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Reactive and Proactive Balance Training effects on Balance and Functional Performance among chronic stroke Survivors

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Reactive and Proactive Balance Training effects on Balance and Functional performance among chronic stroke Survivors

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Dedication

Firstly, I would like to thank Allah for reaching this stage, and for giving me the strength and striving to get here. I will always be thankful for everything you gave me.

To the person who supports me all the time in my life and is proud of me, to the greatest father Mohammad, and to the kindest mother who always surrounds me with her prayers, my beautiful mother Hanaa.

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To Al-Quds University for providing this opportunity to complete my advanced studies, and to Dr. Akram Amro, who helped me get here. And to all the patients and their families who participated in this research and helped to complete it.

Declaration

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

I declare that the content of this thesis (or any part of the same) has not been submitted for a higher degree to any other University or institution.

Signed: *Amany*

Name: Amani Mohammed Shaker Abuassba

Date: 28.05.2024

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My regards and Thanks.

Reactive and Proactive Balance Training effects on Balance and Functional performance among chronic stroke Survivors

By: Amani Mohammad Shaker Abuassba

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Abstract:

Background: Falling is a serious problem after a stroke that leads to loss of function and independence. Balance training is one of the most important elements that we need to focus on with our treatment plan for chronic stroke Patients. Most physical therapy interventions utilize proactive balance training, which is an anticipatory and self-initiated approach of strength and balance exercises to improve balance for the prevention of falls. Reactive balance training, on the other hand, is the practice of responses to unexpected perturbations that cause losses of balance, such as a slip, trip, or nudge. This study will highlight the effects of proactive and reactive training among chronic stroke patients.

Methods: This Randomized control trial (RCT) study consisted of 40 chronic stroke patients and was allocated randomly into 2 groups, the intervention group n=20 had reactive-balance training, and the control group n=20 had proactive balance training, the two groups were blinded. This study used the following outcome measures: Fall Efficacy Scale (FES), Time Up & Go (TUG), 10 Meters Walking Test (10MWT), Tinetti Balance Assessment, Mini-BEST, and 2 Minute Walking Test /(2MWT). The outcome measures were measured on all participants at pre- and post.

Results: There was a statistically significant difference at baseline between groups in FES, 10MWT, Tinetti Balance Assessment, and 2MWT. which means that the proactive balance training group was more severe than the reactive balance training group. Both interventions statistically and significantly improved between pre and post-treatment in all of the outcome measures ($p<0.05$). and at post-treatment, there was a statistically significant difference between groups in favor of the reactive balance training group. The main predictors of FES were FES Pre, Type of intervention, Age, 10 MWT, and duration between D.O.S and D.O.A. The TUG predictors were TUG Pre, 10MWT Pre, and Age. The primary predictors for 10MWT were 10MWT Pre, Age, and Gender, while the Tinetti predictors were Tinetti pre, and Gender, and the primary predictors of Mini BEST were Mi-BEST Pre, Type of intervention, Tinetti pre, and Affected Side. While the 2MWT predictors were recurrent stroke. There was a positive correlation between FES and TUG, and Tinetti, and there was a positive correlation between TUG and 10MWT and Mini-BEST (p<0.05).

Conclusion: Reactive balance and proactive balance training significantly improve balance and functional performance among stroke survivors. Reactive balance training was superior than proactive balance training in improving Balance and functional outcome.

Keywords: Stroke, reactive balance training, proactive balance training, falling, prevention of falling, improve balance**.**

تأثير تدريب التوازن التفاعلي وتدريب التوازن الاستباقي على التوازن والأداء الوظيفي لدى الناجين من السكتات الدماغية المزمنة

إعداد: أماني محمد شاكر أبو عصبه

بإشراف: د. أكرم عمرو

ملخص باللغة العربية:

المقدمة: الوقوع يعد مشكلة خطيرة بعد السكتة الدماغية تؤدي إلى فقدان الوظيفة والاستقلالية. و يعد التدريب على التوازن أحد أهم الأشياء التي نحتاج إلى التركيز عليها في خطتنا العلاجية لمرضى السكتة الدماغية المزمنة. تستخدم معظم تدخلات العلاج الطبيعي التدريب الاستباقي على التوازن، وهو أسلوب استباقي ومبادر ذاتياً لتمارين القوة والتوازن لتحسين التوازن للوقاية من الوقوع. ومن ناحية أخرى، فإن التدريب على التوازن التفاعلي هو ممارسة الاستجابات للاضطرابات غير المتوقعة التي تسبب فقدان التوازن، مثل الانزلاق أو التعثر أو الدفع. سوف تسلط هذه الدراسة الضوء على آثار التدريب الاستباقي والتفاعلي بين مرضى السكتة الدماغية المزمنة.

الطريقة: تتألف هذه الدراسة التجريبية العشوائية (single-blinded RCT) من 40 مريضًا بسكتة دماغية مزمنة وتم توزيعهم عشوائيًا إلى مجموعتين، مجموعة التدخل الأولى n = 20 تلقت التدريب على التوازن التفاعلي، والمجموعة الثانية n = 20 تلقت التدريب على التوازن الاستباقي، . استخدمت هذه الدراسة أدوات القياس التالية: FES، TUG، MWT10، Tenetti، Mini-BEST، وMWT2. تم تطبيق أدوات القياس على جميع المشاركين في مرحلة ما قبل وبعد العلاج.

النتائج: كان هناك فرق ذو دلالة إحصائية عند البداية بين المجموعات في أدوات القياس التالية FES، 10 MWT، Tinetti، و2MWT. مما يعني أن مجموعة تدريب التوازن الاستباقي كانت أكثر شدة من مجموعة تدريب التوازن التفاعلي في الفحص القبلي. وكلتا المجموعتين أظهرت تحسناً ذو دلالة احصائية ملحوظة بين الفحص القبلي و البعدي في نتائج جميع أدوات القياس (P <0.05). وفي الفحص البعدي كان هناك فرق ذو دلالة إحصائية بين المجموعات لصالح مجموعة تدريب التوازن التفاعلي. كانت المتنبئات الرئيسية لـ FES هي FES Pre، ونوع التدخل، والعمر، و10MWT Pre ، والمدة بين الجلطة الدماغية والعلاج. كانت متنبئات TUG هي TUG Pre، و10MWT Pre، والعمر. كانت المتنبئات الأولية لـ 10MWT هي 10MWT Pre، والعمر، والجنس، في حين كانت متنبئات Tinetti هي Tinetti pre، والجنس، وكانت المتنبئات الأولية لـMini BEST هي Mi-BEST Pre، ونوع التدخل، وTinetti pre، والجهة المتأثرة بالسكتة الدماغية. بينما كانت المتنبئات بـ 2MWTهي السكتة الدماغية المتكررة. كان هناك ارتباط إيجابي بين FES وTUG، وTinetti، وكان هناك ارتباط إيجابي بين 10MWT TUG وMini-BEST (P<0.05) .

الملخص: لقد أدى التدريب على التوازن التفاعلي والتدريب على التوازن الاستباقي إلى تحسين التوازن والأداء الوظيفي بشكل ملحوظ بين الناجين من السكتات الدماغية. كان التدريب على التوازن التفاعلي أكثر فعالية من التدريب على التوازن الاستباقي في تحسين التوازن والأداء الوظيفي لدى الناجين من السكتات الدماغية.

الكلمات المفتاحية: السكتة الدماغية، التدريب على التوازن التفاعلي، التدريب على التوازن الاستباقي، الوقوع، الوقاية من الوقوع، تحسين التوازن.

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Chapter One: Definition

1.1Introduction

1.2Statement of problem

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1.6Significance of the problems

1.1. Chapter One: Introduction

Stroke is one of the most serious healthcare problems, it's a common condition and a highly prevalent disease among older people and is a major cause of disability and death worldwide(Sacco et al., 2013).The definition of stroke has a long history and has been updated according to the new findings of stroke-related research. However, the American Heart Association defined stroke as a neurological deficit attributed to an injury of the central nervous system (CNS)(Sacco et al., 2013). In addition, stroke is a non-traumatic, focal vascular-induced CNS and typically results in permanent damage in the form of cerebral infarction, intracerebral hemorrhage (ICH), and/or subarachnoid hemorrhage (SAH)(WARD, 1974). Blockage or rupture of an artery to the brain, which leads to loss of the blood flow to the brain and lack of oxygen, which leads at the end to sudden death, and may also lead to disability and loss of function. WHO reported that stroke is the second leading cause of death and the third leading cause of adult disability(Johnson et al., 2016).

The incidence rates of stroke vary between countries, it depends on the nature of life, the most common diseases, and major risk factors in countries. However, the incidence of stroke is higher in males than, in females worldwide, women in the US suffer from 55,000 more strokes yearly than men do, primarily because of variations in life expectancy between the genders and other causes. Stroke prevalence is significantly higher in women, with 4.1 million women currently living with stroke compared to 3.1 million men (Bushnell et al., 2018a). The incidence rate in Hebron- Palestine as reported by Amro, and Jose was 24.48/100 000 (Amro et al., 2018).

In addition, approximately 50% of all strokes occur in adults over the age of 75, and 30% occur in people over the age of 85. The incidence of stroke disease rises with age in both men and women. Elderly patients have greater mortality rates, lower functional results, and longer hospital stays, and they are more likely to be hospitalized (Lui & Nguyen, 2018).

Adult disability is still mostly caused by stroke, and the demand for stroke rehabilitation treatments is increasing. To meet this need and enhance patient outcomes compared to existing care, significant advancements in stroke rehabilitation practice still need to be accomplished. Most of the time, the results of several substantial intervention trials aimed at motor recovery show that participant motor performance improved, although to a similar degree in both the intervention and control groups. The lack of added advantages from the tested treatments or the various challenges in planning and carrying out significant trials of stroke rehabilitation may be represented in these indifferent outcomes (Stinear et al., 2020). According to the National Institute of Health (NIH), Large Randomized Clinical Trials are limited by a variety of barriers, and low participation numbers are considered to be a significant one. As a result, the majority of the information comes from research with small sample sizes, which frequently produces limited findings (Ferreira et al., 2019).

New methods for patient selection, control interventions, and outcome measurements are among the methods for enhancing trial quality. Even though research on stroke rehabilitation aims to produce better trials, interventions, and results, rehabilitation techniques continue to aid patients in regaining their independence after a stroke (Stinear et al., 2020).

The most prevalent deficiency following a stroke is motor impairment, which can develop as a direct result of the cerebral cortex's inability to transmit signals, as a long process carried on by the damage to the brain, or as a result of muscle atrophy carried on by learned disuse (Lui & Nguyen, 2018). 80% of stroke patients show motor deficits, which can include loss of balance and gait (H. S. Lee et al., 2019). Deficits in motor function, increased fall risks, and injuries resulting from falls can all have a significant impact on a patient's mobility and daily activities, limiting their ability to participate in social activities and other professional endeavors (Lui & Nguyen, 2018). Even though, balance impairments and gait abnormalities are two of the most common manifestations in the chronic stage (Nguyen et al., 2022). However, falls are a common adverse occurrence following a stroke. According to studies, between 14% and 65% of stroke patients experience at least one fall while hospitalized, and between 37% and 73% experience a fall within the first six months of being discharged home. Even after a stroke, the risk of falling is higher than in those of a similar age group (Batchelor et al., 2012). In addition, to possible physiological, falls may result in psychological trauma known as "Fear of Falling (FOF) ". The prevalence of fear of falling in stroke patients is estimated to be between 32% and 88%, which is comparable to the prevalence in older individuals, which is considered to be between 20% and 85% (Batchelor et al., 2012).

In the acute, rehabilitative, and chronic phases following a stroke, falls are common. Fall-related consequences can include death or severe injury, minor injuries, functional impairments, decreased mobility and activity, and fear of falling. After a stroke, these effects may affect one's independence and quality of life. The high frequency of falls may be caused by a combination of risk factors for falls that already existed previous to the stroke and stroke-related impairments, such as decreased strength and balance, hemineglect, perceptual difficulties, and visual problems.

According to Divani et al., elderly stroke patients had a higher risk of falling and falling-related injuries, Poor general health, time since the first stroke, psychological issues, urine incontinence, discomfort, motor impairment, and a history of repetitive falls are risk factors that are linked to an increased risk of falling in stroke survivors (Divani et al., 2009). However, the patient who is at risk of falling is generally going to walk less and be less mobile, which accelerates osteoporosis and increases the risk of injuries from falls (Divani et al., 2009).

In a systematic review study done in 2022 about the risk factors for FOF in stroke patients, the results showed that the factors include Sociodemographic factors (age and women), Physical factors (Balance ability and Mobility), History of falls, use of walking aid, anxiety, depression, poor lower limb motor function (Xie et al., 2022).

Our bodies' stability and coordination in relation to our environment are components of balance. The majority of daily tasks, including moving about and reaching for things, are affected. Patients may feel dizzy or unsteady if their equilibrium has been affected by a stroke. This may lower self-assurance and raise the chance of falling. quality of life may be impacted if balance issues persist for a long period (Helpline, 2017).

proactive balance training is a method that involves self-initiative, strength training, and balancing drills to enhance balance and reduce the risk of falling (Bonaparte et al., 2001). Current balance training procedures are that the majority of stroke patients are trained under proactive conditions (self-initiated actions), while falls generally occur due to an inadequate reactive response to an external force. Reactive balance training, on the other hand, is the practice of responses to unexpected perturbations that cause losses of balance, such as a slip, trip, or nudge (Sadowski et al., 2012). One of the functional goals of balance is the reaction that recovers equilibrium to external disturbances, such as a trip, slip, or push (Mancini & Horak, n.d.).

In this study, we aimed to focus on balance training during the rehabilitation program. And compare the outcomes of two different balance training represented in proactive and reactive balance training.

1.2 Statement of the problem

The prevalence of stroke is continuously increasing and many risk factors contribute to increasing stroke cases (Habibi-Koolaee et al., 2018). The local rehabilitation station options are limited prevailing traditional stroke rehabilitation programs are still common in Palestine.

One of the rehabilitation options is balance training with patients in different ways, as we mentioned balance is one of the most common complications after stroke which leads to FOF and less mobility (Lui & Nguyen, 2018). On the other hand most of the patients after the period of rehabilitation cope with the situation and the motor impairment by using sometimes walking aids or wheelchairs to avoid falling because of the balance challenges that the patients face. However, most of the patients are trained in balance within the functional activities and some balance training, and still there is a gap of knowledge about the new methods of balance training such as proactive balance training and reactive balance training.

This study highlights the effect of reactive balance training versus proactive balance training on the stroke patient's balance and functional performance in the chronic stroke stage.

1.3 Research hypothesis

1.3.1 Reactive balance training is effective in significantly improving balance and chronic stroke rehabilitation functional outcome.

1.3.2 Proactive balance training is effective in significantly improving balance and chronic stroke rehabilitation functional outcome.

1.3.3 Reactive balance training is superior to proactive balance training in significantly improving balance and stroke rehabilitation functional outcomes.

1.3.4 Stroke and other personal variables significantly affect the balance and functional improvement in chronic stroke patients.

1.4 Research questions

1.4.1 Is Reactive balance training effective in significantly improving balance and chronic stroke rehabilitation functional outcome?

1.4.2 Is Proactive balance training effective in significantly improving balance and chronic stroke rehabilitation functional outcome?

1.4.3 Is Reactive balance training superior to proactive balance training in significantly improving balance and stroke rehabilitation functional outcome?

1.4.4 What are the Stroke and other personal variables that significantly affect balance and functional improvement in chronic stroke patients?

1.5 Research objectives

1.5.1 To investigate the effect of reactive balance training on balance and functional performance.

1.5.2 To investigate the effect of proactive balance training on functional activity and balance stroke survivors.

1.5.3 To study the reactive balance training versus the proactive balance on balance and functional performance among stroke survivors.

1.5.4 To investigate the Stroke and other personal variables that significantly affect the balance and functional improvement in chronic stroke patients.

1.6 Significance of the problems

The results of this study will be beneficial for patients and their families, therapists, and Academic bodies and it will highlight the factors associated with better outcomes of stroke rehabilitation, chronic stroke patients, also, the results of this study will add to the literature associated with better rehabilitation practices worldwide after the publication of its results.

1.7 Terminology:

1. CNS: central nervous system.
2. ICH: intracerebral hemorrhage.
3. SAH: subarachnoid hemorrhage.
4. NIH: National Institute of Health.
5. FOF: Fear of Falling.

Chapter Two: Literature Review

2.1 Background

2.2 Similar Study

Chapter Two: Literature Review

2.1 Background

2.1.1 Stroke Definition

The first record of using the stroke term was in 1599, and the ‘stroke’ word related to the Greek word ’apoplexia’. Physicians at the time used the term “apoplexy” instead of it because it was not accepted into the medical vocabulary. Although the Greek word for this condition, “apoplexy,” brings up the idea of suffering a fatal blow, it would be wrong to make a direct comparison between our present context of stroke and what has historically been known as apoplexy(Coupland et al., 2017).

According to the WHO’s previous definition, a stroke is “a rapidly developing clinical sign of focal (or global) disturbance of brain function, with symptoms lasting 24 hours or more or leading to death, with no known cause other than of vascular origin”(“The World Health Organization MONICA Project (Monitoring Trends and Determinants in Cardiovascular Disease): A Major International Collaboration. WHO MONICA Project Principal Investigators.,” 1988).

2.1.1.1 Stroke Types:

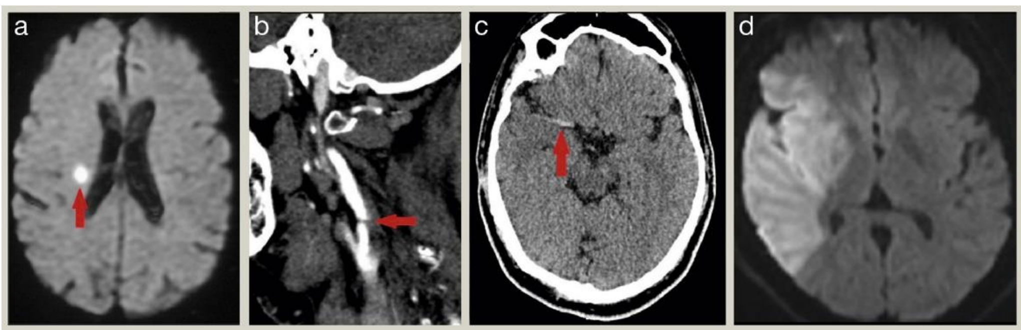
The two main types of stroke are: ischemic and hemorrhagic

1. **Ischemic Stroke**: occurs as a result of the occlusion of a cerebral vessel that blocks 80% or more of the vessel (Alrabghi et al., 2018).
   On the other hand, an ischemic stroke can originate from three main etiologies: ***(1)*** **thrombosis, (2) hypo-perfusion, (3) and embolism**. **Thrombosis** is considered to be **the most common cause**. In contrast to hemorrhagic strokes, clinical manifestations of ischemic strokes progress relatively slowly (over hours) and vary in severity.
   Clinical manifestations of an ischemic stroke can include *(1) paralysis, (2) paresis, (3) ataxia, (4) vomiting, (5) and eye gaze*. ***The specific site of the lesion will determine the symptoms and signs that will appear on the patient*** (Alrabghi et al., 2018).

Approximately 85% of strokes are ischemic and are caused by cerebral small vessel disease, cardioembolism, and large artery atherosclerosis-related thromboembolism (Murphy & Werring, 2020).

2. **Hemorrhagic strokes**: are further subdivided into intracranial hemorrhages ‘ICH’ or subarachnoid hemorrhages ‘SAH’ (Alrabghi et al., 2018) ***Intracerebral hemorrhage*** is an acute focal neurological deficit caused by the rupture of microaneurysms secondary to chronic hypertension. About 15% of strokes are caused by intracerebral hemorrhage, which can be deep or lobar, 80% of these result from cerebral small vessel diseases (Murphy & Werring, 2020).

   Subarachnoid hemorrhage is a spontaneous arterial bleeding into the subarachnoid space, caused by rupture of an arterial aneurysm or AVM (G.Tsagaankhuu & A.Kuruvilla, 2012).



(Murphy & Werring, 2020)

3. **Transient ischemic attack (TIA)**: a neurological deficit lasting less than 24 hours, with complete clinical recovery, caused by focal hypoperfusion within the brain (G.Tsagaankhuu & A.Kuruvilla, 2012).

Functional outcomes improved in patients with ischemic stroke during the past 20 years of studies results, in both genders presumably partly owing to the development of acute reperfusion therapy. The outcomes of patients with hemorrhagic stroke did not improve in the same period (Toyoda et al., 2022).

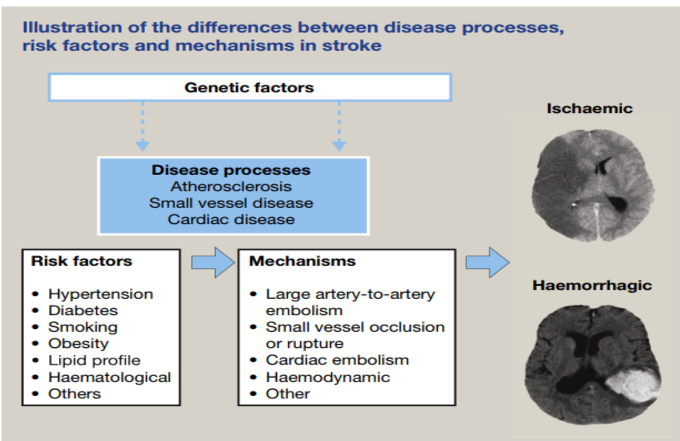
2.1.1.2 Risk Factors for stroke:

Risk factors are modifiable or non-modifiable, **Non-modifiable risk factors**: include (1) a positive family history of strokes, (2) age, (3) male gender, (4) and black or Hispanic race.

Modifiable risk factor:(Murphy & Werring, 2020)(Alrabghi et al., 2018)

- Hypertension
- Diabetes mellitus
- Cardiac factors
- Smoking
- Hyperlipidemia
- Alcohol consumption and substance abuse
- Obesity and sedentary behavior
- Inflammation

Risk of stroke has also been linked to genetic predisposition.(Murphy & Werring, 2020)



(Murphy & Werring, 2020)

2.1.2 Balance:

The word "balance" is commonly used by health professionals across a broad variety of clinical specialties. Balance is frequently used in combination with other words like stability and postural control. Several individuals, including those with neurological deficits, orthopedic deficiencies, and vestibular problems, are thought to benefit from having their balance assessed. Despite the term's widespread usage, there is no agreed definition of what constitutes human balance (Pollock et al., 2000). The ability of an object to balance in a static situation is related to the position of the center of mass (also referred to as the center of gravity or COG) and the area of the base of support (BOS) of that object. If the line of gravity of an object falls within the BOS of that object then the object is balanced, the object becomes unbalanced, and will fall, if the line of gravity is displaced out of the base of support (Pollock et al., 2000). Information from the vestibular receptors, the visual system, and the somatosensory system are used to establish the location of the body's center of gravity. The central nervous system receives this information and uses it to activate the musculoskeletal system (Olchowik et al., 2015). The capacity to maintain one's line of gravity within their base of support with little postural motion is known as ***balance***. The integration of ocular, vestibular, and somatosensory signals to the central nervous system is a key component of the complete process that regulates human balance (Li et al., 2019).

The process of maintaining balance is quite complicated and involves a variety of body organs, including the ears, eyes, and sensory nerves in the muscles and joints (Helpline, 2017).

The coordination of several body parts, including the brain, eyes, and limbs, is necessary for proper balance. Balancing the system's functionality as a whole and how its many components interact can be impacted by a stroke. Generally, the body can deal with little issues, but if they are more serious, the system won't be able to function properly, and will likely feel unstable. (Helpline, 2017).

Research on human balance control has mostly concentrated on measuring motor responses using kinematic measurements (e.g., center of pressure and angular momentum) and/or kinetic data (e.g., movement variability and dynamic stability).(Wittenberg et al., 2017)

There are two types of balance:

1. **Static Balance**: The body's ability to maintain body balance in a still position and for a particular time, for example, when standing. Static balance is a fundamental characteristic of normal motor development (Lengkana et al., 2020).
2. **Dynamic Balance**: The body's ability to maintain balance when moving, such as walking, running, getting up from a sitting position, and agility movements (Lengkana et al., 2020), walking balance control is especially dynamic, involving coordinated adjustments in posture (Wittenberg et al., 2017).

2.1.2.1 Balance Impairment:

Balance impairment is characterized by short supporting time and differences between two sides of the body and slow walking speed, which may increase the risk of falls, and it is reported that about 83% of stroke survivors suffer from balance impairment (Li et al., 2019). Balance impairment imparts a moderate increase in fall risk in community-dwelling older adults.(Muir et al., 2010). Also, the balance impairment increases with age (Laughton et al., 2003).

2.1.2.2 Factors Affected Balance:

1. Weaknesses on one side of the body
2. Loss of sensation
3. Vertigo
4. Concentration problems
5. Neglect
6. Vision problems
7. Perceptual problems
8. Ataxia (Helpline, 2017)

2.1.2.3 Balance Assessment

Clinical balance assessment can help assess fall risk and/or determine the underlying reasons for balance disorders (Mancini & Horak, n.d.). However, the balance assessment with older people is important for appropriate interventions to improve balance performance and to monitor changes in balance over time (Langley & Mackintosh, 2007).

