Kingdom of Saudi Arabia

Ministry of education

Majmaah university

College of applied medical sciences

Department of physical therapy & health rehabilitation

The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.

A Thesis Submitted in Partial Fulfillment of the Requirements for the master's degree in Physical Therapy

By:

Khadijah Abdulrahman Mubarak Alfaleh

421203823

Supervisor:

Dr. Shaik Abdul Rahim, PhD

Associate Professor - Department of Physical Therapy - College of Applied Medical Sciences

1444 H- 2023 G

بسم الله الرحمن الرحيم

Committee's decision and their signatures

المملكة العربية السعودية
وزارة التعليم
جامعة المجمعة
عمادة الدراسات العليا
كلية العلوم الطبية التطبيقية
قسم العلاج الطبيعي والتأهيل الصحي

جامعة المجمعة
Majmaah University

تقرير لجنة المناقشة.

تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية.

خديجة عبد الرحمن مبارك الفالح

تمت الموافقة على تشكيل لجنة المناقشة والحكم على رسالة الباحثة **خديجة بنت عبد الرحمن بن مبارك الفالح** لنيل درجة الماجستير في تخصص العلاج الطبيعي من مجلس قسم العلاج الطبيعي والتأهيل الصحي (رقم٢٢) بتاريخ (١٤٤٤/١٠/١٧هـ) ومن مجلس كلية العلوم الطبية التطبيقية (رقم ٣٠) بتاريخ (١٤٤٤/١٠/٢٧هـ) على أن تكون اللجنة من الأعضاء التالية أسمائهم:

لجنة المناقشة والحكم على الرسالة

أعضاء اللجنة	الاسم	المرتبة العلمية	التخصص	التوقيع	ملاحظات
المشرف الرئيس	د. شيخ عبدالرحيم قادر	أستاذ مشارك	العلاج الطبيعي		مشرفا ومقررا
المناقش الداخلي	د. مساعد الزهراني	أستاذ مشارك	العلاج الطبيعي		عضوا داخليا
المناقش الداخلي	د. محمد شريف سراج الدين	أستاذ مساعد	العلاج الطبيعي		عضوا داخليا

قرار اللجنة ومناقشة الحكم:

تميزت رسالة الطالبة بالمنهجية والأصالة والوضوح وتعتبر نموذج عملي مطبق واشتملت على العديد من النتائج والتوصيات التي تخدم المجال البحثي وتم عرض الرسالة بشكل جيد. وتوصي اللجنة بقبول الرسالة لنيل درجة الماجستير في تخصص ماجستير العلوم في العلاج الطبيعي.

ABSTRACT

Introduction: Stroke is defined as a sudden onset focal neurological impairment that lasts more than 24 hours and is caused by vascular reasons. Stroke is the second leading cause of physical disability in adults and the second leading cause of death in high-income countries worldwide. Following a stroke, activity limitations are common. Furthermore, the individuals will have difficulty performing daily tasks such as eating, bathing, and walking due to cognitive and physical involvement. A motor relearning program (MRP) is a method based on Motor Learning theories. By utilizing repetitive functional tasks, the program assumed the brain's ability to recover after injury.

Aim: The study aimed to determine the effectiveness of the MRP in improving functional mobility of lower extremities among chronic hemiplegic subjects.

Method: This randomized controlled trial included 32 chronic hemiplegic subjects. The subjects were divided into two groups: control (n=16) and experimental (n=16). The control group received Conventional Physical Therapy (CPT) treatment for 45 minutes, whereas the experimental group received CPT treatment for 30 minutes along with 15 minutes of MRP. The duration of the treatment for both groups was three sessions per week, for a period of six weeks. All subjects were given the Mini-Mental State Exam (MMSE) and the Motor Assessment Scale (MAS) prior to treatment. The Barthel Index (BI) and the sit-to-stand component of the Motor Assessment Scale (MAS) were used as outcome measures at the start and end of the treatment.

Results: The 32 subjects included 23 men, nine women, 25 ischemic stroke victims, and seven hemorrhagic stroke victims. Among these subjects, 19 were affected on the left and 13 on the right. Both outcome measures did not improve in the control group. However, statistically significant differences were observed in the experimental group on both outcome measures, with p value < 0.001

Conclusion: This study concluded that six weeks, or 18 sessions of 45-minute MRP combined with CPT therapy, was effective in improving sit-to-stand function as measured by MAS and overall function as measured by BI.

Keywords: Stroke, hemiplegia, motor relearning program, functional mobility

ACKNOWLEDGEMENT

First of all, my deep gratitude to Allah who gave me the capability and capacity to whole this job.

My sincere appreciations go out to my mentor and supervisor, **Dr. Shaik Abdul Rahim**, for his continued leadership, inspiration, fruitful criticism, collaboration, and tenure he gave me on this project. I was profoundly inspired by his vitality, apparition and earnestness. He taught me how to conduct a research approach and present it in the most vivid way possible.

Also, it is my pleasure to prompt my sincere appreciation to the Head of Physical Therapy department, **Dr. Ahmad Alanazi**, and the Dean of the College of Applied Medical Sciences, **Dr. Msaad Alzhrani** for their cooperation, not to forget the Office of the Dean of Graduate Studies for giving me the chance to continue my graduate studies.

Above all, I am deeply indebted to my parents; **Abdulrahman Alfaleh** and **Wadha Alzaid** whose raised me and instilled in me the love of knowledge and the desired to learn since childhood. Their support, supplications and presence have always been with me. I extend my thanks to my siblings and my aunt and her family for standing and being with me.

Special thanks to the companion of this journey, who was with me from its beginning to its end. Her support, presence and constant standing beside me was one of the biggest reasons for me to continue this journey. She was with me in the bad days before the good ones. She was the best helper for me after Allah and my family. Thank you and may Allah bless you my dearest friend **Weam Alsalem.**

Last but not least, I am also grateful to all health facilities that I have worked in and to those whom I have worked with during this study.

Khadijah Abdulrahman Alfaleh

List of Contents

List of Tables

List of Figures

List of abbreviation

WHO	World Health Organization
KSA	Kingdom of Saudi Arabia
WCPT	World Confederation for Physical Therapy
PNF	Proprioceptive Neuromuscular Facilitation
CIMT	Constraint Induced Movement Therapy
MRP	Motor Relearning Program
MT	Mirror Therapy
ADL	Activities of Daily Living
STS	Sit to Stand
CPT	Conventional Physical Therapy
TIA	Transient Ischemic Attack
DALYs	Disability Adjusted Life Years
USA	United States of America
UK	United Kingdom
NDT	Neurodevelopmental Treatment
WHODAS 2.0	World Health Organization Disability Assessment
WHOQL	World Health Organization Quality of Life
MAS	Motor Assessment Scale

MBI	Modified Barthel Index
BI	Barthel Index
SSQL	Stroke Specific Quality of Life
MAS	Modified Ashworth Scale
HAS	Hamilton Anxiety Scale
AES-C	Apathy Evaluation Scale-Clinical
NIHSS	National Institutes of Health Stroke Scale
HDS	Hamilton Depression Scale
MMSE	Mini-Mental State Exam
MCA	Middle Cerebral Artery
RVGA	Rivermead Visual Gait Assessment
FIM	Functional Independence Measure
FAC	Functional Ambulatory Category
DGI	Dynamic Gait Index
SMES	Sording Motor Evaluation Scale
RCT	Randomized Control Trial
IRB	Institutional Review Board
KSMC	King Saud Medical City
SBAHC	Prince Sultan bin Abdul-Aziz Humanitarian City
SPSS	Statistical Package for the Social Sciences

BMI	Body Mass Index
MCID	Minimal clinically important differences

CHAPTER I

Introduction

As per the definition of World health organization (WHO) stroke is "A focal or global neurological damage of sudden occurrence which is existing more than twenty four hours, and it is of assumed vascular origin" (Farooq et al., 2008). Every year 16 million suffer from stroke globally and out of which five million of them die, and five million are left with constant disabilities (Lerma Castaño et al., 2020). Worldwide, stroke is considered as the leading cause of physical disabilities in adults and the second main cause of death in high-economic countries. Over the last decade, the rate of ischemic and hemorrhagic stroke has risen to 85 to 94 per 100,000, and it was found higher with the age group more than 75 years (Murphy & Werring, 2020). On the other hand, the prevalence of death and physical disability because of stroke occur in low-economic countries (Murphy & Werring, 2020). Hypertension, diabetes mellitus had a high prevalence in the middle east as risk factors of stroke (El-Hajj et al., 2016). In addition , the most common type of stroke in the middle east is ischemic, then intracerebral hemorrhage and subarachnoid hemorrhage (El-Hajj et al., 2016). 43.8 people out of one hundred thousand individuals were affected with stroke in the Kingdom of Saudi Arabia (KSA) (Bakraa et al., 2021), whereas ischemic stroke is more common in women

than men (El-Hajj et al., 2016).

According to world health organization, classification of stroke can be divided into three main types, which are: ischemic stroke, intracerebral hemorrhage and subarachnoid hemorrhage (Farooq et al., 2008). The first type of stroke occurs when one of the brain's supplying arteries which are: anterior, posterior, middle cerebral arteries, internal carotid artery, and basilar artery suddenly closes due to thrombus formation, whereas the second occurs if one of these blood vessels ruptures, resulting in bleeding into the brain tissues. Finally, hemorrhage between pia matter and arachnoid matter causes the third kind of stroke (Farooq et al., 2008).

Medical complications can impair functional recovery and then are associated with a lower functional result. Within the first several weeks after a stroke, many medical issues arise. Some complications, such as heart disorders, dysphagia, and pneumonia, show up soon after a stroke, whereas others, including bed sores, venous thrombosis, and falls, take several days to appear. Many consequences can be avoided or, if that is not possible, early detection and treatment can help to mitigate the effects of these events (Kumar et al., 2010). Furthermore, the most prevalent consequence of stroke was

bladder dysfunction (8.0 %), intestinal dysfunction (6.9%), sleep disorders (5.6 %), pneumonia (3.8%) and urinary tract infection (3%) in terms of infectious diseases. The pain related disorders like Shoulder dysfunction was seen in 1.4 % of stroke population. Other pain disorders like complex regional pain syndrome were of 0.5 %, and central post-stroke pain syndrome were of 0.4 % among stroke patients (Kim et al., 2017). Patients who had a hemorrhagic stroke had a high rates of problems than those who had an ischemic stroke (Kim et al., 2017).

There are many associated disabilities appear along with stroke among them some are very crucial for therapist. Abnormality in sensations is common among many patients with stroke especially problems in the proprioceptive system leads to difficulties in motor control, balance and posture. Muscle weakness is one of the major associated issues, which is the baseline for many other functional problems like inability to sit, stand and walk, the amount of muscle weakness is usually determined by place and volume of brain injury Muscle tone changes are also a serious complication that often accompany stroke. Both hypotonicity (a decrease in muscle tone) and hypertonicity (an increase in muscle tone) can result from damage to the cerebral cortex, which in turn reduces higher-center control over the spinal cord in the aftermath of a stroke. Aphasia, decreased muscle coordination,

decreased balance, convulsions, hydrocephalous, abnormal reflexes and modification in the motor programming are some of the other common associated problems seen after the stroke (O'Sullivan, S. B., & Schmitz, 2007).

Physiotherapy is an important profession that deals with problems associated with stroke, and physiotherapists play an important role in the rehabilitation team for managing the problems of stroke patients.

According to the World Confederation for Physical Therapy (WCPT) the physiotherapist treats the problems by their special concepts, methods, techniques and strategies (Lerma Castaño et al., 2020). There are many neurorehabilitation approaches proposed for the rehabilitation of people with stroke. These approaches will be formulated for recovering the voluntary control and mobility after the stroke (Kanase, 2020). Some of the most common approaches used for the rehabilitation of patients with stroke are neurodevelopmental treatment (Bobath approach), proprioceptive neuromuscular facilitation (PNF), brunnstrom techniques, task oriented program, and constraint induced movement therapy (CIMT) (Thiagaraja, 2020).

Carr and Shepherd proposed Motor relearning program (MRP) which trusts in brain capability to recuperate because of its dynamic capacity in

adjustment and reformation. They derived these assumptions based on current theories on motor learning, recent concepts of plasticity, biomechanics, systems theories of motor development and motor control (Bhalerao et al., 2011). There are other adjunct therapies along with these approaches aimed to the functional enhancement like kinesiotaping, strength training, orthotic management, myofascial release, botulinum toxin injections, cognitive rehabilitation, robotic assisted training, body weight supported trainings, mirror therapy (MT), mental imagery etc. (Santos et al., 2019) (Lerma Castaño et al., 2020).

There is evidence that general physiotherapy approaches improve outcome measures in stroke rehabilitation. There are clinical evidences which claim that the adult's brain can be reorganized after an injury and that environmental factors plays a vital role in this neural reorganization (Janet Carr, 2000) (Singha, 2017) .

The Motor Relearning Program (MRP) based its assumptions on the brain's ability to recover after injury by utilizing repetitive functional tasks. The program is based on four issues: abolition of unwanted muscle activity, practice, feedback, and the inter-relationship between movement and postural adjustment. Also, composed of seven daily functional tasks, such as: upper limb function, oro-facial function, motor task performed in sitting and

standing, standing up and sitting down, and walking, to achieve specific goals (Carr & Roberta B. Shepherd., 1997). Recent studies found that the MRP approach had a significant impact on improving functional mobility, the performance of activities of daily living (ADL), basic mobility of sit to stand (STS) and walking in comparison to other approaches such as Bobath and PNF among stroke subjects (Chan et al., 2006; Bhalerao et al., 2011; Singha, 2017; Kanase, 2020). Another study found that the combination between MRP and conventional physiotherapy (CPT) significantly influenced functional balance, functional mobility, and life quality among these subjects. Additionally, MRP can be used in community physical therapy and rehabilitation settings (Ravel 2020).

1.1 Motivation and problem of the study

There is evidence that MRP is effective in helping chronic stroke patients improve crucial mobility skills like STS. Moreover, boosting STS functionality improves walking prospects at low expense. Modern research confirms that MRP helps stroke patients regain their ability to walk, stand, and perform other ADLs, as well as improve their balance and overall quality of life. The research on the effectiveness of MRP in increasing lower extremity functional capacity among chronic stroke populations is limited despite the fact that it is a subject-centered, simple, and inexpensive method.

1.2 Purpose

The purpose of the study is to find out the effectiveness of motor relearning program on improving lower extremity functional mobility among chronic stroke population.

1.3 Study Objectives:

1. To find out the effectiveness of conventional physical therapy in improving functional mobility of lower extremity among chronic hemiplegic subjects.
2. To find out the effectiveness of motor relearning program along with conventional physical therapy in improving functional mobility of lower extremity among chronic hemiplegic subjects.
3. To find out the effectiveness of motor relearning program combined with conventional physical therapy versus conventional physical therapy alone in improving functional mobility of lower extremity among chronic hemiplegic subjects.

1.4 Hypotheses:

1.4.1 Null hypothesis:

It is assumed that there is no effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.

1.4.2 Alternative hypothesis:

It is assumed that there is an effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.

CHAPTER II

2.0 Review of the Literature

2.1 Stroke

Stroke is a vast and collective challenge in healthcare worldwide (Murphy & Werring, 2020). It is a disease of advanced countries. As the world became more modernized, the onset of stroke was also increasing throughout the world. Stroke is one of the foremost reasons for significant long-term disability. Stroke is the acute appearance of cerebrovascular disease (Kannabiran & S, 2016). Stroke is a frequent cause of bodily impairments leading to activity limitations and participation restrictions. Every year, approximately 28 per 100000 persons in the Netherlands suffer from a first-time stroke. Most of the time, neural recovery may occur over a period; however, many subjects experience persistent loss of activity limitations (Janssen et al., 2010).

In 1599, the use of 'stroke' was first recorded as a layman's word (Coupland et al., 2017). Stoke is defined by WHO as a " acutely evolving clinical sign of focal or global neurological damage of sudden occurrence which is existing more than twenty four hours, and it is of assumed vascular origin" (Coupland et al., 2017). The transient ischemic attack that is TIA is

traditionally confused with stroke definition; however, it's definition was proposed as a "short incidence of focal dysfunction of the nervous system which is not connected to any fixed cerebral damage, and existing < twenty four hours" (Murphy & Werring, 2020). Among the majority of stroke survivors, there is a reduced motor function with restriction in the execution of activities of daily due to diminished muscle strength. Paralysis on the opposite side of the brain lesion indicates a motor insufficiency. Moreover, evidence-based literature also supports considerable weakness on the non-affected side of the lesion (Harjpal et al., 2021).

Stroke was the second most common cause of mortality amongst numerous primary reasons for disability (Asgedom et al., 2020). Moreover, cerebro vascular accident is the second most prevalent cause of delayed onset dementia and the main culprit of epilepsy among elderly adults (Murphy & Werring, 2020). In 2016, there were roughly 83 million and 13.6 million cases of stroke, respectively. In addition, roughly six million people worldwide pass away due to stroke annually, and over 15 million people are impacted by cerebrovascular accidents (Asgedom et al., 2020).

