but a score of 3 should be used only if the patient is mute and follows no one-step commands.</p>	<p>0 = No aphasia; normal. 1 = Mild-to-moderate aphasia; some obvious loss of fluency or facility of comprehension, without significant limitation on ideas expressed or form of expression. Reduction of speech and/or comprehension, however, makes conversation about provided materials difficult or impossible. For example, in conversation about provided materials, examiner can identify picture or naming card content from patient's response. 2 = Severe aphasia; all communication is through fragmentary expression; great need for inference, questioning, and guessing by the listener. Range of information that can be exchanged is limited; listener carries burden of communication. Examiner cannot identify materials provided from patient response. 3 = Mute, global aphasia; no usable speech or auditory comprehension.</p>	<p>_____</p>
<p>10. Dysarthria: If patient is thought to be normal, an adequate sample of speech must be obtained by asking patient to read or repeat words from the attached list. If the patient has severe aphasia, the clarity of articulation of spontaneous speech can be rated. Only if the patient is intubated or has other physical barriers to producing speech, the examiner should record the score as untestable (UN), and clearly write an explanation for this choice. Do not tell the patient why he or she is being tested.</p>	<p>0 = Normal. 1 = Mild-to-moderate dysarthria; patient slurs at least some words and, at worst, can be understood with some difficulty. 2 = Severe dysarthria; patient's speech is so slurred as to be unintelligible in the absence of or out of proportion to any dysphasia, or is mute/anarthric. UN = Intubated or other physical barrier, explain: _____</p>	<p>_____</p>

N I H STROKE SCALE

Patient Identification. ____ - ____ - ____

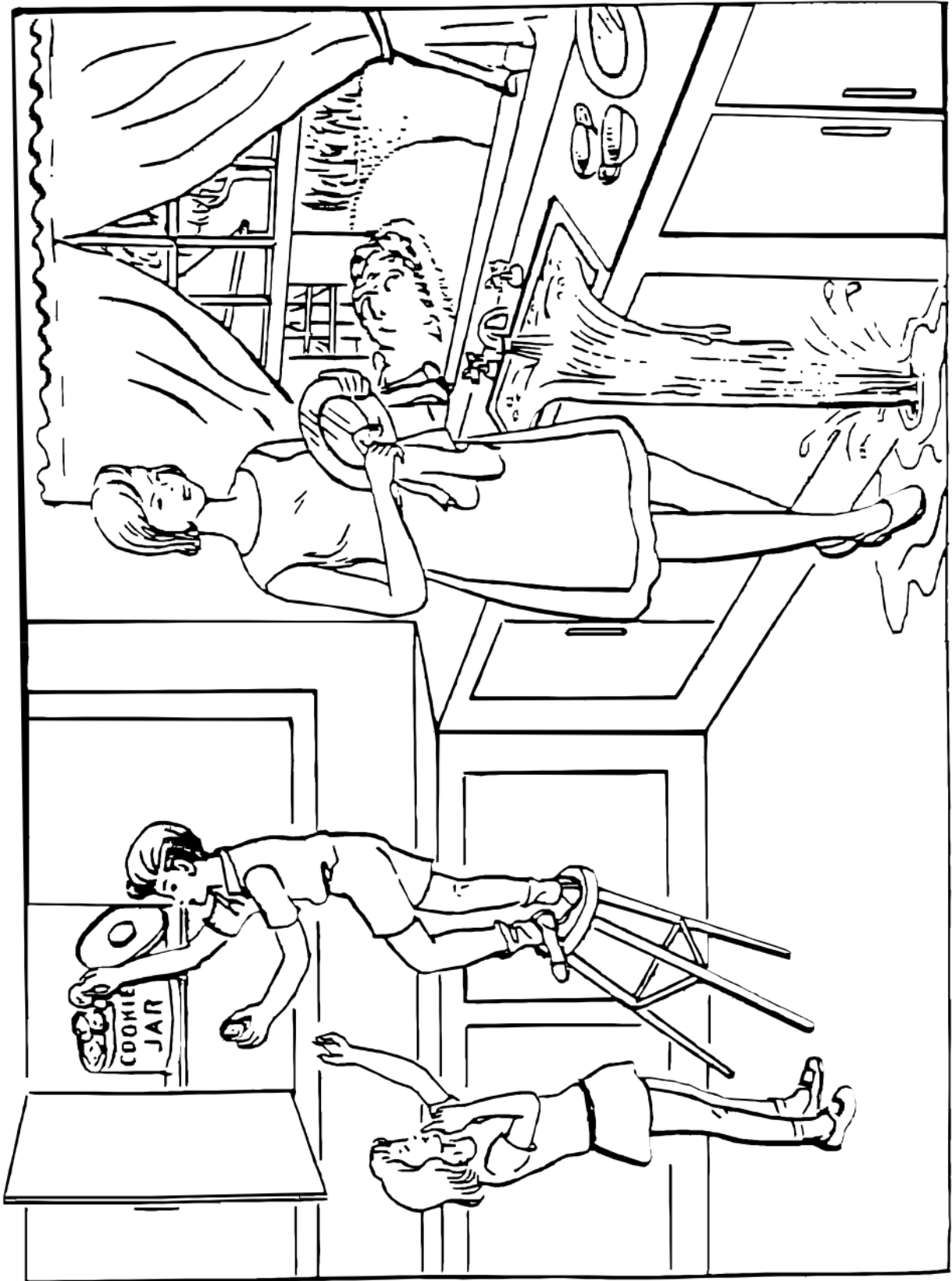
Pt. Date of Birth ____ / ____ / ____

Hospital _____ (____ - ____)

Date of Exam ____ / ____ / ____

Interval: Baseline 2 hours post treatment 24 hours post onset of symptoms \pm 20 minutes 7-10 days
 3 months Other _____ (____)