Most functional balance assessment scales assess fall risk and the need for balance rehabilitation but do not differentiate types of balance deficits (Mancini & Horak, n.d.). Balance can be tested objectively using force platforms, classified using scales, and evaluated subjectively through clinical evaluations. Due to the variety of methods available for evaluating postural balance, selecting the most appropriate tool for clinical or academic use and fulfilling the requirements of the assessor can be challenging (Alonso et al., 2014).

There are several tools to assess the balance for elderly and stroke patients, which include:

2.1.2.3.1 Functional Assessment

Functional balance tests are helpful to document balance status and changes with intervention.(Mancini & Horak, n.d.), includes:

2.1.2.3.1.3 Berg Balance Scale (BBS)

The most commonly used balance assessments in the clinic and in research (Leddy et al., 2011a). It is a specific tool to measure the functional standing balance of the elderly, validated in patients with acute stroke (A. P. Yelnik et al., 2008). The sensitivity is poor to moderate(Mancini & Horak, n.d.), and it is a reliable and valid tool for assessing balance and functional mobility with stroke (Kudlac et al., 2019). The best cut-off was a score of 49 with a sensitivity of 91% and a specificity of 92% (Santos et al., n.d.).

It includes 14 items. Each of these items is scored from 0 to 4, which are summed to make a total score between 0 and 56, with a higher score indicating better balance (Downs et al., 2013).

2.1.2.3.1.2 Activities of Balance Confidence (ABC)

It is a questionnaire that evaluates self-perceived balance confidence while attempting 16 different activities of daily living (Mancini & Horak, n.d.). it is a valid and reliable measurement of stroke (Forsberg & Nilsagård, 2013).

2.1.2.3.1.3 Tinetti Balance Assessment (TBA)

is the oldest clinical balance assessment tool and the widest used among older people, and it includes both balance and gait (Mancini & Horak, n.d.) (A. Yelnik & Bonan, 2008), used to estimate fall risk with a balance score categorizing participants as high, moderate, or low fall risk (King et al., 2016).

2.1.2.3.1.4 Time Up & Go (TUG):

It is the simplest one and probably the most reliable test (A. Yelnik & Bonan, 2008) (Mancini & Horak, n.d.).

2.1.2.3.1.5 Functional Gait Assessment (FGA)

It's proposed to assess higher-level balance in individuals with vestibular impairments (Leddy et al., 2011a). The cutoff value was 22/30 (Wrisley & Kumar, 2010), and it is valid and reliable (Beninato et al., 2014).

2.1.2.3.2 Systems Assessment

Helpful when the purpose of the assessment is to determine the underlying causes of the balance deficit to treat it effectively (Mancini & Horak, n.d.). includes:

2.1.2.3.2.1 The Balance Evaluation Systems Test (BESTest)

It's a newly developed, multifaceted approach to assessing balance that combines portions of different balance assessments (Leddy et al., 2011a). It is the only clinical balance test that includes tests of postural responses to external perturbations and perception of postural vertical (Mancini & Horak, n.d.) , and unique in allowing clinicians to determine the type of balance problems to direct specific treatments for their patients (Mancini & Horak, n.d.), The Mini-BESTest is the most accurate tool for identifying older adult with history of falls compared with the BBS, and TUG (Yingyongyudha et al., 2016).

2.1.2.3.2.2 Physiological Profile Approach (PPA):

It's organized around the physiological impairments that lead to fall risk, involves a series of simple tests of vision, cutaneous sensation on the feet, leg muscle force, reaction time, and postural sway instance (Mancini & Horak, n.d.), and it is a reliable and valid for evaluating fall risk (T.-W. Liu & Ng, 2019)

Methods of Balance Treatment:

A study done in Korea by Gi park, Jin Choi, and Young Kim in 2016, the purpose of the study was to improve falling efficacy, gait ability, and balance in stroke patients, by using multidirectional stepping training and the other group received general physical therapy. They used FES for fall efficacy and 10MWT for gait ability, the treatment period was 6 weeks. The result showed a significant difference between both groups and suggests that combined stepping exercise will improve balance, gait ability, and fall efficacy in stroke patients (Park et al., n.d.). another study in Korea was done to investigate the effect of a multifactorial fall prevention program on balance, gait, and fear of falling in stroke patients, comparing with other groups (treadmill group), they used FES, 10MWT, and 6MWT, the period of the treatment was 5 sessions/week, for 5weeks, 30 min. the result showed no significant differences between groups (Jung et al., n.d.).

a systematic review and meta-analysis done by Ada Tang, and Amy Tao in 2015 about The effect of interventions on balance self-efficacy in the stroke population, the result showed that intensive physical interventions, such as strengthening, balance, endurance, and functional exercises are more effective than less intensive interventions for improving balance self-efficacy after stroke (Tang et al., 2015). Another study done by Alison Schinkel-Ivy, and Elizabeth L. Inness about the relationship between FOF, balance confidence, and control of balance, gait, and reactive stepping in individuals with stroke, showed that balance confidence and gait were related in individuals with stroke. This is also linked between balance and fall risk with stroke patients (Schinkel-Ivy et al., 2016).

An RCT study done by Gozde, and Sibel in 2015, was to improve balance with a chronic stroke patient, by using two methods of training (Wii Fit balance training or progressive balance training), the period of treatment was 8 weeks in the same period as our study, one of the outcome measure used was TUG, and in week 4 the result showed improved significantly in both groups but was no significant difference between groups. However, after 8 weeks of treatment, the patients in the progressive balance training group showed significantly lower results of TUG (IyIGun yatar & akSu yIldIrIm, n.d.)

2.1.3 Proactive Balance Training (PBT):

Proactive balance control is the capacity to actively control balance in anticipation of voluntary movements that could be destabilizing (H. van Duijnhoven, 2020).

People after stroke show an impaired performance on postural tasks necessitating proactive balance control. Anticipatory postural adjustments, essential to minimize the destabilizing effect of predictable balance perturbations, are delayed and reduced (H. van Duijnhoven, 2020).

2.1.4 Reactive Balance Training (RBT):

reactive balance control is the capacity to restore balance after an unexpected perturbation (H. van Duijnhoven, 2020). When a postural task requires reactive balance control, people after stroke show a diminished capacity to withstand perturbations, particularly towards the paretic side (H. van Duijnhoven, 2020). When the perturbation intensity is small, balance can generally be restored by feet-in-place reactions, These reactions are delayed for people after stroke. This impaired reactive balance control after small balance perturbations is an important fall risk factor for people after a stroke. The risk of falling further increases with increasing perturbation intensity.

RBT is a type of exercise use when someone loses their balance and to prevent falling. It's challenging for the patient, to apply force to the patient's, and there is a different types of forces such as internal and external forces, that affect the patient's center of mass and aim to make the patient maintain the center of mass within the base of support to prevent falling (Jagroop et al., 2022), (Barzideh et al., 2020)

The exercises may often involve repeatedly introducing the same unexpected dynamic activity that requires a physical response to prevent a fall until the patient can consistently respond in a way that ensures adequate control of their center of mass. However, RBT incorporates perturbation which is divided into internal perturbation and external perturbation (Mansfield et al., 2018), (Allin et al., 2020)

2.1.4.1 Internal perturbation:

Occur when the patients doing a planned action, and can't control their center of mass because of lack of control, lack of coordination, lack of center of mass awareness, and lack of motor response.

2.1.4.2 External perturbation:

This means something in the environment outside of the patients that causes a force and affects the center of mass and/or exceeds the limits of stability.

2.1.4.3 Perturbation-based balance training (PBT):(Okubo et al., 2019)

Is a training that aims to improve reactive balance control, it involves repeated postural perturbations to improve control of rapid balance reactions and clinical outcomes.

2.2 similar studies

There are many studies about balance training in different ways with stroke patients, this section showed different studies about the effect of proactive and reactive balance training with stroke patients.

One of these studies done in 2016 about the reactive balance among chronic stroke patients, his aim was to examine the effect of stroke on reactive balance control and fall risk in community-dwelling individuals with stroke, The study included 14 community-dwelling individuals with stroke age from 43– 65 years. The protocol of the study was using a single slip-like support surface perturbation for the standing position, in the forward direction, using a motorized treadmill, Prior to each perturbation, participants assumed a comfortable stance position with feet shoulder-width apart. For the safety using safety harness system attached via ropes prevented participants' knees from touching the treadmill belt in case of fall. all of the participants experienced a loss of balance following a large-magnitude, slip-like perturbation. This loss of balance was evident from postural instability, and a larger backward COM velocity relative to BOS. Upon loss of balance, all participants, except for 2 participants in the stroke group, were able to initiate a compensatory stepping response to recover balance. The findings support the view that impaired reactive balance control to large perturbations may reveal the underlying fall risk, which may not be reflected through performance-based clinical balance assessment tools (Salot et al., 2016).

Another study done in 2018 about perturbation-based balance training and it was the first study about this type of training in the chronic phase after stroke. In this study, the experimental group received therapist-induced balance perturbations and demonstrated improved reactive balance control when tested under the trained circumstances. For delivering challenging perturbation-based balance training under safe and standardized circumstances, computer-controlled movable platforms were used. The participants received a 5-week perturbation-based balance training.

The results of a proof-of-principle study to evaluate the effects of a 5-week training program on a movable platform were aimed to improving reactive step quality in multiple perturbation directions, and at enhancing side-stepping upon sideward perturbations with the paretic and non-paretic leg. As a primary outcome, reactive step quality in the backward and forward directions was assessed with a lean-and-release (i.e., non-trained) task at pre-intervention, and immediately post-intervention, at 6 weeks follow-up. In addition, reactive step quality was assessed on the movable platform in multiple directions, as well as, the percentage side steps taken upon sideward perturbations. In the present study, the study focused on community-dwelling people in the chronic phase after stroke, as in this phase no further neurological recovery should be expected. In addition, during the chronic phase, people are frequently exposed to balance perturbations in daily life.

This proof-of-principle study investigated whether a 5-week perturbation-based multidirectional balance training program was able to improve reactive stepping in 20 persons in the chronic phase after stroke. the finding after completion the training program reactive step quality had improved in the backward, forward, and both sideward directions. In addition, both paretic and non-paretic side steps were more frequently used for recovering balance upon sideward perturbations (H. J. R. Van Duijnhoven et al., 2018).

A pilot study was done to compare proactive with reactive balance control responses, in this pilot study the group made a slip trainer device and this was one of the purposes of the study to provides safe, controlled, simple, and inexpensive reactive balance training for adults.

Its more effective at preventing falls, reactive balance training is not typically used clinically because proactive balance training is easier, safer, and more cost effective (Sadowski et al., 2012).

Different studies talked about balance with stroke in different ways, and there were limited studies that dealt with the subject of this study

Chapter Three: Methods and Materials

3.1 Introduction.

3.2 Study settings.

3.3 Study methodology

3.3.1 Study design

3.3.2 Tools of data collection

3.3.3 Data collection procedure

3.3.4 Intervention program

3.4 Sampling and Data Population.

3.4.1 Sampling Method

3.4.2 Sampling Size

3.4.3 Inclusion Criteria

3.4.4 Exclusion Criteria

3.5 Ethical considerations.

3.6 Statistical analysis.

Chapter Three: Methods and Materials

3.1 Introduction

This chapter presents the study design, study sitting, study sample, sampling method, sample size, inclusion, and exclusion criteria, data collection tools, and outcome measures used in this study, the program, in addition to statistical analysis and ethical considerations.

3.2 Study Setting:

The study was conducted at an outpatient clinic (Al Riayaa Center for Physiotherapy) in Hebron city/ Palestine, Alia Hospital Street, Al Quds Building, easy to access, especially since the center on the ground floor, which was easy for patients who used assistive device to reach their no need to use stairs or elevators. The space was suitable for the tests pre- and post, and the training was done in a separate room for rehabilitation.

3.3 Study Methodology

3.3.1 study Design:

This study was a single-blinded RCT study. The single-blinded RCT is a type of clinical trial, in which only the researcher doing the study, and knowns the interventions, and the participants do not know that there is another intervention or another group, this design makes the results less biased, this means that the results are less likely to be affected by factors that are not related to the treatment or intervention being tested. Multiple studies reported significant differences in the effect size of treatment estimates depending on the use of blinding (Penić et al., 2020).

3.3.2 Tools of data collection

The researcher used the following tools:

3.3.2.1 Data collections tool: (Appendix 1)

Includes Personal Data:

1) Name, 2) Gender, 3) Age, 4) Marital Status, 5) Address, 6) social, 7) Medical condition, 8) medication, 9) BMI, 10) occupation, 11) date of stroke, 12) Type of stroke, 13) Co-morbidities, and 14) Physical activity.

- Will measure the physical Activity for the participants by International Physical Activity Questionnaire – short form.

3.3.2.1.1 International Physical Activity Questionnaire (Appendix 2):

This measure assesses the types of intensity of physical activity and sitting time that people do as part of their daily lives are considered to estimate total physical activity in min-hours/week and time spent sitting. The short form consists of 7 questions, the questions ask about the time that patients spent being physically active in the **last 7 days**. The sequence of questions is from vigorous to moderate activities to walking then to sitting. And it is a valid and reliable questionnaire.(P. H. Lee et al., 2011)

In this research physical activity was divided into 5 categories based on the total number of minutes, hours, and days, the categories were: 1. Not active, 2. Poor active, 3. Moderate, 4. Active, and 5. Very active.

3.3.2.2 Outcome measures:

The outcome measures were chosen after reviewing the most specific and important tools designated for balance with the elderly and after strokes, and 6 outcome measures were approved:

3.3.2.2.1 The Falls Efficacy Scale- International (FES-I) (Appendix 3):

The FES-I is a self-report questionnaire, that provides information on the level of concern about falls for several activities of daily living (Delbaere et al., 2010), this scale has excellent reliability, is correlated with measures of balance and gait, and predicts future falls and decline in functional capacity. Most importantly, the FES has proven sensitive to changes in fears following clinical interventions (Yardley et al., 2005). Sensitivity = 0.71, specificity = 0.57, positive predictive value = 51%, and negative predictive value = 74% (Faria-Fortini et al., 2021).

It is a 16-item questionnaire, scored on a four-point scale:

1= not at all concerned

4= very concerned

- **minimum 16 (no concern about falling)**
- **maximum 64 (severe concern about falling)** (Delbaere et al., 2010)

In this research, we used the Arabic version of FES-I, and it is a valid and reliable(Hasan et al., 2024).

3.3.2.2.2 Time Up and Go (TUG) (Appendix 4):

Is a reliable and valid outcome measure (Christopher et al., 2021) and easy-to-administer clinical tool for assessing advanced functional mobility after a stroke (P. P. Chan et al., 2017). It's a sensitive and specific test to measure balance and risk of falls among the elderly, the sensitivity and specificity = 87% (Shumway-Cook et al., 2000), the predictive value, 12.47 seconds was the best cutoff point (Alexandre et al., 2012). The patient will be sitting on the chair with armrest then will stand up and walk in a straight line 3 m then will turn around and back to the chair and sit down, the timing will start when the patient stands up from the chair and ends when back to the chair and sit down.(Dunning, 2011).

The score of the TUG:

1. ≤10s → completely independent
2. ≤ 2s → Independent for main transfers
3. ≥ 30s → require assistance

3.3.2.2.3 10 Meters walking test (MWT) (Appendix 5):

It is a reliable and vailed outcome measure; it is evaluated by measuring speed and counting the steps and time. The steps and time will be measured when the patient starts to walk from the beginning point. Individuals walk without assistance 10 meters (32.8 feet) and the time is measured for the intermediate 6 meters (19.7 feet) to allow for acceleration and deceleration.(Saito et al., 2022), sensitivity = 87.5%, specificity = 86.2% (Yoshimoto & Oyama, Ba, n.d.).

measure and mark a 10-meter walkway

- **add a mark at 2-meters**
- **add a mark at 8-meters**

3.3.2.2.4 Tinetti Balance Assessment tool or Tinetti Performance-Oriented Mobility Assessment (POMA) (Appendix 6):

It is a balancing tool with both a balance and a gait component that was created for the elderly. The balance component of the test evaluates the patient's ability to maintain postural control while standing, sitting statically, rising from a chair, immediately after standing, standing with eyes open and closed, turning 360 degrees, and during perturbation. The gait component evaluates the following during gait: symmetry, initiation, continuation, path, base of support, and postural sway. measures reactive balance by asking the patient to react to a perturbation (Canbek et al., 2013), the sensitivity = 88.3%, and specificity = 84.7% (Panella et al., 2008), the cutoff value of the Tinetti POMA in 53 older adults were 14, 68%, and 78%, and the cut-off value of the Tinetti POMA in older adults with a mean age of 84.9 years were 19, 64.0%, and 66.1% (Sertel et al., 2018).

The test comprises 16 items:

- **9 balance-related items and**
- **7 gait-related items**

The maximal score being 28 points, 16 of which are in the balance component and 12 of which are in the gait component.

Score ≤ 18 → High risk of fall

Score 19-23 → Moderate risk of fall

Score 24 → low risk of fall (Sertel et al., 2018)

The test takes approximately 10 minutes to administer. The POMA allows the use of assistive devices during testing. (Canbek et al., 2013)

3.3.2.2.5 Mini-BESTest Balance Evaluation System Test (BEST) (Appendix 7):

The BESTest was developed to assess underlying systems for balance control to be able to individual rehabilitation interventions for people with balance disorders (Hamre et al., 2017). The Mini-BESTest, the shorter version of the BESTest, was developed to reduce the assessment time. It is the most comprehensive balance measure for elderly individuals, and with stroke, and Parkinson's disease (Di Carlo et al., 2016). Several studies have shown that the Mini-BESTest also was reliable and valid and useful for fall prediction. The use of the Mini-BESTest in community-dwelling people with chronic stroke has recently been reported, with excellent interrater and interrater reliability and validity.(Chinsongkram et al., 2014), Test-retest reliability for the BESTest was 0.86, and Mini-BEST 0.84 and it is good to excellent (Anson et al., 2019) (Hamre et al., 2017). The sensitivity of the Mini-BESTest = 85%, and the specificity = 75%. (Yingyongyudha et al., 2016).

The cutoff scores for adults with fall risk according to the Mini-BESTest in the different age groups were 99 and 25 points for people aged 60 to 69 years, 92 and 23 points for people aged 70 to 79 years (Magnani et al., 2020).

Consists of 14 items, scored on a 3-point scale from 0 to 2 (Leddy et al., 2011b).

- 0 : poor balance performance
- 2: no balance impairment.

3.3.2.2.6 2 Minutes Walking test (Appendix 8):

- There are 5 versions of walking tests available in the stroke population, the 12-, 6-, 5-, 3-, and 2-minute Walk Tests, we used the 2MWT because it's the most time-efficient.(Leung et al., 2006), and it is a valid and reliable test measure of self-selected walking speed (W. L. S. Chan & Pin, 2019), the sensitivity = 61% and the specificity = 67% (Nogueira et al., 2021).

3.3.3 Data collection procedure

After the presentation of the study proposal to the higher education committee of the physiotherapy department, the study was ethically approved by the central of ethical committee at Al-Quds University. After the approval, we were given a formal paper from the university to facilitate the task of obtaining patient information from hospitals for scientific research, after that, the sample collection began, so we went to the hospitals and were given the files of stroke patients who were in the hospital. The phone number of each patient was taken, and then all the patients we obtained were contacted, 47 stroke patients were obtained from Al-Ahli Hospital who had had a stroke since 2021, and 23 patients from the Arab Society (who live in Hebron), and what was taken from Alia Hospital had also gone to Al-Ahli Hospital. They were contacted and the researcher introduced the research to them, and how to reach the center in which the research would be conducted, then the screening phase was started for inclusion and exclusion criteria through patients coming to the center and being examined, the patients who met the inclusion criteria were asked to participate and sign a consent form. So out of the 70 patients' males and females, only 38 of them met the inclusion criteria and were selected, and 2 patients came to the center for treatment and met the inclusion criteria so entered the research.

The 40 chronic stroke patients males and females had an Excel file on the computer containing all the information that the researcher needed, such as personnel data, and then were randomly divided into 2 groups, the intervention group was the reactive balance training n = 20, and the control group was the proactive training group n = 20. Each group is unaware of the existence of the second group so the research was single-blinded.

All patients were examined twice, the first time was at baseline, and the second one was after 8 weeks (24 sessions), all the sessions were individualized.

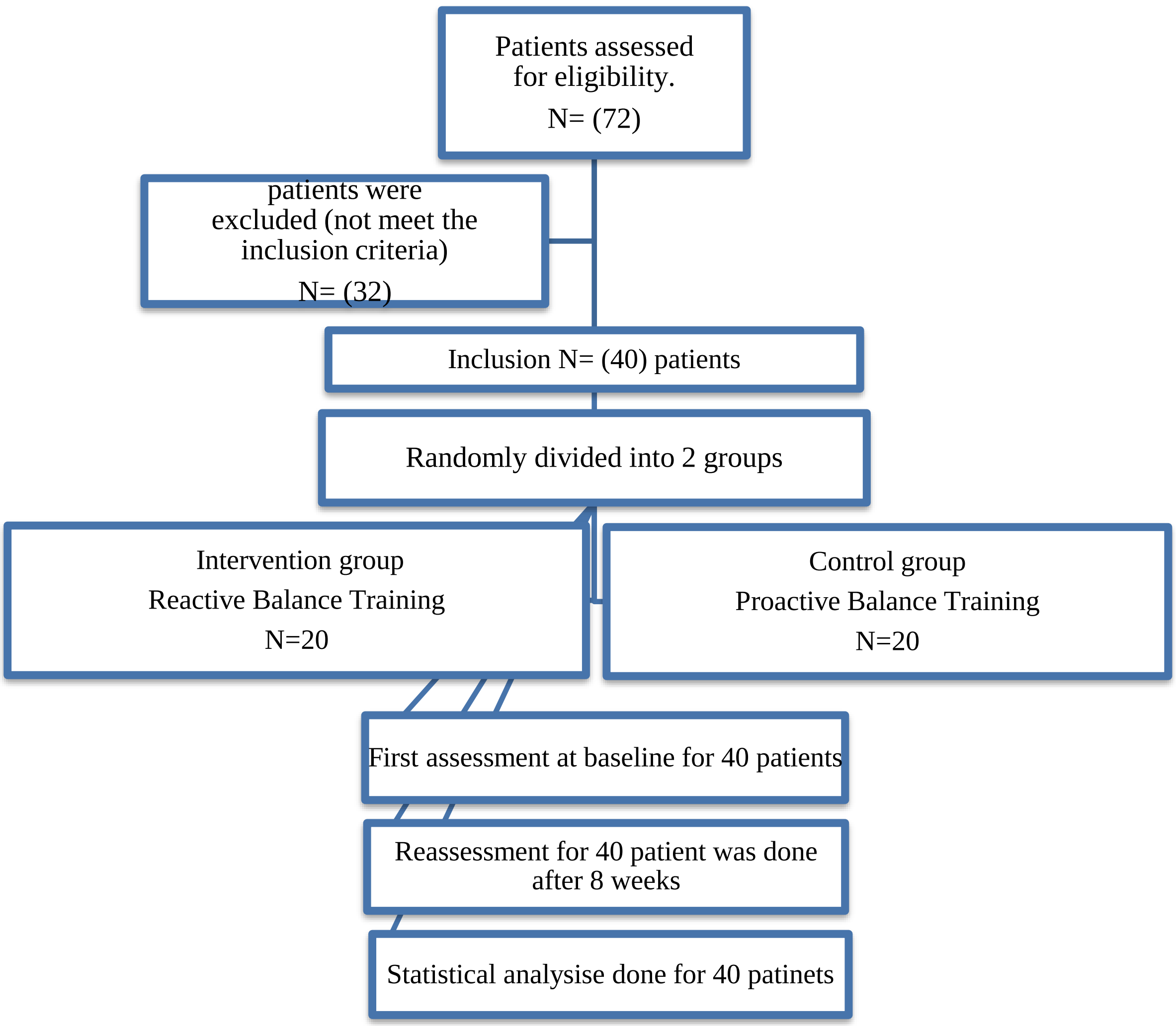


Figure 3.1 Flow Chart of the participants

3.3.4 Intervention program

The program consisted of 24 sessions in 8 weeks, through 3 sessions weekly for both groups.