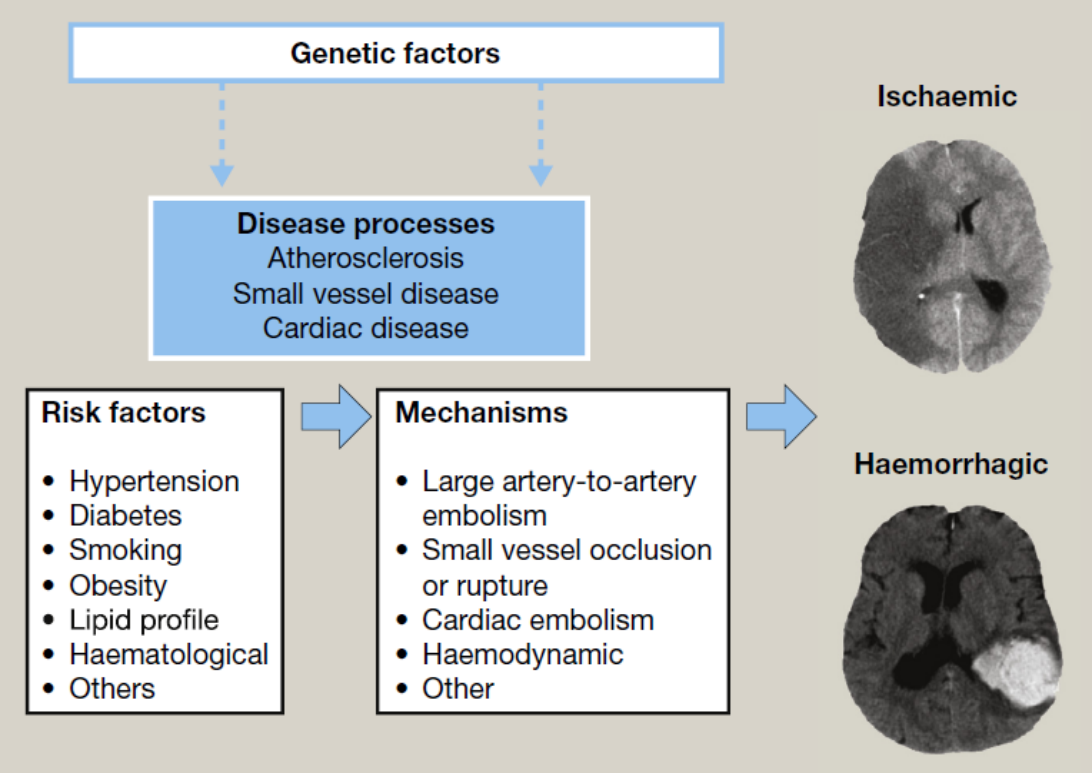


Figure 1: Showing the dissimilarities between illness pathophysiology, potential causes, and types of vascular abnormalities in stroke.

2.1.1 Localization of Stroke:

Understanding intra-cranial vascular areas and neuro-anatomical paths allow the focalization of injuries. This knowledge is further enhanced by interpreting brain scans and understanding stroke's clinical presentation and prognosis. For example, intracranial hemorrhage presentation cannot be distinguished from ischemic stroke without the help of brain scans (Murphy & Werring, 2020).

In the case of the anterior cerebral artery involvement, the clinical presentation will be the affection of the lower limb more than the upper limb

with sparing of hand function, bladder incontinence, apraxia of gait, and akinetic mutism. In the case of the middle cerebral artery involvement, the clinical presentation will be the affection of face, upper limb, and lower limb, homonymous hemianopia, Wernickes, and Brochas aphasia, lack of attention, and paralysis of visual gaze. Finally, in the case of the vertebral basilar artery involvement, the clinical presentation will be the affection of one side body in the form of hemiparesis, hemi sensory loss, cortical visual deficiencies, cerebellar ataxia, nystagmus, cranial nerve involvement in the brainstem region (Murphy & Werring, 2020).

2.1.2 Prevalence and incidence of stroke:

Worldwide, it is estimated that one among six persons may have a cerebrovascular accident in their lifespan. According to studies, the Disability Adjusted Life Years (DALYs) from a stroke were above 87% in middle-income and low-income nations. Moreover, cerebrovascular accident accounts for greater than four percent of the expenses incurred of hospitalization in high-income nations (Asgedom et al., 2020). The number of persons surviving cerebrovascular accidents was projected to be 27% between 2017 to 2047 in the European regions due to population aging and enhanced survival rates (Ghrouz et al., 2019). In the United Kingdom (UK), stroke management and loss of productivity due to stroke were estimated to be 8.9 billion pounds a

year; this stroke budget represented approximately 5% of total national health system costs (Murphy & Werring, 2020).

Middle Eastern countries have radically increased the occurrence of cerebrovascular accidents in the last decade. As per the systematic review findings, the incidence rate of cerebrovascular accidents in Middle East countries was 22.7 to 250 per one hundred thousand populations per year from 2000 to 2014. These incident numbers crossed the rates in advanced nations where the crude stroke incidence rates were 112 to 223 per one hundred thousand population per year from 2000 to 2008 (Memon et al., 2019). Hypertension and diabetes mellitus had an excessive the prevalence rate in the gulf region constitutes 30% and 11% risk factors of stroke, respectively (El-Hajj et al., 2016).

In the Kingdom of Saudi Arabia, stroke positions second in the top ten reasons for death (Alluqmani et al., 2021). A recent systematic review in Saudi Arabia estimated yearly occurrence of twenty-nine cerebro vascular accidents per one hundred thousand people. According to Awada et al., 76 percent of these cases are ischemic cerebro vascular accidents and one third of them were infarcts in the lacunar region. Intra-cerebral hemorrhages were common verities among hemorrhagic type of cerebro vascular accidents, and only two percent were subarachnoid hemorrhages (Samkari et al., 2021).

2.1.3 Risk factors for stroke:

2.1.3.1 Non-modifiable risk factors are:

Age: aging is the greatest significant contributor to cerebrovascular accident risk. The incidence of stroke increases two folds each ten years after age 55.

Sex: as a whole, women are more prone to stroke than men. At younger ages, due to the risks of conception and usage of oral contraceptives, pre-menopausal females have more cerebro vascular accident possibility than men. However, men have a slightly higher incidence in older ages than women.

Ethnicity: In United States of America (USA) and UK the African Caribbean people have double the possibility of cerebro vascular accident incidence. Among the young population, black adults have twice the risk of intracerebral hemorrhage than their age equaled white people. The reason for the increased prevalence amongst African Caribbean populations is due to the enhanced occurrence of cerebro vascular accident causative factors like diabetes, obesity, and hypertension.

Genetics: There was one gene abnormality seen in the following disease conditions was associated with incidence of cerebral vascular accidents

(Examples: Fabry's disease, CARASIL, homocystinuria, CADASIL, sickle cell disease, and connective tissue disorders) (Murphy & Werring, 2020).

2.1.3.2The modifiable risk factors are:

Hypertension: Which was the greatest significant changeable causative factor for cerebro vascular accidents. Fifty percent of the cerebro vascular accident clients and most people with Intra Cranial Hemorrhage have a history of hypertension. Since hypertension is the most common cause of stroke, for the primary as well as secondary avoidance of cerebro vascular accidents, the detection and treatment of high blood pressure are of utmost importance.

Diabetes mellitus: is a causative condition which doubles the risk of cerebrovascular disease. First time cerebral vascular accidents is responsible for twenty percent of mortality in subjects with diabetes mellitus.

Cardiac factors: The most serious ischemic stroke subtype, with substantial mortality and morbidity, is cardiac embolus infarction, which is mostly caused by atrial fibrillation. Age-related increases in arterial fibrillation cause twenty to twenty-five percentage of cerebro vascular accidents in persons over the age of 80. Cerebro vascular accidents prevention in patients with arterial fibrillation is particularly effective with anticoagulation medication.

Smoking: increases the stroke risk of two folds, and smoking cessation swiftly decreases the stroke risk. Moreover, the absolute stroke risk will nearly disappear two to four years after quitting smoking.

Hyperlipidemia: With higher overall lipid levels and lower levels of high-density lipoprotein cholesterol, hyperlipidemia raises the likelihood of an ischemic cerebro vascular accidents. In contrary, the risk of cerebral bleeding is negatively correlated with total cholesterol. Using statins in hyperlipidemia prevention decreases the chances of ischemic cerebro vascular accidents with no absolute hike in the chances of intracerebral hemorrhage.

Alcohol intake and drug misuse: Greater consumption of alcohol are unquestionably connected to elevated cardiovascular events, however low and medium alcohol use that is less than four units per day is narrated to lessen the risk of ischemic stroke. Excessive drinking increases the risk of cerebral bleeding in a linear fashion. Casual substance abuse is associated with a greater likelihood of ischemic cerebro vascular accidents and intracranial hemorrhage, including substances like heroin, cocaine, amphetamines, ecstasy, and cannabis.

Obesity and sedentary behaviors: The relationship between body mass index and chances of developing cerebro vascular accidents is backed up by

information on cholesterol, blood pressure, and glucose levels. Those who are fit and healthy have a reduced risk of cerebro vascular accidents and overall mortality than inactive people.

Inflammation: Finally, infections can cause strokes as well as indication that those who have received an influenza vaccine have reduced levels of cerebrovascular accident than those who have not received the vaccine. Raised inflammatory biomarkers have a moderate association with an increased risk of stroke. Also linked to the recent coronavirus illness pandemic is the linkage between a hyperinflammatory and hypercoagulable state and large vessel blockages (Murphy & Werring, 2020).

2.1.4 Complications of stroke:

Persons who have had cerebrovascular accidents are susceptible to several complications. These complications can result as a straight consequence of the brain damage itself or from the resultant disabilities or disease-related treatments. These complications considerably affect the decisive outcome of patients with stroke and often interfere with their neurological recovery. Cardiac complications, deep vein thrombosis, pneumonia, incontinence, increased body temperature, pain, difficulty swallowing, and depression are common after a stroke. They commonly need

particular interventions for their prevention and treatment (Kumar et al., 2010).

Undergoing complications after stroke are correlated with enhanced risk of mortality and increased length of hospital duration in acute stroke patients. In the most usual cases, simple complications include pain, fever, and infections; however, life-threatening complications such as pulmonary embolism, myocardial infarctions, and cardiac arrest may also occur. Most of the complications commence within the first few days after stroke. After that, morbidity and mortality escalate with an increasing number of complications (Bovim et al., 2016).

2.1.5 Disabilities that can result from a stroke:

The types and extensibility of morbidity that follow a cerebrovascular accident depend upon which part of the cortex is damaged. Commonly, a cerebrovascular accident can cause five verities of morbidities:

Hemiplegia/Hemiparesis: Injury to brain cells and their neuronal connections in the cortex following a cerebrovascular accident can cause various movement and sensory system issues on the opposite side of the lesion (Whitehead & Baalbergen, 2019).

Sensory involvement: Numerous sensory disruptions can occur following a cerebrovascular accident, including lack of touch, reduced in pain, and inappropriate in body position sense are common issues post-stroke. Lack of stereognosis and incontinence due to lack of bowel and bladder sensations and pain due to musculoskeletal imbalance is also prevalent post-stroke (Whitehead & Baalbergen, 2019).

Difficulty in speaking and understanding: speaking is one of the most common body functional problems after stroke, and one-fourth of stroke subjects have impairments in language, including difficulty in speaking, writing, and understanding spoken and written languages. The resulting speech difficulties are due to the involvement of the verbal brain centers (Whitehead & Baalbergen, 2019).

Cognitive and perceptual issues: decreased attention span, problems in short-term memory, dyspraxia, unable to understand sensory inputs, inability in motor learning, anosognosia, and hemi neglect are some common cognitive and perceptual issues among stroke subjects (Whitehead & Baalbergen, 2019).

Psychological problems: Post-stroke, many subjects experience depression, anxiety, anger, frustration, sadness, fear, and a sense of grief.

These psychological issues are due to direct damage to the brain or due to their capabilities in life (Whitehead & Baalbergen, 2019).

2.1.6 Principles underlying rehabilitative therapies:

There are two basic philosophies proposed for the approach to stroke patient management. The primary one is that the matured brain system which is adjustive, or neuroplastic, and can re-arrange itself to improve damaged cognitive and motor deficits. The next is that following a cerebro vascular accident, sustained recoveries depend on continuous, competent physical exercise. For retraining to be successful, the brain's motivational, attentional, and cognitive circuits must be activated (Dobkin & Dorsch, 2013).

The objective of rehabilitation is to improve the functional capacities of a person. The research proposes that the physiotherapy strategies are linked with modification in the activity of the areas of cerebral cortex. These treatment approaches also improve communication in the corticospinal tracts. In addition, motor management provides in functional enhancements related to re-organization (Fernandes & Kumar, 2017).

The rehabilitation progression involves six foremost areas of emphasis: preventing, identifying, and treating co-morbid illness and medical problems; preparation for maximum independence; enabling most excellent psychosocial adaptation and coping by family and patient and preventing secondary

complications by facilitating community reintegration, including recommencement of family, home, vocational and recreational activities augmenting the quality of life because of residual disability and preventing recurring stroke and other vascular conditions (Aichner et al., 2002).

Prior to the 1940s, the focus of physiotherapy was on corrective techniques based on concepts of orthopedic rehabilitation connected to the relaxation and contraction of the affected muscles, with emphasis placed on regaining body function by compensating with the uninjured upper and lower extremities (Ashburn, 1995; Partridge, 1996) (Pollock et al., 2014).

In the years between 1950s to1960s, rehabilitation was based on existing neuro-physiological understanding. Hence, treatment approaches were newly evolved to improve healing of the involved extremity. These new methodologies comprised of Rood (GoJ 1969), Brunnström (Brunnström 1970), proprioceptive neuromuscular facilitation approach. and Bobath (Bobath 1990; Davies 1985), (Knott 1968; Voss 1985) (Pollock et al., 2014).

In the eighties, the MRP was developed, and the importance of cognitive neuroscience and motor learning was highlighted (Anderson 1986; Turnbull 1982) (Carr 1982). According to this program, actively performing context-specific physical skills with appropriate feedback would improve

learning and motor recovery (Carr 1980; Carr 1982; Carr 1987a; Carr 1987b; Carr 1989; Carr 1990; Carr 1998). The therapeutic use of MRP appeared to have a profound effect on affected persons rehabilitation. Physiotherapist moved patients via numerous motor activity positions as part of therapeutic techniques based on neurophysiological concepts, with the physiotherapist acting as the decision-maker and trouble shooter and the patients as the relatively passive recipients (Lennon 1996). The motor learning program, in contrast, placed a strong emphasis on the value of the patient's active participation (Carr 1982) (Pollock et al., 2014).

Stroke patient management aims to attain independent functional activities in daily life and improve movement, walking, and balance. For this commitment, early physiotherapy intervention is critical for acute stroke patients. In addition, physical Therapy also helps them in reducing their disability and refurbish movements. Hence, selecting ideal treatment techniques and rehabilitation interventions is crucial for a speedy and healthier recovery. For this purpose, several rehabilitation approaches can be used, are the Roods, Bobath, Brunnstrom, Proprioceptive Neuromuscular Facilitation (PNF), and Motor Relearning Program (MRP) (Nizami & Rafique, 2016) (Kannabiran & S, 2016) (Immadi et al., 2015) (Thiagaraja, 2020).

The conventional management of stroke survivors does not recover the patients entirely on the clinical outcomes, and this is one of the purposes why physical therapists are discovering numerous rehabilitation techniques of different varieties, which include neurodevelopmental therapy, proprioceptive neuromuscular facilitation, task-oriented training, motor relearning program, Brunnstorm therapy, functional electrical muscle stimulation, biofeedback, and strength training (Aftab et al., 2021). Among them, the MRP was established based on theories of motor learning. These approaches were selected for patient care because they are well-established for use in subjects with stroke and have been shown to enhance physical and cognitive improvements from stroke and able to prevent post stroke depression (Chen et al., 2019).

2.2 Motor Relearning Program (MRP)

Motor Relearning Program **(**MRP) is a physical therapy approaches primarily utilized with subjects with cerebro vascular accidents. Carr and Shepherd's developed motor learning theory, which proposed that training in motor control necessitates anticipatory actions and continuing practice, served as the foundation for MRP (Immadi et al., 2015). Carr and Shepherd proposed MRP believing in brain capability to improve because of its neuroplasticity in adjustment and reformation. They established these treatment principles based

on motor learning theories, concepts of neuroplasticity, body kinesiology, and systems theory of motor control and motor development (Bhalerao et al., 2011).

The Motor relearning program (MRP) presumes the cortex's capability in recovery after brain injury through the application of functional activities in a repetitive manner. The MRP depends on four factors: dismissal of unwanted muscle activity, practice, feedback, and the interrelation among postural adjustment and movement. MRP comprises seven daily functional tasks: oro-facial function, upper limb function, standing up and sitting down, and a motor task performed in sitting and standing, and walking to achieve specific goals (Carr & Roberta B. Shepherd., 1997). As soon as the patient is medically steady the MRP will be started (Fernandes & Kumar, 2017). Every task is laid out in four discrete stages: one examination of the essential components of the task, two practicing of the missing component, the task practice, and transference of training (Carr & Roberta B. Shepherd., 1997).

In the first step of the MRP, the task is analyzed and observed by comparing the portrayal of the regular activity, embracing the essential movement components. While in the second step, which is practicing missing components, the therapist identifies the goal and explains the missing component. The missing components were practiced using verbal/visual

instructions/commands and manual guidance. In the third component, they practiced the whole task, including the practiced missing components. While doing this again, the therapist uses verbal/visual instructions/commands and manual guidance while re-evaluating the task. The last step is training transference, the practice of the learned task is performed in a structured learning environment with context. The practice is self-monitored and organized and involves patient relatives and rehabilitation staff (Carr & Roberta B. Shepherd., 1997).

The MRP is proposed to be adequate for attaining control over motor tasks. However, other means of stimulating muscles and training tasks, by providing auditory or visual confirmation of muscle contraction (especially biofeedback) and which helps the subject contract a previously flaccid muscle or turn off an overactive muscle, may be used in association with the MRP (Carr & Roberta B. Shepherd., 1997).

Through effective feedback, training, and development of active motion control, MRP focuses on task-specific learning. In contrast to verbal instruction, demonstration, and manual guiding, facilitation approaches are once again emphasized. Recent research revealed that MRP enhanced the functional recovery among ADL more effectively than Bobath in acute stroke rehabilitation. Moreover, MRP was additionally effectual than proprioceptive

neuromuscular facilitation and conventional training for improving basic and functional mobility (Ghrouz et al., 2019).