<p>11. Extinction and Inattention (formerly Neglect): Sufficient information to identify neglect may be obtained during the prior testing. If the patient has a severe visual loss preventing visual double simultaneous stimulation, and the cutaneous stimuli are normal, the score is normal. If the patient has aphasia but does appear to attend to both sides, the score is normal. The presence of visual spatial neglect or anosagnosia may also be taken as evidence of abnormality. Since the abnormality is scored only if present, the item is never untestable.</p>	<p>0 = No abnormality.</p> <p>1 = Visual, tactile, auditory, spatial, or personal inattention or extinction to bilateral simultaneous stimulation in one of the sensory modalities.</p> <p>2 = Profound hemi-inattention or extinction to more than one modality; does not recognize own hand or orients to only one side of space.</p>	<p>_____</p> <p>_____</p>
---	--	---------------------------



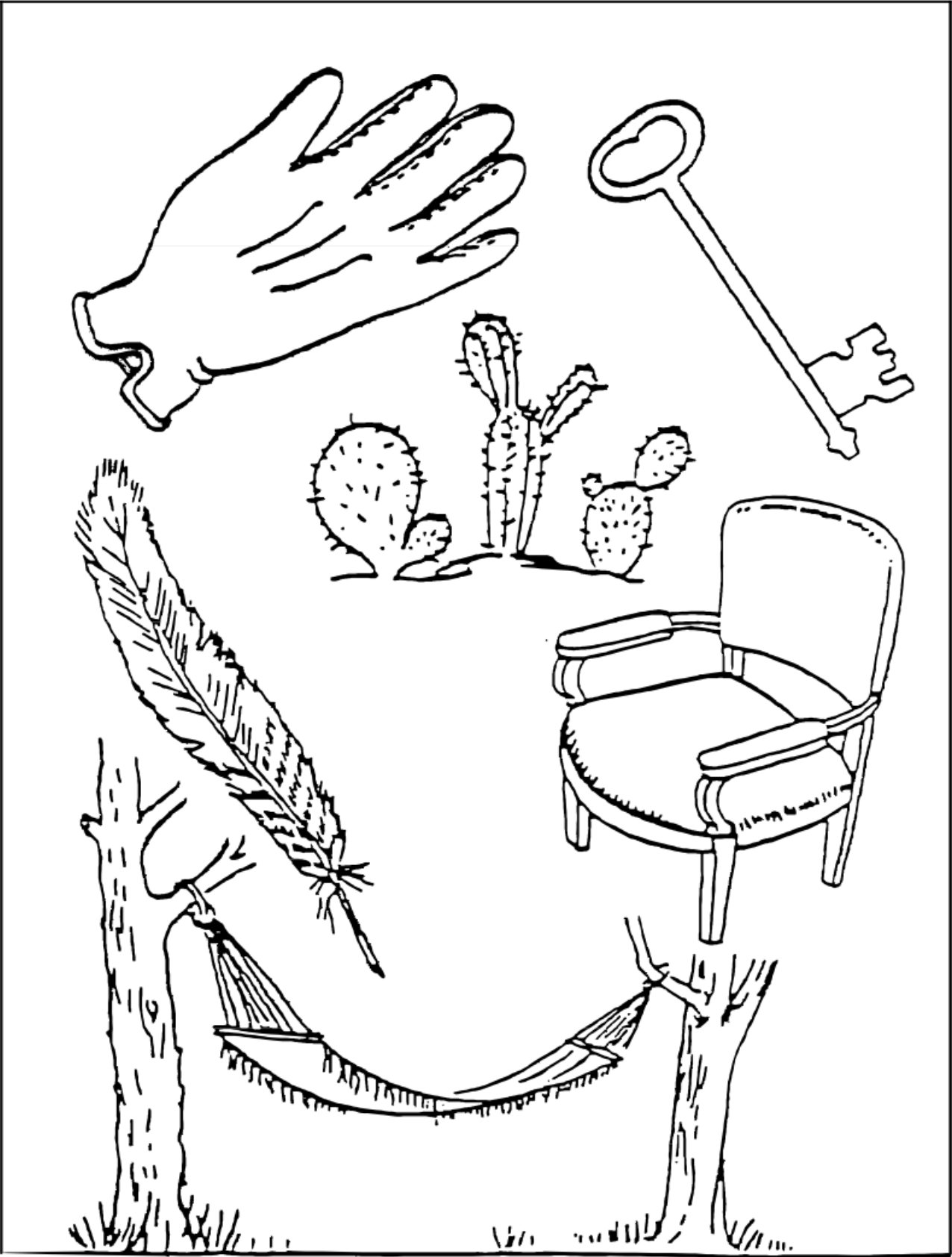
You know how.

Down to earth.

I got home from work.

**Near the table in the dining
room.**

**They heard him speak on the
radio last night.**



MAMA
TIP – TOP
FIFTY – FIFTY
THANKS
HUCKLEBERRY
BASEBALL PLAYER

Appendix 4 Fugl-Meyer Assessment for Upper Extremity

FMA-UE PROTOCOL

Rehabilitation Medicine, University of Gothenburg

FUGL-MEYER ASSESSMENT UPPER EXTREMITY (FMA-UE) Assessment of sensorimotor function

ID:
Date:
Examiner:

Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S: The post-stroke hemiplegic patient. A method for evaluation of physical performance. Scand J Rehabil Med 1975, 7:13-31.