The sessions were 45 minutes, starting with a 10-minute warm-up exercise (Fradkin et al., 2010) and then the balance training and the sessions ended with a 5-minute cool-down exercises (Afonso et al., 2021). **All the sessions were individualized, and the sequences of the program depending on the patient's ability and were based on a balance training protocol.**

The session started with a warm-up exercise for 10 minutes as presented in Table 3.1 below for both groups:

Table 3.1 Warm Up Exercises

Name of exercise	Exercise description	Time (10 min)
1. Head rotation	Stand with your legs straight, Place your feet at shoulder-width, and Keep your hands loosely at your sides. 20 REPETITIONS, Rotate your head clockwise and counterclockwise.	1 min
2. Shoulders rotation	Place your legs at shoulder-width, Keep your arms straight at your sides. 20 REPETITIONS, Perform both shoulders rotation clockwise and counterclockwise.	2 min
3. Torso swings	Stand with your legs straight, Place your feet at shoulder-width, Bend your torso forward 90 degrees, and Raise both arms straight to the outside. 15 REPETITIONS TO EACH SIDE, Perform the most extensive movements to the left and to the right. Look at the hand you are lifting.	3 min
4. Hips rotation	Place your hands on your hips and your head straight.10 REPETITIONS, Perform extensive hips rotation. Perform the exercise 10 times clockwise and 10 times counterclockwise.	**4 min**

Then 30 minutes was pure balance training, based on the balance

The program for both groups consisted of 3 levels of balance training:

1. Sitting training

2. Standing training

3. Walking training

3.3.4.1 Reactive Balance Training

3.3.4.1.1 Sitting Training

3.3.4.1.1.1 Sitting on the edge of the chair and foot on a static surface

1. Nudge the patient in all directions with different forces
2.
3. Steady Steps and push the patients in all directions (backward, forward, Rt, and Lt), taking into consideration the principles and sequence of balance training:
   - **Wide BOS, Eyes open:**
     - with 2 hands support
     - with one hand support
     - with no hand support
   - **Wide BOS, Eyes closed**
     - with 2 hands support
     - with hand support
     - with no hand Support
   - **Narrow BOS, Eyes open**
     - with 2 hands support
     - with hand support
     - with no hand Support
   - **Narrow BOS, Eyes closed**
     - with 2 hands support
     - with hand support
     - with no hand Support

4. Catching and throwing a small ball
   - **Wide BOS:**
     - with 2 hands
     - with one hand (Rt, Lt)
   - **Narrow BOS:**
     - with 2 hands
     - with one hand (Rt, Lt)

   With changing the distance between therapist and patients.

5. Sit to stand with nudged the patients

Then we did the same exercises with changing the foot surface from static to dynamic by putting the patient's foot on the balance board.

3.3.4.1.1.2 Sitting on a Physioball and feet on a static surface

1. Nudge the patient in all directions with different force

2. Steady steps and push the patients in all directions (backward, forward, Rt, and Lt)

- **Wide BOS, Eyes open:**
    - with 2 hands support
    - with one hand support
    - with no hand support
        - with arm movement backward and forward
        - With arm crossing
- **Wide BOS, Eyes closed**
    - with 2 hands support
    - with hand support
    - with no hand Support
        - with arm movement backward and forward
        - With arm crossing
- **Narrow BOS, Eyes open**
    - with 2 hands support
    - with hand support
    - with no hand Support
        - with arm movement backward and forward
        - With arm crossing
- **Narrow BOS, Eyes closed**
    - with 2 hands support
    - with hand support
    - with no hand Support
        - with arm movement backward and forward
        - with arm crossing

3. Slight movement forward and backward with hand support, then for to the Rt and Lt, and nudge the patient.

4. Catching and throwing a small ball, with the same sequence above.

Then we did the same exercises with changing the foot surface from static to dynamic by putting the patient's foot on the balance board, so the patient was sitting on a dynamic surface and the foot was also on a dynamic surface, which was very challenging for the patients.

3.3.4.1.2 Standing Training

1. Nudge the patient in all directions with different force
2. Steady steps and push the patients in all directions (backward, forward, Rt, and Lt)

- **Wide BOS, Eyes open:**
    - with 2 hands support
    - with one hand support
    - with no hand support
        - with arm movement backward and forward
        - with arm crossing
- **Wide BOS, Eyes closed**
    - The same sequence above
- **Narrow BOS, Eyes open**
    - The same sequence above
- **Narrow BOS, Eyes closed**
    - The same sequence above
- **Tandem Standing, Eyes open**
    - with 2 hands support
    - with one hand support
    - with no hand support
        - with arm movement backward and forward
        - with arm crossing
- **Tandem Standing, Eyes closed**
    - The same above

3. Catching and throwing a small ball, with the same sequence above.
4. Standing by crossing the leg, and crossing the arm then push the patient in all directions

   Then we did the same exercises with changing the foot surface from static to dynamic by putting the patient's foot on the balance board.
5. Compensatory stepping correction backward, forward, Rt, and Lt
6. Standing with different BOS and using the mulligan belt to change the direction for the patient and hands-free to protect patients from falling.

3.3.4.1.3 Walking Training

1. Make steps forward and backward and push the patient in all directions
2. Catching and throwing
3. Stepping and pushing the patient
4. Make a cycle and push the patient
5. Walking on foam and push the patient
6. Lateral walking and pushing the patient
7. Tandem walking and pushing the patient
8. Walking with changing speed, and changing direction

All the exercises were done with surrounding the patient to prevent falls and for safety.

The sessions ended with cool-down exercises, as presented in Table 3.2 **below.**

Table 3.2 Cool- down exercises

Name of exercise	**Exercise description**	**Time (5 min)**
Side bends.	Start in stand position with your body straight and your arms by your sides Slide one arm, then the other, a short way towards the floor, bending sideways.	2 min
Shoulder circle	Keeping your arms relaxed by your side or resting on your lap, slowly move your shoulders round in a circle forward, and then backward.	2 min
Ankle circle	Ankle circles Using one foot, draw circles with your toes; repeat with the other foot	1 min

3.4 Sampling and Data Population.

The study population was chronic stroke patients discharged from Bethlehem Arab Society for Rehabilitation (BASR), Al Ahli Hospital, and Alia Hospital, who live in Hebron city and their villages.

3.4.1 Sampling Method:

The researcher used convenient sampling methods to recruit stroke patients through scanning of discharged patients from BASR, Al Ahli Hospital, and Alia Hospital. The convenient sampling is one of the most commonly used sampling procedures in studies (Farrokhi & Mahmoudi-Hamidabad, 2012). The main disadvantage of convenience sampling is that the study is somewhat caught between a single-subject approach where a treatment or intervention is used with a few participants to focus on the efficacy of that treatment or intervention, and a randomized control group approach where a sample of participants are randomly chosen from a large population and randomly assigned to treatment and control groups (Emerson, 2021). Another disadvantage of this sampling is the inability to control initial differences between intervention and control groups (Farrokhi & Mahmoudi-Hamidabad, 2012). In another hand the lack of random selection of participants means that selection bias restricts large-scale generalization of the findings.

All patients were screened for eligibility by the researcher, and the patient had the right to participate or to refuse.

3.4.2 Sample Size:

Firstly, 47 stroke patients were obtained from Al-Ahli Hospital who had had a stroke since 2021, 23 patients from the Arab Society (who live in Hebron), and what was taken from Alia Hospital also gone to Al-Ahli Hospital, 70 patients, only 38 of them met the inclusion criteria and were selected, in addition to another 2 patients came to the center to treatment and after examined met the inclusion criteria so entered to the study, Thus, 40 stroke patients were obtained and were implanted. Then 40 chronic stroke patients were recruited and entered into an Excel file and then randomly divided into two groups, the first group received reactive balance training (n=20) and the second group received proactive balance training (n=20).

3.4.3 Inclusion Criteria:

1. chronic stroke patients

2. Males and females

3. Age from 50-70 years old

4. Able to follow up instructions

5. Able to walk at least 10 meters continuously

6. Able to perform sub-maximal physical activity

7. stable health condition

3.4.4 Exclusion Criteria:

1. Acute stage or Subacute stage (less than 3 months)

2. stroke patients with other severe diseases

3. Head injuries

4. patients with mental problems

5. patients with vestibular problems

6. Patients refuse to sign the consent form

3.5 Ethical considerations

- Ethical clearance was granted by the Ethical Committee of Al-Quds University.
- Every patient who met the inclusion criteria and agreed to enter the study was invited to sign a consent form written in Arabic version, with an understanding of the study risks, objectives, and procedures, in addition to the right to withdraw at any stage of the study. All the data is just for scientific research and all the personal information of the participants was kept private, without using any names in the statistical analysis, the participants' safety was given careful consideration over the treatment period,

3.6. Statistical analysis

Data was captured using SPSS 23, descriptive statistics was used to summarize variables like age, and gender, BMI,co-morbidities, type of stroke, affected side, using assistive device, and physical activity. And personal variables using mean, median, and standard deviation. The sample t-test, and Wilcoxon was used to test the hypothesis regarding the effectiveness of intervention within the group. An Independent sample t-test and Mann-Whitney were used to investigate the difference in the post-test between the two groups. Person and Spearman correlation will be used to investigate the correlation between ordinal and continuous personal variables and the improvement.

Chapter Four: Result Presentation

4.1 Result presentation and analysis

4.2 Result Discussion

4.3 Study Limitation

Chapter Four: Result Presentation

4.1 Result presentation and analysis

4.1.1Recruitment and Follow-up Process

Forty patients were recruited from 3 different hospitals in Hebron, Al Ahli Hospital, Alia Governmental Hospital, and Bethlehem Arab Society for Rehabilitation only the patients who live in Hebron and their villages. The 40 patients were divided into two groups, 20 participants received reactive balance training, and the other 20 participants received proactive balance training, both groups were assessed at baseline and post-treatment (24 sessions, 8 weeks).

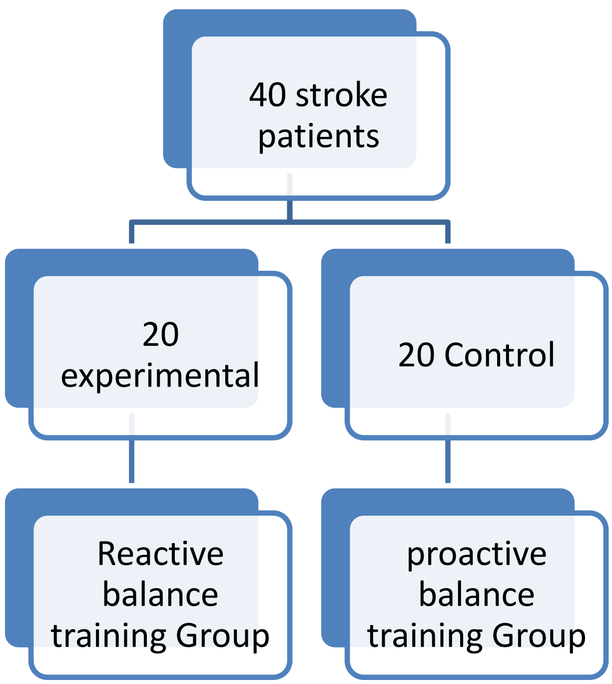


Figure 1 Recruitment

4.1.2 Descriptive statistics of variables

4.1.2.1 Age of Participants

Table 4.1 shows the average age of the reactive training group was **63.5 ± 7.338** (mean ± STD), whereas the average age of the Proactive training group was **67 ± 5.912** (mean ± STD), and there is no statistically significant difference between groups **(p>0.05).**

Table 4.1 Age of each group

Group	Mean age	Median	Minimum	Max	STD	t-test	sig
Reactive training	63.5	65	50	75	7.338	-1.661	0.105
Proactive training	67	68.5	55	75	5.912		

4.1.2.2 Age Group

As Shown in Figure 4.1, **35%** of reactive training participants aged from **66 to 70 years**, and **40%** of proactive training participants. The lowest age group percentage in the reactive training group was aged from **56 to 60 years 10%**, and the lowest percentage for the proactive training group was aged from **50 to 55 years 5%**.

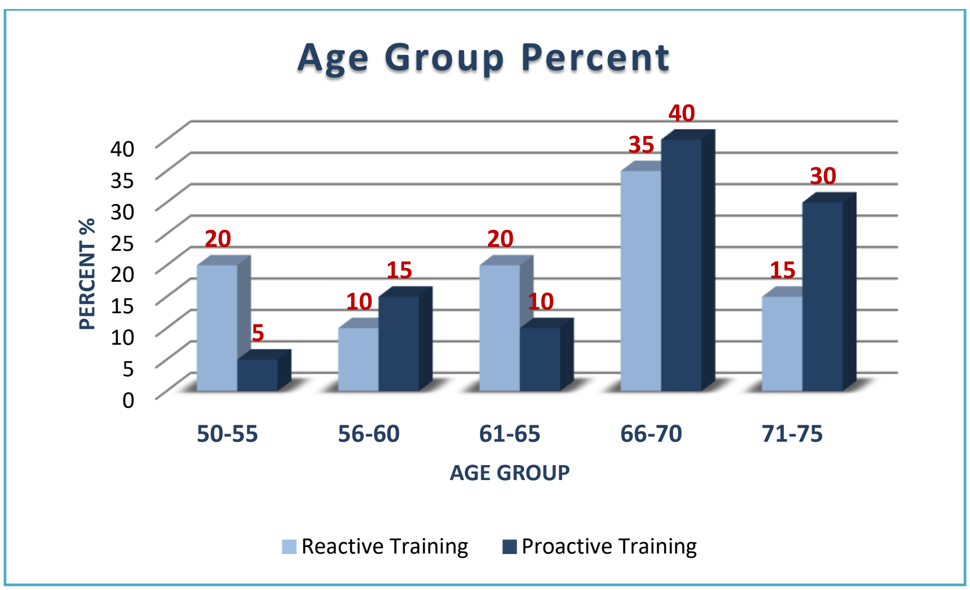


Figure 4.1 Age Group Percent

4.1.2.3 Gender of Participants

Figure 4.2 shows the percentage of gender in each group, The reactive balance training group included **14 participants (70%)** were males, and **6 participants (30%)** were females, while the proactive balance training group included **12 participants (60%)** were males, and **8 participants (40%)** were females.

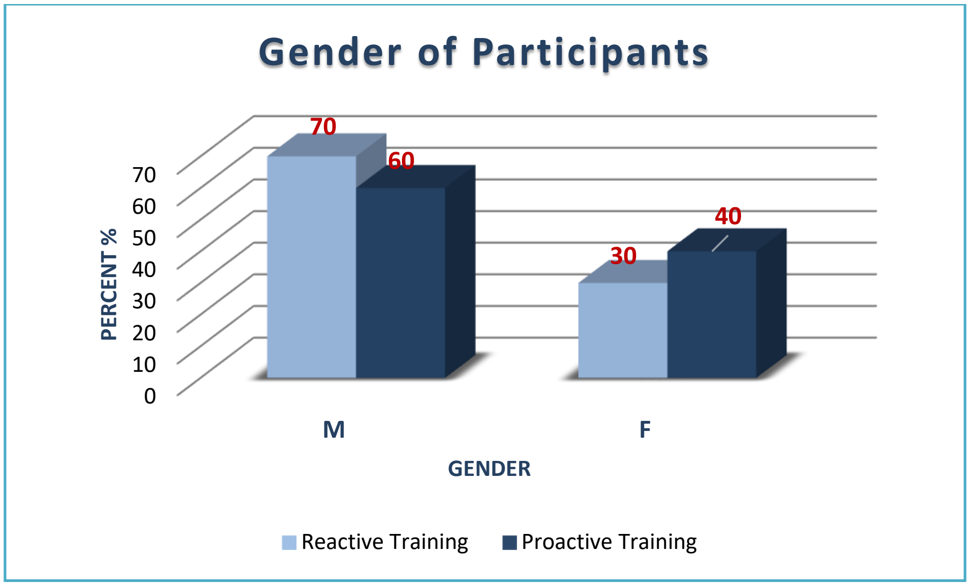


Figure 4.2 Gender of Participants

4.1.2.4 BMI of Participants

Table 4.2 below, shows the average BMI of the reactive balance training group was **26.92**, while the average BMI of proactive balance training group was **28.18**, and there was no statistically significant difference between groups (p>0.05).

Table 4.2 BMI of Participants

Group	Mean	Minimum	Maximum	STD	t-test	sig
Reactive training	26.92	21	35	4.075	-1.01	0.319
Proactive training	28.18	22	38	3.778		

4.1.2.5 BMI Categories

As shown in Figure 4.3, BMI Categories of the Participants, in the reactive balance training group, the distribution was: **8 Participants (40%)** have a healthy weight (20-25), **7 participants (35%)** are overweight (26-30), and **5 participants (25%)** are obese (36-40), while in proactive balance training group, **6 participants (30%)** participants have a healthy weight (20-25), **9 participants (45%)** are overweight (26-30), and **5 participants (25%)** are obese (31-40).

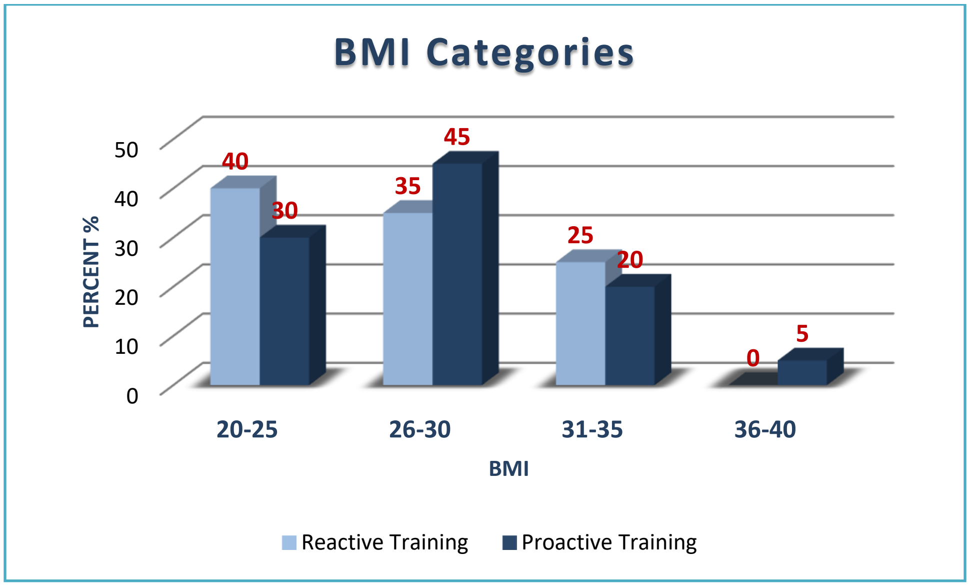


Figure 4.3 BMI Categories

4.1.2.6 Co-morbidities

Figure 4.4 shows the co-morbidities which included HTN, DM, Cardiac diseases, Cholesterol, and others, the highest percentage in the reactive balance training group was ***12 participants 60%*** for DM, while in the proactive balance training group was ***10 participants 50%*** for both HTN and Cardiac diseases.

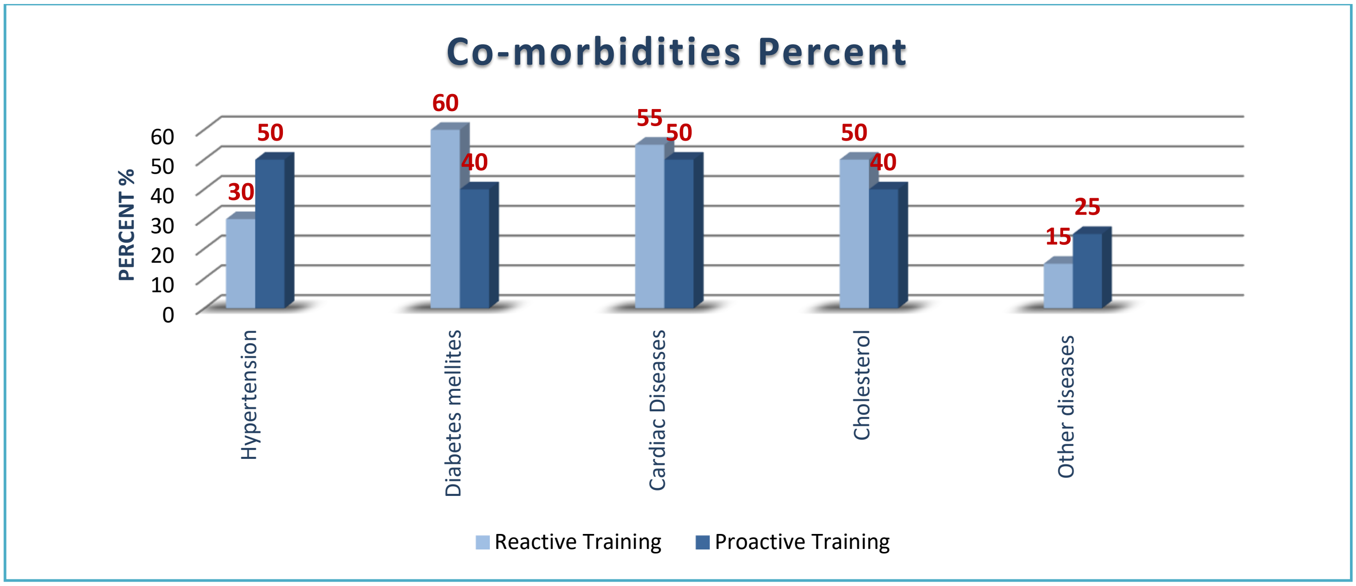


Figure 4.4 Co-morbidities percent

4.1.2.7 Type of Stroke

As shown in Figure 4.5 the percentage of Ischemic stroke in both groups was **(60%)** 12 participants, and **(40%)** 8 participants were Hemorrhagic.

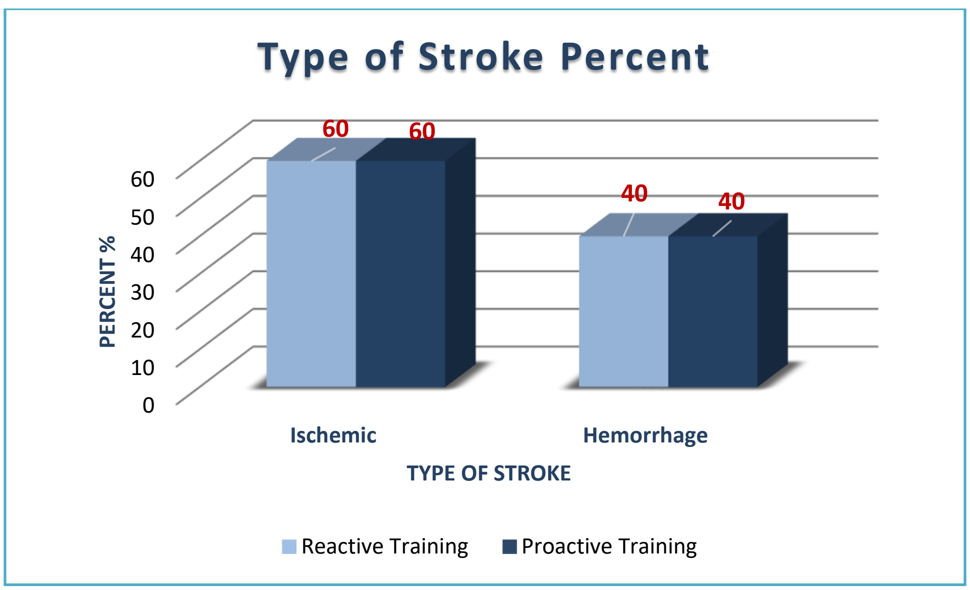


Figure 4.5 Type of Stroke

4.1.2.8 Affected Side

As Shown in Figure 4.6 the affected side in the reactive balance training group was **50%** left side and 50% right side, while in the proactive balance training group was **60%** left side and **40%** right side.

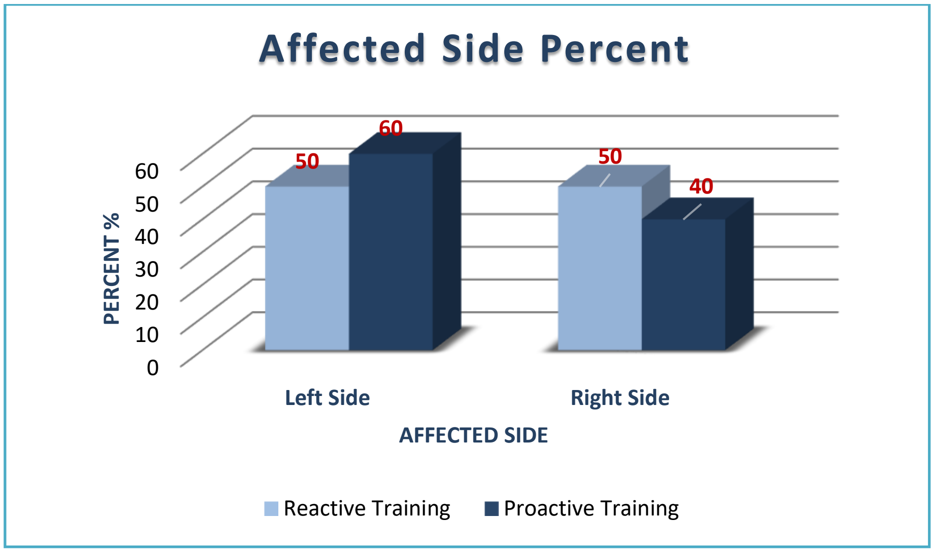


Figure 4.6 Affected Side

4.1.2.10 Smoking

Figure 4.7 shows the smoking percentage of participants, in both groups 6 participants (**30%**) of participants were still smoking and 14 participants **(70%)** of them were not.