The MRP involves rehabilitation in a homely environment where the patient is active and participates in the program with the help of therapists. The person must examine the components and causes of their functional deficiency and use ongoing training to address the problems. MRP is a professional program since it is designed for commonly affected impairment in subjects with cerebro vascular accidents and is based on theories of kinesiology, sports expertise, neuroscience, and cognitive psychology. The MRP is particular, and each program's learning and training materials are created specifically for it. The program's motor training is directly related to practical everyday living activities. MRP is systematic, where learning in the treatment room will be transferred into various contexts of daily function and requires the participation of the patient's families. Hence, the MRP is considered one of the furthermost advanced rehabilitation methods (Yin et al., 2013).

2.2.1 Standing Up and Sitting Down:

The sit-to-stand movement, that serves as the foundation for bed-to-seat and seat-to-restroom motions, is a necessary requirement for vertical locomotion and mobility and requires the ability of adequate lower limb

function and postural control. These useful activities monitor the autonomy of individuals who have disabilities and are comparable to daily life activities (Liu et al., 2016). After a cerebrovascular accident, the difficulty standing on one's own can make it difficult to carry out regular everyday tasks. While coming to stand, patients of hemiplegia frequently show severe imbalance in the weight distribution, with considerably more weight bearing on the uninvolved side (Farqalit & Shahnawaz, 2013).

The movement association of standing up varies according to the task's requirement. Which may not be to stand up but rather to walk out of the room or shake hands with a friend etc. Both, standing up and sitting down involve shifting the body mass from one base of support to another base of support with minimum energy expenditure (Carr & Roberta B. Shepherd., 1997).

2.2.1.1 Motor Relearning Program for standing up and sitting down:

In standing up, one or both bases are moved backward. This gives a base under the center of gravity as it's moved forward. The inclination of the extended trunk forward at the hips with the anterior shifting of the knee joint brings the center of mass over the bases and enables the body's weight to be shifted forward and upward. However, the trunk has to incline further forward or move nearer the edge of the chair, If the chair prevents the base from

moving far enough backward. It's important to consider the tips of knees and shoulders, that is, in the paths through which they move, since observation of these is helpful for the therapist in assuming the dysfunction and in training control over the task. While sitting down, people normally verify the whereabouts of the seat by turning to glance, feeling for the chair with their hand, or feeling it against the back of one's leg. The hips and knees flex to move the center of gravity backward while the trunk leans forward. A lengthening or eccentric contraction of the extensor muscles lowers the body weight of the chair. The pelvis can travel backward and lower toward the chair due to the forward tilt of the trunk, which generates hip flexion and forward knee movement (Carr & Roberta B. Shepherd., 1997).

In a randomized controlled trial titled efficacy of Motor relearning program (MRP) on balance and upright mobility in subacute stroke patients conducted by Pinzón Bernal et al. compared the benefits of MRP combined with routine physiotherapy to the effects of CPT alone in subacute stroke patients. The experimental group and the control group were randomly assigned to sixty eight patients of both genders who were having their first stroke occurrence. The control group underwent normal physiotherapy, motor relearning training, sit-to-stand training, gait training, balance training, stretching exercises, and strengthening exercises. For four weeks, the

instruction was conducted five days a week. The first follow-up after a baseline assessment was noted at week four. Patients received advice on an additional one-month home plan. At eight weeks, a second round of follow-up data was collected. The results were measured using the timed up and go test and the berg balance scale. The results of this experiment demonstrated that an MRP combined with standard physiotherapy treatment is more effective than routine physiotherapy alone in helping stroke patients restore balance and upright mobility (Pinzón Bernal et al., 2020) .

One of the most recent studies was conducted to determine the improvements in hemiparetic adults participating in an MRP on their capacity to function and their health-related quality of life. In total, 69 individuals were divided into two groups: thirty-five were in the experimental group and thirty-four were in the control group. Both groups participated in a six-week physiotherapy program that met three times each week. The World Health Organization Disability Assessment Schedule 2.0 (WHODAS 2.0) and World Health Organization Quality of Life (WHOQL) were used to evaluate both health-related quality of life and disability. According to the study's findings, patients with hemiparesis who got both standard medical care and MRP experienced a considerable reduction in their level of disability. However, the

perception of health-related quality of life mainly remained the same (Scheper et al., 2021).

The objective of scientific literature was to compare MRP with Bobath to improve standing balance in stroke patients. 24 people were split into two groups. MRP was administered to the treatment group, while Bobath was administered to the control group. Exercises performed three times a week for a month, lasting 40 minutes each. The MRP and Bobath were the independent factors. Standing balance served as the dependent variable. The study concluded that the Bobath approach led to intricate connections between the musculoskeletal and sensory systems, which were subsequently controlled by the brain. Therefore, MRP was more successful because it improves standing balance in stroke patients through the cognitive, associative, and autonomic systems (Mufidah et al., 2020).

Thiagaraja et al. studied the literature to investigate the efficacy of MRP in enhancing daily activities and quality of life, particularly in stroke patients. Five randomized control studies were examined. In every study that used MRP as an intervention, individuals with a clinical diagnosis of cerebrovascular accident and at least one clinically appropriate outcome measure were included. The review authors evaluated each qualifying study's methodological quality using the Pedro scale as they independently extracted

and processed the data. The results of this review indicate that motor relearning is very helpful in enhancing the quality of life and everyday activities of stroke patients (Thiagaraja, 2020).

In research on post-stroke patients, the authors compared the effects of MRP and traditional training on functional mobility. A sample size of thirty patients of cerebro vascular accidents involved in the research. The Motor Assessment Scale (MAS) for Stroke and the Modified Barthel Index (MBI) were involved to assess the participants. The student's t test was utilized to assess the data statistically. MRP was discovered to be incredibly significant for enhancing functional mobility when compared between the groups. According to the study, MRP is superior to traditional training in enhancing functional mobility in post-stroke patients (Kanase, 2020).

In research on post-stroke patients, Ravel et al. evaluated the impact of MRP on functional balance, functional mobility, and quality of life. Thirty-four participants with their first stroke were given training in functional mobility and balance with MRP in addition to regular traditional workouts for six weeks. MAS, Barthel Index (BI), and Stroke Specific Quality of Life (SSQL) were evaluated at the beginning and ending. Improvements in mobility, balance, and participation among subjects with cerebro vascular

accidents are achieved when MRP is used with standard therapy (Ravel, 2020).

In a 2022 study, Abrar et al. examined the effects of upper limb spasticity in chronic stroke patients between MRP and neurodevelopmental treatment (NDT). They were divided randomly into two groups of 80 sample size, MRP and NDT. Patients aged 45 and 70 were selected, and as a baseline form of care, both groups underwent regular physical therapy. One group also received MRP, while the other received NDT for eight weeks (3 sessions a week for 45 minutes). The modified Ashworth Scale was the outcome measurement. Both treatment modalities have been demonstrated to be successful in treating upper limb spasticity in chronic stroke patients. However, MRP is much more successful than NDT in effectively reducing spasticity.

Lerma Castaño et al. also did a study to examine the effects of Kinesio Taping in conjunction with the motor relearning technique on upper limb activity in subjects with cerebro vascular accidents. Ten adult patients with cerebro vascular accidents were divided randomly into two groups: the experimental group (n = 5) received Kinesio Taping adding to the MRP for 12 sessions, and the control group (n = 5) obtained the motor relearning method for 12 sessions. Before and after each intervention, the motor function of adult

patients with upper motor neuron damage was evaluated using the selected movement pattern scale. In individuals with spastic hemiparesis, using Kinesio Taping in conjunction with the motor relearning technique was encouraging for upper limb motor function (Lerma Castaño et al., 2020).

In a trial, Ullah et al. sought to ascertain the efficacy of MRP combined with electrical stimulation for enhancing upper limb function in stroke patients with subacute stroke. The study included forty-four patients who had experienced a post-stroke period. In addition to MRP for an hour five days a week for six weeks, subjects also got electrical stimulation for the affected arm for 15 minutes. The motor assessment scale's upper extremity subscales were used to accumulate the before and after management data. According to the study's findings, electrical stimulation combined with MRP dramatically enhances upper limb function in stroke patients (Ullah et al., 2020).

In research by Chen et al. to assess the MRP and Bobath approaches for preventing post-stroke apathy selected consecutively, 258 men and 230 women who had not shown any signs of indifference or despair during the initial appointment were recruited. Two groups of patients underwent block randomization. In the first four weeks, Group A consisting of two hundred and forty-five subjects and Group B consisting of two hundred and forty-three subjects received physical therapy by MRP and Bobath, respectively. The

additional treatment was the same for both groups. At the time of admission, patients were evaluated using the Hamilton Anxiety Scale (HAS), Apathy Evaluation Scale-Clinical (AES-C), BI, National Institutes of Health Stroke Scale (NIHSS), Hamilton Depression Scale (HDS), and Mini-Mental State Examination (MMSE). Using the Apathy Evaluation Scale-Clinical, patients were evaluated for apathy diagnosis and severity at first, third, sixth, ninth-, and twelfth-month follow-ups following cerebro vascular accident. They discovered that the MRP method prevented post-stroke apathy better than the Bobath method (Chen et al., 2019).

A study by Jan et al. compared the efficacy of MRP and mirror treatment in improving stroke patients' upper limb motor capabilities. Sixty-six participants were divided into the treatment and control groups at random. Mirror therapy was the choice of treatment in the control group. Whereas the participants in the experimental group received MRP. The upper extremity sub sections of motor assessment scale were used to collect the information. Significant variations existed between the two groups. The study indicated that both MRP and MT successfully restored upper limb motor capabilities in stroke patients. However, MRP was more successful than MT (Jan et al., 2019).

The usefulness of the Bobath technique and MRP individually and in combination to enhance upper limb functional recovery and motor control in stroke patients was examined in a study by Annethattil et al. Patients with Right Middle Cerebral Artery (MCA) strokes are chosen using a random selection technique. Thirty patients were involved, each group that is group A, group B, and Group C were randomly assigned with ten subjects. Group A received MRP, Group B received Bobath, and group C received a combination of these approaches. The Modified Ashworth Scale was used to assess the spasticity, Stroke Rehabilitation Assessment of Movement assessed voluntary control, and Fugal Meyer Scale was used to measure their upper limb's functional ability. The outcomes demonstrated that the use of individual MRP effects was superior to Bobath techniques, but that the combined effects of these two techniques were superior to the personal effects, with appreciable modifications in the activity improvement of the upper extremity in patients with right middle cerebral artery infarctions (Annethattil et al., 2017).

Singha et al. performed another research to compare the effect of motor relearning approach and traditional physiotherapy using Proprioceptive Neuromuscular Facilitation for enhancing essential movements in chronic patients with cerebro vascular accidents. 30 individuals were divided into the MRP and PNF groups using a simple random sample and lottery procedure.

For three weeks, control and experimental groups obtained management for thirty minutes per session three sessions per week. Utilizing the STS component of the Motor Assessment Scale and Timed Up and Go test, the outcomes were measured at the pretest, posttest, and after a 1-month follow-up. The study was conducted in each participant's house. The findings indicated that MRP is superior to PNF for enhancing essential mobility in chronic stroke patients, including the ability to sit to stand, and walk. The enhancements obtained in the study were maintained constantly even after one month of follow up (Singha, 2017).

In a study conducted at 2016, Bhalerao and Parab examined the impact of shoe elevation and MRP on ambulation in chronic stroke victims. We chose and treated 27 patients with chronic strokes. The subjects were randomly split into two groups: the control group (n = 14) and the experimental group (n = 13). Each group received MRP six sessions a week for a total of one hour for four weeks. The experimental group also had their unaffected side shoes raised an additional 1 cm while ambulating during therapy and at home. The patients were evaluated for spatiotemporal parameters before and after therapy using the footprint analysis approach and the Rivermead Visual Gait Assessment (RVGA) scale. This study finds that, in comparison to MRP alone, adding shoe raises on the unaffected side to MRP improves step length,

stride length cadence, and gait velocity. However, the usage of the shoe lift had no further impact on the RVGA Score.

The effect of the Bobath and motor relearning approach was associated by Kannabiran et al., The authors performed research on the efficacy of the MRP and Bobath technique with MRP in increasing functional activities among hemiplegic patients. Purposive sampling was used to choose 30 stroke patients aged 40 to 55 and divide them into two groups, each with 15 patients. For four weeks, one group received MRP while the other received the Bobath technique combined with MRP. Functional activities were assessed using the Functional Independence Measure scale (FIM). According to the study's findings, patients in experimental group II, which combined the Bobath procedure with MRP, recovered functionally more quickly than those in experimental group I, which alone used MRP (Kannabiran & S, 2016).

This research was conducted by Immadi et al. to determine how well the MRP promoted the activity of upper extremity following a cerebro vascular accidents. Wolf motor function scores and Fugl-Meyer assessment were used as end measures. Sixty subjects with cerebro vascular accidents allotted in to group A and B. Both the groups had 40 1-hour sessions where group A had traditional physiotherapy and group B had MRP over eight weeks (5 days/week). The study's findings indicated that MRP is more successful

than traditional physical therapy in improving stroke patients' functional recovery of the upper limb (Immadi et al., 2015).

A research conducted in 2013 by Bhalerao et al. compared the efficacy of the MRP and Bobath approaches on mobility and functional activities at intervals of two weeks in acute cerebro vascular accidents patients. Thirty-two participants were split into two groups for the study. For six weeks, 15 patients in Group B and 17 subjects in Group A underwent management based on the Bobath technique. Barthel Index (BI) and Functional Independence Measure (FIM) were used for the assessment of daily activities. Whereas, Functional Ambulatory Category, and Dynamic Gait Index are used to assess gait parameters. Compared to the Bobath method, the results showed that MRP significantly improved BI, FIM, FAC, and DGI. Furthermore, the study concluded that when compared every two weeks in acute rehabilitation of cerebro vascular accident subjects during the initial six weeks of training, physiotherapy treatment employing MRP was successful than the Bobath technique in the initial augmentation of mobility and functional activities (Bhalerao et al. 2013).

Physiotherapy effect on rehabilitation of clients with cerebro vascular accidents by using Bobath approach resulted in better movement eminence than the MRP was researched by Langhammer et al. The study sought to

determine whether the Bobath technique improved the movement quality of stroke patients during rehabilitation more effectively than the MRP. The MRP and Bobath approaches were used to treat the patients, and the Motor Assessment Scale, Nottingham Health Profile, Sodring Motor Evaluation Scale (SMES), and Barthel Index (BI) were used to evaluate them. They concluded that Bobath versus MRP study results support and reinforce previous results that MRP approach activities were preferable in the acute rehabilitation of patients with cerebro vascular accidents, both in movement capacity and quality (Langhammer & Stanghelle, 2011).

A randomized controlled experiment was done by Chan et al. to determine the effectiveness of the MRP in enhancing physical function and task performance for stroke patients. Fifty-two stroke patients were split equally into two groups. The patients had either a conventional therapy regimen or 182-hour sessions of MRP over six weeks. As outcome measures, Functional Independence Measure, Modified Lawton Instrumental Activities of Daily Living Test, and Timed Up and Go test, the Community Integration Questionnaire were all used. The outcomes demonstrated that, compared to the control group, the motor relearning group performed significantly better on all tests besides the Timed Up and Go test. According to the study, MRP accelerates stroke patients' functional recovery (Chan et al., 2006).

CHAPTER III

3.0 Methodology

3.1 Study approach

The study aimed to find out effectiveness of the Motor Relearning Program (MRP) in improving functional mobility of lower extremity among chronic hemiplegic subjects.

3.2 Study design

Randomized Control Trial (Pre-test-post-test).

3.3 Ethical consideration

The study was conducted after obtaining the institutional review board approval from the following hospitals: King Saud Medical City (KSMC); registration number (H1RE-24-May22-01), Aljouf health affairs; registration number (2022.19) and Prince Sultan Bin Abdul-Aziz Humanitarian City (SBAHC); IRB number (85-2022-IRB).

3.4 Study setting

The study took place at KSMC, Hospitals of Aljouf Health Affairs and SBAHC.

3.5 Study population

Thirty-two chronic hemiplegic subjects were included.