A. UPPER EXTREMITY , sitting position				
I. Reflex activity		none	can be elicited	
Flexors: biceps and finger flexors (at least one)		0	2	
Extensors: triceps		0	2	
Subtotal I (max 4)				
II. Volitional movement within synergies , without gravitational help		none	partial	full
Flexor synergy: Hand from contralateral knee to ipsilateral ear. From extensor synergy (shoulder adduction/ internal rotation, elbow extension, forearm pronation) to flexor synergy (shoulder abduction/ external rotation, elbow flexion, forearm supination). Extensor synergy: Hand from ipsilateral ear to the contralateral knee	Shoulder retraction	0	1	2
	Shoulder elevation	0	1	2
	Shoulder abduction (90°)	0	1	2
	Shoulder external rotation	0	1	2
	Elbow flexion	0	1	2
	Forearm supination	0	1	2
	Shoulder adduction/internal rotation	0	1	2
	Elbow extension	0	1	2
Forearm pronation	0	1	2	
Subtotal II (max 18)				
III. Volitional movement mixing synergies , without compensation		none	partial	full
Hand to lumbar spine hand on lap	cannot perform or hand in front of ant-sup iliac spine hand behind ant-sup iliac spine (without compensation) hand to lumbar spine (without compensation)	0	1	2
Shoulder flexion 0°- 90° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 90°, no shoulder abduction or elbow flexion	0	1	2
Pronation-supination elbow at 90° shoulder at 0°	no pronation/supination, starting position impossible limited pronation/supination, maintains starting position full pronation/supination, maintains starting position	0	1	2
Subtotal III (max 6)				
IV. Volitional movement with little or no synergy		none	partial	full
Shoulder abduction 0 - 90° elbow at 0° forearm pronated	immediate supination or elbow flexion supination or elbow flexion during movement abduction 90°, maintains extension and pronation	0	1	2
Shoulder flexion 90° - 180° elbow at 0° pronation-supination 0°	immediate abduction or elbow flexion abduction or elbow flexion during movement flexion 180°, no shoulder abduction or elbow flexion	0	1	2
Pronation/supination elbow at 0° shoulder at 30°- 90° flexion	no pronation/supination, starting position impossible limited pronation/supination, maintains start position full pronation/supination, maintains starting position	0	1	2
Subtotal IV (max 6)				
V. Normal reflex activity assessed only if full score of 6 points is achieved in part IV; compare with the unaffected side		0 (IV), hyper	lively	normal
biceps, triceps, finger flexors	2 of 3 reflexes markedly hyperactive or 0 points in part IV 1 reflex markedly hyperactive or at least 2 reflexes lively maximum of 1 reflex lively, none hyperactive	0	1	2
Subtotal V (max 2)				
Total A (max 36)				

B. WRIST support may be provided at the elbow to take or hold the starting position, no support at wrist, check the passive range of motion prior testing		none	partial	full
Stability at 15° dorsiflexion elbow at 90°, forearm pronated shoulder at 0°	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion / volar flexion elbow at 90°, forearm pronated shoulder at 0°, slight finger flexion	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Stability at 15° dorsiflexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	less than 15° active dorsiflexion dorsiflexion 15°, no resistance tolerated maintains dorsiflexion against resistance	0	1	2
Repeated dorsiflexion / volar flexion elbow at 0°, forearm pronated slight shoulder flexion/abduction	cannot perform volitionally limited active range of motion full active range of motion, smoothly	0	1	2
Circumduction elbow at 90°, forearm pronated shoulder at 0°	cannot perform volitionally jerky movement or incomplete complete and smooth circumduction	0	1	2
Total B (max 10)				

C. HAND support may be provided at the elbow to keep 90° flexion, no support at the wrist, compare with unaffected hand, the objects are interposed, active grasp		none	partial	full
Mass flexion from full active or passive extension		0	1	2
Mass extension from full active or passive flexion		0	1	2
GRASP				
a. Hook grasp flexion in PIP and DIP (digits II-V), extension in MCP II-V	cannot be performed can hold position but weak maintains position against resistance	0	1	2
b. Thumb adduction 1-st CMC, MCP, IP at 0°, scrap of paper between thumb and 2-nd MCP joint	cannot be performed can hold paper but not against tug can hold paper against a tug	0	1	2
c. Pincer grasp, opposition pulpa of the thumb against the pulpa of 2-nd finger, pencil, tug upward	cannot be performed can hold pencil but not against tug can hold pencil against a tug	0	1	2
d. Cylinder grasp cylinder shaped object (small can) tug upward, opposition of thumb and fingers	cannot be performed can hold cylinder but not against tug can hold cylinder against a tug	0	1	2
e. Spherical grasp fingers in abduction/flexion, thumb opposed, tennis ball, tug away	cannot be performed can hold ball but not against tug can hold ball against a tug	0	1	2
Total C (max 14)				

D. COORDINATION/SPEED , sitting, after one trial with both arms, eyes closed, tip of the index finger from knee to nose, 5 times as fast as possible		marked	slight	none
Tremor	at least 1 completed movement	0	1	2
Dysmetria at least 1 completed movement	pronounced or unsystematic slight and systematic no dysmetria	0	1	2
		≥ 6s	2 - 5s	< 2s
Time start and end with the hand on the knee	at least 6 seconds slower than unaffected side 2-5 seconds slower than unaffected side less than 2 seconds difference	0	1	2
Total D (max 6)				

TOTAL A-D (max 66)				
H. SENSATION , upper extremity eyes closed, compared with the unaffected side		anesthesia	hypoesthesia or dysesthesia	normal
Light touch	upper arm, forearm	0	1	2
	palmary surface of the hand	0	1	2
		less than 3/4 correct or absence	3/4 correct or considerable difference	correct 100%, little or no difference
Position small alterations in the position	shoulder	0	1	2
	elbow	0	1	2
	wrist	0	1	2
	thumb (IP-joint)	0	1	2
Total H (max12)				

J. PASSIVE JOINT MOTION , upper extremity, sitting position, compare with the unaffected side				J. JOINT PAIN during passive motion, upper extremity		
	only few degrees (less than 10° in shoulder)	decreased	normal	pronounced pain during movement or very marked pain at the end of the movement	some pain	no pain
Shoulder						
Flexion (0° - 180°)	0	1	2	0	1	2
Abduction (0°-90°)	0	1	2	0	1	2
External rotation	0	1	2	0	1	2
Internal rotation	0	1	2	0	1	2
Elbow						
Flexion	0	1	2	0	1	2
Extension	0	1	2	0	1	2
Forearm						
Pronation	0	1	2	0	1	2
Supination	0	1	2	0	1	2
Wrist						
Flexion*	0	1	2	0	1	2
Extension	0	1	2	0	1	2
Fingers						
Flexion	0	1	2	0	1	2
Extension	0	1	2	0	1	2
Total (max 24)				Total (max 24)		

A. UPPER EXTREMITY	/36
B. WRIST	/10
C. HAND	/14
D. COORDINATION / SPEED	/ 6
TOTAL A-D (motor function)	/66

H. SENSATION	/12
J. PASSIVE JOINT MOTION	/24
J. JOINT PAIN	/24

Appendix 5 Fugl-Meyer Assessment for Lower Extremity

FMA-LE PROTOCOL

Rehabilitation Medicine, University of Gothenburg

FUGL-MEYER ASSESSMENT LOWER EXTREMITY (FMA-LE) Assessment of sensorimotor function

ID:
Date:
Examiner:

Fugl-Meyer AR, Jaasko L, Leyman I, Olsson S, Steglind S: The post-stroke hemiplegic patient. I. a method for evaluation of physical performance. Scand J Rehabil Med 1975, 7:13-31.