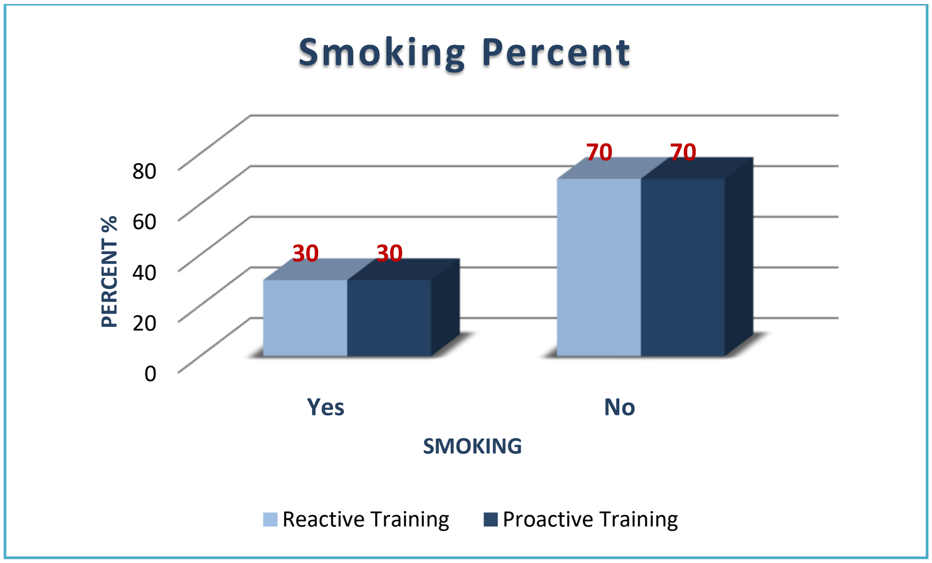


Figure 4.7 Smoking Percent

4.1.2.11 Returnee to Work of Participants

As Shown in Figure 4.9 in the reactive balance training group **6 participants (30%)** returned to work after the stroke, and **14 participants (70%)** of them stopped working. While in the proactive balance training group, only **1 participant (5%)** of participants returned to work, and **19 participants (95%)** of them stopped working.

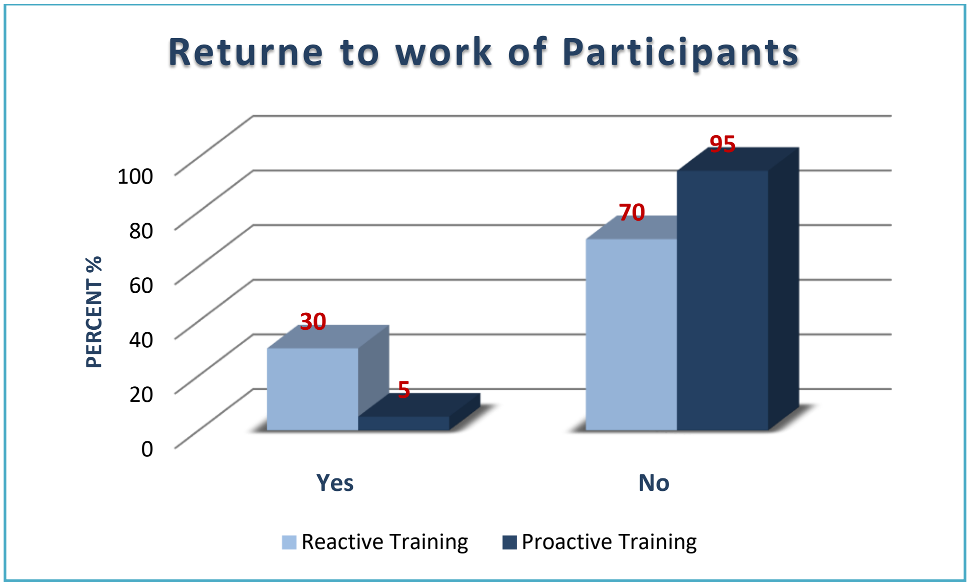


Figure 4.8 Returned to work

4.1.2.12 Using Assistive Device

19 participants in both groups were using an assistive device as shown in Figure 4.9, **10 participants (50%)** in the reactive balance training group were using an assistive device and **10 participants (50%)** were not using an assistive device, while in the proactive balance training group, **9 participants (45%)** were using an assistive device and **11 participants (55%)** were not using.

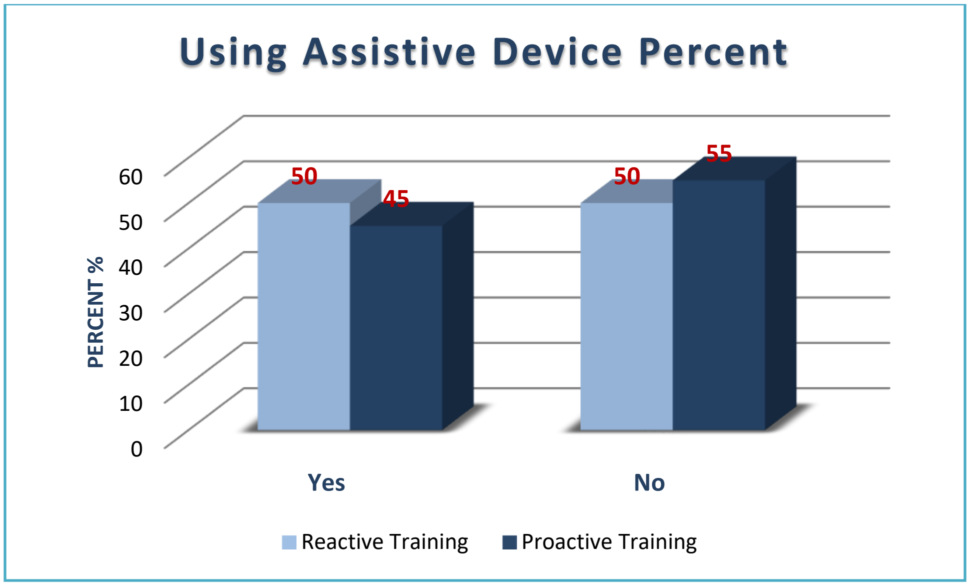


Figure 4.9 Using Assistive Device

4.1.2.13 Physical Activity

As presented in Figure 4.10, **35%** of the reactive balance training group were active during days, and **5%** of them were not active, while **20%** of the proactive balance training group were active, and **25%** were not active.

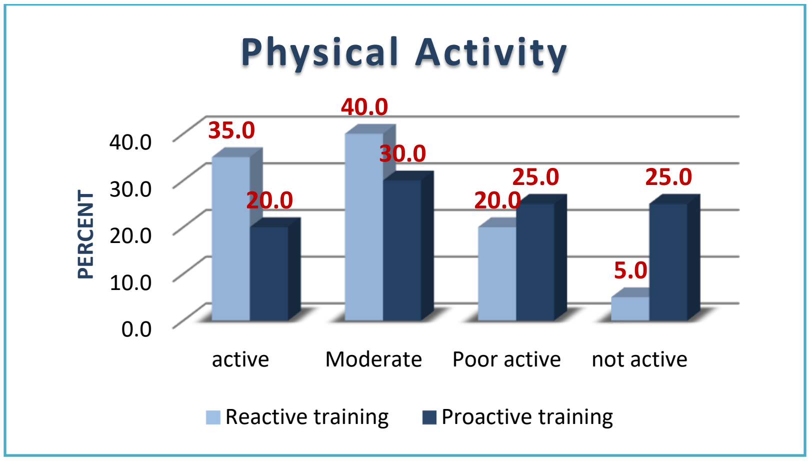


Figure 4.10 Physical Activity

4.1.3 Normality test of study Variables

The normality of study variables among the study groups (Reactive balance training and proactive balance training) was conducted before starting the analysis of the data. The test of Kolmogorov-Smirnov and Shapiro-Wilk was used to decide if the variables were parametric ***p*>0.05** or non-parametric ***p*< 0.05**. Table 4.3 below shows the results of the normality test for study variables for both groups.

Table 4.3 Results of the Normality Test of Improvement of Outcome Measures

Study Variables	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
	Statistic	df	Sig.	Statistic	df	Sig.
Improvement in FES	0.083	40	.200*	0.985	40	0.865
Improvement in TUG	0.17	40	0.005	0.841	40	.000
Improvement in 10 MWT	0.187	40	0.001	0.883	40	0.001
Improvement in Tinetti	0.12	40	0.15	0.973	40	0.458
Improvement in Mini BEST	0.125	40	0.116	0.962	40	0.189
Improvement in 2 MWT	0.119	40	0.158	0.958	40	0.142
***. This is a lower bound of the true significance.**						
a. Lilliefors Significance Correction						

Table 4.3 above shows the results of the Kolmogorov-Smirnov and Shapiro-Wilk test that most of the study variables were normally distributed (***p*> 0.05**) except in Improvement in TUG and 10 MWT (***p*<0.05**).

4.1.4 Inferential Statistical Analysis

4.1.4.1 Fall Efficacy Scale

4.1.4.1.1 Difference of mean FES between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.11 the FES Pre for the reactive balance training group was **48.05 ± 9.08** and for the proactive balance training group was **53.5 ± 9.77** the difference means between groups was **-5.450,** and there was a statistically significant difference in the reactive balance training group and proactive balance training group at baseline **($p<0.05$)** as presented in Table 4.4 below.

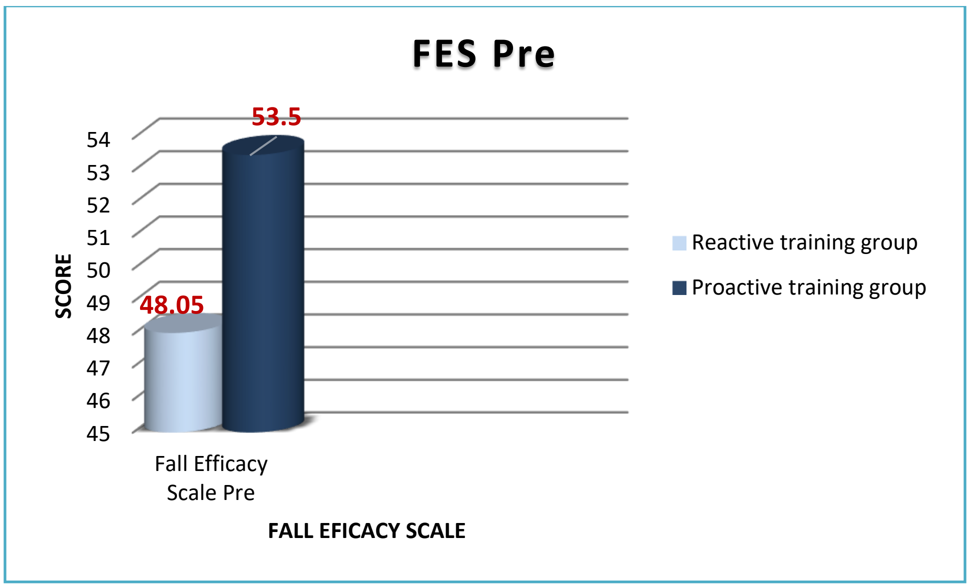


Figure 4.11 Fall Efficacy Scale pre

Table 4.4 Difference of mean FES Pre in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Fall Efficacy Scale Pre	48.05 ± 9.08	53.5± 9.77	-5.450	-1.979	.048

4.1.4.1.2 Differences of FES Mean within groups (reactive balance training and proactive balance training) at baseline and post-treatment

FES in the reactive balance training group was ***48.05*** at baseline and improved to ***22.45*** at post-treatment, the improvement between pre-and post was ***25.6***, while in the proactive balance training group at baseline was ***53.5***and ***32*** at post-treatment, the improvement between pre-and post was ***21.500***, Figure 4.12 shows the difference between the pre-and post in both groups.

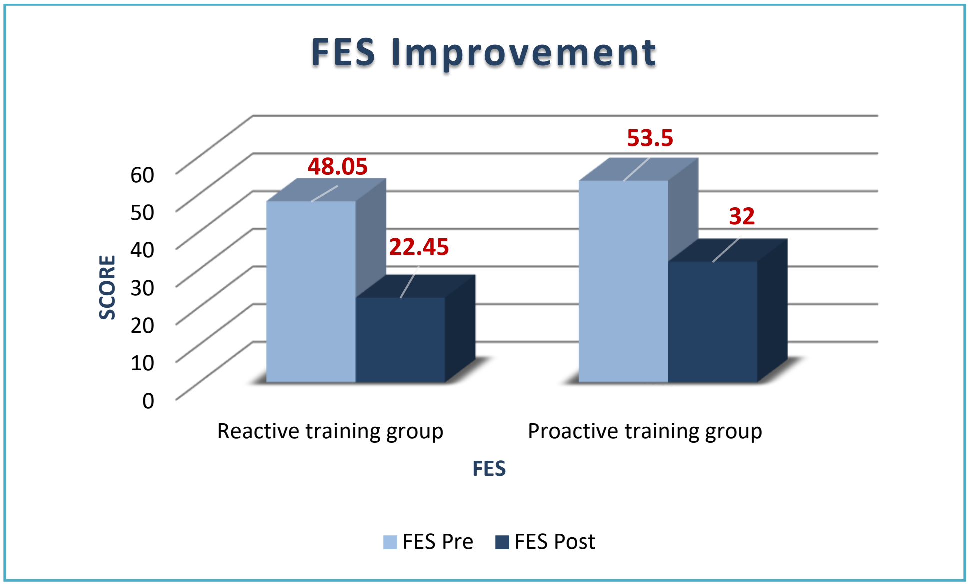


Figure 4.12Fall Efficacy Scale Improvement

Table 4.5 below, shows the mean for both groups at pre-and post-treatment, which shows that the improvement between pre-and post was statistically significant ***(P< 0.05)*** in both groups.

Table 4.5 FES Improvement between pre-and post-treatment for both groups

Groups	Mean of FES Pre	Mean of FES Post	Mean Difference	Wilcoxon	sig
Reactive balance training	48.05	22.45	25.6	-3.921	0.00
Proactive balance training	53.5	32	21.5	-3.923	0.00

4.1. 4..1.3 Difference of mean FES Improvement between two groups (reactive balance training and balance proactive training)

Figure 4.13 shows the mean difference of FES post-treatment between the two groups, the mean of FES post-treatment in the reactive balance training group was ***22.45***, while the proactive balance training group was ***32 post-treatment***.

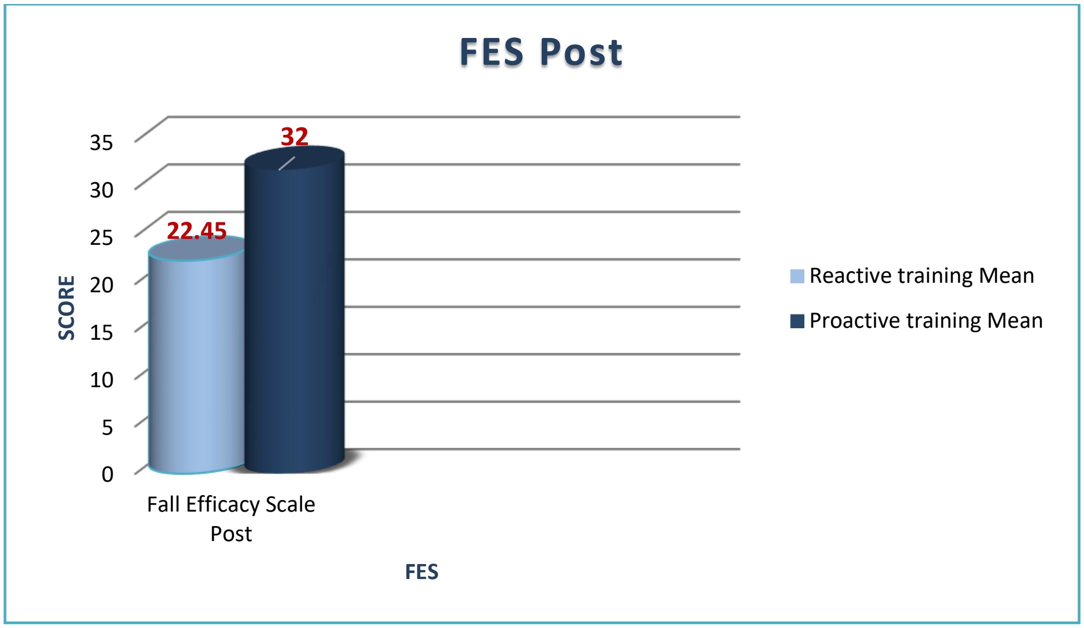


Figure 4.13 Fall Efficacy Scale Post

Table 4.6 shows the mean ± Std at post-treatment for FES in the reactive balance training group and proactive balance training group. This demonstrates that there was a significant difference between the reactive and proactive balance training at the post-treatment point in favor of the reactive balance training ***(P<0.05).***

Table 4.6 Difference of mean FES post-treatment in both groups

	Reactive balance training (mean ± Std)	**Proactive balance training (mean ± Std)**	**Mean Difference**	**Mann-Whitney**	**Sig. (2-tailed)**
Fall Efficacy Scale Post	22.45 ± 5.86	32.00 ± 9.91	-9.550	-3.069	.002

4.1.4.1.4 Difference of mean FES Improvement according to study nominal variables:

As presented in Table 4.7 below the testing for the difference of FES improvement according to the other study nominal variables (gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, Type of training, and using an assistive device), there was no statistically significant difference in mean of FES improvement based on any of other variables mentioned above.

Table 4.7 Difference of FES Improvement according to study variables

Variables		N	Mean	Std	Mann-Whitney	Sig
Gender	M	26	22.89	9.61	-0.639	0.523
	F	14	24.79	7.45		
Type of stroke	Ischemic	24	22.63	8.66	-0.511	0.609
	Hemorrhage	16	24.94	9.26		
Recurrent stroke	Yes	5	19.20	10.08	-1.106	0.269
	No	35	24.17	8.66		
Affected Side	Left	22	22.82	8.93	-0.667	0.505
	Right	18	24.44	8.96		
Hypertension	Yes	16	20.44	7.62	-1.921	0.055
	No	24	25.63	9.17		
Diabetes mellites	Yes	20	24.7	8.46	-0.989	0.323
	No	20	22.4	9.32		
Cardiac Diseases	Yes	21	23.86	9.40	-0.19	0.849
	No	19	23.21	8.48		
Cholesterol	Yes	18	23.78	10.31	-0.136	0.892
	No	22	23.36	7.73		
Other diseases	Yes	8	23	10.77	-0.372	0.71
	No	32	23.69	8.52		
Smoking	Yes	12	25.17	8.45	-0.99	0.322
	No	28	22.86	9.10		
Type of training	Reactive	20	25.6	7.51	-1.584	0.113
	Proactive	20	21.50	9.80		
Using assistive device	Yes	18	25.39	8.92	-0.898	0.369
	No	22	22.05	8.73		

4.1.4.1.5 Association between FES Improvement and Study ordinal and continuous Variables

As presented in Table 4.8 below, there was no significant correlation between FES and study variables represented in Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity ***(p>0.05)***.

Table 4.8 Correlation between FES Improvement and Study Variables

Variables		Improvement in FES
Age	Pearson Correlation	-.065
	Sig. (2-tailed)	.689
Body Mass Index	Pearson Correlation	.114
	Sig. (2-tailed)	.485
Weight	Pearson Correlation	.038
	Sig. (2-tailed)	.817
Hight	Pearson Correlation	-.122
	Sig. (2-tailed)	.454
Duration between D.O.A and D.O.S	Pearson Correlation	.054
	Sig. (2-tailed)	.743
Physical Activity	Spearman Correlation	.107
	Sig. (2-tailed)	.511

4.1.4.1.6 Predictors of Fall Efficacy Scale Improvement:

The multivariate analysis identifies a mode predicts ***60.9%*** of the variation in the FES improvement in patients between baseline and post-treatment ***(p<0.05)***, and the variation in FES improvement was predicted significantly by 5 independent variables, FES Pre (B=.924), Type of training ***(B= -4.237***), Age ***(B= -.658)***, 10 MWT ***(B= -.525)***, and duration between D.O.S and D.O.A ***(B= .570)***, according to Tables 4.9,4.10,4.11.

Table 4.9 Model Summary for Predictors of FES improvement

Model Summary[f]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
5	.780[e]	.609	.551	5.93680

a. Predictors: (Constant), Fall Efficacy Scale Pre

b. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training

c. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age

d. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age, 10 Meters Walking Test Pre

e. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age, 10 Meters Walking Test Pre, Duration between D.O.A and D.O.S

f. Dependent Variable: Improvement in FES

Table 4.10 ANOVA for FES improvement's predictors

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
5	Regression	1865.550	5	373.110	10.586	.000[f]
	Residual	1198.350	34	35.246		
	Total	3063.900	39			

a. Dependent Variable: Improvement in FES

b. Predictors: (Constant), Fall Efficacy Scale Pre

c. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training

d. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age

e. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age, 10 Meters Walking Test Pre

f. Predictors: (Constant), Fall Efficacy Scale Pre, Type of training, Age, 10 Meters Walking Test Pre, Duration between D.O.A and D.O.S

Table 4.11 Coefficients of FES improvement's predictors

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
5	(Constant)	28.154	9.183		3.066	.004
	Fall Efficacy Scale Pre	.924	.133	1.012	6.925	.000

Type of training	-4.237	2.102	-.242	-2.016	.052
Age	-.658	.187	-.505	-3.509	.001
10 Meters Walking Test Pre	-.525	.201	-.332	-2.614	.013
Duration between D.O.A and D.O. S	.570	.268	.271	2.123	.041

a. Dependent Variable: Improvement in FES

4.1.4.2 Time Up and Go

4.1.4.2.1 Difference of mean TUG between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.14 the TUG Pre for the reactive balance training group was **21.91** and for the proactive balance training group was **25.33** the difference mean between groups was **-3.416**. and there was no statistically significant difference between the reactive balance training group and proactive balance training group at baseline **(p>0.05)** as presented in Table 4.12 below.

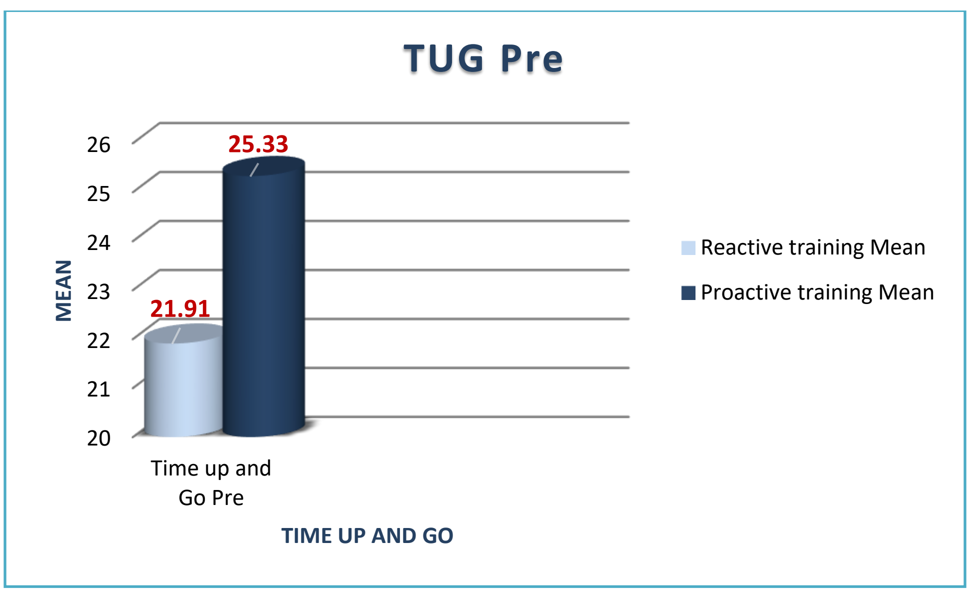


Figure 4.14 Time Up and Go Pre

Table 4.12 Difference of mean TUG pre in both groups

	Reactive balance training (mean ± Std)	**Proactive balance training (mean ± Std)**	**Mean Difference**	**Mann-Whitney**	**Sig. (2-tailed)**
Time Up and Go Pre	21.91 ± 6.14	25.33 ± 6.66	-3.416	-1.531	.126

4.1.4.2.2 Differences of TUG Mean within groups (reactive balance training and proactive balance training) at baseline and post-treatment

Figure 4.15 shows the improvement of TUG in both groups, in the reactive balance training group TUG at baseline was ***21.91 sec*** and at post-treatment was ***15.47 sec***, which means that the improvement was ***6.443 sec*** between pre-and post-treatment. On another hand the TUG at baseline in the proactive balance training group was ***25.33 sec*** and at post-treatment was ***18.46 sec***, the improvement between pre-and post was ***6.866 sec***.