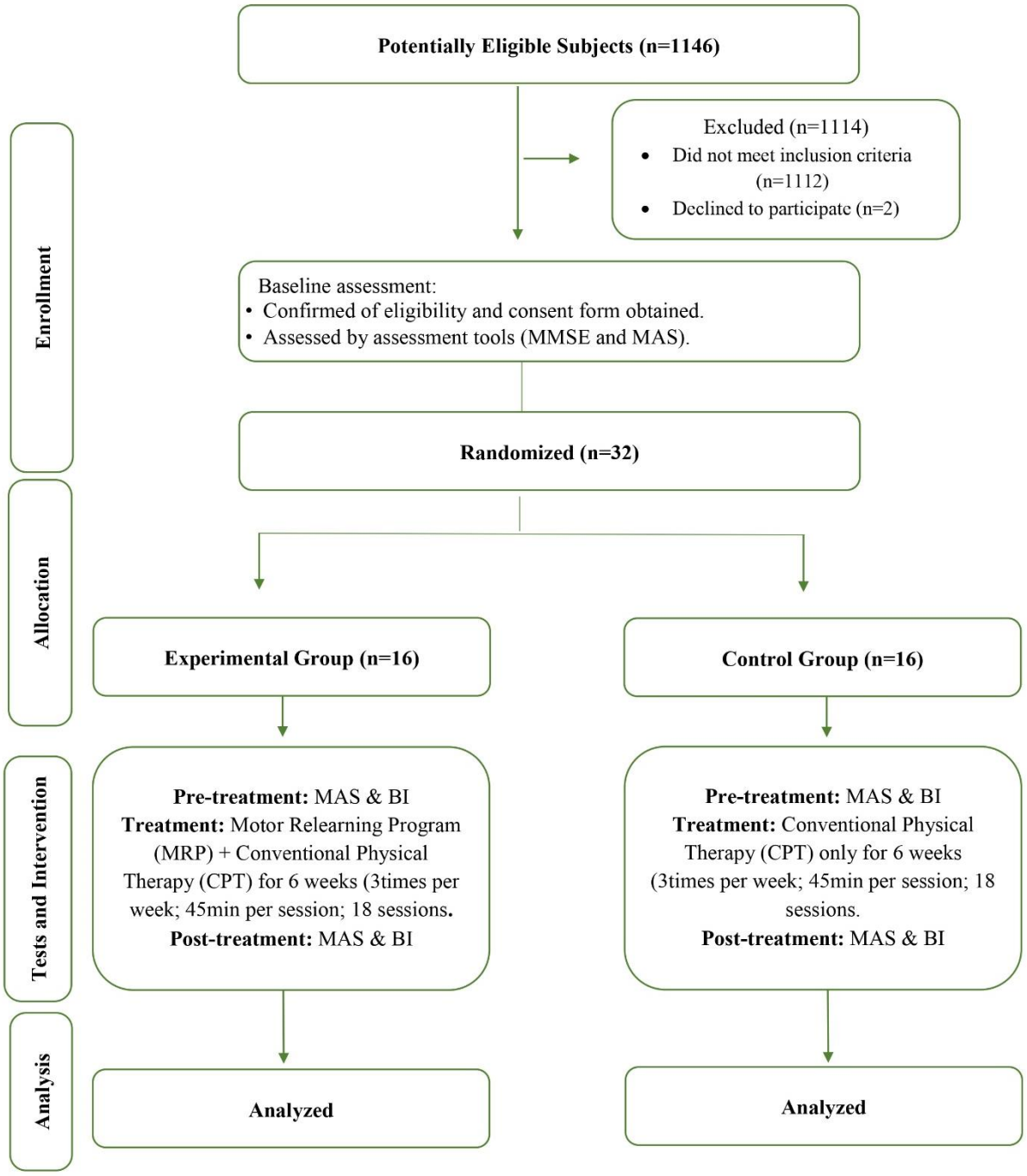


Figure 2. Flow chart of study population of the subjects.

3.5.1 Inclusion criteria: The following subjects were included:

- Right or left-sided chronic hemiplegic subjects.
- More than six months after the onset of stroke.
- Age group between 45-65 years of both genders.
- Scored minimally 24/30 on the Mini-Mental State Exam (MMSE).
- Motor assessment scale of sitting to standing section.
- Having normal visual perception.
- Able to follow verbal commands.

3.5.2 Exclusion criteria: The following subjects were excluded:

- Less than six months after the onset of stroke.
- Unable to follow visual and oral commands.
- The age group is below 45 years and more than 65 years.
- Unilateral neglect.
- Cognitive impairments (MMSE scores less than 24/30), or language deficits.
- Any other neurological disorders and recent surgeries.
- Previous exposure to MRP.

3.6 Sampling technique

Non-probability convenience sampling technique. Sampling is the process of selecting a portion of the population to represent the entire

population. Convenience sampling entails using the most conveniently available people as participants (Polit & Beck, 2010).

3.7 Sample and sample size

Based on the previous study, the sample size was calculated as 32 (Kanase,2020). The sample size was estimated by using the following equation. Furthermore, the sample size we got was 16 in each group, making the total sample required for the study as 32.

$k=n_2/n_1=1$

$n_1=(\sigma^2_1+\sigma^2_2/K)\ (z_{1-\alpha/2}+z_{1-\beta})^2/\Delta^2$

$n_1= (0.5^2+0.5^2/1)\ (1.96+0.84)^2/0.5^2$

$n_1=16$

$n_2=K*n_1=16$

$\Delta = |\mu_2-\mu_1|$ = absolute difference between two means

σ_1, σ_2 = variance of mean #1 and #2

n_1 = sample size for group #1

n_2 = sample size for group #2

α = probability of type I error (usually 0.05)

β = probability of type II error (usually 0.2)

z = critical Z value for a given α or β

k = ratio of sample size for group #2 to group #1

3.8 Data collection tools and techniques

The subjects' demographic data were collected on the data entry sheet of each subject. The assessment of MMSE was done for the screening purpose, and regular neurological assessment was carried out for the treatment decision-making process. The outcome measures like Barthel index and Motor Assessment Scale (MAS) were conducted before and after the treatment.

3.8.1 Materials

3.8.1.1 Instrumentations:

- Pen & papers.
- Chair with armrest.
- Quiet environment with limited visual and auditory distractions.

3.8.1.2 Assessment Tools:

1. **Mini-Mental State Exam (MMSE):** Due to its role as a screening tool for cognitive impairments, the MMSE-2 tool was most frequently used in clinical and research settings. MMSE-2 can yield values between 0

and 30, with higher scores reflecting considerably stronger cognitive capacity. MMSE-2 evaluates the following six cognitive domains: attention and calculation (5 points), place orientation (5 points), time orientation (5 points), registration of memory (3 points), memory recall (3 points), and language and other skills (9 points) (Yang et al., 2021) .

2. **Motor Assessment Scale (MAS):** MAS is used to evaluate motor skills. MAS records eight functional activities: rolling in bed, sitting, sit to stand, walking, balancing in seated position, upper arm, hand, and wrist activities. The general tone of the body is noted in the ninth item. The scale for each item is 0 to 6. Hence, a score of 0 to 54 (normal function). According to WHO guidelines, MAS is supposed to be tested on the severity of disabilities. The MAS was highly dependable, with an average inter-rater reliability of .95 and an average test-retest reliability of 0.98 (Bhalerao et al., 2011).

3.8.1.3 Outcome Measurements:

1. **Barthel Index (BI):** The Barthel index, frequently used for stroke, gauges the level of help needed by an individual for ten mobility and daily living tasks. The total of all weighted individual item scores is converted into a single overall score, which ranges from 0 to 100. Consequently, "0" represents total independence from all ten activities.

It takes 5 to 10 minutes to complete, has strong validity and reliability, and has minimal sensitivity for high-level functioning (Bhalerao et al., 2011).

2. **Motor Assessment Scale** (MAS; sit to stand section).

3.9 Procedure

After a careful monitor of inclusion and exclusion criteria and obtaining the institutional review board approval, the study was conducted by convenience sampling to select the suitable subjects, explaining the procedure to them, and got the written & oral informed consent. The study included two groups, each with 16 participants, which were allocated randomly to the control and experimental groups by lottery method. CPT was administered to the control group three times per week for six weeks (45 minutes per session). CPT treatments such as mat activities, assisted movements, weight-bearing strategies, and gymnasium training were given to the control group. At the same time, the experimental group received the previously mentioned CPT treatment as well as MRP for sitting to standing for six weeks, for a total duration of 45 minutes per session (30 minutes of CPT treatment followed by 15 minutes MRP), three sessions per week.

MRP of sitting and standing activities: The physical therapist was standing in front of the participant, who was sitting in an armrest-equipped chair. Participants

were initially taught to keep their feet back, followed by forward trunk positioning. The physical therapist then aided the activity by holding the involved side of the hand and shoulder, where the subject had informed to execute anterior trunk bending more quickly, if the participant did not do it well or performed it in an abnormal manner. Finally, participants were instructed to press down through the affected foot, stand up as quickly as possible, and bring their hips anterior. The physical therapist suggested pressing down through the participant's knee along the shaft of the leg while moving it anteriorly through the affected foot.

MRP of standing to sitting: The participant was on his feet. The physiotherapist assisted the participant with anterior shoulder movement and knee bending at the start of the stand-to-sit movement. The physiotherapist then assisted the participant in keeping his weight on the affected leg while sitting. The subject progressed by standing and sitting with different seat heights, stopping in different parts of the range of motion, and varying speed. These variations in time and space were directed by the physical therapist. The number of reps and intensity of the exercise were classified according to the subject's capacity level and gradually increased as they improved. Subjects were given verbal feedback on weight distribution, performance speed, and encouragement.

3.10 Data analysis

Statistical Package for the Social Science version 28 was used to analyze the study results. The confidence interval was kept at 95%, and the significance level was less than 0.05. The demographic characteristics like age, gender distribution, duration of the stroke, height, weight, body mass index, etc., were analyzed by univariate analysis using descriptive statistics. The differences between the pre and post-measurements for BI and MAS for each group were assessed by using the Wilcoxon Signed Ranks Test. The differences between the control and experimental group were analyzed by The Mann-Whitney U Test for outcome measures like BI and MAS.

CHAPTER IV

4.0 Results

Descriptive statistics including frequency and percentage were calculated for the demographic and clinical characteristics of the study population using Statistical Package for the Social Sciences (SPSS) version 28 which are depicted in Table 1 and Figure 3. The findings indicated that the study population consists of 32 participants, divided equally into two groups: experimental and control. The majority of the participants were male (71.9%), and the most common type of stroke was ischemic (78.1%). Most of the participants had hypertension (78.1%) and diabetes (71.9%), while smoking history was present in 31.2% of the participants. The affected side of the stroke was left in 59.4% of the cases.

Table 1 Demographical and Clinical Characteristics of the study Population

Variable	Category	*F*	%
Group	Experimental	16	50.0
	Control	16	50.0
Gender	Male	23	71.9
	Female	9	28.1
Type of Stroke	Ischemic	25	78.1
	Hemorrhagic	7	21.9
Affected Side	Left	19	59.4
	Right	13	40.6
Hypertension	No	7	21.9
	Yes	25	78.1
Diabetes	No	9	28.1
	Yes	23	71.9
Smoking History	No	22	68.8
	Yes	10	31.2

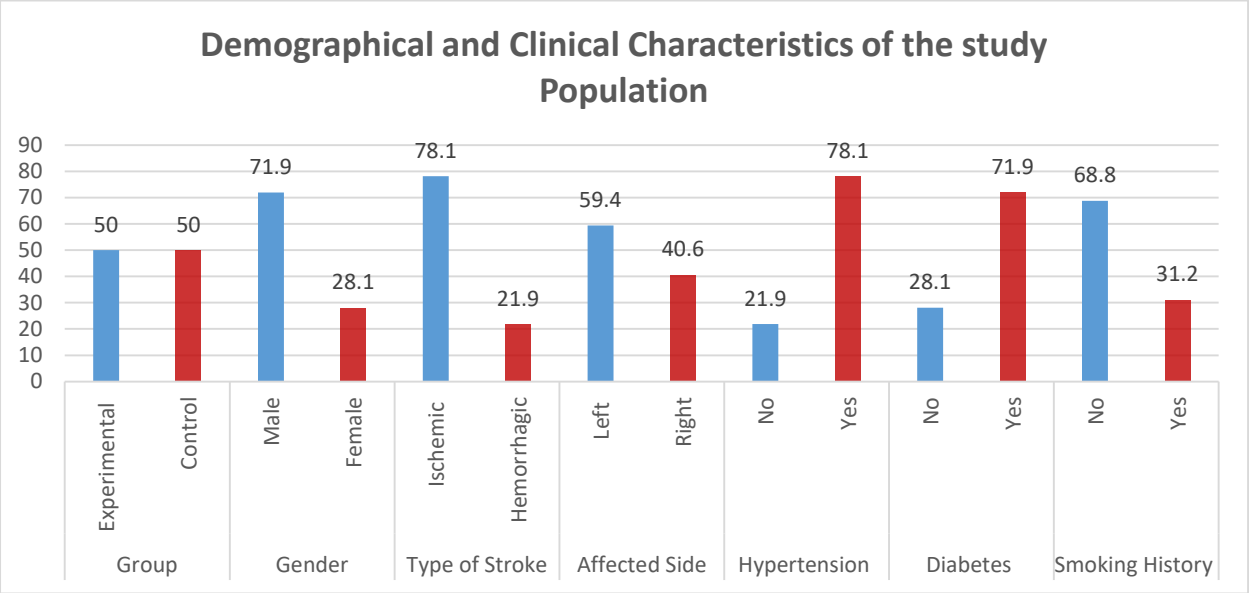


Figure 3: Demographical and Clinical Characteristics of the study Population

The descriptive statistics were calculated for demographic and clinical characteristics, including mean, median, standard deviation, range, minimum, and maximum are presented in Table 2. The findings show that the mean age is 54.81 years, with a median of 55 years, and a standard deviation of 6.54 years. The age range is 20 to 65 years. The mean duration in months is 21.5, with a median of 12 months, and a standard deviation of 30.84 months. The range is 6 to 168 months. The mean weight is 80.70 kg, with a median of 78.10 kg, and a standard deviation of 17.27 kg. The weight range is 63 to 115 kg. The mean height is 166.22 cm, with a median of 167.50 cm, and a standard deviation of 9.73 cm. The height range is 150 to 193 cm. The mean Body Mass Index (BMI) is 29.34, with a median of 28.65, and a standard deviation of 6.34. The range is 16 to 41.6.

Regarding the assessment tool MMSE used for screening, the mean is 26.69, with a range of 6 (from 24 to 30). The median is 27, indicating relatively symmetrically distributed data. The standard deviation is 2.46, indicating relatively low variability around the mean. For the assessment tool MAS used for screening, the mean is 28.19, with a range of 37 (from 8 to 45). The median is 28, indicating relatively symmetrically distributed data. The standard deviation is 9.66, indicating high variability.

For the outcome measure Barthel Index Pre-Intervention, the mean is 60.94, with a range of 30 (from 30 to 90). The median is 62.5, indicating relatively symmetrically distributed data. The standard deviation is 15.05, indicating relatively low variability around the mean. The outcome measure Barthel Index Post Intervention has a mean of 68.28, with a range of 65 (from 30 to 95). The median is 70, indicating relatively symmetrically distributed data. The standard deviation is 17.58, indicating relatively low variability around the mean.

The outcome measure of MAS Pre-Intervention has a mean of 2.94, with a range of 4 (from 1 to 5). The median is 3, indicating relatively symmetrically distributed data. The standard deviation is 1.22, indicating relatively low variability around the mean. The outcome measure of MAS Post-Intervention has a mean of 4.06, with a range of 5 (from 1 to 6). The median is 4.5, indicating heavily skewed data towards higher scores. The standard deviation is 1.34, indicating relatively low variability around the mean.

Table 2 Descriptive Statistics for Demographic and Clinical Characteristics of the Study Population (n=32)

Variables	Mean	Median	SD	Range	Minimum	Maximum
Age	54.81	55.00	6.53	20.00	45.00	65.00
Duration in Months	21.50	12.00	30.83	162.00	6.00	168.00
Weight (kg)	80.70	78.10	17.27	63.00	52.00	115.00
Height (cm)	166.22	167.50	9.72	43.00	150.00	193.00
BMI	29.34	28.65	6.34	25.60	16.00	41.60
Assessment of MMSE	26.69	27.00	2.45	6.00	24.00	30.00
Assessment of MAS	28.18	28.00	9.66	37.00	8.00	45.00
Barthel Index Pre-Intervention	60.93	62.50	15.05	60.00	30.00	90.00
Barthel Index Post Intervention	68.28	70.00	17.57	65.00	30.00	95.00
MAS Pre Intervention	2.93	3.00	1.21	4.00	1.00	5.00
MAS Post Intervention	4.06	4.50	1.34	5.00	1.00	6.00

Note. SD = Standard Deviation; BMI = Body Mass Index; MMSE = Mini-Mental State Examination; MAS = Motor Assessment Scale

To compare the experimental and the control group on various assessment tools for screening and outcome measures, the Mann-Whitney U tests were performed. Regarding the assessment tool MMSE, there was no significant difference between the two groups, as indicated by a Mann-Whitney U of 127.50 and p-value of .984. Similarly, for the assessment tool MAS for screening and the outcome measures Barthel Index Pre-Intervention and Barthel Index Post-Intervention, there were no significant differences between the experimental and control groups. However, for the outcome measure MAS Pre-Intervention, the experimental group had significantly lower scores than the control group, with a Mann-Whitney U of 69.00 and p-value of .020. In contrast, for the outcome measure MAS Post-Intervention, there was no significant difference between the two groups, with a Mann-Whitney U of 81.00 and p-value of .080. Overall, these results suggest that the experimental and control groups were largely similar on most of the measures, except for the MAS Pre-Intervention measure where the experimental group had significantly lower scores than the control group. The details are shown in Table 3 and Figure 4

Table 3 Comparison between Experimental and Control Groups on Various Assessment and Outcome Measures

Conditions/Measures	Group	N	Mean Rank	Mann-Whitney U	*p*
Assessment of MMSE	Experimental	16	16.47	127.50	.984
	Control	16	16.53		
Assessment of MAS	Experimental	16	15.50	112.00	.546
	Control	16	17.50		
Barthel Index Pre-Intervention	Experimental	16	14.91	102.50	.333
	Control	16	18.09		
Barthel Index Post Intervention	Experimental	16	18.19	101.00	.306
	Control	16	14.81		
MAS Pre Intervention	Experimental	16	12.81	69.00	.020
	Control	16	20.19		
MAS Post Intervention	Experimental	16	19.44	81.00	.080
	Control	16	13.56		