E. LOWER EXTREMITY				
I. Reflex activity , supine position		none	can be elicited	
Flexors: knee flexors		0	2	
Extensors: patellar, achilles (at least one)		0	2	
Subtotal I (max 4)				
II. Volitional movement within synergies supine position		none	partial	full
Flexor synergy: Maximal hip flexion (abduction/external rotation), maximal flexion in knee and ankle joint (palpate distal tendons to ensure active knee flexion). Extensor synergy: From flexor synergy to the hip extension/adduction, knee extension and ankle plantar flexion. Resistance is applied to ensure active movement, evaluate both movement and strength (compare with the unaffected side)	Hip flexion	0	1	2
	Knee flexion	0	1	2
	Ankle dorsiflexion	0	1	2
	Hip extension	0	1	2
	Knee adduction	0	1	2
	Ankle extension	0	1	2
Subtotal II (max 14)				
III. Volitional movement mixing synergies sitting position, knee 10cm from the edge of the chair/bed		none	partial	full
Knee flexion from actively or passively extended knee	no active motion less than 90° active flexion, palpate tendons of hamstrings more than 90° active flexion	0	1	2
Ankle dorsiflexion compare with unaffected side	no active motion limited dorsiflexion complete dorsiflexion	0	1	2
Subtotal III (max 4)				
IV. Volitional movement with little or no synergy standing position, hip at 0°		none	partial	full
Knee flexion to 90° hip at 0°, balance support is allowed	no active motion or immediate, simultaneous hip flexion less than 90° knee flexion and/or hip flexion during movement at least 90° knee flexion without simultaneous hip flexion	0	1	2
Ankle dorsiflexion compare with unaffected side	no active motion limited dorsiflexion complete dorsiflexion	0	1	2
Subtotal IV (max 4)				
V. Normal reflex activity supine position, assessed only if full score of 4 points is achieved in part IV, compare with the unaffected side		hyper	lively	normal
Reflex activity knee flexors, Patellar, Achilles,	2 of 3 reflexes markedly hyperactive 1 reflex markedly hyperactive or at least 2 reflexes lively maximum of 1 reflex lively, none hyperactive	0	1	2
Subtotal V (max 2)				
Total E (max 28)				

F. COORDINATION/SPEED , supine, after one trial with both legs, eyes closed, heel to knee cap of the opposite leg, 5 times as fast as possible		marked	slight	none
Tremor		0	1	2
Dysmetria	pronounced or unsystematic slight and systematic no dysmetria	0	1	2
		≥ 6s	2 - 5s	< 2s
Time	6 or more seconds slower than unaffected side 2-5 seconds slower than unaffected side less than 2 seconds difference	0	1	2
Total F (max 6)				

H. SENSATION , lower extremity eyes closed, compare with the unaffected side		anesthesia	hypoesthesia or dysesthesia	normal
Light touch	leg foot sole	0 0	1 1	2 2
		less than 3/4 correct or absence	3/4 correct or considerable difference	correct 100%, little or no difference
Position	hip knee ankle great toe (IP-joint)	0 0 0 0	1 1 1 1	2 2 2 2
Total H (max12)				

I. PASSIVE JOINT MOTION , lower extremity supine position, compare with the unaffected side				J. JOINT PAIN during passive motion, lower extremity			
	only few degrees (<10° hip)	decreased	normal	pronounced pain during movement or very marked pain at the end of the movement	some pain	no pain	
Hip	Flexion	0	1	2	0	1	2
	Abduction	0	1	2	0	1	2
	External rotation	0	1	2	0	1	2
	Internal rotation	0	1	2	0	1	2
Knee	Flexion	0	1	2	0	1	2
	Extension	0	1	2	0	1	2
Ankle	Dorsiflexion	0	1	2	0	1	2
	Plantar flexion	0	1	2	0	1	2
Foot	Pronation	0	1	2	0	1	2
	Supination	0	1	2	0	1	2
Total (max 20)				Total (max 20)			

E. LOWER EXTERMTY	/28
F. COORDINATION / SPEED	/6
TOTAL E-F (motor function)	/34

H. SENSATION	/12
I. PASSIVE JOINT MOTION	/20
J. JOINT PAIN	/20

Appendix 6 Action Research Arm Test (ARAT)

ACTION RESEARCH ARM TEST

Patient Name: _____

Rater Name: _____

Date: _____

Instructions

There are four subtests: Grasp, Grip, Pinch, Gross Movement. Items in each are ordered so that:

- if the subject passes the first, no more need to be administered and he scores top marks for that subtest;
- if the subject fails the first *and* fails the second, he scores zero, and again no more tests need to be performed in that subtest;
- otherwise he needs to complete all tasks within the subtest

Activity	Score
Grasp	
1. Block, wood, 10 cm cube (If score = 3, total = 18 and to Grip) Pick up a 10 cm block	_____
2. Block, wood, 2.5 cm cube (If score = 0, total = 0 and go to Grip) Pick up 2.5 cm block	_____
3. Block, wood, 5 cm cube	_____
4. Block, wood, 7.5 cm cube	_____
5. Ball (Cricket), 7.5 cm diameter	_____
6. Stone 10 x 2.5 x 1 cm	_____
Coefficient of reproducibility = 0.98	
Coefficient of scalability = 0.94	
Grip	
1. Pour water from glass to glass (If score = 3, total = 12, and go to Pinch)	_____
2. Tube 2.25 cm (If score = 0, total = 0 and go to Pinch)	_____
3. Tube 1 x 16 cm	_____
4. Washer (3.5 cm diameter) over bolt	_____
Coefficient of reproducibility = 0.99	
Coefficient of scalability = 0.98	
Pinch	
1. Ball bearing, 6 mm, 3 rd finger and thumb (If score = 3, total = 18 and go to Grossmt)	_____
2. Marble, 1.5 cm, index finger and thumb (If score = 0, total = 0 and go to Grossmt)	_____
3. Ball bearing 2 nd finger and thumb	_____
4. Ball bearing 1 st finger and thumb	_____
5. Marble 3 rd finger and thumb	_____
6. Marble 2 nd finger and thumb	_____
Coefficient of reproducibility = 0.99	
Coefficient of scalability = 0.98	