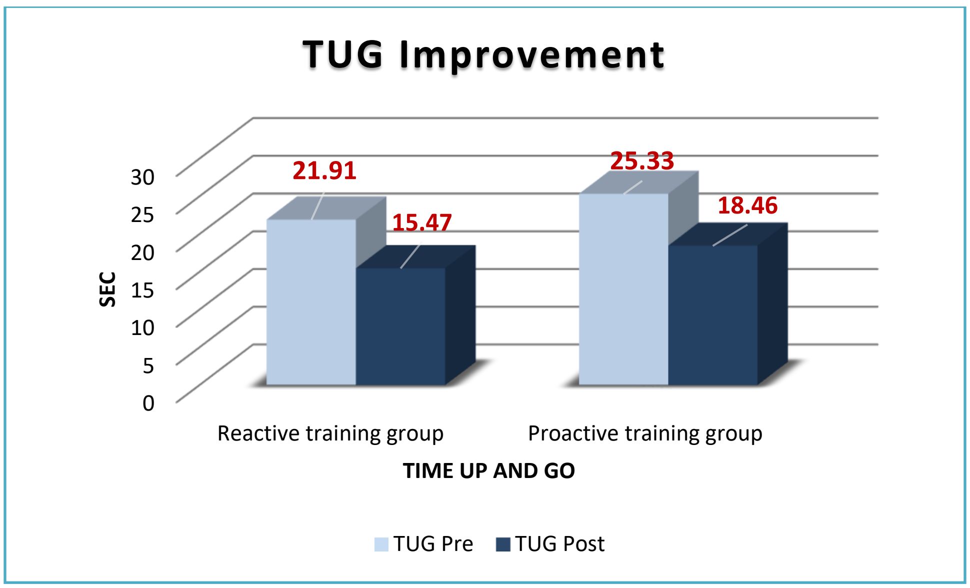


Figure 4.15 Time Up and Go Improvement

According to Table 4.13, the improvement between pre-and post was statistically significant ***(P< 0.05)*** in both groups.

Table 4.13 TUG Improvement between pre-and post-treatment for both groups

Groups	Mean of TUG Pre	Mean of TUG Post	Mean Difference	Wilcoxon	sig
Reactive training	21.91	15.47	6.443	-3.925	0.00
Proactive training	25.33	18.46	6.866	-3.928	0.00

4.1.4.2.3 Difference of mean TUG Improvement in reactive balance training and proactive balance training Groups

Figure 4.16 shows the mean difference of TUG post-treatment between the two groups, the score of TUG post-treatment in the reactive balance training group was **15.47 sec**, while the proactive balance training group was **18.46** sec post-treatment.

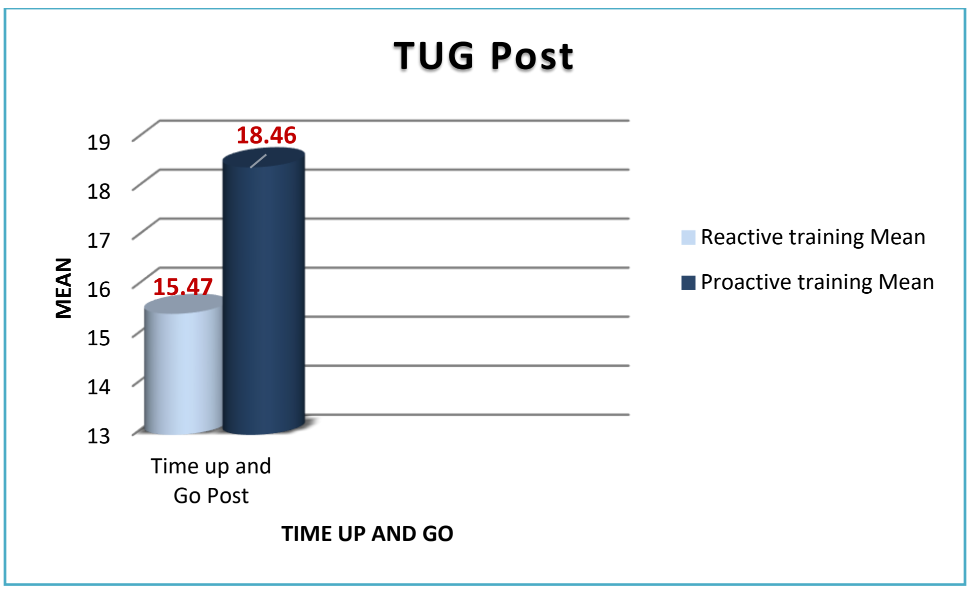


Figure 4.16 Time Up and Go Post

Table 4.14 shows the mean ± Std at post-treatment for TUG in the reactive balance training group and proactive balance training group. This demonstrates that there was a significant difference between the reactive balance training group and the proactive balance training group at the post-treatment point in favor of the reactive balance training ***(P<0.05)***.

Table 4.14 Difference of mean TUG Post-treatment in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Time Up and Go Post	15.47 ± 4.73	18.46 ± 3.98	-2.993	-2.234	.025

4.1.4.2.4 Difference of mean TUG Improvement according to study variables:

As presented in Table 4.15 below the testing for the difference of TUG improvement according to the other variables (gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, Type of training, and using an assistive device), there was a statistically significant difference in mean of TUG improvement based on gender, and using an assistive device ***(p<0.05),*** and there was no statistically significant difference in mean of TUG improvement based on any of other variables mentioned above ***(P>0.05).***

Table 4.15 Difference of mean TUG Improvement according to study variables

Variables		N	Mean	Std	Mann-Whitney	Sig
Gender	M	26	6.37	3.4	-2.074	0.038
	F	14	7.17	1.913		
Type of stroke	Ischemic	24	6.15	2.459	-1.508	0.132
	Hemorrhage	16	7.40	3.542		
Recurrent stroke	Yes	5	7.5	4.272	-0.369	0.712
	No	35	6.53	2.793		
Affected Side	Left	22	6.17	3.016	-1.607	0.108
	Right	18	7.24	2.871		
Hypertension	Yes	16	20.43	7.615	-1.12	0.263
	No	24	25.62	9.174		
Diabetes mellites	Yes	20	6.95	2.64	-1.22	0.223
	No	20	6.35	3.295		
Cardiac Diseases	Yes	21	6.54	3.118	-0.231	0.818
	No	19	6.77	2.862		
Cholesterol	Yes	18	7.32	3.572	-1.199	0.231
	No	22	6.10	2.298		
Other diseases	Yes	8	8.67	4.871	-1.355	0.175
	No	32	6.15	2.092		

Smoking	Yes	12	6.31	2.792	-0.621	0.535
	No	28	6.80	3.071		
Type of training	Reactive training	20	15.46	4.737	-0.19	0.85
	Proactive training	20	18.46	3.983		
using assistive device	Yes	18	7.73	3.422	-2.275	0.023
	No	22	5.76	2.236		

4.1.4.2.5 Association between TUG Improvement and Study Variables

As presented in Table 4.16 below, there was a significant positive correlation between TUG Improvement and BMI, and physical activity ***(p<0.05)***, and there was no significant correlation between TUG and other study variables (Age, Weight, Height, or Duration between D.O.S and D.O.A,) ***(p>0.05),***

Table 4.3 Correlation between TUG Improvement and Study Variables

		Improvement in TUG
Age	Pearson Correlation	.110
	Sig. (2-tailed)	.499
Body Mass Index	Pearson Correlation	.325*
	Sig. (2-tailed)	.041
Weight	Pearson Correlation	.278
	Sig. (2-tailed)	.083
Hight	Pearson Correlation	-.149
	Sig. (2-tailed)	.360
Duration between D.O.A and D.O.S	Pearson Correlation	.052
	Sig. (2-tailed)	.751
Physical Activity	Spearman Correlation	.377*
	Sig. (2-tailed)	.017

4.1.4.2.6 Predictors of Time Up and Go

As shown in Tables 4.17,4.18,4.19 the multivariate analysis showed a model that predicts ***70.7%*** of the variation of the TUG improvement in subjects between baseline and post-treatment ***(P***

<0.05). and the variation in TUG improvement was predicted significantly by 3 independent variables, TUG Pre ***(B= .516)***, 10MWT Pre ***(B= -.184)***, and Age ***(B= -.088).***

Table 4.4 Model Summary for Predictors of TUG Improvement

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3	.841[c]	.707	.683	1.66889

a. Predictors: (Constant), Time Up and Go Pre
b. Predictors: (Constant), Time Up and Go Pre, 10 Meters Walking Test Pre
c. Predictors: (Constant), Time Up and Go Pre, 10 Meters Walking Test Pre, Age
d. Dependent Variable: Improvement in TUG

Table 4.18 ANOVA for predictors of TUG improvement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	242.140	3	80.713	28.979	.000[d]
	Residual	100.267	36	2.785		
	Total	342.407	39			

a. Dependent Variable: Improvement in TUG
b. Predictors: (Constant), Time Up and Go Pre
c. Predictors: (Constant), Time Up and Go Pre, 10 Meters Walking Test Pre
d. Predictors: (Constant), Time Up and Go Pre, 10 Meters Walking Test Pre, Age

Table 4.19 Coefficients for the predictors of TUG improvement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	3.373	2.578		1.308	.199
	Time Up and Go Pre	.516	.069	1.142	7.425	.000

10 Meters Walking Test Pre	-.184	.079	-.347	-2.326	.026
Age	-.088	.042	-.203	-2.107	.042

a. Dependent Variable: Improvement in TUG

4.1.4.3 10 Meters Walking Test

4.1.4.3.1 Difference of mean 10 MWT between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.17 the 10 MWT Pre for the reactive balance training group was **15.59** and for the proactive balance training group was **18.53** the difference means between groups was **-2.935**. and there was a statistically significant difference in the reactive balance training group and proactive balance training group at baseline **(p<0.05)** as presented in Table 4.20 below.

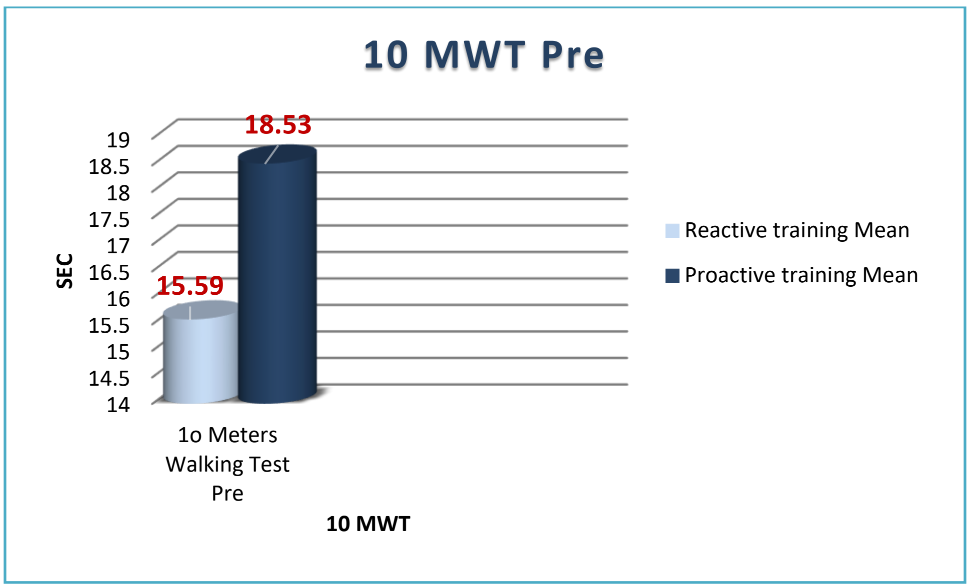


Figure 4.17 **10** Meters Walking Test Pre

Table 4.5 Difference of mean 10 MWT Pre in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann Whitney	Sig. (2-tailed)
10 Meters Walking Test Pre	15.59 ± 6.28	18.53 ± 4.51	-2.935	-2.304	.021

4.1.4.3.2 Differences of 10 MWT Mean within groups (reactive balance training and proactive balance training) at baseline and post-treatment

Figure 4.18 shows the improvement of 10 MWT in both groups, in the reactive balance training group 10 MWT at baseline was ***15.59 sec*** and at post-treatment was ***10.87 sec***, which means that the improvement was ***4.722 sec*** between pre-and post-treatment. On another hand the 10 MWT at baseline in the proactive balance training group was ***18.53 sec*** and at post-treatment was ***14.02 sec***, the improvement between pre-and post was ***4.505 sec***.

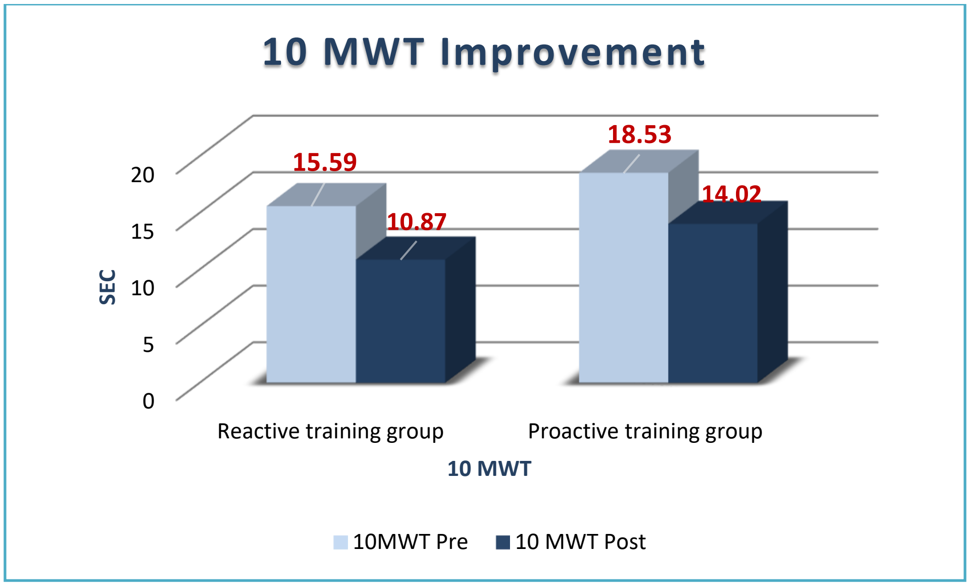


Figure 4.18 10 Meters Walking Test Improvement

Table 4.21 below, shows the mean for both groups at pre-and post-treatment, which shows that the improvement of 10 MWT between pre-and post was statistically significant ***(P< 0.05)*** in both groups.

Table 4.6 10MWT Improvement between pre-and post for both groups

Groups	Mean of 10MWT Pre	Mean of 10 MWT Post	Mean Difference	Wilcoxon	sig
Reactive training	15.59	10.87	4.722	-3.921	0.00
Proactive training	18.53	14.02	4.505	-3.928	0.00

4.1.4.3.3 Difference of mean 10 MWT improvement in reactive balance training and proactive balance training Groups

Figure 4.19 shows the mean difference of 10 MWT post-treatment between the two groups, the score of 10 MWT post-treatment in the reactive balance training group was ***10.87 sec***, while the proactive balance training group was ***14.02 sec*** post-treatment.

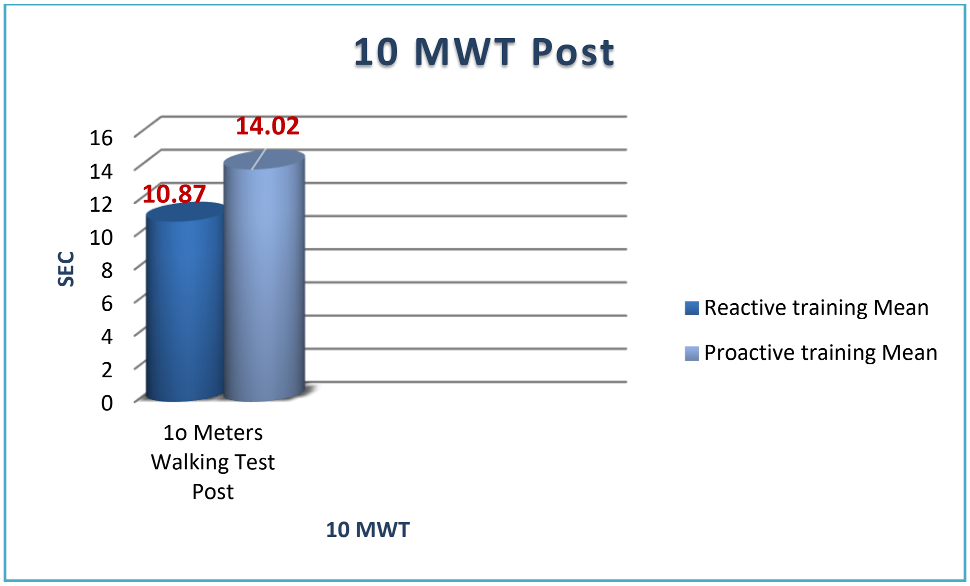


Figure 24.19 10 Meters Walking Test Post

Table 4.22 shows the mean ± Std at post-treatment for 10 MWT in the reactive balance training group ***(10.87 sec)*** and proactive balance training ***(14.02 sec)***, the mean difference between the two groups was ***-3.153***. This demonstrates that there is a significant difference between the reactive and proactive balance training at the post-treatment point in favor of the reactive balance training ***(P<0.05).***

Table 4.7 Difference of mean 10MWT post-treatment in both groups

	Reactive balance training (mean ± Std)	**Proactive balance training (mean ± Std)**	**Mean Difference**	**Mann Whitney**	**Sig. (2-tailed)**
10 Meters Walking Test Post	10.87 ± 4.38	14.02 ± 3.88	-3.153	-2.817	.005

4.1.4.3.4 Difference of 10MWT Improvement according to Study nominal variables:

As presented in Table 4.23 below the testing for the difference of 10MWT improvement according to the other variables (gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, Type of training, and using an assistive device), there was no statistically significant difference in mean of 10 MWT improvement based on any of other variables mentioned above ***(P>0.05).***

Table 4.8 Difference of 10 MWT Improvement according to study nominal variables

Variables		N	Mean	Std	Mann-Whitney	Sig
Gender	M	26	4.82	2.53	-0.156	0.876
	F	14	4.24	1.24		
Type of stroke	Ischemic	24	4.58	2.25	-0.429	0.668
	Hemorrhage	16	4.66	2.1		
Recurrent Stroke	Yes	5	5.54	3.006	-0.861	0.389
	No	35	4.48	2.04		
Affected Side	Left	22	4.24	1.59	-0.79	0.429
	Right	18	5.06	2.68		
Hypertension	Yes	16	4.64	2.08	-0.263	0.793
	No	24	4.59	2.26		
Diabetes mellites	Yes	20	4.98	2.53	-0.827	0.408
	No	20	4.24	1.70		
Cardiac Diseases	Yes	21	4.52	1.95	-0.122	0.903
	No	19	4.71	2.42		
Cholesterol	Yes	18	4.56	1.92	-0.123	0.902
	No	22	4.65	2.38		
Other diseases	Yes	8	4.03	1.60	-0.474	0.635
	No	32	4.75	2.28		
Smoking	Yes	12	4.81	2.85	-0.429	0.668
	No	28	4.52	1.85		
Type of training	Reactive training	20	10.86	4.38	-0.407	0.684
	Proactive training	20	14.02	3.88		

using assistive device	Yes	18	4.80	2.60	-0.095	0.924
	No	22	4.45	1.77		

4.1.4.3.5 Association between 10MWT Improvement and Study ordinal and continuous Variables

As presented in Table 4.24 below, there is no significant correlation between 10MWT and study variables represented in Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity ***(p>0.05)***.

Table 4.9 Correlation between 10MWT Improvement and study ordinal and continuous variables

		Improvement in 10 MWT
Age	Pearson Correlation	-.075
	Sig. (2-tailed)	.646
Body Mass Index	Pearson Correlation	-.045
	Sig. (2-tailed)	.782
Weight	Pearson Correlation	.060
	Sig. (2-tailed)	.712
Hight	Pearson Correlation	.163
	Sig. (2-tailed)	.315
Duration between D.O.A and D.O. S	Pearson Correlation	-.089
	Sig. (2-tailed)	.586
Physical Activity	Spearman Correlation	.270
	Sig. (2-tailed)	.092

4.1.4.3.6 Predictors of 10 Meters Walking Test

As shown in Tables 4.25,4.26,4.27 the multivariate analysis showed a model that predicts ***60.0%*** of the variation of the 10 MWT improvement in subjects between baseline and post-treatment ***(P <0.05)***. and the variation in TUG improvement was predicted significantly by 3 independent variables, 10MWT Pre ***(B=.307),*** Age ***(B= -.090), and*** Gender ***(B= -.993).***

Table 4.10 Model Summary for Predictors of 10 MWT Improvement

Model Summary[d]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
3	.775[c]	.600	.567	1.42538

a. Predictors: (Constant), 10 Meters Walking Test Pre
b. Predictors: (Constant), 10 Meters Walking Test Pre, Age
c. Predictors: (Constant), 10 Meters Walking Test Pre, Age, Gender
d. Dependent Variable: Improvement in 10 MWT

Table 4.11 ANOVA for predictors of 10 MWT improvement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
3	Regression	109.669	3	36.556	17.993	.000[d]
	Residual	73.142	36	2.032		
	Total	182.811	39			

a. Dependent Variable: Improvement in 10 MWT
b. Predictors: (Constant), 10 Meters Walking Test Pre
c. Predictors: (Constant), 10 Meters Walking Test Pre, Age
d. Predictors: (Constant), 10 Meters Walking Test Pre, Age, Gender

Table 4.12 Coefficients for the predictors of 10 MWT improvement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
3	(Constant)	6.589	2.278		2.893	.006
	10 Meters Walking Test Pre	.307	.043	.795	7.212	.000
	Age	-.090	.035	-.283	-2.590	.014
	Gender	-.993	.476	-.221	-2.084	.044

a. Dependent Variable: Improvement in 10 MWT

4.1.4.4 Tinetti Balance Assessment (TBA)

4.1.4.4.1 Difference of mean Tinetti between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.20 the Tinetti Pre for the reactive balance training group was **17.05** and for the proactive balance training group was **13** the difference mean between groups was **4.050.** and there was a statistically significant difference in the reactive balance training group and proactive balance training group at baseline **($p<0.05$)** as presented in Table 4.28 below.

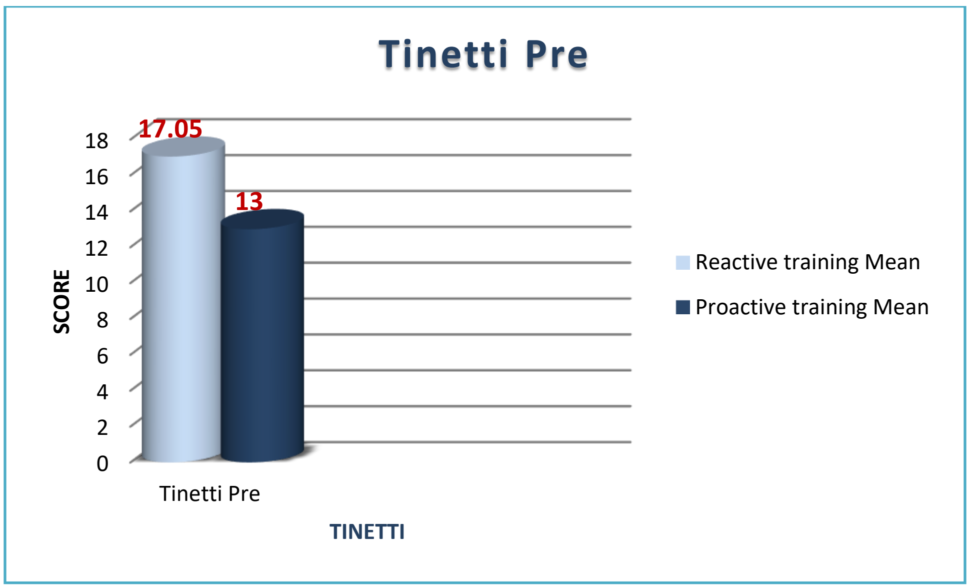


Figure 4.20 Tinetti Pre

Table 4.28 Difference of mean Tinetti pre between groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Tinetti Pre	17.05 ± 3.28	13 ± 4.35	4.050	-2.784	.005

4.1.4.4.2 Differences of Tinetti Mean between two groups (reactive balance training and proactive balance training) at baseline and post-treatment

The improvement of Tinetti in both groups was ***17.05*** pre-treatment and ***26.40*** post-treatment in the reactive balance training group, while in the proactive balance training group was ***13*** pre-treatment and ***18.46*** post-treatment as shown in Figure 4.21.

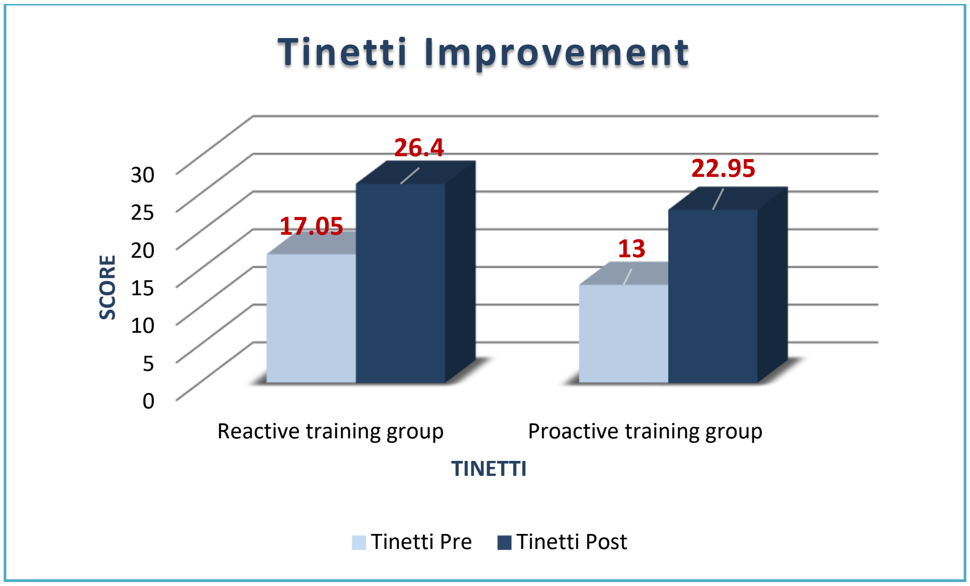


Figure 4.21 Tinetti Improvement

Table 4.29 shows the improvement of Tinetti between the pre-and post-treatment, in the reactive balance training group the mean difference was ***-9.350***, while in the proactive balance training group was ***-9.950,*** which means in both groups there is a significant difference between pre-and post-treatment.