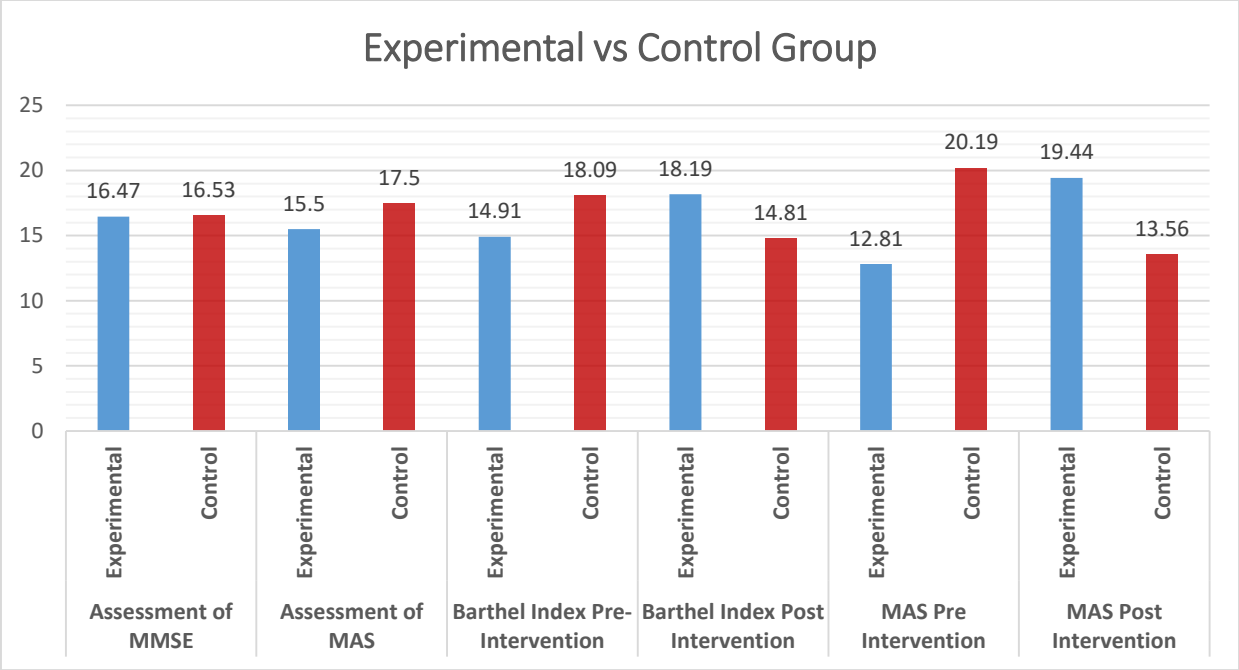


Figure 4: Comparison between Experimental and Control Groups on Various Assessment and Outcome Measures

To compare the Outcome measure Barthel Index scores Pre and Post Intervention in experimental group, the Wilcoxon Signed Ranks Test was performed. The results indicated a statistically significant difference between the pre and post-intervention phases ($z = -3.31$, $p < .001$). Further, the results indicated that the mean score for Barthel Index increased from 58.75 (SD = 15.22) in the pre-intervention phase to 71.56 (SD = 17.86) in the post-intervention phase. The maximum score for pre-intervention was 90.00 and for post-intervention, it was 95.00. The percentiles indicate that the median score for Barthel Index increased from 55.00 in the pre-intervention phase to 72.50 in the post-intervention phase. Furthermore, the results indicated that the mean rank for the pre-intervention phase was 7.5, while for the post-intervention phase it was 0. The sum of ranks for the pre-intervention phase was 105.00, while for the post-intervention phase it was 0. This indicates that, on average, participants had higher scores on the Barthel Index after the intervention. Overall, the results suggest that the intervention had a significant positive effect on the outcome measure Barthel Index. The details are shown in Table 4 and Figure 5

To compare the Outcome measure MAS scores Pre and Post Intervention in the experimental group, the Wilcoxon Signed Ranks Test was performed. The results indicated a statistically significant difference between

the pre and post-intervention phases ($z = -3.46$, $p < .001$). Further, the results indicated that the mean score for MAS increased from 2.43 (SD = 1.03) in the pre-intervention phase to 4.50 (SD = 1.21) in the post-intervention phase. Furthermore, the results indicated that the mean rank for the pre-intervention phase was 8.0, while for the post-intervention phase it was 0. The sum of ranks for the pre-intervention phase was 120.00, while for the post-intervention phase it was 0. This indicates that, on average, participants had higher scores on the MAS after the intervention. The maximum score for pre-intervention was 4.00 and for post-intervention, it was 6.00. The percentiles showed that the median score for MAS increased from 2.00 in the pre-intervention phase to 5.00 in the post-intervention phase. These results suggest that the intervention had a significant positive effect on the outcome measure MAS in experimental group. The details are shown in Table 4 and Figure 6

To compare the Outcome measure Barthel Index scores Pre and Post Intervention in control group, the Wilcoxon Signed Ranks Test was performed. The results indicated a non-significant difference between the pre and post-intervention phases ($z = -1.71$, $p = 0.083$). Further, the results indicated that the mean score for Barthel Index increased from 63.13 (SD = 15.04) in the pre-intervention phase to 65.00 (SD = 17.22) in the post-intervention phase. In addition, the findings indicated that the mean rank for

the pre-intervention phase was 2.0, while for the post-intervention phase it was 0.0. The sum of ranks for the pre-intervention phase was 6.00, while for the post-intervention phase it was 0.00. This indicates that, on average, participants had slightly lower scores on the Barthel Index after the intervention. The maximum score for pre-intervention was 80.00 and for post-intervention, it was 90.00. The percentiles indicate that the median score for Barthel Index remained the same at 67.50 in both pre and post-intervention phases. Overall, the results suggest that the intervention did not have a significant effect on the outcome measure Barthel Index, although there was a slight increase in the mean score in the control group. The details are shown in Table 4 and Figure 5

To compare the Outcome measure MAS scores Pre and Post Intervention in the control group, the Wilcoxon Signed Ranks Test was performed. The results indicated that the difference between pre- and post-intervention scores was not statistically significant ($z = -1.73$, $p = 0.083$). In addition, the findings indicated that the mean rank for the pre-intervention phase was 2.0, while for the post-intervention phase it was 0.0. The sum of ranks for the pre-intervention phase was 6.00, while for the post-intervention phase it was 0.00. This indicates that, on average, participants had slightly lower scores on the MAS after the intervention. Further, the results indicated

that the mean score for MAS increased from 3.4375 (SD = 1.20) in the pre-intervention phase to 3.62 (SD = 1.36) in the post-intervention phase. The maximum score for pre-intervention and post-intervention was 5.00. The percentiles indicate that the median score for MAS was 4.0000 in both pre- and post-intervention phases, with a range of 1.00 to 5.00. These findings suggest that the intervention did not have a significant effect on the outcome measure MAS in the control group. The details are shown in Table 4 and Figure 6

Table 4 Comparison between Experimental and Control Groups based on pre and post intervention in terms of Outcome Measures

Measures	Group	Condition	N	M	Mean Rank	Wilcoxon signed-rank test	P value
Barthel Index	Experimental	Pre	16	58.75	7.50	-3.31	<.001
		Post	16	71.65	0.00		
	Control	Pre	16	63.12	2.00	-1.71	0.083
		Post	16	65.00	0.00		
MAS	Experimental	Pre	16	2.44	8.00	-3.46	<.001
		Post	16	4.50	0.00		
	Control	Pre	16	3.43	2.00	-1.73	0.083
		Post	16	3.62	0.00		

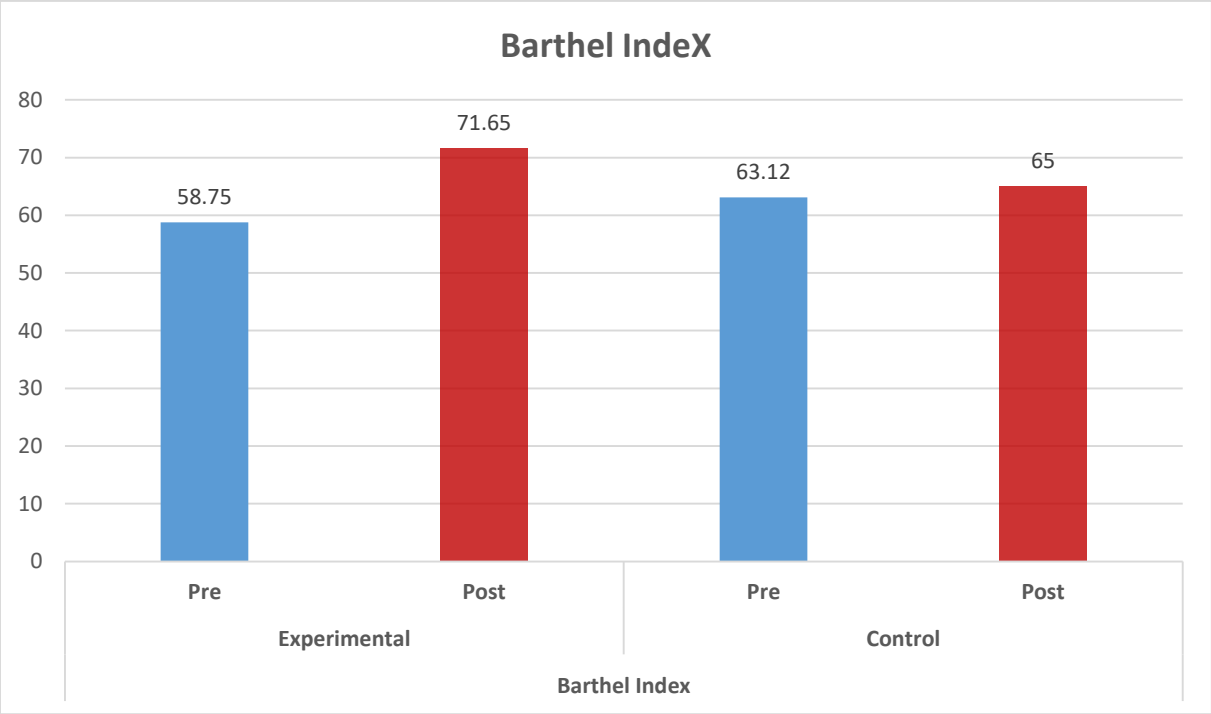


Figure 5: Comparison of Experimental and Control Groups in terms of Barthel Index

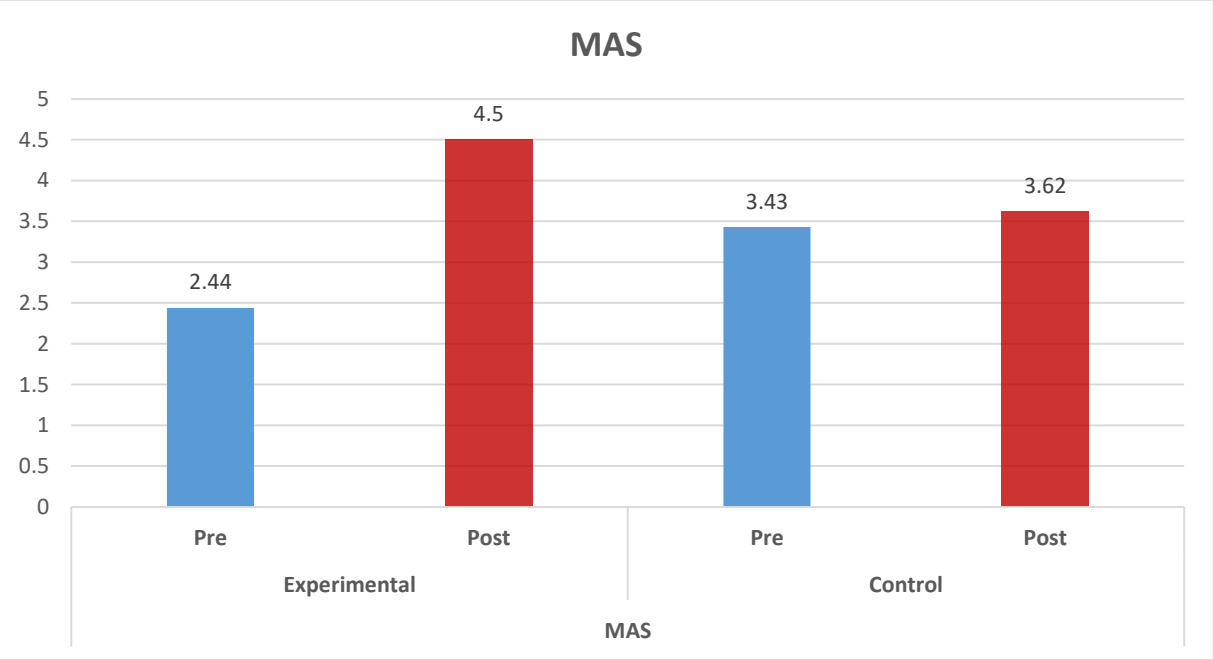


Figure : Comparison of Experimental and Control Groups in terms of MAS

To compare the mean differences of post to pre interventions between the experimental and the control group on various outcome measures, the Mann-Whitney U tests were performed. Both MAS and BI scores mean differences between pre to post intervention had shown statistically significant differences with level of significance less than 0.001. This indicates that the overall function evaluated by MAS and BI had significantly improved with the experimental group interventions than control group interventions. Table 5, Figure 7 and 8 shows these details.

Table 5 Comparison between Experimental and Control Groups on mean differences of post to pre interventions for BI and MAS

Conditions/Measures	**Group**	**N**	**Mean Rank**	**Mann-Whitney U**	***p***
Barthel Index mean difference Post – Pre-Intervention	Experimental	16	22.56	31	<0.001
	Control	16	10.44		
MAS mean difference Post – Pre-Intervention	Experimental	16	23.63	14	<0.001
	Control	16	9.38		

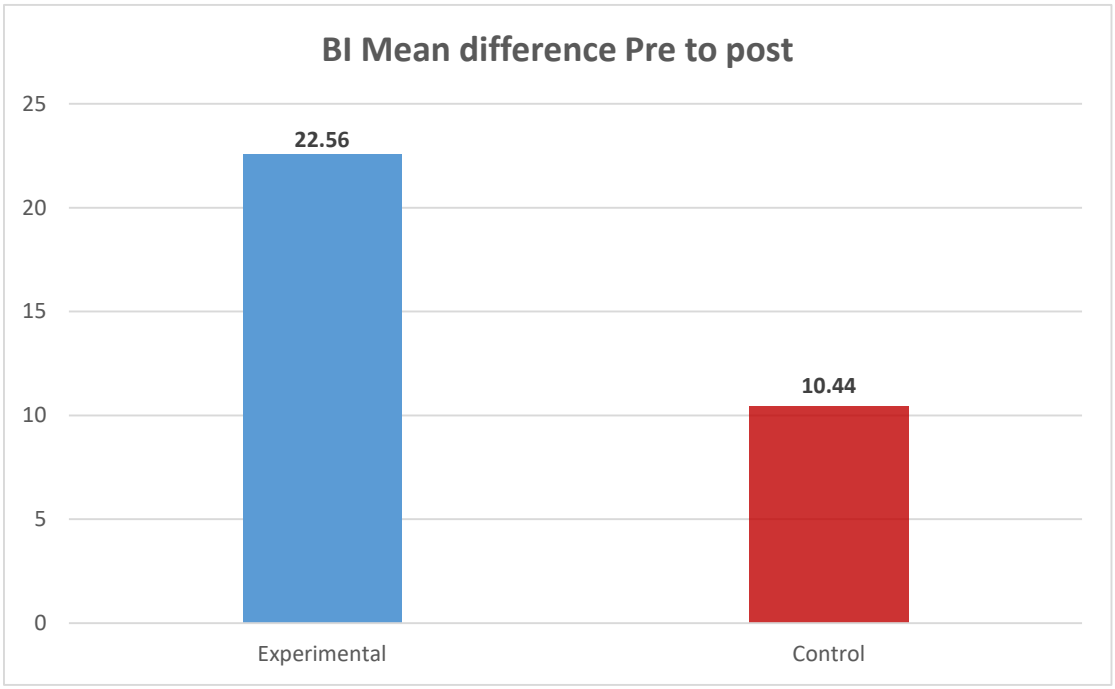


Figure 7: Mean differences of Pre and Post Intervention comparison for experimental and control groups in term of BI

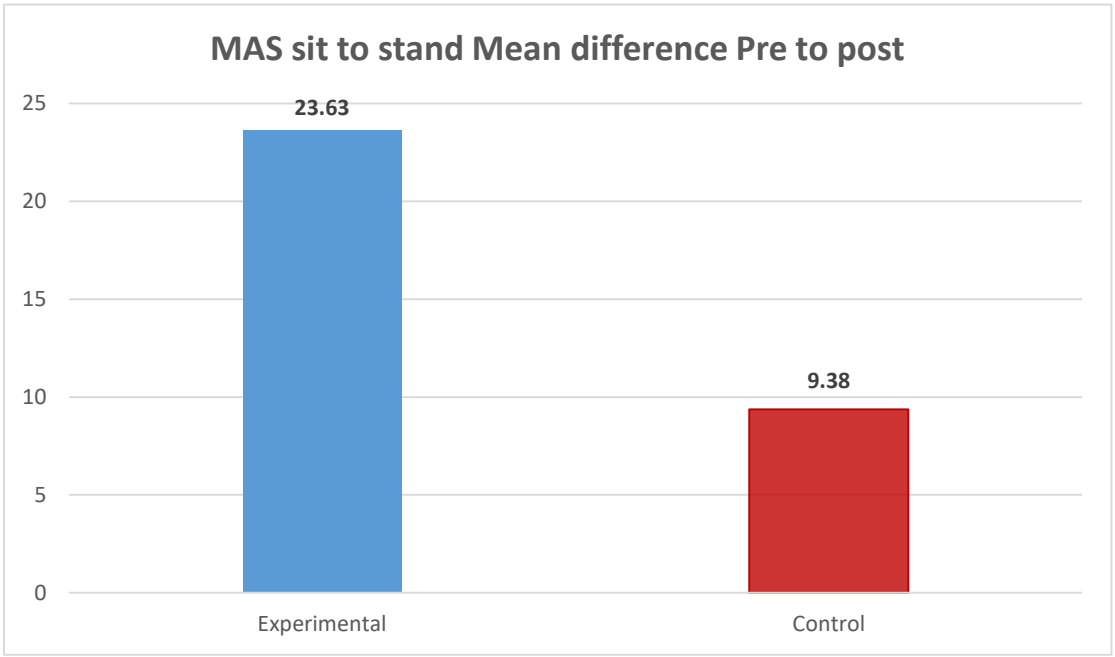


Figure 8: Mean differences of Pre and Post Intervention comparison for experimental and control groups in term of MAS

CHAPTER V

5.0 Discussion

The current study is one of the few randomized controlled trials conducted in Saudi Arabia to determine the efficacy of MRP combined with CPT in improving overall function and sit-to-stand capacity in patients with chronic stroke. The study found that using the MRP improved experimental group functions significantly more than conventional physical therapy.