Grossmt (Gross Movement)

1. Place hand behind head (If score = 3, total = 9 and finish) _____
2. (If score = 0, total = 0 and finish) _____
3. Place hand on top of head _____
4. Hand to mouth _____

Coefficient of reproducibility = 0.98

Coefficient of scalability = 0.97

References

Carroll D. "A quantitative test of upper extremity function."
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De Weerd WJG, Harrison MA. "Measuring recovery of arm-hand function in stroke patients: a comparison of the Brunnstrom-Fugl-Meyer test and the Action Research Arm test."
Physiotherapy Canada. 1985;37:65-70.

Lyle RC. "A performance test for assessment of upper limb function in physical rehabilitation treatment and research."
[Int J Rehabil Res](#). 1981;4:483-492.

Appendix 7: Barthel Index

THE BARTHEL INDEX

Patient Name: _____

Rater Name: _____

Date: _____

Activity	Score
FEEDING 0 = unable 5 = needs help cutting, spreading butter, etc., or requires modified diet 10 = independent	_____
BATHING 0 = dependent 5 = independent (or in shower)	_____
GROOMING 0 = needs to help with personal care 5 = independent face/hair/teeth/shaving (implements provided)	_____
DRESSING 0 = dependent 5 = needs help but can do about half unaided 10 = independent (including buttons, zips, laces, etc.)	_____
BOWELS 0 = incontinent (or needs to be given enemas) 5 = occasional accident 10 = continent	_____
BLADDER 0 = incontinent, or catheterized and unable to manage alone 5 = occasional accident 10 = continent	_____
TOILET USE 0 = dependent 5 = needs some help, but can do something alone 10 = independent (on and off, dressing, wiping)	_____
TRANSFERS (BED TO CHAIR AND BACK) 0 = unable, no sitting balance 5 = major help (one or two people, physical), can sit 10 = minor help (verbal or physical) 15 = independent	_____
MOBILITY (ON LEVEL SURFACES) 0 = immobile or < 50 yards 5 = wheelchair independent, including corners, > 50 yards 10 = walks with help of one person (verbal or physical) > 50 yards 15 = independent (but may use any aid; for example, stick) > 50 yards	_____
STAIRS 0 = unable 5 = needs help (verbal, physical, carrying aid) 10 = independent	_____
TOTAL (0-100): _____	

The Barthel ADL Index: Guidelines

1. The index should be used as a record of what a patient does, not as a record of what a patient could do.
2. The main aim is to establish degree of independence from any help, physical or verbal, however minor and for whatever reason.
3. The need for supervision renders the patient not independent.
4. A patient's performance should be established using the best available evidence. Asking the patient, friends/relatives and nurses are the usual sources, but direct observation and common sense are also important. However direct testing is not needed.
5. Usually the patient's performance over the preceding 24-48 hours is important, but occasionally longer periods will be relevant.
6. Middle categories imply that the patient supplies over 50 per cent of the effort.
7. Use of aids to be independent is allowed.

References

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- Collin C, Wade DT, Davies S, Horne V. "The Barthel ADL Index: a reliability study." *Int Disability Study*.1988;10:61-63.

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Mahoney FI, Barthel D. "Functional evaluation: the Barthel Index."
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Appendix 8 Ethical Approval from Al Quds University Research Ethics Committee

Al-Quds University
Jerusalem
Deanship of Scientific Research



جامعة القدس
القدس
عمادة البحث العلمي

Research Ethics Committee
Committee's Decision Letter

Date: February 25, 2025
Ref No: 513/REC/2025

Dears Dr. Akram Amro, Ms. Malak Wazwaz,

Thank you for submitting your research ethics application. After reviewing your submission titled: "Predictors of Stroke Rehabilitation Outcome", the Research Ethics Committee (REC) at Al-Quds University confirms that your application aligns with our ethics guidelines, which are based on the principles outlined in the Declaration of Helsinki.

Please note that this approval does not replace other required permissions, such as for sample shipment or data sharing. We also request a copy of your final report or publication when available.

This approval is valid for two years. If your research extends beyond this period, a renewal request will be necessary. The approval remains valid as long as there are no changes to the research protocol.

Sincerely,

Suheir Ereqat, PhD
Associate Professor of Molecular Biology



Research Ethics Committee Chair

Cc. Prof. Imad Abu Kishek - President
Cc. Members of the committee
Cc. file

Abu-Dies, Jerusalem P.O.Box 20002
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تلفاكس: #970-02-2791293

Appendix 9 Information Sheet



نموذج تعريف ومعلومات عن البحث

اسم البحث: المتنبئات بنتائج إعادة التأهيل لدى مرضى السكتة الدماغية لأول مرة في مدينة الخليل، فلسطين

اسم الباحث: ملاك وزوز.

تحية طيبة وبعد،

نشكركم لاستعدادكم للمشاركة بهذا البحث، الذي هو جزء من دراسة الماجستير في العلاج الطبيعي في جامعة القدس. والذي يهدف إلى التعرف مؤشرات نتائج إعادة التأهيل بعد السكتة الدماغية.

معلومات عن طبيعة الدراسة، والفحوصات التي سيتم تقديمها لمرضى الجلطات الدماغية:

من خلال هذه الدراسة، نهدف الى تقديم برنامج فحوصات لمرضى الجلطات الدماغية في مدينة الخليل والذي مر على اصابته ما لا يزيد عن أسبوع، حيث نستهدف في هذا البرنامج مرضى الجلطات الدماغية في مدينة الخليل وقراها، وسيتم فحص المرضى في عيادة خارجية في مدينة الخليل.