Table 4.29 Tinetti Improvement between pre-and post for both groups

Groups	Mean of Tinetti Pre	Mean of Tinetti Post	Mean Difference	Wilcoxon	sig
Reactive training	17.05	26.4	-9.35	-3.929	0.00
Proactive training	13	22.95	-9.95	-3.924	0.00

4.1.4.4.3 Difference of mean Tinetti improvement in reactive balance training and proactive balance training Groups

Figure 4.22 shows the mean difference of Tinetti post-treatment between the two groups, the score of Tinetti post-treatment in the reactive balance training group was ***26.4***, while the proactive balance training group was ***22.95*** post-treatment.

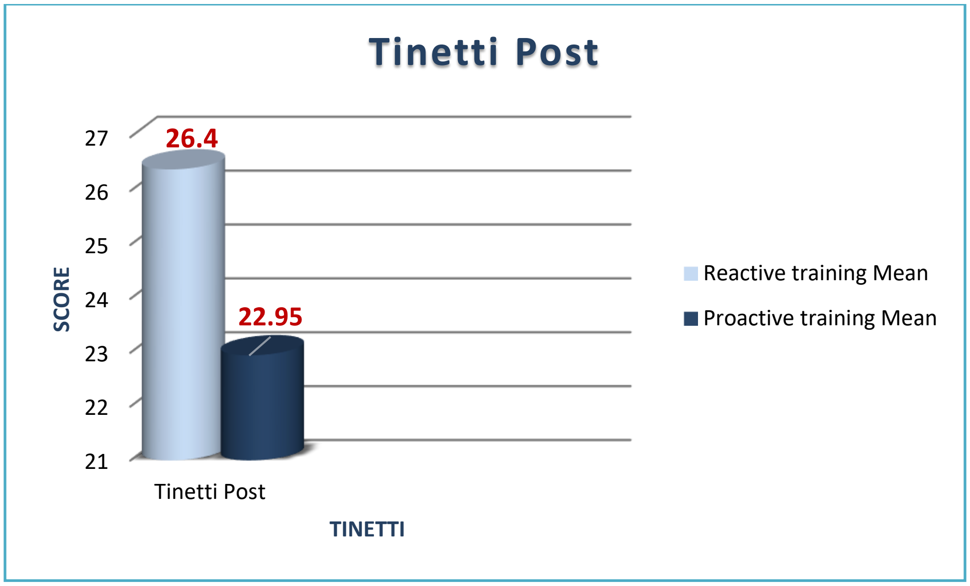


Figure 4.22 Tinetti Post

The mean difference between the reactive balance training group and the proactive balance training group was ***3.450*** as shown in Table 4.30, This demonstrates that there is a significant difference between the reactive and proactive balance training at the post-treatment point in favor of the reactive balance training ***(P<0.05).***

Table 4.13 Difference of mean Tinetti post-treatment in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Tinetti Post	26.40 ± 2.21	22.95 ± 3.69	3.450	-3.217	.001

4.1.4.4.4 Difference of Tinetti Improvement according to study nominal variables:

As presented in Table 4.31 below the testing for the difference of Tinetti improvement according to the other variables (gender, type of stroke, recurrent Stroke, affected side, Co-morbidities, smoking, Type of training, and using an assistive device), there was a statistically significant difference in mean of Tinetti improvement based on cardiac diseases ***($p<0.05$),*** and there was no statistically significant difference in mean of Tinetti improvement based on any of other variables mentioned above ***($p>0.05$).***

Table 4.14 Difference of Tinetti improvement according to study nominal variables

Variables		**N**	**Mean**	**Std**	**Mann-Whitney**	**Sig**
Gender	M	26	10.07	3.04	-1.084	0.278
	F	14	8.85	3.13		
Type of stroke	Ischemic	24	10.25	2.69	-1.43	0.153
	Hemorrhage	16	8.75	3.51		
Recurrent Stroke	Yes	5	9.2	3.56	-0.247	0.805
	No	35	9.71	3.07		
Affected Side	Left	22	9.72	3.19	0	1
	Right	18	9.55	3.05		
Hypertension	Yes	16	9.81	3.79	-0.014	0.989
	No	24	9.54	2.60		
Diabetes mellites	Yes	20	9.3	2.79	-0.544	0.586
	No	20	10	3.40		
Cardiac Diseases	Yes	21	10.81	3.12	-2.452	0.014
	No	19	8.36	2.56		
Cholesterol	Yes	18	10.05	3.24	-0.123	0.902
	No	22	9.31	2.99		
Other diseases	Yes	8	8.75	4.52	-0.474	0.635
	No	32	9.87	2.67		
Smoking	Yes	12	10.08	2.96	-0.429	0.668
	No	28	9.46	3.18		

Type of training	Reactive training	20	9.35	2.23	-0.558	0.577
	Proactive training	20	9.95	3.80		
using assistive device	Yes	18	10.16	3.31	-0.095	0.924
	No	22	9.22	2.91		

4.1.4.4.5 Association between Tinetti Improvement and Study ordinal and continuous Variables

As presented in Table 4.32 below, there is no significant correlation between Tinetti improvement and study variables represented in Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity ***(p>0.05)***.

Table 4.15 Correlation between Tinetti improvement and study ordinal and continuous variables

		Improvement in Tinetti
Age	Pearson Correlation	.141
	Sig. (2-tailed)	.387
Body Mass Index	Pearson Correlation	.030
	Sig. (2-tailed)	.854
Weight	Pearson Correlation	.055
	Sig. (2-tailed)	.738
Hight	Pearson Correlation	.034
	Sig. (2-tailed)	.833
Duration between D.O.A and D.O.S	Pearson Correlation	.130
	Sig. (2-tailed)	.425
Physical Activity	Spearman Correlation	.218
	Sig. (2-tailed)	.177

4.1.4.4.6 Predictors of Tinetti Balance Assessment

As Presented in Tables 4.33,4.34,4.35 the multivariate analysis showed a model that predicts ***44.3%*** of the variation of the Tinetti improvement in subjects between baseline and post-treatment ***(P <0.05)***. The main predictors were Tinetti pre (***B=-.461***) and Gender ***(B= -1.795).***

Table 4.16 Model Summary for Predictors of Tinetti Improvement

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
2	.666[b]	.443	.413	2.36917

a. Predictors: (Constant), Tinetti Pre
b. Predictors: (Constant), Tinetti Pre, Gender
c. Dependent Variable: Improvement in Tinetti

Table 4.17 ANOVA for predictors of Tinetti improvement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
2	Regression	165.420	2	82.710	14.735	.000[c]
	Residual	207.680	37	5.613		
	Total	373.100	39			

a. Dependent Variable: Improvement in Tinetti
b. Predictors: (Constant), Tinetti Pre
c. Predictors: (Constant), Tinetti Pre, Gender

Table 4.18 Coefficients for the predictors of Tinetti improvement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
2	(Constant)	18.999	1.859		10.219	.000
	Tinetti Pre	-.461	.089	-.644	-5.202	.000
	Gender	-1.795	.793	-.280	-2.263	.030

a. Dependent Variable: Improvement in Tinetti

4.1.4.5 Mini-BEST

4.1.4.5.1 Difference of mean Mini-BEST between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.23 the Mini-BEST Pre for the reactive balance training group was **13.75** and for the proactive balance training group was **11.95** the difference mean between groups was 1.800**.** and there was no statistically significant difference between the reactive balance training group and proactive balance training group at baseline **(p>0.05)** as presented in Table 4.36 below.

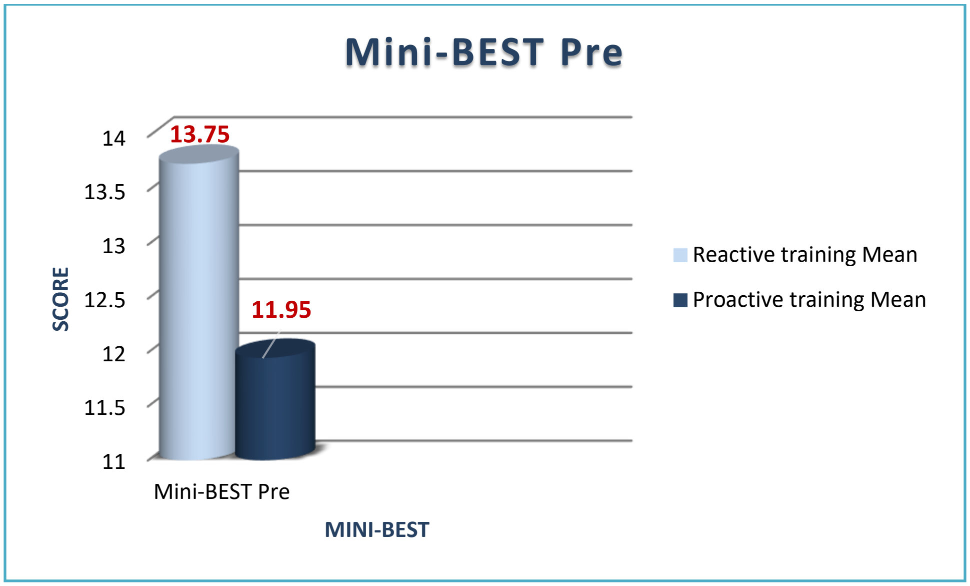


Figure 4.23 Mini-BEST Pre

Table 4.19 Difference of mean Mini-BEST pre between groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Mini-BEST Pre	13.75 ± 4.36	11.95 ± 4.006	1.800	-1.424	.154

4.1.4.5.2 Differences of Mini-BEST Mean within groups (reactive balance training and proactive balance training) at baseline and post-treatment

Figure 4.24 shows the improvement of Mini-Best in the reactive balance training group the pretreatment score was **13.75** and post-treatment was ***24.55***, so the improvement was ***10.8*** (mean difference) as shown in Table 4.37**,** while in the proactive balance training group, the pre-treatment-score-was ***11.95*** and post-treatment was ***21.23***, so the improvement ***9.2*** (mean difference),

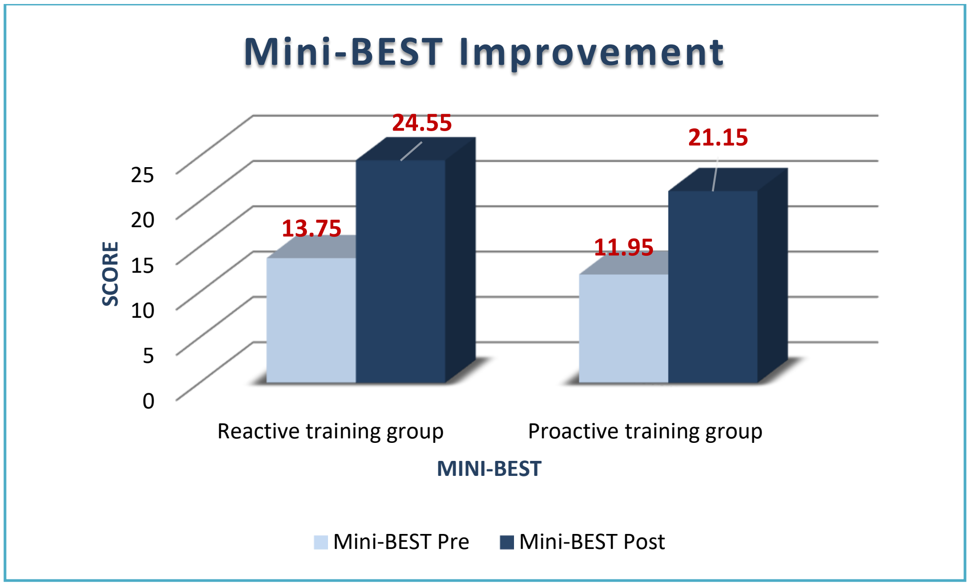


Figure 4.24 Mini-BEST Improvement

Table 4.37 Tinetti Improvement between pre-and post for both groups

	Mean of Mini-BEST Pre	Mean of Mini-BEST Post	Mean difference	Wilcoxon	sig
Reactive training	13.75	24.55	-10.8	-3.925	0.00
Proactive training	11.95	21.15	-9.2	-3.941	0.00

4.1.4.5.3 Difference of mean Mini-BEST improvement in reactive balance training and proactive balance training Groups

Figure 4.25 shows the mean difference of Mini-BEST post-treatment between the two groups, the score of Mini-BEST post-treatment in the Reactive balance training group was ***24.55***, while the proactive balance training group was ***21.15*** post-treatment.

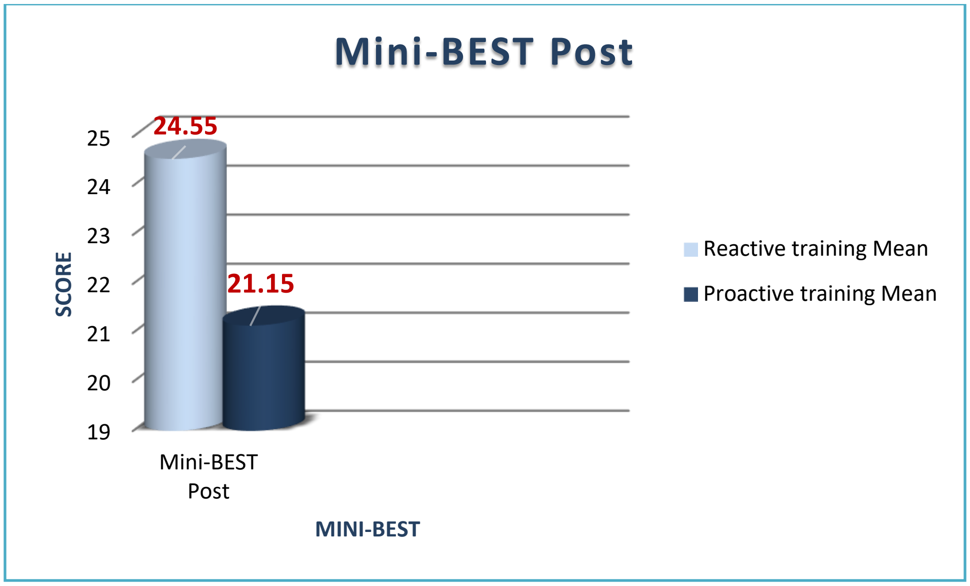


Figure 4.25 Mini-BEST Post

The mean difference between the reactive balance training group and the proactive balance training group was ***3.4*** as shown in Table 4.38, This demonstrates that there is a significant difference between the reactive and proactive balance training at the post-treatment point in favor of the reactive balance training ***(P<0.05).***

Table 4.38 Difference of mean Mini-BESR post Treatment in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	Mann-Whitney	Sig. (2-tailed)
Mini-BEST Post	24.55 ± 2.91	21.15 ± 2.77	3.400	-3.332	.001

4.1.4.5.4 Difference of Mini-BEST Improvement according to study nominal variables

As presented in Table 4.39 below the testing for the difference of Mini-BEST improvement according to the other variables (gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, Type of training, and using an assistive device), there was no statistically significant difference in mean of Mini-BEST improvement based on any of other variables mentioned above ***(P>0.05).***

Table 4.39 Difference of Mini-BEST Improvement according to study nominal variables

Variables		N	Mean	Mann-Whitney	Sig
Gender	M	26	9.808	-0.515	0.606
	F	14	10.357		
Type of stroke	Ischemic	24	10.125	-0.376	0.707
	Hemorrhage	16	9.813		
Recurrent Stroke	Yes	5	8.2	-1.239	0.215
	No	35	10.257		
Affected Side	Left	22	9.864	-0.453	0.651
	Right	18	10.167		
Hypertension	Yes	16	10.5	-0.92	0.358
	No	24	9.666		
Diabetes mellites	Yes	20	10.1	-0.109	0.913
	No	20	9.9		
Cardiac Diseases	Yes	21	10.571	-1.217	0.224
	No	19	9.368		
Cholesterol	Yes	18	10.389	-0.686	0.492
	No	22	9.682		
Other diseases	Yes	8	10.375	-0.546	0.585
	No	32	9.906		
smoking	Yes	12	10.167	-0.03	0.976
	No	28	9.929		
Type of training	Reactive training	20	10.800	-1.324	0.1852
	Proactive training	20	9.200		
using assistive device	Yes	18	10.5	-0.769	0.442
	No	22	9.591		

4.1.4.5.5 Association between Mini-BEST Improvement and Study ordinal and continuous Variables

As presented in Table 4.40 below, there is no significant correlation between Mini-BEST improvement and study variables represented in Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity ***(p>0.05)***.

Table 4.20 Correlation between Mini-BEST Improvement and Study ordinal and continuous variables

		Improvement in Mini-BEST
Age	Pearson Correlation	-.101
	Sig. (2-tailed)	.536
Body Mass Index	Pearson Correlation	.126
	Sig. (2-tailed)	.439
Weight	Pearson Correlation	.072
	Sig. (2-tailed)	.657
Hight	Pearson Correlation	-.105
	Sig. (2-tailed)	.519
Duration between D.O.A and D.O. S	Pearson Correlation	.157
	Sig. (2-tailed)	.333
Physical Activity	Spearman Correlation	.031
	Sig. (2-tailed)	.849

4.1.4.5.6 Predictors of Mini-BEST

As Presented in Tables 4.41,4.42,4.43 the multivariate analysis showed a model that predicts ***72.3%*** of the variation of the Mini-BEST improvement in subjects between baseline and post-treatment ***(P <0.05)***. and the variation in Mini-BEST improvement is predicted significantly by 4 independent variables, Mi-BEST Pre ***(B= -.798)***, Type of training ***(B= -2.101)***, Tinetti pre ***(B= .283),*** Affected Side ***(B= -2.109).***

Table 4.21 Model Summary for Predictors of Mini-BEST Improvement

Model Summary[g]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
6	.850[f]	.723	.691	1.74443

a. Predictors: (Constant), Mini-BEST Pre
b. Predictors: (Constant), Mini-BEST Pre, Type of training
c. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity Questionnaire Pre
d. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity Questionnaire Pre, Tinetti Pre
e. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity questionnaire Pre, Tinetti Pre, Affected Side
f. Predictors: (Constant), Mini-BEST Pre, Type of training, Tinetti Pre, Affected Side
g. Dependent Variable: Improvement in Mini BEST

Table 4.22 ANOVA for predictors of Mini-BEST improvement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
6	Regression	277.494	4	69.373	22.797	.000[g]
	Residual	106.506	35	3.043		
	Total	384.000	39			

a. Dependent Variable: Improvement in Mini BEST

b. Predictors: (Constant), Mini-BEST Pre

c. Predictors: (Constant), Mini-BEST Pre, Type of training

d. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity

e. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity, Tinetti Pre
f. Predictors: (Constant), Mini-BEST Pre, Type of training, Physical Activity, Tinetti Pre, Affected Side
g. Predictors: (Constant), Mini-BEST Pre, Type of training, Tinetti Pre, Affected Side

Table 4.23 Coefficients for the predictors of Mini-BEST improvement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	22.211	2.217		10.018	.000
	Mini-BEST Pre	-.798	.092	-1.076	-8.695	.000
	Type of training	-2.101	.637	-.339	-3.300	.002
	Tinetti Pre	.283	.093	.390	3.048	.004
	Affected Side	-2.109	.610	-.339	-3.456	.001

a. Dependent Variable: Improvement in Mini BEST

4.1.4.6 2 Minutes Walking Test

4.1.4.6.1 Difference of mean 2 MWT between two groups (reactive balance training and proactive balance training) at baseline

As shown in Figure 4.26 the 2 MWT Pre for the reactive balance training group was **40.25** and for the proactive balance training group was **33.45.** and there was a statistically significant difference in the reactive balance training group and proactive balance training group at baseline **($p<0.05$)** as presented in Table 4.44 below.

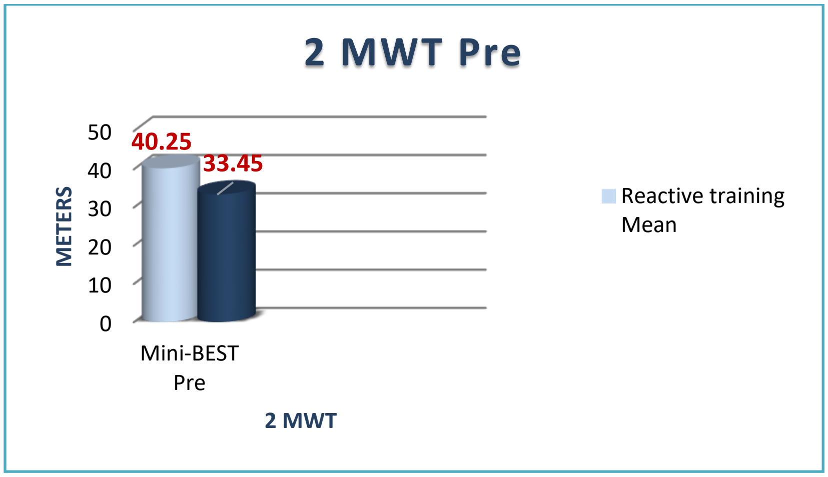


Figure 4.26 2 Minutes Walking Test Pre

Table 4.24 Difference of mean 2MWT Pre between groups

	Reactive balance training (mean ± Std)	**Proactive balance training (mean ± Std)**	**Mean Difference**	**t-test**	**Sig. (2-tailed)**
2 Minutes Walking Test Pre	40.25 ± 9.40	33.45 ± 8.351	6.800	2.418	.020

4.1.4.6.2 Differences of 2 MWT Mean within groups (reactive balance training and proactive balance training) at baseline and post-treatment

As shown in Figure 4.27 the improvement of 2MWT in the reactive balance training group was from ***40.25 m*** (pre) to ***50.40 m*** (post), and in the proactive balance training group the improvement was from ***33.45 m*** (pre) to ***43.55 m*** (post). The mean difference in the reactive balance training group was ***10.150 m***, and in the proactive balance training group was ***10.1 m***. which means there is a significant difference between pre-and post-treatment in both groups as shown in Table 4.45.