A similar study (Kanase,2020) was conducted to determine the efficacy of using MRP and conventional physical therapy in improving functional capability in the post-stroke population. The authors included 30 post-stroke subjects and randomly assigned them to two groups. They had both control and experimental groups, similar to the current study, and included MRP treatment as their experimental treatment compared to conventional physical therapy. The outcome measures used in that study were modified BI (MBI) and MAS, and the results were as follows: control group pre-intervention MBI mean ± SD was 9.6±3.66, and the post-intervention MBI mean ± SD was 47.66±5.5, whereas in the experimental group's pre-intervention MBI mean ± SD was 16.214±7.54, and the post-intervention MBI mean ± SD was 80±12.5. Similar improvements were noted in the current study, where the control

group pre-intervention BI mean ± SD was 63.12±15.04 and the post-intervention BI mean ± SD was 65±17.22, whereas, in the experimental group's pre-intervention BI mean ± SD was 58.75±15.22, and the post-intervention BI mean ± SD was 71.56±17.86. In the comparable study, the control group's pre-intervention sit-to-stand MAS mean ± SD was 0.8±0.41, and the post-intervention sit-to-stand MAS mean ± SD was 2.8±0.41. Whereas the experimental group's pre-intervention sit-to-stand MAS mean ± SD was 0.78±0.42 and the post-intervention sit-to-stand MAS mean ± SD was 4.5±0.51 (Kanase,2020). Comparable improvements were noted in the current study where the control group pre-intervention sit-to-stand MAS mean ± SD was 3.43±1.20, and the post-intervention sit-to-stand MAS mean ± SD was 3.62±1.36 whereas the experimental group pre-intervention sit to stand MAS mean ± SD was 2.43±1.03, and the post-intervention sit to stand MAS mean ± SD was 4.5±1.21.

When compared to the current study, the pre-intervention scores in the previous study (Kanase,2020) were very low, and the post-intervention improvements were very large. The reasons for these differences could be due to the duration of the stroke population included. The current study only included chronic subjects who had suffered a stroke for more than six months. The duration of the stroke was not mentioned in the comparable study

(Kanase,2020), and it is assumed to be acute, which is why the pre-intervention scores were very low. In terms of session length, the previous study had 24 sessions over six weeks, with each group receiving its own treatment. Unlike the current study, which only had 18 sessions over six weeks, the experimental group received both conventional physical therapy and MRP. As a result, the treatment focus must shift away from pure MRP, resulting in fewer improvements than in the previous study. In addition, the current study's treatment duration was 45 minutes, the sample included was from three centers, and the treating therapist's experience was post-bachelor. The treatment duration was not specified in the (Kanase,2020) study, patients were recruited from a single center, and the treating therapist has an associate professor grade. These factors may also contribute to the significant improvements observed in the previous study.

The sit-to-stand component of MAS was used as an outcome measure in three studies conducted on the stroke population by different authors (Langhammer & Stanghelle, 2011; Singha, 2017; Sherin U, 2022) and showed similar improvements in the MAS sit-to-stand components with mean differences of pre to post scores of 2.20, 1.1, and 2.90, respectively. The mean pre-to-post difference in MAS sit-to-stand score in the current study was 2.17. Based on the principle of specificity in exercise training (Ammann et al.,

2014), these improvements in the MAS sit-to-stand components were expected. All of these studies used the MRP approach, and training for sit-to-stand is one of the key components in MRP training; thus, improvements in sit-to-stand occurred. More details of the individual studies' MAS sit-to-stand component scores can be seen in the appendix 12.

MBI was the next significant functional outcome measure used in the current study. Two studies (Ravel, 2020; Bhalerao et al., 2011) used BI as one of their outcome measures, and the mean pre-to-post difference in the experimental group was 57.94 and 69.5, respectively. In contrast, the mean pre- to post-differences in the control groups in the study (Bhalerao et al., 2011) were 47.5 scores. The mean pre-to-post differences in the experimental and control groups in the current study were 12.81 and 1.88, respectively. The minimal clinically important difference (MCID) for BI among stroke patients was 1.85 (0.89 - 2.81) (Hsieh et al., 2007).

Despite the fact that our pre-to-post differences were small in comparison to previous studies, the MCID was met, and thus the treatment effects were valid. The difference in improvements could be attributed to the duration of stroke subjects in previous studies. Some studies (Ravel 2020; Bhalerao et al., 2011) revealed that stroke subjects were recruited within six months, whereas in the current study, chronic stroke patients with an average

duration of 21.5 months were included, which could explain why there was a smaller pre to post mean difference on MBI scores.

The improvements in the experimental group can be attributed to the current study's combination therapy, which included MRP and conventional physical therapy. Walking, standing, sit to stand, sitting, upper limb activities, oro-motor functions, and bed mobility were all practiced using the MRP. Because the approach is based on dynamic systems theory principles, the authors concentrate on a variety of factors such as patients, tasks, and the environment. Furthermore, the analysis identifies the critical and missing components required to complete the task successfully. The movements practiced and the numbers of repetitions performed were based on the task, and it was relevant to the patients' daily lives. As a result of this type of practice, repetition, and adaptation to daily activities, would have enhanced neuroplastic changes, neuronal connections, and engrams in improving patient functions more than control group interventions.

CHAPTER VI

6.0 Conclusion, Limitation, and Future Suggestions

6.1 Conclusion

Compared to the control group, stroke patients in the experimental group who underwent a six-week intervention that included MRP in addition to CPT showed significant improvement in their functional mobility and sit-to-stand capacity. Even in cases of chronic stroke, the MRP training improved sit-to-stand function as measured by MAS and overall function as measured by BI, with statistically significant improvements in the experimental group compared to the control group (p value < 0.001).

6.2 Limitation and future suggestions

The current study was more concerned with the effect of MRP on the international classification of function and disability model's activity components than with impairments and participation restrictions. In the Barthel index, the outcome measures primarily lower extremity functions such as sit-to-stand and general functions. As a result, future authors can concentrate on impairment components, gait analysis, balance, and quality of life outcomes. The treatment emphasized the sit-to-stand component of the

MRP program rather than the seven basic life activities. As a result, the enhancements are training specific. Future research can, however, incorporate all aspects of MRP training without conventional physical therapy to determine the impact of MRP on functional and participation enhancements. Both the outcome measures that is BI and MAS were used in English and the population of the study were Arabic speaking and hence it would have some affect on the results obtained in the current study. The future studies should use these scales which are cross culturally adapted to the Arabic population to avoid any of such disparities.

References

Abrar, A., Shahid, Z., Ali Behram Subazwari, S., Manzoor, S., Hadiqa Shafique, H., & Idrees, H. (2022). Comparison of Effects of Neurodevelopmental Treatment versus Motor Relearning Program on Upper Limb Spasticity in Chronic Stroke Patients. A Randomized. Researchgate.NetSign In, May. https://www.researchgate.net/profile/Zohaib-Shahid 3/publication/360426484_Comparison_of_Effects_of_Neurodevelopmental_Treatment _versus_Motor_Relearning_Program_on_Upper_Limb_Spasticity_in_Chronic_Stroke_ Patients_A_Randomized_Control_Trial/links/62755b7c2f9ccf58eb32ed34/Comparison -of-Effects-of-Neurodevelopmental-Treatment-versus-Motor-Relearning-Program-on-Upper-Limb-Spasticity-in-Chronic-Stroke-Patients-A-Randomized-Control-Trial.pdf

Aftab A, Umar M, Irshaad A, Rashid H, Rauf R. Effectiveness of motor learning program and task specific training for the treatment of chronic stroke. *Rehman J Health Sci. 2021;3(2)*. 80-84

Aichner, F., Adelwöhrer, C., & Haring, H.-P. (2002). Rehabilitation approaches to stroke BT - Stroke-Vascular Diseases (W. W. Fleischhacker & D. J. Brooks (eds.); pp. 59–73). Springer Vienna.

Alluqmani, M. M., Almshhen, N. R., Alotaibi, R. A., Aljardi, O. Y., & Zahid, H. M. (2021). Public awareness of ischemic stroke in Medina city, Kingdom of Saudi Arabia. *Neurosciences, 26(2)*, 134–140. https://doi.org/10.17712/nsj.2021.2.20200105

Ammann, B. C., Knols, R. H., Baschung, P., de Bie, R. A., & de Bruin, E. D. (2014). Application of principles of exercise training in sub-acute and chronic stroke survivors: A systematic review. *BMC Neurology*, *14*(1), 1–11. https://doi.org/10.1186/s12883-014-0167-2

Annethattil, A., Paul, J., & Sebastian, J. (2017). Combined effect of Bobath technique and Motor Relearning Program (MRP) over its individual effects to improve upper limb

functions in stroke patients. *International Journal Medical and Exercise Science, 03(04)*, 435–442. https://doi.org/10.36678/ijmaes.2017.v03i04.003

Asgedom, S. W., Gidey, K., Gidey, K., Niriayo, Y. L., Desta, D. M., & Atey, T. M. (2020). Medical complications and mortality of hospitalized stroke patients. *Journal of Stroke and Cerebrovascular Diseases, 29(8)*, 104990. https://doi.org/10.1016/j.jstrokecerebrovasdis.2020.104990

Bakraa, R., Aldhaheri, R., Barashid, M., Benafeef, S., Alzahrani, M., Bajaba, R., Alshehri, S., & Alshibani, M. (2021). Stroke risk factor awareness among populations in Saudi Arabia. *International Journal of General Medicine, 14*, 4177–4182. https://doi.org/10.2147/IJGM.S325568

Bhalerao, G. (2016). Effect of Shoe Raise along with Motor Relearning Programme (MRP) on Ambulation in Chronic Stroke. *International Journal of Physiotherapy, 3(3)*, 297–303. https://doi.org/10.15621/ijphy/2016/v3i3/100831

Bhalerao, G., Kulkami, V., & Kapoor, D. (2011). Acute Stroke Rehabilitation : Motor Relearning Program Versus Bobath Approach . *Journal of Orthopaedics and Rehabilitation*, *1*(1), 79–88.

Bhalerao, G., Kulkarni, V., & Shyam, A. K. (2013). COMPARISON OF MOTOR RELEARNING PROGRAM VERSUS BOBATH APPROACH AT EVERY TWO WEEKS INTERVAL FOR IMPROVING ACTIVITIES OF DAILY LIVING AND AMBULATION IN ACUTE STROKE REHABILITATION Compound Distal Femur with Extruded Fragments View project Musculoskeletal dis. Article in I*nternational Journal of Sciences: Basic and Applied Research, 3(September 2015)*, 70–77. http://www.cibtech.org/jms.htm

Bovim, M. R., Askim, T., Lydersen, S., Fjærtoft, H., & Indredavik, B. (2016). Complications in the first week after stroke: A 10-year comparison. *BMC Neurology, 16(1)*, 1–9. https://doi.org/10.1186/s12883-016-0654-8

Carr, J., & Roberta B. Shepherd. (1997). *A motor relearning programme for stroke* (2nd ed., pp. 5, 6, 29). Oxford: Butterworth-Heinemann.

Carr, J., & Roberta B. Shepherd. (2000). *Neurological Rehabilation: Optimizing Motor Performance* (ch. stroke.p.260-261;274.standing up and sitting down p.71-90. .walking.p.93.). Oxford: Butterworth-Heinemann.

Chan, D. Y. L., Chan, C. C. H., & Au, D. K. S. (2006). Motor relearning programme for stroke patients: A randomized controlled trial. *Clinical Rehabilitation, 20(3)*, 191–200. https://doi.org/10.1191/0269215506cr930oa

Chen, L., Xiong, S., Liu, Y., Lin, M., Zhu, L., Zhong, R., Zhao, J., Liu, W., Wang, J., & Shang, X. (2019). Comparison of Motor Relearning Program versus Bobath Approach for Prevention of Poststroke Apathy: A Randomized Controlled Trial. *Journal of Stroke and Cerebrovascular Diseases, 28(3)*, 655–664. https://doi.org/10.1016/j.jstrokecerebrovasdis.2018.11.011

Coupland, A. P., Thapar, A., Qureshi, M. I., Jenkins, H., & Davies, A. H. (2017). The definition of stroke. *Journal of the Royal Society of Medicine, 110(1)*, 9–12. https://doi.org/10.1177/0141076816680121

Dobkin, B. H., & Dorsch, A. (2013). New Evidence for Therapies in Stroke Rehabilitation. *Current Atherosclerosis Reports, 15(6)*, 1–14. https://doi.org/10.1007/s11883-013-0331-y

El-Hajj, M., Salameh, P., Rachidi, S., & Hosseini, H. (2016). The epidemiology of stroke in the Middle East. *European Stroke Journal*, *1*(3), 180–198. https://doi.org/10.1177/2396987316654338

Farooq, M. U., Chaudhry, A. H., Amin, K., & Majid, A. (2008). The WHO STEPwise approach to stroke surveillance. *Journal of the College of Physicians and Surgeons Pakistan, 18*(10), 665. https://doi.org/10.2008/JCPSP.665665

Farqalit, R., & Shahnawaz, A. (2013). Effect of foot position during sit-to-stand training on balance and upright mobility in patients with chronic stroke. *Hong Kong Physiotherapy Journal, 31(2)*, 75–80. https://doi.org/10.1016/j.hkpj.2013.06.001

Fernandes, J., & Kumar, S. (2017). Effect of motor relearning program poststem cell therapy in chronic stroke. *Journal of the Scientific Society, 44(1)*, 46.

https://doi.org/10.4103/0974-5009.202537

Ghrouz, A., Marco, E., Muñoz-Redondo, E., Boza, R., Ramirez-Fuentes, C., & Duarte, E. (2019). The effect of motor relearning on balance, mobility and performance of activities of daily living among post-stroke patients: Study protocol for a randomised controlled trial. Study Protocol *European Stroke Journal, 2022(1),* 76–84. https://doi.org/10.1177/23969873211061027

Harjpal, P., Qureshi, M. I., Kovela, R. K., & Jain, M. (2021). Efficacy of Bilateral Lower Limb Training over Unilateral to Re-educate Balance and Walking in Post-stroke Survivors: A Protocol for Randomized Clinical Trial. *Journal of Pharmaceutical Research International, 33*, 281–287. https://doi.org/10.9734/jpri/2021/v33i56a33912

Hsieh, Y. W., Wang, C. H., Wu, S. C., Chen, P. C., Sheu, C. F., & Hsieh, C. L. (2007). Establishing the minimal clinically important difference of the barthel index in stroke patients. *Neurorehabilitation and Neural Repair*, *21*(3), 233–238. https://doi.org/10.1177/1545968306294729

Janssen, W., Bussmann, J., Selles, R., Koudstaal, P., Ribbers, G., & Stam, H. (2010). Recovery of the sit-to-stand movement after stroke: A longitudinal cohort study. *Neurorehabilitation and Neural Repair, 24(8),* 763–769. https://doi.org/10.1177/1545968310363584

Immadi, S. K., Achyutha, K. K., Reddy, A., & Tatakuntla, K. P. (2015). Effectiveness of the Motor Relearning Approach in Promoting Physical Function of the Upper Limb after a Stroke. *International Journal of Physiotherapy, 2(1),* 386. https://doi.org/10.15621/ijphy/2015/v2i1/60047

Jan, S., Arsh, A., Darain, H., & Gul, S. (2019). A randomized control trial comparing the effects of motor relearning programme and mirror therapy for improving upper limb motor functions in stroke patients. *JPMA. The Journal of the Pakistan Medical Association*, *69*(9), 1242–1245.

Kanase, S. B. (2020). Effect of Motor Relearning Programme and Conventional Training on Functional Mobility in Post Stroke Patients. *Indian Journal of Public Health*

Research & Development, *11*(05), 496–501. https://doi.org/10.37506/ijphrd.v11i5.9375

Kannabiran, B., & S, C. (2016). A Study on Efficacy of Bobath Technique and Motor Relearning Programme on Functional Activities in Hemiplegic Patients. *International Journal of Neurorehabilitation, 03(06).* https://doi.org/10.4172/2376-0281.1000235

Kim, B. R., Lee, J., Sohn, M. K., Kim, D. Y., Lee, S. G., Shin, Y. Il, Oh, G. J., Lee, Y. S., Joo, M. C., Han, E. Y., & Kim, Y. H. (2017). Risk factors and functional impact of medical complications in stroke. *Annals of Rehabilitation Medicine, 41(5)*, 753–760. https://doi.org/10.5535/arm.2017.41.5.753

Kumar, S., Selim, M. H., & Caplan, L. R. (2010). Medical complications after stroke. *The Lancet Neurology*, *9(1)*, 105–118. https://doi.org/10.1016/S1474-4422(09)70266-2

Langhammer, B., & Stanghelle, J. K. (2000). Bobath or motor relearning programme? A comparison of two different approaches of physiotherapy in stroke rehabilitation: A randomized controlled study. *Clinical Rehabilitation, 14(4)*, 361–369. https://doi.org/10.1191/0269215500cr338oa

Langhammer, B., & Stanghelle, J. K. (2011). Can Physiotherapy after Stroke Based on the Bobath Concept Result in Improved Quality of Movement Compared to the Motor Relearning Programme. *Physiotherapy Research International, 16(2)*, 69–80. https://doi.org/10.1002/pri.474

Lerma Castaño, P. R., Rodríguez Laiseca, Y. A., Montealegre Suárez, D. P., Castrillón Papamija, D. B., & Losada Urriago, G. E. (2020). Effects of kinesiotaping combined with the motor relearning method on upper limb motor function in adults with hemiparesis after stroke. *Journal of Bodywork and Movement Therapies, 24(4)*, 546–553. https://doi.org/10.1016/j.jbmt.2020.07.003

Liu, M., Chen, J., Fan, W., Mu, J., Zhang, J., Wang, L., Zhuang, J., & Ni, C. (2016). Effects of modified sit-to-stand training on balance control in hemiplegic stroke patients: A randomized controlled trial. *Clinical Rehabilitation, 30(7)*, 627–636. https://doi.org/10.1177/0269215515600505

Mufidah, N., Wahyudi, R., & Hasinuddin, M. (2020). The differences between motor

relearning programme and bobath method on standing balance in stroke patients. *Journal of Global Pharma Technology*, *12(1)*, 415–419.