يتكون هذا البرنامج من جلستين شاملتين لجميع الفحوصات بحيث تكون الجلسة الأولى في الأسبوع الأول بعد اخذ موافقة المريض، وتكون الجلسة الثانية كجلسة متابعة بعد ثلاثة شهور، بحيث سوف تكون مدة الجلسة من 45 دقيقة الى 60 دقيقة.

من الجدير ذكره أن الجلسات سوف تكون فردية وتعتمد بشكل أساسي على قدرة المريض، بحيث يتضمن البرنامج مستويات مختلفة من الفحوصات حسب تصنيف منظمة الصحة العالمية للإعاقة والأداء الوظيفي والمشارك، والتي تتكون من:

1. استبيان المشاركة الفلسطيني المعدل (APPQ) هو نسخة مُعدّلة أو مُكيّفة ثقافيًا من أحد أدوات تقييم المشاركة، تم تصميمه لقياس مستوى مشاركة الأفراد، وخاصة الناجين من السكتة الدماغية أو الأشخاص ذوي الإعاقة، في السياق الفلسطيني.

يأخذ هذا التكييف بعين الاعتبار العوامل الاجتماعية والاقتصادية والثقافية والبيئية الفريدة لفلسطين، مثل الوصول إلى خدمات إعادة التأهيل، أنظمة الدعم الاجتماعي، قيود الحركة بسبب البنية التحتية، والأدوار المجتمعية. قد يقيم الاستبيان المجالات الأساسية التالية:

- الأنشطة اليومية والعناية الذاتية
- المشاركة في العمل والتوظيف
- التفاعل المجتمعي والاجتماعي
- الأنشطة الترفيهية وأوقات الفراغ
- الوصول إلى خدمات إعادة التأهيل والرعاية الصحية
- الحواجز البيئية والمجتمعية.

2. مقياس السكتة الدماغية للمعاهد الوطنية للصحة (NIHSS): هو أداة سريرية تُستخدم على نطاق واسع لتقييم شدة السكتة الدماغية ومراقبة تقدم المرضى خلال مراحل العلاج وإعادة التأهيل. تم تطويره بواسطة المعاهد الوطنية للصحة (NIH) ويُعتبر معيارًا عالميًا في تقييم التأثير العصبي للسكتة الدماغية.

3. تقييم Fugl-Meyer للطرف العلوي: هو أداة معيارية تُستخدم على نطاق واسع في تقييم ضعف الحركة، الوظيفة الحركية، والتعافي العصبي لدى مرضى السكتة الدماغية، مع تركيز خاص على الطرف العلوي (الذراع واليد).

4. **تقييم Fugl-Meyer للطرف السفلي:** هو أداة قياس معيارية تُستخدم لتقييم الوظيفة الحركية للطرف السفلي لدى مرضى السكتة الدماغية.

5. **اختبار أبحاث الحركة للذراع (ARAT - Action Research Arm Test)** اختبار أبحاث الحركة للذراع (ARAT) هو أداة معيارية تُستخدم لتقييم الوظيفة الحركية لليد والذراع بعد السكتة الدماغية أو إصابات الجهاز العصبي المركزي. يتميز الاختبار بقدرته على قياس مهارات الإمساك، القبضة، التثبيت، والتلاعب بالأشياء.

6. **مؤشر بارتل (Barthel Index - BI)** هو أداة معيارية تُستخدم لتقييم مستوى الاستقلالية الوظيفية لدى الأفراد الذين يعانون من إعاقات وظيفية، خاصة مرضى السكتة الدماغية. يقيس المؤشر قدرة الشخص على أداء الأنشطة اليومية الأساسية (ADLs)، مثل الأكل، الاستحمام، وارتداء الملابس.

7. **القياسات الحركية لمهام مَدّ والتقاط الأشياء بالطرف العلوي** تشير القياسات الحركية إلى تحليل الحركة الميكانيكية للطرف العلوي أثناء تنفيذ مهام المَدّ والإمساك، مما يساعد في تقييم الأداء الحركي بعد السكتة الدماغية أو إصابات الجهاز العصبي المركزي. تُستخدم هذه القياسات لفهم أنماط الحركة، الكفاءة الحركية، والتنسيق العضلي العصبي أثناء تنفيذ الحركات الوظيفية.

من الجدير التأكيد على التالي:

- تدخل العلاج الطبيعي ليس له اي آثار جانبية او تعريض المريض للخطر وجميع تدابير السلامة سوف تأخذ بعين الاعتبار
- طبيعة الفحوصات التي سوف تستخدم في هذا البحث هي فحوصات أمنة ولا يوجد منها اي ضرر على المريض.
- سيكون هناك فحص اولي عند مقابلة المريض، وآخر للمتابعة بعد ثلاثة شهور.
- تحدث إلى عائلتك وأصدقائك حول هذا الموضوع وخذ وقتك لاتخاذ القرار. إذا قررت المشاركة، يجب عليك توقيع نموذج الموافقة لإظهار رغبتك في المشاركة.
- إن قرار عدم المشاركة أو قرار مغادرة الدراسة لاحقاً لن يؤدي إلى أي عقوبة أو يؤثر على الرعاية الصحية الحالية أو المستقبلية.
- إن اشتراككم في هذا البحث هو طوعي ومرتببط بتوقيعكم على نموذج موافقة بالمشاركة وتصريح فهمكم لطبيعة البحث، فحوصاته. وفي حال وجود اي استفسار عن البحث او اي شيء متعلق بهذه الدراسة، يرجى التواصل مباشرة مع الباحثة (ملاك وزوز) على الرقم

التالي 0599901635

- شاكرين لكم حسن تعاونكم
- ملاك وزوز
- اخصائية علاج طبيعي
- طالبة ماجستير علاج طبيعي
- جامعة القدس

Appendix 10 Informed Consent



Informed consent to participate in Research

نموذج الموافقة على المشاركة بالبحث

اسم البحث: **Predictors of Stroke Rehabilitation Outcomes**

اسم الباحث: ملاك وزوز .