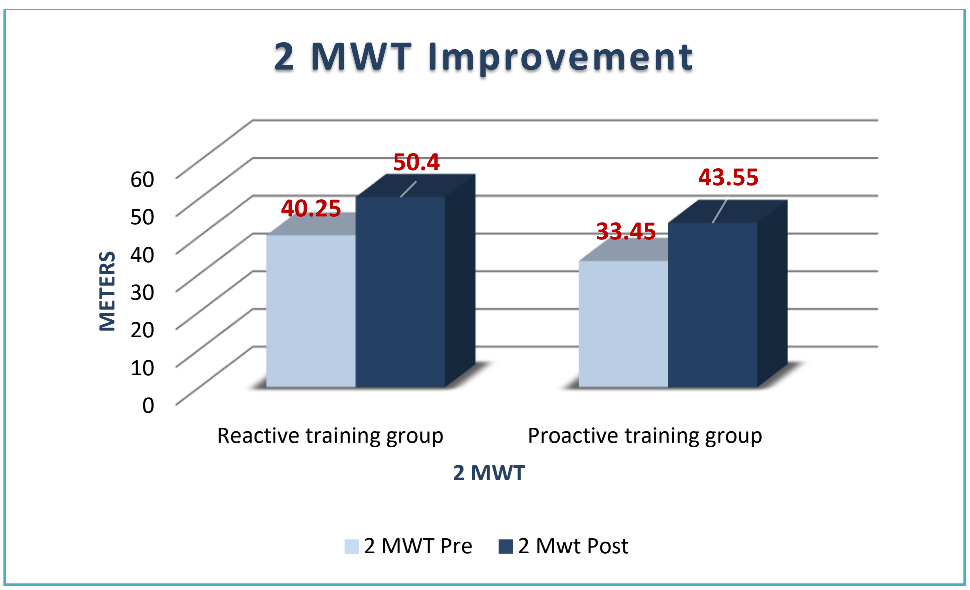


Figure 4.27 2Minutes Walking Test Improvement

Table 4.25 2 Minutes Walking Test Improvement between pre-and post-treatment for both groups

	2 Minutes Walking Test Pre	**2 Minutes Walking Test Post**	**Mean difference**	**t-test**	**sig**
Reactive training	40.25	50.4	-10.15	-11.375	0.00
Proactive training	33.45	43.55	-10.1	-12.876	0.00

4.1.4.6.3 Difference of mean 2 MWT Improvement in reactive balance training and proactive balance training

As shown in Table 4.46, The mean difference between the reactive balance training group and the proactive balance training group was ***6.850.*** This demonstrates that there is a significant difference between the reactive and proactive balance training at the post-treatment point in favor of the reactive balance training ***(P<0.05).***

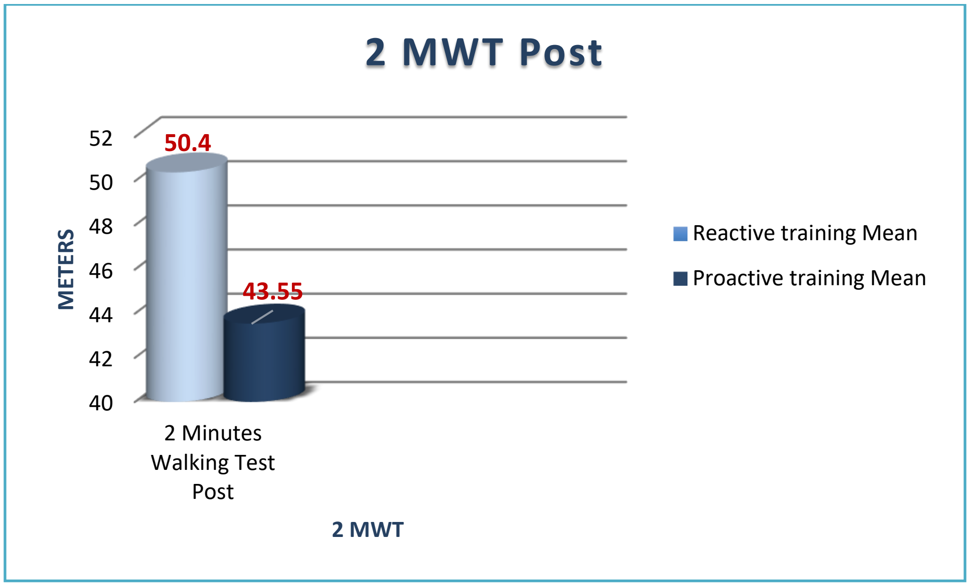


Figure 4.28 2 Minutes Walking Test Post

Table 4.26 Difference of mean 2MWT post-treatment in both groups

	Reactive balance training (mean ± Std)	Proactive balance training (mean ± Std)	Mean Difference	t-test	Sig. (2-tailed)
2 Minutes Walking Test Post	50.40 ± 9.36	43.55 ± 7.79	6.850	2.516	.016

4.1.4.6.4 Difference of 2MWT Improvement according to study nominal variables

As presented in Table 4.47 below the testing for the difference of 2 MWT improvement according to the other variables (gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, type of training, and using an assistive device), there was a statistically significant difference in mean of 2 MWT improvement based on recurrent stroke, and diabetes mellites ***(p<0.05),*** and there was no statistically significant difference in mean of 2 MWT improvement based on any of other variables mentioned above ***(P>0.05).***

Table 4.27 Difference of 2MWT Improvement According to Study Nominal Variables

Variables		N	Mean	t-test	Sig
Gender	M	26	9.846	-0.643	0.524
	F	14	10.643		
Type of stroke	Ischemic	24	10.000	-0.258	0.798
	Hemorrhage	16	10.313		
Recurrent Stroke	Yes	5	13.200	2.063	0.046
	No	35	9.686		
Affected Side	left side	22	10.000	-0.233	0.817
	Right side	18	10.278		
Hypertension	Yes	16	9.875	-0.344	0.733
	No	24	10.291		
Diabetes mellites	Yes	20	11.500	2.497	0.017
	No	20	8.750		
Cardiac Diseases	Yes	21	10.095	-0.053	0.958
	No	19	10.158		
Cholesterol	Yes	18	10.056	-0.106	0.916
	No	22	10.182		
Other diseases	Yes	8	11.375	1.068	0.292
	No	32	9.813		
Smoking	Yes	12	9.667	-0.507	0.615

	No	28	10.321		
Type of training	Reactive training	20	10.15	0.042	0.967
	Proactive training	20	10.1		
using assistive device	Yes	18	9.500	-0.963	0.342
	No	22	10.636		

4.1.4.6.5 Association between 2 MWT Improvement and Study ordinal and continuous Variables

As presented in Table 4.48 below, there is no significant correlation between 2 MWT improvement and study variables represented in Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity ***(p>0.05)***.

Table 4.48 Correlation between 2 MWT improvement and study variables

		Improvement in 2 MWT
Age	Pearson Correlation	.212
	Sig. (2-tailed)	.189
Body Mass Index	Pearson Correlation	-.073
	Sig. (2-tailed)	.655
Weight	Pearson Correlation	-.075
	Sig. (2-tailed)	.644
Hight	Pearson Correlation	.007
	Sig. (2-tailed)	.966
Duration between D.O.A and D.O.S	Pearson Correlation	-.185
	Sig. (2-tailed)	.252
Physical Activity	Spearman Correlation	.150
	Sig. (2-tailed)	.357

4.1.4.6.6 Predictors of 2 Minutes Walking Test

As Presented in Tables 4.49,4.50,4.51 the multivariate analysis showed a model that predicts ***10.1%*** of the variation of the 2 MWT improvement in subjects between baseline and post-treatment ***(P <0.05)***. The main predictors were recurrent stroke ***(B= -3.514)***

Table 4.49 Model Summary for Predictors of 2 MWT Improvement

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.317[a]	.101	.077	3.56276

a. Predictors: (Constant), Recurren Stroke

b. Dependent Variable: Improvement in 2 MWT

Table 4.28 ANOVA for predictors of 2 MWT improvement

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	54.032	1	54.032	4.257	.046[b]
	Residual	482.343	38	12.693		
	Total	536.375	39			

a. Dependent Variable: Improvement in 2 MWT

b. Predictors: (Constant), Recurrent Stroke

Table 4.29 Coefficients for the predictors of 2 MWT improvement

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	16.714	3.243		5.154	.000
	Recurrent Stroke	-3.514	1.703	-.317	-2.063	.046

a. Dependent Variable: Improvement in 2 MWT

4.1.5 Correlation between Outcome Measures

As presented in Table 4.52 below, there is a significant positive correlation between FES and TUG, and Tinetti ***(P<0.05)***,while there is no significant correlation between TUG and 10MWT, and

Mini-BEST, and 2MWT ***(P>0.05).*** there is a positive correlation between TUG and 10MWT and Mini-BEST ***(p<0.05).***

Table 4.30 Correlation between outcome measures

		Improvement in FES	Improvement in TUG	Improvement in 10 MWT	Improvement in Tinetti	Improvement in Mini BEST	Improvement in 2 MWT
Improvement in FES	Pearson Correlation	1	.419**	.151	.322*	.299	.047
	Sig. (2-tailed)		.007	.352	.042	.061	.773
Improvement in TUG	Pearson Correlation	.419**	1	.400*	.103	.381*	.008
	Sig. (2-tailed)	.007		.011	.527	.015	.963
Improvement in 10 MWT	Pearson Correlation	.151	.400*	1	.226	.124	.177
	Sig. (2-tailed)	.352	.011		.161	.447	.273
Improvement in Tinetti p	Pearson Correlation	.322*	.103	.226	1	.299	.071
	Sig. (2-tailed)	.042	.527	.161		.061	.663
Improvement in Mini BEST	Pearson Correlation	.299	.381*	.124	.299	1	-.040
	Sig. (2-tailed)	.061	.015	.447	.061		.808
Improvement in 2 MWT	Pearson Correlation	.047	.008	.177	.071	-.040	1
	Sig. (2-tailed)	.773	.963	.273	.663	.808	

4.2 Result Discussion

The average age of the reactive balance training group was 63.5 ± 7.338 (mean±STD), whereas the average age of the Proactive balance training group was 67 ± 5.912 (mean±STD) as shown in Table 4.1. the highest percentage of age group was 66-70 years in both groups as presented in Figure 4.1, which reflects a younger age than the mean age of stroke, as reported by (Béjot et al., 2019) . This is also consistent with the incidence of stroke cases increasing by age ≥75 years +65%, and age < 75 +25%. While in a systematic study done in 2021 for the global burden of diseases (GBD), reported that there is a significant increase in stroke prevalence and incidence in people younger than 70 years, while over 70 years old there is an increase in the rate of mortality (Feigin et al., 2021).

26 of the participants were males, 14 of them were in the reactive training group and 12 were in the proactive training group, while 14 of the participants were females, as presented in Figure 4.2, which indicates that the percent of males incidence was higher than females, and this was consistent with the study of Vyas et al (Vyas et al., 2021) who reported that women have a lower incidence of stroke than men.

As presented in Figure 4.3 35% of the reactive balance training group participants, and 45% of the proactive balance training group were overweight, the average BMI of the reactive balance training group was 26.92, and the average BMI of the proactive balance training group was 28.18, as demonstrated in Table 4.2, and this result confirms the findings of Liu (X. Liu et al., 2018) who concluded in a systematic review that overweight and obesity increase the risk of stroke.

As for Co-morbidities prevalence, according to Figure 4.4, the most prevalent comorbidities were diabetes mellitus, Cardiac diseases, Hypertension, cholesterol, and other diseases, this supported Elamy and Ashfaq Shuaib, finding that the most common comorbidities with stroke patients were, cardiac diseases, hypertension, and Diabetes, and these comorbidities increase with age (Elamy et al., 2020). Marilyn J Cipolla and David S Liebeskind found that the common feature of stroke is comorbidities, which both raise the risk of stroke and deteriorate its prognosis. The most significant changeable risk factor for stroke is hypertension, which is common in the population at risk for stroke (Cipolla et al., 2018). This supported our finding as presented, the Hypertension percentage in the reactive balance training group was 30%, and in the proactive balance training group was 50% Figure 4.7 showed 30% of participants were smoking. As reported by Pan, Biqi BS, stroke has a dependent relationship with smoking.(Pan et al., 2019).

The majority of the participants had an ischemic stroke 60% as presented in Figure 4.5, this was consistent with the percentage rereported by (Boehme et al., 2017) that the majority of stroke cases are ischemic (80%).

As presented in Figure 4.10 35% of the reactive balance training group and 20% of the proactive balance training group were active, and 40% of the reactive balance training, and 30% of the proactive balance training group were moderately active. As reported by Thomas, and Ewan regular physical activity improves balance in the elderly (Thomas et al., 2019).

The FES, was more severe at baseline in the proactive training group (mean= 53.5), while in the reactive balance training group was (mean=48.05), as shown in Figure 4.11, the mean difference between groups was -5.450, and this difference was statically significant .048<0.05, as presented in Table 4.4, one of the reasons behind this difference may be due to the fact that the test itself very subjective. Which may also be clinically insignificant.

Figure 4.12 showed the FES improvement, in the reactive balance training group was 22.45, while in the proactive balance training group was 21.5, at post-treatment the improvement in the reactive balance training group was better than proactive training group and was statistically significantly different ($p<0.05$) as presented in Table 4.6, both interventions were effective in improving (decreasing) FES with the favor of reactive training, justification of this variation could be because the reactive balance training puts the patients in an actual pre-fall position on the contrary of the proactive balance training which reaches the limit of fall anticipation only, this variation of philosophy of threat limit of falling may have contributed to the more improvement in the reactive balance training group. This supports the Shirley Handelzalts, and Michal Kenner-Furman study which that reactive balance training had a positive effect in reducing the risk of falls among older adults and persons with stroke. Incorporating perturbation training during the rehabilitation of people with stroke improved reactive balance and balance confidence (Handelzalts et al., 2019).

As presented in Tables 4.7 and 4.8 nothing of the nominal/ordinal, and the continuous variables (gender, type of stroke, recurrent stroke, affected side, co-morbidities, smoking, type of intervention, using an assistive device, age, BMI, weight, height, duration between D.O.S and

D.O.A, and physical activity questionnaire pre) had any different of improvement or association in any of the two groups and this contrary the finding of Luciano Magalhães Vitorino, and Carla Araujo Bastos Teixeira, that a higher number of previous falls, and fear of falling was in the female gender, older age, and worse health self-assessment (Vitorino et al., 2017), and Hita and Fidel found that obesity increases the risk of falls, especially in females (Hita-Contreras et al., 2013).

As presented in Tables 4.9, 4.10,4.11 the FES improvement was predicted by using reactive balance training, less age, better 10MWT pre, and positively associated with the duration between stroke and intervention, the things that could be due to the fact that more time between stroke and intervention, could have allowed for better improvement and neuroplasticity, which had been obvious with those patients having a longer period after stroke showing better improvement in FES, and this contrary with Gert Kwakkel, and Boudewijn Kollen, finding that the first 10 weeks after stroke showed more improvement in the outcomes (Kwakkel et al., 2006).

The more severe the FES at pre-intervention justifies the perceived threats of falling by the patients, which have better improvement, with patients who had been given the chance to experience a pre-falling point, which may have contributed to the improvement of their fall perception and threats (represented in lower FES). What Merrill R. Landers and Sarrie Oscar found in their study when studying the balance confidence and FoF among the elderly, showed that balance confidence was the best predictor of falling, followed by fear of falling avoidance behavior, they suggested that participants may have had a better sense of their fall risk than with a test that provides a snapshot of their balance (Landers et al., 2016).

Age is associated with the aging of the systems responsible or associated with balance (proprioception, vestibular, and vision) also balance output system that includes range, and muscle power, which are also a part of the aging process, and they may justify the delayed improvement with the older patients and this support Trombetti, and K. F. Reid, study, that in older adults increase Fear of falling due to mobility limitations, declining muscle mass, strength, power, and physical performance (Trombetti et al., 2016). Ana Laveda´n and Maria Viladrosa studied the prevalence of fear of falling (FOF) among the elderly and showed that female gender, comorbidity, depressive symptoms, and disability are factors associated with FOF (Lavedán et al., 2018).

In the case of 10MWT, it has some speed components that were not the core concentration of both programs, which may justify why there was a less achievement FES in more severe 10MWT. This supported Addie Middletona, and Carty H. Braun's finding, that patients with chronic stroke often find it difficult to increase their walking speed because of balance impairment which leads to fear of falling (Middleton et al., 2017) .

Figure 4.15 shows the improvement of TUG, which was in the reactive training group 6.433 and in the proactive training group was 6.866, and This means the improvement in the proactive training group was higher than the reactive balance training group, and in both groups, improvement was statistically significant, as shown in Table 4.13. at post-treatment, there was a significant difference between groups in favor of the reactive balance training, despite the difference in mean of TUG Improvement between pre and post-treatment was higher in the proactive training group but the mean of the reactive balance training group (15.47) was less than proactive balance training group (18.46), This means that reactive balance training group needed less time (sec) than proactive balance training group to finish the TUG.

TUG improvement was shown to be better in females compared to males Table 4.15, this was represented by Camila Pereira, and Rubens A. da Silva finding that women presented better balance than men (Pereira et al., 2018), and contradicts the findings reported by Daniel Hamacher, and Dominik Liebl's results, that gender was a factor that contributed to gait stability, and balance, that found the males improved better than females (Hamacher et al., 2019).

Those who were using an assistive device improved better than those who did not use an assistive device as presented in Table 4.15. It could be that those who were using the assistive devices had worse balance, and since severity was positively associated with better improvement of different outcomes in this study, this may justify that those with active devices improved better than those who do not use assistive devices. This was represented by Hamid Bateni, and Brian E. Mak's finding confirmed that using a walking assistive device improves balance and mobility (Bateni & Maki, 2005). Furthermore, there was a positive correlation between TUG improvement and BMI, and physical activity, and this was consistent with Cancela Carral, and José M's finding that there was a statistically significant correlation between BMI and balance improvement (Cancela Carral et al., 2019), and contradicts Camila Pereira, and Rubens A. da Silva , who reported BMI and fat mass does not seem to influence the balance of older adult (Pereira et al., 2018).

As presented in Tables 4.17,4.18,4.19 of multivariate analysis (predictors) of TUG, TUG pre, and 10 MWT pre, were the main predictors of TUG improvement.

There was a positive association between the score of TUG pre- and improvement of TUG, which in other words means that those who had worse (Higher) TUG (poor balance) showed better improvement, this may be associated with the fact that we have been working on improvement aspects that included maneuvering in actual life falling experience, and improvement was manifested among those who needed more balance training (more severe), and who had the better potential for improvement.

There was a negative correlation with10MWT Pre, this may be justified that 10 MWT is a test associated with speed, and therefore those who show higher 10MWT showed less improvement which may be due to other factors like strength, vision, and tone that dictate speed status in patients and not necessarily mirroring the improvement in TUG, and this was consistent with Faria Fortini, which reported that walking speed with chronic stroke patients associated with other factors such as strength, and daily activities (Faria-Fortini et al., 2019). Part of this justification could be also that we did not concentrate on speed in our program while changing position and reaching sideways and more challenges in position change were part of our program, which may justify the variation of both 2 outcome measures pre-test in the direction of association with the improvement.

Age was inversely predicted with the improvement of TUG, this could be justified by that TUG is a typical test for measuring balance abilities and age is associated with the aging process of less vision, less proprioception, and less effective vestibular status, which are the triangle of balance, this consistent with Prakruti J. Patel, and Tanvi Bhatt finding that aging with and without stroke impacts the ability to maintain balance (Patel & Bhatt, 2016), This finding emphasizes the importance of incorporating balance training as part of elderly management and aging consequences mitigation.

In 10MWT at baseline, there was a significant difference between groups as presented in Table 4.20, which supports that the proactive balance training group is more severe than the reactive balance training group, which may affect 10MWT improvement. Table 4.22 shows that the improvement in the reactive balance training group was better than the proactive balance training group, and was a statistically significant difference in favor of the reactive balance training group. The 3 sec in 10MWT is also considered clinically significant.

10MWT despite that it is a speed test, it is a reflection of better balance by the fact that better balance dictates faster steps, a bigger distance for each step, and less fear of falling, which may all contribute to better speed, and better 10MWT, this consistent with Masumeh Hessam, reported that improvement in balance lead to better improvement in walking speed with chronic stroke patients (Hessam et al., n.d. 2018), However, this was inconsistent with Caroline Lund, who found that improvement in balance does not necessarily improve walking distance and speed, especially when patients use an assistive device (Lund et al., 2018).

There was no association between 10 MWT improvement and other study nominal, ordinal, and continuous variables, as presented in Tables 4.23, and 4.24. and this supported Gert Kwakkel and Boudewijn Kollen's finding which showed no association between outcome measures improvement and other factors such as age, gender, type of stroke, and type of intervention (Kwakkel et al., 2006).

10 MWT Improvement was mainly predicted by severity, age, and gender, as presented in Tables 4.25,4.26,4.27 . The improvement of 10MWT with more severe patients could be due to the improved balance with patients tested by 10MWT, and with the reactive balance training group improvement was more since we think it had more challenges to balance requirement, which may have translated to a better improvement in 10MWT.

For the age it is just a reflection of the negative association between the age consequences and the improvement of 10MWT, the things that were confirmed by the same results with FES and TUG. Females showed less improvement with 10MWT, this supports Daniel Hamacher, and Dominik Liebl's results, that gender was a factor that contributed to gait stability, and balance, which was in females worse than men, which means that men walked more stable than female. and this result confirmed why females are more likely to fall (Hamacher et al., 2019). Another study that supported our findings was conducted by Cheryl D Bushnell, and Seemant Chaturved which found women with stroke have worse outcomes, increased disability, and decreased quality of life. These quality of life challenges in women may be related to increased anxiety, depression, pain, and discomfort, as well as decreased mobility compared to men (Bushnell et al., 2018b)

In the Tinetti Balance Assessment at baseline, there was a significant difference between groups, which supports the result above that the proactive balance training group was more severe than the reactive training group, both interventions improved Tinetti because both interventions had targeted different components of balance training, meanwhile, the improvement of the reactive balance training group was better significantly, despite that, there were better significantly at the pre-intervention, this improvement superiority could have a cross-linked effect of the less severity at baseline together with the challenging requirements of the reactive balance training (cross the limit).

As presented in Tables 4.33,4.34,4.35 Multivariable regression has confirmed bivariate analysis by pointing to that females and Tinetti pre were negatively predicting improvement of Tinetti. This supports Milada Krejci , and Martin Hill results, which showed differences between males and females in the Tinetti summary balance test(Krejci et al., 2020).

The negative association of Tinetti pre with Tinetti improvement included both groups, which may point to that patients with higher scores of Tinetti pre, did not need higher improvement to reach maximum and the potential of their improvement scores are lower because they started from higher positions.

As presented in Table 4.37 the Mini-BEST improvement in the reactive balance training group was 10.8, and that proactive balance training group was 9.2, after the intervention both groups showed significant improvement between the pre-test and post-test, Marla K Beauchamp, and Rudy Niebuhr reported that change of 4–5 points on the Mini-BESTest reflects the minimal clinically important difference for people with stroke (Beauchamp et al., 2021) , while the reactive balance training group had shown statistically significant better improvement of Mini-BEST, this may be justified by the nature of the test itself, which resembles in its items many of the reactive balance training items including the reactive postural control section which practicing them is expected to improve their performance which may support the findings of Davide G de Sousa, and Lisa A Harvey study where they concluded that repetitive practice improves balance after stroke (de Sousa et al., 2018). Those results also support the findings of another study that was conducted by French B, Thomas LH, and Coupe J, which showed moderate evidence on that repetitive tasks improve function, and balance this depends on the amount of training, and the number of repetitions (French et al., 2016).

Tables 4.41,4.42,4.43 showed the predictors of Mini-BEST were represented in severity that was negatively associated with improvement in contrast to other outcome measures, which may be related to the same fact that the Mini-BEST items are challenging balance activities.

The left side was a negative predictor of Mini-BEST improvement, which supports the findings of Takaaki Fujita, and Atsushi Sato study which showed that the affected lower limb influenced motor function and ADL performance (FujiTa et al., n.d.). and Kyunghoon Kim reported that the affected side influences the walking ability in stroke patients (Kim et al., n.d.). Those with RT hemiplegia may improve well as most of the people are commonly right-dominant, which helps them to retrieve motor programs as part of the rehabilitation

Regarding the type of training, as we mentioned above the reactive balance training was practicing and performing similar sections in the Mini-BEST, this is consistent with the finding of Mansi Joshi (Joshi et al., 2018) and Prakruti J. Patel (Patel & Bhatt, 2016) that the reactive balance training improved balance with stroke and the elderly.

There was a significant difference between groups at baseline in 2MWT, the improvement was higher in the reactive balance training group than the proactive balance training group, and there was a significant difference between groups at post-treatment favor in the reactive balance training group, there was a relation between 2MWT improvement and recurrent stroke and diabetes mellites. The predictor was a recurrent stroke. Having the recurrent stroke improve better than 1st stroke, may be justified by the fact that we had only 5 participants with recurrent stroke, and on the other hand recurrent stroke may have had more secondary complications from the 1st stroke, that our program helped in revealing which may have contributed to better improvement.

In the 2MWT there was a better improvement by 10 meters for the favor reactive balance training group, this could be justified by that they already have this 10-meter difference at baseline, which was reflected in the difference of average improvement in meters between the two groups, this is why when analyzing multivariate analysis of predictors of improvement of 2MWT, type of intervention was not part of the predictors nor the issues of recurrent stroke and diabetes Miletus that appeared to have minor statistical significant difference without any clinical significance represented in around 4 meters variation with those who had a recurrent stroke or not, and diabetes or not, and that in the multivariate regression, recurrent stroke was the main negative predictors of 2MWT,

2MWT test is a reflection of balance, endurance, and strength, without significant challenge for balance, despite the importance of balance as a pre-request minimum level of balance to be able to do 2MWT, this is why it may be the type of training was not determinant in the predictors of improvement of 2MWT score, the negative prediction of improvement 2MWT was associated with being first stroke, and maybe these people with recurrent stroke were more familiar with a rehabilitation program, and balance activities, this why they improved more, despite the recurrent stroke, the issues of balance are more associated with severity rather than the number, in our case first-ever stroke was worse in the other variables, this is consistent with the finding of Hui-Ting Goh, that a person with a first stroke is more likely to have recurrent falls and fear of falling (Goh et al., 2016).

4.3 Study Limitation

The researcher notices several limitations in this study:

1. That included a variation in severity between groups
2. The variation of the length of time between stroke and assessment, which may have affected the variation in results of improvement on different outcome measures.
3. Balance could have been tested by a computerized subjective balance board which could have been much more accurate and objective.

Chapter Five: Conclusion and Recommendation

5.1 Conclusion

5.2 Recommendations

Chapter Five: Conclusion and Recommendation

5.1 Conclusion

1. This single-blinded RCT study aimed to compare the effect of reactive balance training, and proactive balance training on the balance and functional performance of chronic stroke patients. by conveniently recruiting 40 chronic stroke patients from Al Ahli Hospital, and Bethlehem Arab Society for Rehabilitation, who were further randomly divided into two groups, 20 were in the reactive training group, and 20 were in the proactive training group.
2. The study proved that there was a significant effect on improving balance and stroke rehabilitation functional outcomes in both groups and that reactive balance training was significantly superior in improving balance and stroke rehabilitation functional outcome
3. There was a statistically significant difference in FES, 10MWT, Tinetti, and 2MWT, between groups, which was the proactive training group was more severe than the reactive training group.
4. The study found that there was no association between FES, 10MWT, and Mini-BEST improvement with any of the other study nominal, ordinal, and continuous variables which were: gender, type of stroke, recurrent stroke, affected side, Co-morbidities, smoking, Type of training, using an assistive device, Age, BMI, Weight, Height, Duration between D.O.S and D.O.A, and Physical Activity Questionnaire.
5. Females improved better in TUG
6. BMI and physical activity were correlated with TUG improvement
7. Tinetti improved more in patients who had cardiac diseases,
8. There is statistically significant better improvement in 2MWT improvement for favor of patients with recurrent strokes

   In summary, there was a statistically significant difference in all outcome measures between pre and post-treatment in both groups, and that reactive balance training is superior in improving both balance and functional outcomes in chronic stroke patients.