Memon, I., Abu-Shaheen, A., Heena, H., & Al-Tannir, M. (2019). Point prevalence study for stroke in Saudi Arabia: A cross-sectional survey. *Saudi Journal for Health Sciences, 8(2)*, 93. https://doi.org/10.4103/sjhs.sjhs_142_18

Murphy, S. J., & Werring, D. J. (2020). Stroke: causes and clinical features. *Medicine (United Kingdom)*, *48*(9), 561–566. https://doi.org/10.1016/j.mpmed.2020.06.002

Naz, A., Batool, S., Ahmad, A., & Siddique, K. (2022). Effectiveness of motor relearning program on balance and upright mobility in sub-acute stroke patients: A randomized control trial: Motor Relearning Program in Sub-Acute Stroke Patients. *Pakistan BioMedical Journal*, 313-317

Nizami, G. N., & Rafique, N. (2016). Effect of Motor Relearning Program on Quality of Life Among Stroke Patients: a Systematic Review. *Pakistan Journal of Rehabilitation, 5(2)*, 4–18. https://doi.org/10.36283/pjr.zu.5.2/009

O'Sullivan, S. B., & Schmitz, T. J. (2007). *Physical Rehabilitation* (Fifth edition, pp. 718-719-720-721-722–726). F A Davis Company.

Pinzón Bernal, M. Y., Henao Lema, C. P., Pérez-Parra, J. E., Amezquita-Londoño, A. P., Apolinar-Joven, L. Y., Arias-Becerra, L. J., Betancourt-Sánchez, C. L., Cardozo-Santofimio, L. F., García-Mora, N., López-García, C. J., Mariño-Neira, C. M., Osorio-Pérez, M. B., Ramírez-Rivera, B. S., Restrepo-Yepes, C., Rubio-Barreto, C. M., Sarango-Povea, A. C., & Soria-Vizcaíno, A. L. (2020). Effect of an intervention program based on motor relearning on postural control in adults with hemiparesis. *Fisioterapia, 42(1)*, 5–16. https://doi.org/10.1016/j.ft.2019.09.001

Polit, D. F., & Beck, C. T. (2010). Essentials of nursing research: Appraising evidence for nursing practice. Lippincott Williams & Wilkins.

Pollock, A., Baer, G., Campbell, P., Pl, C., Forster, A., Morris, J., Vm, P., Langhorne, P., Pollock, A., Baer, G., Campbell, P., Pl, C., Forster, A., Morris, J., Vm, P., & Langhorne, P. (2014). mobility following stroke (Review).

https://doi.org/10.1002/14651858.CD001920.pub3.www.cochranelibrary.com

Raval, P., 2021. Need based approach: effectiveness of motor relearning program on functional balance, functional mobility and quality of life among post stroke patients. I*nternational Journal of Recent Scientific Research, [online] 11(5),* pp.38730-38734.

Samkari, E. T., Alkhotani, A. M., & Siddiqui, M. I. (2021). Impact of covid-19 on the rate of stroke cases at a tertiary hospital in makkah, saudi arabia. *Neurosciences, 26(2)*, 158–162. https://doi.org/10.17712/nsj.2021.2.20200141

Scheper, M., Cp, H., Cp, P., Je, P., & Jc, V. (2021). *Effect of an intervention program based on motor relearning on disability and health-related quality of life in ...* https://doi.org/10.9790/1959-1001064957

Sherin U, H. (2022). Effect of Motor Re-Learning Program with Motor Imagery on Sit-To-Stand Activity in Stroke. *Journal of Rehabilitation and Pain Medicine*, *1(1)*, 31–39. https://doi.org/10.37191/mapsci-jrpm-1(1)-003

Singha, R. (2017). Motor Relearning Program Versus Proprioceptive Neuromuscular Facilitation Technique for Improving Basic Mobility in Chronic Stroke Patients-a Comparative Study. *International Journal of Physiotherapy and Research*, *5*(6), 2490–2500. https://doi.org/10.16965/ijpr.2017.235

Thiagaraja, T. (2020). To Compare the Effectiveness of Motor Relearning Programme in Improving Patient Quality of Life and Activity Daily Living for Hemiplegic Stroke Patients. *3*(4), 6–15.

Ullah, I., Arsh, A., Zahir, A., & Jan, S. (2020). Motor relearning program along with electrical stimulation for improving upper limb function in stroke patients: A quasi experimental study. Pakistan Journal of Medical Sciences, 36(7), 1613–1617. https://doi.org/10.12669/pjms.36.7.2351

Whitehead, S., & Baalbergen, E. (2019). Post-stroke rehabilitation. South African Medical Journal, 109(2), 81–83. https://doi.org/10.7196/SAMJ.2019.v109i2.00011

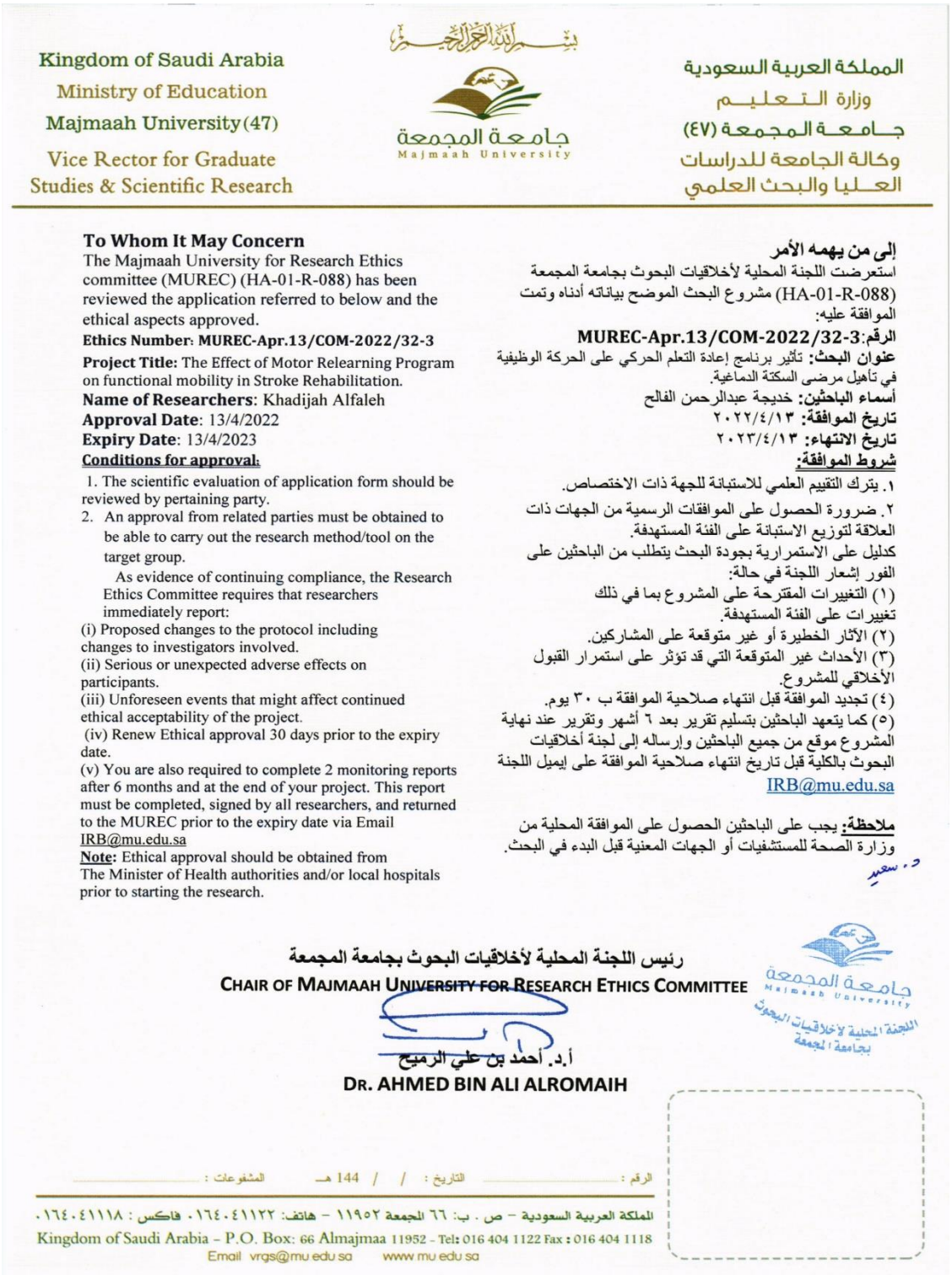
Yang, H., Yim, D., & Park, M. H. (2021). Converting from the Montreal Cognitive

Assessment to the Mini-Mental State Examination-2. PLoS ONE, 16(7 July), 1–11. https://doi.org/10.1371/journal.pone.0254055

Yin, Y., Gu, Z., Pan, L., Gan, L., Qin, D. D., Yang, B., Guo, J., Hu, X. T., Wang, T. H., & Feng, Z. T. (2013). How does the motor relearning program improve neurological function of brain ischemia monkeys? *Neural Regeneration Research, 8(16)*, 1445–1454. https://doi.org/10.3969/j.issn.1673-5374.2013.16.001

Appendices

Appendix 1: Study Approval



Kingdom of Saudi Arabia
Ministry of Education
Majmaah University (47)
Vice Rector for Graduate Studies & Scientific Research

بسم الله الرحمن الرحيم

جامعة المجمعة
Majmaah University

المملكة العربية السعودية
وزارة التعليم
جامعة المجمعة (٤٧)
وكالة الجامعة للدراسات العليا والبحث العلمي

To Whom It May Concern

The Majmaah University for Research Ethics committee (MUREC) (HA-01-R-088) has been reviewed the application referred to below and the ethical aspects approved.

Ethics Number: MUREC-Apr.13/COM-2022/32-3

Project Title: The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.

Name of Researchers: Khadijah Alfaleh

Approval Date: 13/4/2022

Expiry Date: 13/4/2023

Conditions for approval:

1. The scientific evaluation of application form should be reviewed by pertaining party.
2. An approval from related parties must be obtained to be able to carry out the research method/tool on the target group.

As evidence of continuing compliance, the Research Ethics Committee requires that researchers immediately report:

(i) Proposed changes to the protocol including changes to investigators involved.
(ii) Serious or unexpected adverse effects on participants.
(iii) Unforeseen events that might affect continued ethical acceptability of the project.
(iv) Renew Ethical approval 30 days prior to the expiry date.
(v) You are also required to complete 2 monitoring reports after 6 months and at the end of your project. This report must be completed, signed by all researchers, and returned to the MUREC prior to the expiry date via Email IRB@mu.edu.sa

Note: Ethical approval should be obtained from The Minister of Health authorities and/or local hospitals prior to starting the research.

إلى من يهمه الأمر

استعرضت اللجنة المحلية لأخلاقيات البحوث بجامعة المجمعة (HA-01-R-088) مشروع البحث الموضح بياناته أدناه وتمت الموافقة عليه:

الرقم: MUREC-Apr.13/COM-2022/32-3

عنوان البحث: تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية.

أسماء الباحثين: خديجة عبدالرحمن الفالح

تاريخ الموافقة: ٢٠٢٢/٤/١٣

تاريخ الانتهاء: ٢٠٢٣/٤/١٣

شروط الموافقة:

١. يترك التقييم العلمي للاستبانة للجهة ذات الاختصاص.
٢. ضرورة الحصول على الموافقات الرسمية من الجهات ذات العلاقة لتوزيع الاستبانة على الفئة المستهدفة.

كدليل على الاستمرارية بجودة البحث يتطلب من الباحثين على الفور إشعار اللجنة في حالة:

(١) التغييرات المقترحة على المشروع بما في ذلك تغييرات على الفئة المستهدفة.
(٢) الآثار الخطيرة أو غير متوقعة على المشاركين.
(٣) الأحداث غير المتوقعة التي قد تؤثر على استمرار القبول الأخلاقي للمشروع.
(٤) تجديد الموافقة قبل انتهاء صلاحية الموافقة ب ٣٠ يوم.
(٥) كما يتعهد الباحثين بتسليم تقرير بعد ٦ أشهر وتقرير عند نهاية المشروع موقع من جميع الباحثين وإرساله إلى لجنة أخلاقيات البحوث بالكلية قبل تاريخ انتهاء صلاحية الموافقة على إيميل اللجنة IRB@mu.edu.sa

ملاحظة: يجب على الباحثين الحصول على الموافقة المحلية من وزارة الصحة للمستشفيات أو الجهات المعنية قبل البدء في البحث.

د. سعيد

رئيس اللجنة المحلية لأخلاقيات البحوث بجامعة المجمعة
CHAIR OF MAJMAAH UNIVERSITY FOR RESEARCH ETHICS COMMITTEE

أ.د. أحمد بن علي الرميح
DR. AHMED BIN ALI ALROMAIH

جامعة المجمعة
Majmaah University
اللجنة المحلية لأخلاقيات البحوث بجامعة المجمعة

الرقم : ..... التاريخ : / / 144 هـ المشفوعات : .....

المملكة العربية السعودية – ص . ب: ٦٦ المجمعة ١١٩٥٢ – هاتف: ٠١٦٤٠٤١١٢٢ فاكس : ٠١٦٤٠٤١١١٨
Kingdom of Saudi Arabia – P.O. Box: 66 Almajmaa 11952 - Tel: 016 404 1122 Fax : 016 404 1118
Email vrgs@mu.edu.sa www.mu.edu.sa

Appendix 2: IRB Approval from King Saud Medical City (KSMC)

Kingdom of Saudi Arabia
Ministry of Health
King Saud Medical City

مدينة الملك سعود الطبية
KING SAUD MEDICAL CITY

المـملكة العـربية السـعوديـة
وزارة الـصحة
مدينة الملك سعود الطبية

INSTITUTIONAL REVIEW BOARD (IRB)
***IRB Registration Number with KACST, KSA*: H-01-R-053**
***IRB Registration Number U.S. Department of HHS IORG #:* IORG0010374**

- Memorandum -

Date: July 24, 2022

Proposal Reference No.	: **H1RE-24-May22-01**
Proposal Title	: "The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation."
PI	: Ms. Khadeejah Abdulrahman Alfaleh
Co-Investigators	: Abdulrahman Ibrahim Alduhaymi; Hassna Sharahili
Type of Review	: Modification
Category of Approval	: Full
Date of IRB Approval-Expiration (Validity)	: 24/07/2022 23/01/2023 (06 months)

Dear Ms. Khadeejah Abdulrahman Alfaleh:

The Institutional Review Board (IRB) committee found that the research met the applicability criteria for full review. We are pleased to inform you that the above-referenced research proposal reviewed and we would like to take this opportunity to congratulate you on behalf of the Institutional Review Board Committee that after modification/revision it has been accepted and approved. However, to commence the collection of data a permission letter must be issued from the Director of Research Centre first.

This approval is valid for **06 months** from the date of IRB review when approval is granted. The approval will no longer be in effect on the date listed above as the IRB expiration date. Please note that you are obligated to submit the following to IRB committee:

1. progress/final report on the **06 months (23-Jan-2023)** (or earlier in the case the study has completed)
2. any manuscript resulting from this research for approval by IRB before submission to journals for publication.

The approval of the conduct of this proposal will be automatically suspended after 06 months, in the case the Progress Report (or Final Report, if relevant) is pending acceptance. You also need to notify the Research Centre as soon as possible in case of:

1. any amendments to the proposal;
2. termination of the study;
3. any serious or unexpected adverse events;
4. any event or new information that may affect the benefit/risk ratio of the proposal.

All records relating to the research including consent form must be retained and available for audit for at least 3 years after the research has ended.