Patient name: _____

Patient code: _____

Evaluator name: _____

Date of evaluation and signature: _____

عزيزي المشارك/المشاركة :

توقيعك أدناه على نموذج الموافقة هذا هو بموجب موافقة مكتوبة وموقعة على المشاركة في دراسة بحثية التي تقوم بها الباحثة ملاك وزوز " **Predictors of Stroke Rehabilitation Outcomes** ". وهو إقرار بأنه قد تم شرح أهداف البحث

وطريقة الفحص, وانه قد تم شرح حقوقك المتضمنة :

- سرية المعلومات التي تصرح بها وعدم إطلاع أي شخص عليها وتخزينها في مكان آمن لا يصل إليه سوى الباحث .
- استخدام المعلومات للأغراض العلمية فقط .
- إخفاء هوية المشارك في تحليل البحث والنتائج .
- حرية انسحابه بأي وقت من الدراسة ومن دون الحاجة لإبداء الأسباب ودون أية عواقب شخصية أو مالية .
- حقك في الإطلاع على نتيجة فحوصاتك ونتائج البحث النهائية .

وأنة في حال كان لديك أسئلة حول الدراسة أو حول أي معلومة متعلقة بها ,يرجى الاتصال بالباحثة : ملك وزوز على رقم
التلفون : **0599901635**

موافقة المشارك/المشاركة:

لقد تم وصف الدراسة البحثية لي شفهيأ , وبما فيه المعلومات المدرجة أعلاه , وأوافق على المشاركة بهذه الدراسة البحثية.
سوف أحصل على نسخة موقعة من هذا النموذج للاحتفاظ بها في سجلاتي .

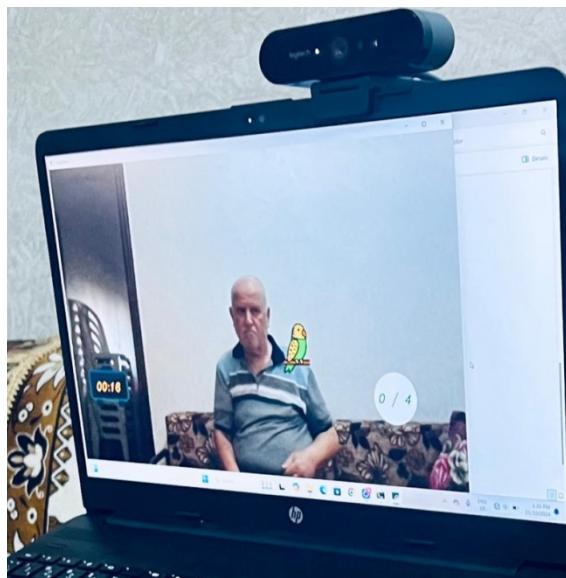
أوافق على المشاركة بهذه الدراسة .

اسم المشارك الرباعي : _____

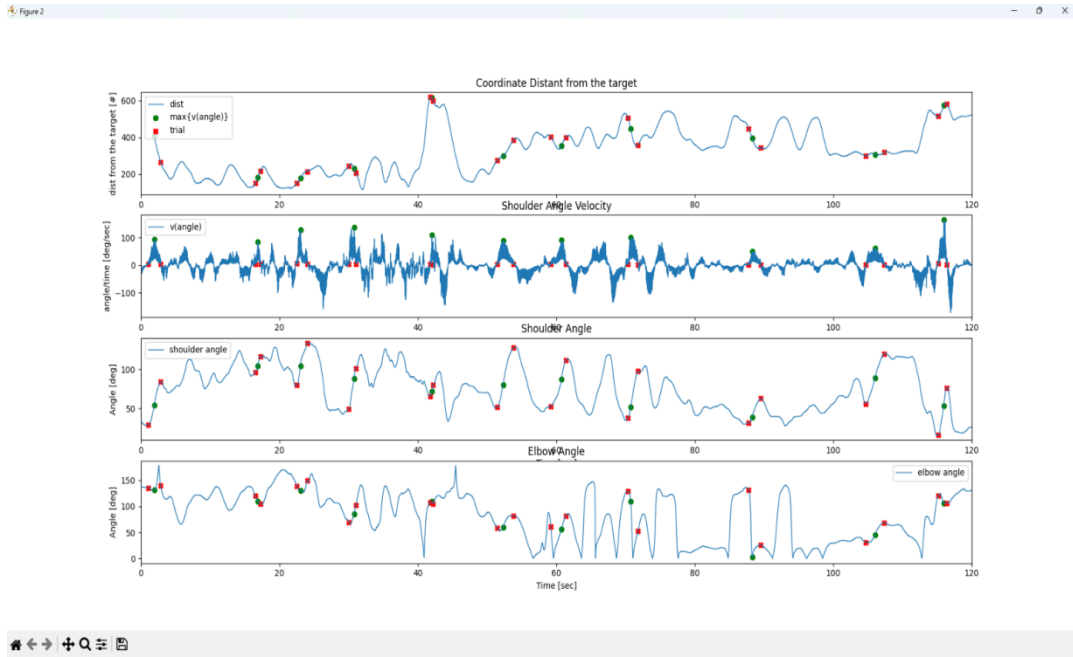
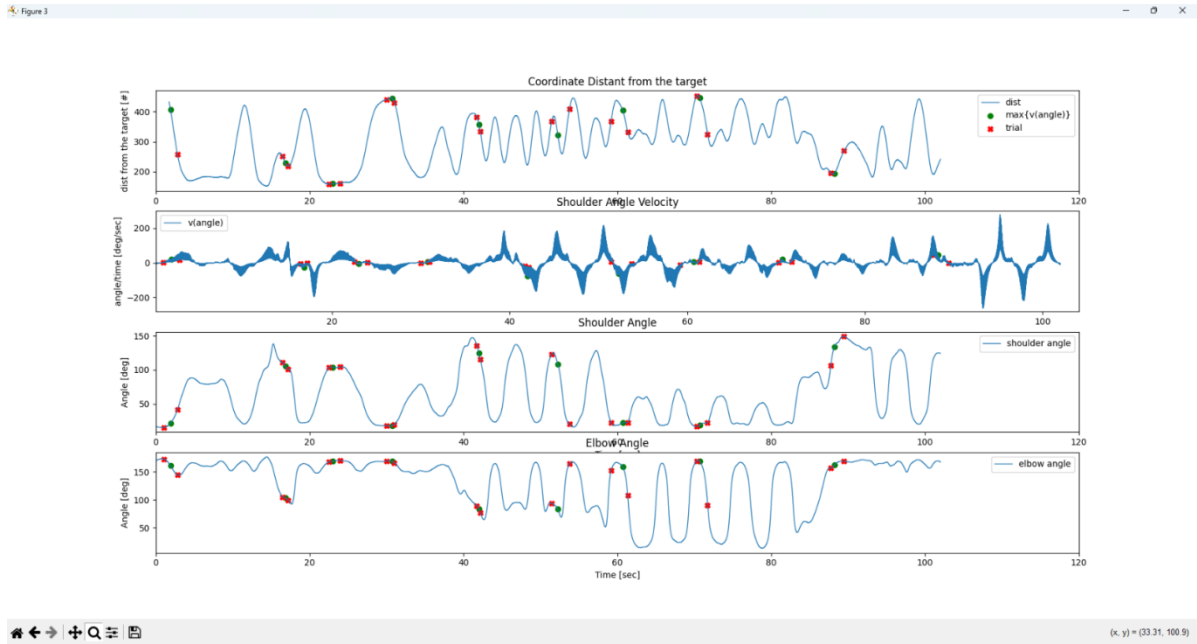
توقيع المشارك _____ التاريخ : _____