5.2 Recommendations for clinicians:

1. To promote the use of reactive balance training as a method to improving balance and functional performance among stroke survivors, and the elderly
2. Incorporating balance training as part of elderly management and aging consequences mitigation
3. To Use functional balance training as part of the stroke rehabilitation programs as it may contribute to better balance performance.

Recommendation for future researchers:

Based on this study's results, we suggest the following for future studies and other researchers:

1. To make sure that there is a homogenous stroke cluster that could be between 12 -1 8 months post-stroke.
2. Studying the effect of reactive balance training and proactive balance training with the elderly without stroke and comparing the results with our findings related to stroke.
3. To evaluate the efficacy of applying this program in rehabilitation centers with subacute stroke patients.
4. Investigate the most appropriate balance training among the elderly community include: intensity, frequency, and time.
5. To use further computerized objective assessment tools like computerized balance boards and gait labs.
6. To use up-to-date modern perturbation instruments with acute and chronic stroke patients.

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Appendixes

Appendix 1: Data Collection Sheet

Faculty of Health Profession

Physiotherapy & Rehabilitation Department

Jerusalem – Abu Dies

Master of Physiotherapy (MPT)

Proactive and Reactive Balance Training effects on Balance and Functional performance among chronic stroke Survivors

RCT study

تأثيرات تدريب التوازن الاستباقي وتدريب التوازن التفاعلي على التوازن والأداء الوظيفي بين الناجين من السكتات الدماغية المزمنة

الدراسة لرسالة ماجستير للطالبة أماني أبو عصيه في دائرة العلاج الطبيعي/جامعة القدس

Participant Name: ____________________________

Participant Code: _____________________________

Date of Signature: _____________________________

1. Personal Data:

1. **Name:** ______________________
2. **Age:** ______________________
3. **Gender:** ______________________
4. **Marital Status:** ______________________
5. **Address:** ______________________
6. **Occupation:** ______________________
7. **BMI:** ______________________
8. **Weight:** ______________________
9. **Height:** ______________________
10. **Phone Number:** ______________________

2. Medical History:

1. **Date of Stroke:** ______________________
2. **Type of Stroke:** ______________________
3. **Currents medications:** ______________________
4. **Other diseases:** ______________________

3. Outcome Measures:

	Outcome Measures	Pre	Post
1.	Time Up and Go		
2.	10 MWT		
3.	The Falls Efficacy Scale		
4.	Tinetti Assessment tool		
5.	Mini- BEST Balance Evaluation System Test		
6.	2 Minutes Walking test		

Appendix 2: Physical Activity Questionnaire

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the **last 7 days**. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise or sport.

Think about all the **vigorous** activities that you did in the **last 7 days**. **Vigorous** physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think *only* about those physical activities that you did for at least 10 minutes at a time.

1. During the **last 7 days**, on how many days did you do **vigorous** physical activities like heavy lifting, digging, aerobics, or fast bicycling?

   ____ **days per week**

   ☐ No vigorous physical activities → ***Skip to question 3***

2. How much time did you usually spend doing **vigorous** physical activities on one of those days?

   ____ **hours per day**

   ____ **minutes per day**

   ☐ Don't know/Not sure

Think about all the **moderate** activities that you did in the **last 7 days**. **Moderate** activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the **last 7 days**, on how many days did you do **moderate** physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

   ____ **days per week**

   ☐ No moderate physical activities → ***Skip to question 5***

SHORT LAST 7 DAYS SELF-ADMINISTERED version of the IPAQ. Revised August 2002.

4. How much time did you usually spend doing **moderate** physical activities on one of those days?

____ **hours per day**

____ **minutes per day**

☐ Don't know/Not sure

Think about the time you spent **walking** in the **last 7 days**. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the **last 7 days**, on how many days did you **walk** for at least 10 minutes at a time?

____ **days per week**

☐ No walking → ***Skip to question 7***

6. How much time did you usually spend **walking** on one of those days?

____ **hours per day**

____ **minutes per day**

☐ Don't know/Not sure

The last question is about the time you spent **sitting** on weekdays during the **last 7 days**. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the **last 7 days**, how much time did you spend **sitting** on a **week day**?

____ **hours per day**

____ **minutes per day**

☐ Don't know/Not sure

This is the end of the questionnaire, thank you for participating.

Appendix 3: Falls Efficacy Scale

FES-I

الآن نود أن نطرح بعض الأسئلة عن درجة حذرك من إمكانية الوقوع، الرجاء الإجابة مع الأخذ بعين الاعتبار طريقة قيامك بالنشاط. إذا كنت في الوقت الحاضر لا تقوم/ين بأداء النشاط بنفسك (على سبيل المثال يقوم شخص اخر بالتسوق عنك)، الرجاء الإجابة لتبيين درجة حذرك من إمكانية الوقوع عند القيام بالنشاط بنفسك.
الرجاء وضع علامة في المربع الأقرب لرأيك عن درجة حذرك من إمكانية الوقوع عند القيام بالنشاط.

		غير حذر على الإطلاق 1	حذر نوعاً ما 2	حذر 3	حذر جدًا 4
1	تنظيف المنزل (مثلا الكنس، المسح أو نفض الغبار)	☐ 1	☐ 2	☐ 3	☐ 4
2	ارتداء الملابس أو خلعها (تغيير الملابس)	☐ 1	☐ 2	☐ 3	☐ 4
3	تحضير وجبات طعام بسيطة	☐ 1	☐ 2	☐ 3	☐ 4
4	الاستحمام	☐ 1	☐ 2	☐ 3	☐ 4
5	الذهاب إلى الدكان او الى محلٍ تجاري	☐ 1	☐ 2	☐ 3	☐ 4
6	النهوض عن أو الجلوس على كرسي	☐ 1	☐ 2	☐ 3	☐ 4
7	صعود أو نزول الدرج	☐ 1	☐ 2	☐ 3	☐ 4
8	التنزه أو المشي في الحي	☐ 1	☐ 2	☐ 3	☐ 4
9	تناول شيء من مكانٍ عالٍ أو من على الأرض	☐ 1	☐ 2	☐ 3	☐ 4
10	الذهاب للرد على الهاتف قبل أن يتوقف عن الرنين	☐ 1	☐ 2	☐ 3	☐ 4
11	المشي على أرضية أو سطح زلق (مبتل أو جليدي)	☐ 1	☐ 2	☐ 3	☐ 4
12	زيارة صديق أو قريب	☐ 1	☐ 2	☐ 3	☐ 4
13	المشي في مكان مزدحم بالناس والمشاة	☐ 1	☐ 2	☐ 3	☐ 4
14	المشي على سطحٍ غير مستوٍ (كطريقٍ صخريةٍ أو غير ممهدةٍ بشكلٍ جيد)	☐ 1	☐ 2	☐ 3	☐ 4
15	المشي على طريق منحدرة صعوداً أو نزولاً	☐ 1	☐ 2	☐ 3	☐ 4
16	الخروج للمشاركة في مناسبة اجتماعية (عائلية أو دينية أو اخرى)	☐ 1	☐ 2	☐ 3	☐ 4

FES-I translated to Arabic by Dr. Hadeel Halaweh from Yardley L, Todd C, et al. 2005; doi:https://doi.org/10.1093/ageing/afi196

Appendix 4: Time Up and Go Test

Hamilton County FALL PREVENTION TASK FORCE presented by People Working Cooperatively WHOLE HOME MODIFICATIONS

TIMED GET UP AND GO TEST

Measure mobility in people who are able to walk on their own (assistive device permitted)

NAME ____________________

DATE ____________________

TIME TO COMPLETE ________ **SECONDS**

INSTRUCTIONS

The person may wear their usual footwear and can use any assistive device they normally use.

1. Have the person sit in the chair with their back to the chair and their arms resting on the arm rests.
2. Ask the person to stand up from a standard chair and walk a distance of 10ft. (3m)
3. Have the person turn around, walk back to the chair and sit down again.

Timing begins when the person starts to rise from the chair and ends when he or she returns to the chair and sits down.

The person should be given 1 practice trial and then 3 actual trials. The times from the three actual trials are averaged.

PREDICTIVE RESULTS

Seconds	Rating
<10	Freely mobile
<20	Mostly independent
20-29	Variable mobility
>20	Impaired mobility

Source: Podsiadlo, D. Richardson, S. The timed "Up and Go" Test a Test of Basic Functional Mobility for Frail Elderly Persons. *Journal of America Geriatric Society* 1991; 39:142-148

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Appendix 5: 10 MWT

10 Meter Walk Testing Form

Name:____

Assistive Device and/or Bracing Used:________________________________

Date:________

Seconds to ambulate 10 meters (only the middle 6 meters are timed)

Self-Selected Velocity: Trial 1_______sec.___ Fast Velocity: Trial 1_______sec.___

Self-Selected Velocity: Trial 2_______sec.___ Fast Velocity: Trial 2_______sec.___

Self-Selected Velocity: Trial 3 _______sec.___ Fast Velocity: Trial 3_______sec.___

Self-Selected Velocity: Average time___sec.__ Fast Velocity: Average time___sec.__

Actual velocity: Divide 6 by the average seconds

Average Self-Selected Velocity:_________m/s

Average Fast-Velocity:_______________m/s

Date:________

Seconds to ambulate 10 meters (only the middle 6 meters are timed)

Self-Selected Velocity: Trial 1_______sec.___ Fast Velocity: Trial 1_______sec.___

Self-Selected Velocity: Trial 2_______sec.___ Fast Velocity: Trial 2_______sec.___

Self-Selected Velocity: Trial 3 _______sec.___ Fast Velocity: Trial 3_______sec.___

Self-Selected Velocity: Average time___sec.__ Fast Velocity: Average time___sec.__

Actual velocity: Divide 6 by the average seconds

Average Self-Selected Velocity:_________m/s

Average Fast-Velocity:_______________m/s

Appendix 6: Tinetti Balance Assessment Tool

TINETTI BALANCE ASSESSMENT TOOL

Tinetti ME, Williams TF, Mayewski R, Fall Risk Index for elderly patients based on number of chronic disabilities. Am J Med 1986:80:429-434

PATIENTS NAME ____________________ D.o.b. __________ Ward _____

BALANCE SECTION

Patient is seated in hard, armless chair;

	Date		
Sitting Balance	Leans or slides in chair = 0 Steady, safe = 1		
Rises from chair	Unable to without help = 0 Able, uses arms to help = 1 Able without use of arms = 2		
Attempts to rise	Unable to without help = 0 Able, requires > 1 attempt = 1 Able to rise, 1 attempt = 2		
Immediate standing Balance (first 5 seconds)	Unsteady (staggers, moves feet, trunk sway) = 0 Steady but uses walker or other support = 1 Steady without walker or other support = 2		
Standing balance	Unsteady = 0 Steady but wide stance and uses support = 1 Narrow stance without support = 2		
Nudged	Begins to fall = 0 Staggers, grabs, catches self = 1 Steady = 2		
Eyes closed	Unsteady = 0 Steady = 1		
Turning 360 degrees	Discontinuous steps = 0 Continuous = 1		
	Unsteady (grabs, staggers) = 0 Steady = 1		
Sitting down	Unsafe (misjudged distance, falls into chair) = 0 Uses arms or not a smooth motion = 1 Safe, smooth motion = 2		
	Balance score	/16	/16

P.T.O.

TINETTI BALANCE ASSESSMENT TOOL

GAIT SECTION

Patient stands with therapist, walks across room (+/- aids), first at usual pace, then at rapid pace.

	Date		
Indication of gait (Immediately after told to 'go'.)	Any hesitancy or multiple attempts = 0 No hesitancy = 1		
Step length and height	Step to = 0 Step through R = 1 Step through L = 1		
Foot clearance	Foot drop = 0 L foot clears floor = 1 R foot clears floor = 1		
Step symmetry	Right and left step length not equal = 0 Right and left step length appear equal = 1		
Step continuity	Stopping or discontinuity between steps = 0 Steps appear continuous = 1		
Path	Marked deviation = 0 Mild/moderate deviation or uses w. aid = 1 Straight without w. aid = 2		
Trunk	Marked sway or uses w. aid = 0 No sway but flex. knees or back or uses arms for stability = 1 No sway, flex., use of arms or w. aid = 2		
Walking time	Heels apart = 0 Heels almost touching while walking = 1		
	Gait score	/12	/12
Balance score carried forward		/16	/16
Total Score = Balance + Gait score		/28	/28

Risk Indicators:

Tinetti Tool Score	Risk of Falls
≤18	High
19-23	Moderate
≥24	Low

Appendix 7: Mini- BEST Balance Evaluation Test

Mini-BESTest Instructions

Subject Conditions: Subject should be tested with flat-heeled shoes OR shoes and socks off.
Equipment: Temper® foam (also called T-foam™ 4 inches thick, medium density T41 firmness rating), chair without arm rests or wheels, incline ramp, stopwatch, a box (9" height) and a 3 meter distance measured out and marked on the floor with tape [from chair].
Scoring: The test has a maximum score of **28** points from **14 items** that are each scored from **0-2**.
"0" indicates the lowest level of function and "2" the highest level of function.
If a subject must use an assistive device for an item, score that item one category lower.
If a subject requires physical assistance to perform an item, score "0" for that item.
For **Item 3** (stand on one leg) and **Item 6** (compensatory stepping-lateral) only include the score for one side (the worse score).
For **Item 3** (stand on one leg) select the best time of the 2 trials [from a given side] for the score.
For **Item 14** (timed up & go with dual task) if a person's gait slows greater than 10% between the TUG without and with a dual task then the score should be decreased by a point.

1. SIT TO STAND	Note the initiation of the movement, and the use of the subject's hands on the seat of the chair, the thighs, or the thrusting of the arms forward.
2. RISE TO TOES	Allow the subject two attempts. Score the best attempt. (If you suspect that subject is using less than full height, ask the subject to rise up while holding the examiners' hands.) Make sure the subject looks at a non-moving target 4-12 feet away.
3. STAND ON ONE LEG	Allow the subject two attempts and record the times. Record the number of seconds the subject can hold up to a maximum of 20 seconds. Stop timing when the subject moves hands off of hips or puts a foot down. Make sure the subject looks at a non-moving target 4-12 feet ahead. Repeat on other side.
4. COMPENSATORY STEPPING CORRECTION-FORWARD	Stand in front of the subject with one hand on each shoulder and ask the subject to lean forward (Make sure there is room for them to step forward). Require the subject to lean until the subject's shoulders and hips are in front of toes. After you feel the subject's body weight in your hands, very suddenly release your support. The test must elicit a step. NOTE: Be prepared to catch subject.
5. COMPENSATORY STEPPING CORRECTION - BACKWARD	Stand behind the subject with one hand on each scapula and ask the subject to lean backward (Make sure there is room for the subject to step backward.) Require the subject to lean until their shoulders and hips are in back of their heels. After you feel the subject's body weight in your hands, very suddenly release your support. Test must elicit a step. NOTE: Be prepared to catch subject.
6. COMPENSATORY STEPPING CORRECTION- LATERAL	Stand to the side of the subject, place one hand on the side of the subject's pelvis, and have the subject lean their whole body into your hands. Require the subject to lean until the midline of the pelvis is over the right (or left) foot and then suddenly release your hold. NOTE: Be prepared to catch subject.
7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE	Record the time the subject was able to stand with feet together up to a maximum of 30 seconds. Make sure subject looks at a non-moving target 4-12 feet away.
8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE	Use medium density Temper® foam, 4 inches thick. Assist subject in stepping onto foam. Record the time the subject was able to stand in each condition to a maximum of 30 seconds. Have the subject step off of the foam between trials. Flip the foam over between each trial to ensure the foam has retained its shape.
9. INCLINE EYES CLOSED	Aid the subject onto the ramp. Once the subject closes eyes, begin timing and record time. Note if there is excessive sway.
10. CHANGE IN SPEED	Allow the subject to take 3-5 steps at normal speed, and then say "fast". After 3-5 fast steps, say "slow". Allow 3-5 slow steps before the subject stops walking.
11. WALK WITH HEAD TURNS-HORIZONTAL	Allow the subject to reach normal speed, and give the commands "right, left" every 3-5 steps. Score if you see a problem in either direction. If subject has severe cervical restrictions allow combined head and trunk movements.
12. WALK WITH PIVOT TURNS	Demonstrate a pivot turn. Once the subject is walking at normal speed, say "turn and stop." Count the number of steps from "turn" until the subject is stable. Imbalance may be indicated by wide stance, extra stepping or trunk motion.
13. STEP OVER OBSTACLES	Place the box (9 inches or 23 cm height) 10 feet away from where the subject will begin walking. Two shoeboxes taped together works well to create this apparatus.
14. TIMED UP & GO WITH DUAL TASK	*Use the TUG time to determine the effects of dual tasking. The subject should walk a 3 meter distance. TUG:* Have the subject sitting with the subject's back against the chair. The subject will be timed from the moment you say "Go" until the subject returns to sitting. Stop timing when the subject's buttocks hit the chair bottom and the subject's back is against the chair. The chair should be firm without arms. *TUG With Dual Task:* While sitting determine how fast and accurately the subject can count backwards by threes starting from a number between 100-90. Then, ask the subject to count from a different number and after a few numbers say "Go". Time the subject from the moment you say "Go" until the subject returns to the sitting position. Score dual task as affecting counting or walking if speed slows (>10%) from TUG and or new signs of imbalance.

Appendix 8: 2MWT

2 Minute Walk Test

Name:____

Assistive Device and/or Bracing Used:____

Date:_________

Distance ambulated in 2 minutes: ________________

Date:_________

Distance ambulated in 2 minutes: ________________

Date:_________

Distance ambulated in 2 minutes: ________________

Date:_________

Distance ambulated in 2 minutes: ________________

Appendix 9: Information sheet:

نموذج تعريف ومعلومات عن البحث

سم البحث: تأثيرات تدريب التوازن الاستباقي وتدريب التوازن التفاعلي على التوازن والأداء الوظيفي بين الناجين من السكتات الدماغية المزمنة

اسم الباحث: أماني أبو عصبه

تحية طيبة وبعد,

نشكركم لاستعدادكم للمشاركة بهذا البحث، الذي هو جزء من دراسة الماجستير في العلاج الطبيعي في جامعة القدس. والذي يهدف إلى التعرف على مدى تأثيرات تدريب التوازن الاستباقي وتدريب التوازن التفاعلي على التوازن والأداء الوظيفي بين الناجين من السكتات الدماغية المزمنة

معلومات عن طبيعة الدراسة والبرنامج الذي سيتم تقديمه لمرضى الجلطات الدماغية و تأثيره على التوازن و الأداء الوظيفي:

من خلال هذه الدراسة, نهدف الى تقديم برنامج علاجي مبني على التوازن الاستباقي و التوازن التفاعلي لمرضى الجلطات الدماغية المزمنة و الذي مر على اصابته ما لا يقل عن 3 اشهر, حيث نستهدف في هذا البرنامج مرضى الجلطات الدماغية في مدينة الخليل و قراها, و سيتم تدريب المرضى في عيادة خارجية في مدينة الخليل.

يتكون هذا البرنامج من 3 جلسات في الأسبوع على مدار 8 اسابيع بحيث سيتم تقسيم المشاركين الى مجموعتين , مجموعة سيتم تدريبها على التوازن الاستباقي والمجموعة الأخرى على التوازن التفاعلي

بحيث كل مجموعة ايامها تختلف عن الأخرى وبواقع 24 جلسة لكل مشارك. حيث سوف تكون مدة الجلسة من 45 دقيقة الى 60 دقيقة, تبدأ الجلسة بتمارين الاحماء لمدة 10 دقائق , ثم تبدأ تدريب التوازن , ثم تنتهي الجلسة بتمارين تهدئة لمردة 5 دقائق.

من الجدير ذكره أن الجلسات سوف تكون فردية وتعتمد بشكل أساسي على قدرة المريض, بحيث يتضمن البرنامج مستويات مختلفة من التدريب والتي تعتمد على قدرة المريض في تخطي كل مستوى, حيث المستويات من الاسهل الى الأصعب , والتي تتكون من:

1. الجلوس
2. الوقوف
3. المشي

بحيث لا ينتقل المريض للمستوى الثاني قبل اتقان جميع التمارين في المستوى الأول مع الاختلافات التي يتضمنها كل مستوى من حيث قاعدة الدعم الواسعة الى قاعدة الدعم الضيقة , قاعدة دعم ثابتة الى قاعدة دعم غير ثابتة, عمل التمارين والاعين مفتوحة الى عملها والاعين مغلقة , الوقوف مع اختلاف المسافات بين القدمين و عمل التمارين على نفس المبادئ التي تم المشي عليها خلال الجلوس مع تغير السطحية التي تم الوقوف عليها, عمل التمارين بسرعات مختلفة و ايقاعات مختلفة مع تغير الاتجاهات, ثم مستوى المشي الذي سوف يزيد فيها تحدي المريض مع اخذ الحيطة و الحذر حيث سيبدأ المريض من المشية العادية الى الضيقة الى الترادفية , سيتم استخدام أدوات مختلفة خلال عمل التمارين مثل كرة صغيرة, و كرة العلاج الفيزيائي ذات الحجم الكبير, قاعدة متحركة, اوزان مختلفة, حزام موليغان, و سادة التوازن , و الاربطة المرنة.

تم وضع البرنامج بناء على البروتوكول العالمي للتوازن بالإضافة الى التحديات التي سيتم وضع المريض بها للتقدم والتحسن وتجنب السقوط. و من الجدير ذكره أيضا ان الجلسة سوف تتضمن ثمانية الى عشرة تمارين مع تكرار من 10 الى 20 حسب قدرة تحمل المريض.

من الجدير التأكيد على التالي:

- تدخل العلاج الطبيعي ليس له اي آثار جانبية او تعريض المريض للخطر و جميع 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 قبل التدخل العلاجي وبعده.
- 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 لاحقًا لن يؤدي إلى أي عقوبة أو يؤثر على الرعاية الصحية الحالية أو المستقبلية.
- إن اشتراككم في هذا البحث هو طوعي ومرتبط 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 **(أماني أبو عصيه)** على الرقم التالي **05952910234**
- **شاكرين لكم حسن تعاونكم**

- **أماني أبو عصيه**
- **اخصائية علاج طبيعي**
- **طالبة ماجستير علاج طبيعي**
- **جامعة القدس**

Appendix 10: Informed consent

Informed consent to participate in Research

نموذج الموافقة على المشاركة في البحث

اسم البحث: تأثيرات تدريب التوازن الاستباقي وتدريب التوازن التفاعلي على التوازن والأداء الوظيفي بين الناجين من السكتات الدماغية المزمنة

اسم الباحث: أماني أبو عصبه

اسم المشارك: ______________________

رقم المشارك: ______________________

اسم المقيم: ________________________

تاريخ التقييم والتوقيع: ___________________

عزيزي المشارك /المشاركة:

توقعيك ادناه على نموذج الموافقة هو إقرار بالموافقة على المشاركة في الدراسة البحثية التي تقوم بها الباحثة أماني أبو عصبه والتي تدرس تأثيرات تدريب التوازن الاستباقي وتدريب التوازن التفاعلي على التوازن والأداء الوظيفي بين الناجين من السكتات الدماغية المزمنة , وهو إقرار بانه قد تم شرح البحث وأهدافه وكيف سيتم تطبيقه, وانه قد تم أيضا شرح حقوقك في هذا البحث والتي تتضمن:

1. السرية التامة للمعلومات وعدم مشاركتها مع أي شخص تحت أي سبب , وحفظها في مكان لا يصل اليه سوى الباحث.
2. استخدام هذه المعلومات لغرض البحث فقط.
3. إخفاء هوية المشارك في التحليل وعرض النتائج.
4. الحق في الانسحاب في أي وقت من الدراسة دون اية عواقب.
5. الحق في الاطلاع على نتائجك في البحث.
6. وأنه يمكنك التواصل مع الباحثة أماني أبو عصبه على الرقم 0595291034 في حال وجود أي أسئلة متعلقة بالبحث.

موافقة المشارك

تم وصف الدراسة البحثية وأهدافها والية تطبيقها من قبل الباحثة اماني أبو عصبه, بما فيها المعلومات المدرجة أعلاه, وبناء على ذلك أوافق على المشاركة في هذه الدراسة, وأنني سوف احصل على نسخة موقعة من الطرفين من هذا النموذج للاحتفاظ به.

اسم المشارك الرياضي:

____

توقيع المشارك: ______________ **التاريخ:** ______________

اسم وتوقيع الشاهد: ______________ **التاريخ:** ______________