اسم وتوقيع الشاهد : _____ التاريخ : _____

Appendix 11 Kinematic Assessment Tool



Appendix 12 Kinematic Figure



المتنبات بنتائج إعادة التأهيل لدى مرضى السكتة الدماغية.

إعداد: ملك عايد عبد المغني عبد الحافظ وزوز

إشراف: د. أكرم عمرو

ملخص

خلفية :

السكتة الدماغية هي السبب الثاني للوفاة وسنوات العمر المعدلة حسب الإعاقة (DALY) على مستوى العالم، حيث يعاني أكثر من 30% من المرضى من صعوبات في الأنشطة اليومية الحركية . (ADLs)تحسن إعادة التأهيل النتائج الوظيفية وجودة الحياة لمرضى السكتة الدماغية. تشمل العوامل التي تؤثر على التعافي شدة الحالة السريرية، والأمراض المصاحبة، والخصائص الديموغرافية، والحالة الاجتماعية والاقتصادية، والوصول إلى الخدمات. في فلسطين، تواجه إعادة تأهيل السكتة الدماغية قيودًا هيكلية، حيث تقدم المنظمات غير الحكومية خدمات العلاج الأساسي بعد السكتة الدماغية.

المنهجية :

أُجريت دراسة جماعية استباقية في مدينة الخليل، فلسطين، وشملت 36 مريضًا يعانون من السكتة الدماغية لأول مرة، تم تجنيدهم من المستشفيات، أكمل 32 مشاركًا التقييمين الأساسي وبعد 3 أشهر. كان متوسط العمر 64.22 سنة، مع توزيع متساوٍ بين الذكور والإناث. تم تقييم نتائج إعادة التأهيل باستخدام أدوات موحدة مستندة إلى تصنيف منظمة الصحة العالمية الدولي للأداء والعجز (ICF) : مقياس فوجل-ماير ومقياس IHSS (المستوى القصور/الإعاقة)، واختبار الأداء الذراعي البحثي (ARAT) ومؤشر بارثل (المستوى النشاط الوظيفي)، واستخدم استبيان المشاركة المعدل لتقييم مستوى المشاركة. كما جُمعت بيانات حول الخصائص الديموغرافية، والأمراض المصاحبة، والوضع الاجتماعي والاقتصادي، ومدى استخدام خدمات إعادة التأهيل عبر مختلف بيئات الرعاية.

النتائج:

أظهرت النتائج تحسناً ذا دلالة إحصائية في مستوى الإعاقة بين التقييم الأساسي والمتابعة بعد 3 أشهر، حسب مقياس فوجل-ماير للطرف العلوي. (FMUE) $(Z = -2.657, p = 0.008)$ تتباً بهذا التحسن كل من العمر، مؤشر كتلة الجسم، نوع وشدة السكتة الدماغية (NIHSS) ، وجود السكري،

وعدد جلسات العلاج الطبيعي في المنزل والمستشفى ومرافق التنويم الداخلي. كما لوحظ تحسن معنوي في وظيفة الطرف السفلي (FMLE) ($Z = -2.621$, $p = 0.009$) ، وتنبأت به عوامل مثل الجنس، التدخين، التهاب المفاصل (OA)، أمراض الشرايين التاجية (CAD)، والعلاج الطبيعي الداخلي. على مستوى النشاط الوظيفي، أظهر مؤشر بارتل تحسناً كبيراً ($Z = -4.787$ ، $p < 0.001$)، مع ارتباط التحسن بعدد الأطفال، الحالة الاقتصادية، نوع السكتة الدماغية، الإحالة إلى التأهيل، والعلاج الطبيعي، المهني، والنفسي في المرافق الداخلية، بالإضافة إلى العلاج الطبيعي في المنزل. وأظهر مقياس ARAT أيضاً تحسناً معنوياً ($Z = -3.521$ ، $p < 0.001$) ، وارتبط بالسكري، ارتفاع ضغط الدم، التهاب المفاصل، الوضع المالي، شدة السكتة الدماغية، الحالة الوظيفية، العلاج الطبيعي المنزلي، والعلاج المهني الخارجي.

أما على مستوى المشاركة، فلم يُسجَل أي تحسن ذي دلالة إحصائية كما تم قياسه باستخدام استبيان المشاركة المعدّل ($Z = -1.387$ ، $p = 0.07$)

الخلاصة:

بعد ثلاثة أشهر من السكتة الدماغية، كانت إعادة التأهيل مرتبطة بتحسينات ذات دلالة إحصائية في مستويات العجز والنشاط الوظيفي. ومع ذلك، لم يُلاحظ أي تغيير كبير في مستوى المشاركة .

الكلمات المفتاحية:

السكتة الدماغية، المؤشرات، التصنيف الدولي للتصنيف الوظيفي والإعاقة والصحة، مستوى العجز، مستوى النشاط الوظيفي، مستوى المشاركة، استخدام مرافق الرعاية.