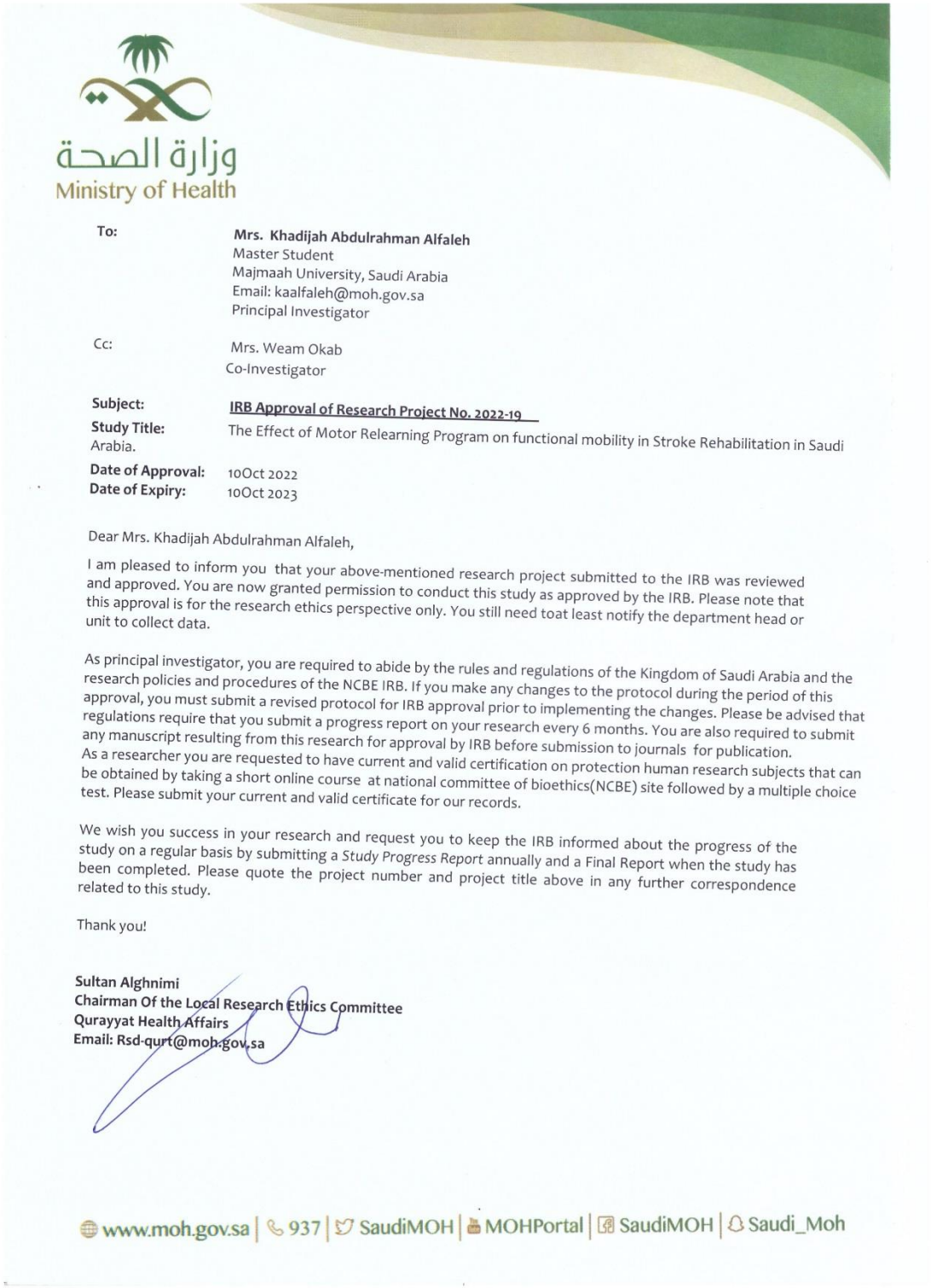
We wish you every success in your research endeavors.

Dr. Faisal Almazroua
Chairman, Institutional Review Board (IRB)
King Saud Medical City Riyadh, KSA

وزارة الصحة المملكة العربية السعودية
مدينة الملك سعود الطبية
King Saud Medical City
لجنة أخلاقيات البحوث (IRB)

☎435-5555 Ext. 2345 irb@ksmc.med.sa

Appendix 3: IRB Approval from Aljouf Health Affairs



وزارة الصحة
Ministry of Health

To: **Mrs. Khadijah Abdulrahman Alfaleh**
Master Student
Majmaah University, Saudi Arabia
Email: kaalfaleh@moh.gov.sa
Principal Investigator

Cc: Mrs. Weam Okab
Co-Investigator

Subject: **IRB Approval of Research Project No. 2022-19**

Study Title: The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation in Saudi Arabia.

Date of Approval: 10Oct 2022
Date of Expiry: 10Oct 2023

Dear Mrs. Khadijah Abdulrahman Alfaleh,

I am pleased to inform you that your above-mentioned research project submitted to the IRB was reviewed and approved. You are now granted permission to conduct this study as approved by the IRB. Please note that this approval is for the research ethics perspective only. You still need toat least notify the department head or unit to collect data.

As principal investigator, you are required to abide by the rules and regulations of the Kingdom of Saudi Arabia and the research policies and procedures of the NCBE IRB. If you make any changes to the protocol during the period of this approval, you must submit a revised protocol for IRB approval prior to implementing the changes. Please be advised that regulations require that you submit a progress report on your research every 6 months. You are also required to submit any manuscript resulting from this research for approval by IRB before submission to journals for publication.
As a researcher you are requested to have current and valid certification on protection human research subjects that can be obtained by taking a short online course at national committee of bioethics(NCBE) site followed by a multiple choice test. Please submit your current and valid certificate for our records.

We wish you success in your research and request you to keep the IRB informed about the progress of the study on a regular basis by submitting a *Study Progress Report* annually and a Final Report when the study has been completed. Please quote the project number and project title above in any further correspondence related to this study.

Thank you!

Sultan Alghnimi
Chairman Of the Local Research Ethics Committee
Qurayyat Health Affairs
Email: Rsd-qurt@moh.gov.sa

www.moh.gov.sa | 937 | SaudiMOH | MOHPortal | SaudiMOH | Saudi_Moh

Appendix 4: IRB Approval from Prince Sultan Bin Abdul-Aziz Humanitarian City (SBAHC)

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY
لجنة أخلاقيات البحوث الطبية
Institutional Review Board (IRB)

Date: 01/12/2022
IRB No.: 85-2022-IRB

To: **Ms. Khadijah Alenazi**
MSc: "The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation."
AlMajmaah University
E-mail: khadooj1411@hotmail.com

Subject:	Approval for MSc Research No. 80/MSc/2022
Study Title:	"The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation
Study Code:	81/MSc/2022
Date of Approval:	01/12/2022
Date of Expiry:	1/10/2023
Board approval:	Approved by the members.

Dear **Ms. Khadijah Alenazi,**

Your Project has been approved and you have the permission to conduct this study following your submitted documents as follow:

1. Curriculum Vitae for the PI researcher
2. Letter from the researcher requesting SBAHC participation in the clinical study
3. Research proposal according to SBAHC IRB Guidelines
4. SBAHC Informed Consent Template
5. Research Obligatory Agreement. Available upon the completion of the other requirements

You are required to obey by the rules and regulations of the Government of Saudi Arabia, the SBAHC IRB Policies and procedures and the ICH-GCP guidelines. You have to note that this approval mandate responding to IRB's periodic request and surveillance result. Drawing your attention to the following:

- Amendment of the project with the required modification to providing Periodical report for this project specially when study extension is required or expiry before study completion

Page 1 of 2

- All unforeseen events that might affect continued ethical acceptability of the project should be reported to the IRB as soon as possible
- Any serious unexpected adverse events should be reported immediately within 24 hours.
- Personal identifying data should only be collected when necessary for research.
- Secondary disclosure of personal identifiable data is not allowed.
- Monitoring: projects may be subject to an audit by the IRB at any time.
- The PI is responsible for the storage and retention of original data pertaining to the project for a minimum period of five (5) years.
- Data should be stored securely so that a few authorized users are permitted access to the database.

The IRB registered with the IRB KACST Registration No. H-01-R-090. It is authorized to conduct the ethical review of clinic studies and operates in accordance with ICH-GCP Guidelines and all applicable national/local and institutional regulations and guidelines which govern Good Clinical Practices.

A final report should be provided upon completion of the study a long with a copy of thesis should be submitted to the research center for archiving purposes.

Wish you a success in your research project.

Yours sincerely,

Prof. Khalid Al-Rubeaan
Chairman-IRB
Sultan Bin Abdulaziz Humanitarian City

Appendix 5: Consent Form for KSMC

King Saud Medical City Research Center Generic Signed Consent Form		مدينة الملك سعود الطبية مركز الابحاث استمارة موافقة للمشاركة في بحث

Computer Number			رقم السجل
Study Number			رقم الدراسة
Patient Name			إسم المريض
Date of Birth			تاريخ الميلاد
Gender (Male/Female)			الجنس (ذكر | أنثى)
Nationality			الجنسية

You are free to ask as many questions as you like before, during or after in this research, you decide to give consent to participate in this research study. The information in this form is only meant to better inform you all possible risks or benefits. Your participation in this study is voluntary. You do not have to take part in this study, and your refusal to participate will involve no penalty or loss of rights to which you are entitled. You may withdraw from this study at any time without penalty or loss of rights or other benefits to which you are entitled. The investigator(s) may stop your participation in this study without your consent for reasons such as: it will be in your best interest; you do not follow the study plan; or you experience a study-related injury.	كمشارك فى هذا البحث العلمى لك مطلق الحرية في طرح أى سؤال أو إستفسار عن هذا البحث وذلك قبل ، أثناء إجراء، أو بعد إكمال إجراء البحث إذا قررت إعطاء الموافقة على المشاركة في هذا البحث. الهدف الرئيسى من المعلومات الواردة في هذا النموذج هو أن نقدم لكم الشرح الوافى والمستفيض عن كل الأخطار والفوائد التى يمكن أن تتمخض عن إجراء هذا البحث. المشاركة فى هذا البحث عمل طوعى خالص وبالتالى لكم مطلق الحرية بعدم المشاركة. قراركم بعدم المشاركة فى هذا البحث العلمى لا يترتب عليه اى تبعات او حرمان من حقوقكم المستحقة. أيضا يمكنكم الانسحاب وعدم مواصلة المشاركة فى هذا البحث فى أى وقت أو مرحلة دون أن يؤثر ذلك فى حقوقكم أو فوائدكم المستحقة والمشروعة. لأعضاء فريق البحث العلمى الخاص بهذه الدراسة الحق في إيقاف أو إلغاء مشاركتكم في هذه الدراسة إذا رأو مصلحة لكم فى هذا الإيقاف أو الإلغاء أو فى حالة عدم التزامكم بخطة البحث الموضوعة أو إذا تبين لهم ضرر أو إصابة نتيجة إجراء الدراسة وذلك دون أخذ موفقتكم

Project Title	The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.
عنوان المشروع	تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية.
Principle investigator	Khadijah Alfaleh
الباحث الرئيسي	خديجة الفالح

Appendix 6: Consent Form for Aljouf Health Affairs

Consent Form for Minimal Risk

IRB Log Number:			رقم البحث العلمي:
Subject or Study Number:			اسم المشارك:
Medical Record Number:			رقم السجل الطبي:
Study Title E:			
تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية.			عنوان البحث العلمي بالعربي:
Principal Investigator:	Khadijah Abdulrahman Alfalch	خديجة عبدالرحمن الفالح	الباحث الرئيس:
Affiliation:	General Directorate of Health Affairs	المديرية العامة للشؤون الصحية بمنطقة الجوف	مكان العمل :
Telephone or Mobile No.:	0543997595	٠٥٤٣٩٩٧٥٩٥	رقم الهاتف أو الجوال:

Why this study is being done?	ما سبب القيام بهذا البحث العلمي؟
This research is required part of the master's thesis.	هذا البحث هو جزء متطلب للحصول على درجة الماجستير.

How many people will take part in this study? Sample size	كم عدد الأشخاص المفترض مشاركتهم في هذا البحث العلمي؟ حجم عينة البحث
32	٣٢

What are the objectives of the Study?	ما هي أهداف هذا البحث العلمي؟
1.To find out the effectiveness of conventional physiotherapy on improving functional mobility of lower extremity among chronic hemiplegic subjects. 2. To find out the effectiveness of motor relearning program along with conventional physical therapy treatment on improving functional mobility of lower extremity among chronic hemiplegic subjects. 3. To find out the effectiveness of motor relearning program along with conventional physical therapy treatment over conventional physical therapy on improving functional mobility of lower extremity among chronic hemiplegic subjects.	

Appendix 7: Consent Form for SBAHC

مدينة سلطان بن عبد العزيز للخدمات الإنسانية
SULTAN BIN ABDULAZIZ HUMANITARIAN CITY
RESEARCH & SCIENTIFIC CENTER

INFORMED CONSENT FOR RESEARCH INVOLVING THE ADMINISTRATION OF (DRUGS, USE OF DEVICES OR PERFORMANCE OF PROCEDURES) *
اذن ناف للجهالة بالموافقة على المشاركة في الأبحاث التي تتطلب استعمال (دواء/جهاز/ أو إجراءات خاصة)*
(اشطب ما لا ينطبق)*

Patient's Nameplate:

Title of Proposal: The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation	**عنوان البحث :** تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية
Part I – Research Participant Information Sheet: You are invited to participate in a scientific research project	**الجزء الأول – معلومات للمشارك في البحث: ندعوك للمشاركة في بحث علمي**
A. Purpose of the Research is to increase general knowledge about	**أ. الغرض من البحث هو زيادة المعرفة عن**
To find out the effective of Motor Relearning Program on functional mobility in Stroke Rehabilitation.	لمعرفة مدى تأثير برنامج إعادة التعلّم الحركي على الحركة الوظيفية لمرضى السكتة الدماغية
B. Description of the Research:	**ب. وصف البحث:**
The motor relearning program (MRP) is one of the rehabilitative strategies used primarily with the post-stroke population(Ghrouz et al., 2022). It focuses on active participation of patient. These patients are capable to relearn the motor tasks that they were performing before stroke. Physical therapists identify the problem in different individual tasks and then help the patient to learn them, through task specificity, task repetition, type of practice, type of feedback, retention testing. (Nizami & Rafique, 2016). This approach includes many aspects of motor learning theory and provides practical guidelines for retraining functional skills (e.g. balanced sitting, sitting and standing, transfer skills and gait). This approach focuses on task-specific learning through effective feedback and practice development of active movement control. The approach is based on four distinct steps: (1) analysis of the essential components of the task; (2) practice of the missing component, that is, when a patient cannot control the necessary muscles to perform a task, this component is practiced separately before	يعد برنامج إعادة التعلم الحركي (MRP) أحد استراتيجيات إعادة التأهيل المستخدمة بشكل أساسي مع السكان بعد السكتة الدماغية (Ghrouz et al., 2022). يركز على المشاركة النشطة للمريض. هؤلاء المرضى قادرون على إعادة تعلم المهام الحركية التي كانوا يؤدونها قبل السكتة الدماغية. يحدد المعالجون الفيزيائيون المشكلة في المهام الفردية المختلفة ثم يساعدون المريض على تعلمها ، من خلال تخصيص المهمة ، وتكرار المهمة ، ونوع الممارسة ، ونوع التغذية الراجعة ، واختبار الاستبقاء (Nizami & Rafique, 2016). يتضمن هذا النهج العديد من جوانب نظرية التعلم الحركي ويوفر إرشادات عملية لإعادة تدريب المهارات الوظيفية (مثل الجلوس المتوازن والجلوس والوقوف ومهارات النقل والمشي). يركز هذا النهج على التعلم الخاص بالمهمة من خلال التغذية الراجعة الفعالة وتطوير الممارسة للتحكم النشط في الحركة. يعتمد النهج على أربع خطوات متميزة: (١) تحليل المكونات الأساسية للمهمة. (٢) ممارسة المكون المفقود ، أي عندما لا يتمكن المريض من التحكم في العضلات اللازمة لأداء مهمة ما ، يتم ممارسة هذا المكون بشكل منفصل قبل دمجه في المهام المعقدة ؛ (٣) ممارسة المهمة ؛ (٤) تحويل التدريب إلى ممارسة . (Ghrouz et al., 2022) هذا البحث هو جزء متطلب للحصول على رسالة الماجستير، وسيتم تطبيقه من قبل الباحث الرئيس والباحث المساعد وفريق البحث. وستكون خطواته كالتالي:

Appendix 8: MMSE-2 Arabic Version

Creating Connections. Changing Lives. PAR®

Sent Via Email: khadooj1411@hotmail.com

April 7, 2022

Khadijah A. Alfaleh
Almajmaah University
Saudi Arabia, Sakaka, Aljouf, Alfarouq street
Sakaka, Aljouf 8079
Saudi Arabia

Dear Khadijah Alfaleh:

In response to your recent request, permission is hereby granted to you to reproduce up to a total of 38 copies of the Arabic version of the Mini-Mental State Examination-2 (MMSE-2) Standard Version Blue Form for use only in your research titled, *The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation*. If additional copies are needed, it will be necessary to write to PAR for further permission.

Permission is also granted for you to include the approved Sample Items from the MMSE-2 in the Appendix of your thesis, any further publication in a Journal (or otherwise) will require additional permission. The approved sample items are provided to you in Appendix A of this Permission Agreement. No other sample items will be allowed to be published from the MMSE-2. **PAR will not grant permission to publish the entire MMSE-2 in any publication**.

This Agreement is subject to the following restrictions:

(1) Any and all materials used will contain the following credit line:

"Reproduced by special permission of the Publisher, Psychological Assessment Resources, Inc. (PAR), 16204 North Florida Avenue, Lutz, Florida 33549, from the Mini-Mental State Examination, by Marshal F. Folstein, MD and Susan E. Folstein, MD, Copyright 1975, 1998, 2001 and the Mini-Mental State Examination-2, Copyright 2010 by Mini Mental LLC, Inc. Published 2001, 2010 by PAR. Further reproduction is prohibited without permission of PAR. [Copyright@parinc.com]"

(2) None of the material may be sold, given away, or used for purposes other than those described above.

16204 N. Florida Ave. | Lutz, FL 33549 | 813.968.3003 | parinc.com

(3) The Forms will be supplied to all persons/sites in hard copy. The form will not be distributed by electronic means (e-mail or website download) to any person/site. Distribution of forms will be in-person or via postal mail /courier only.

(4) The Forms will not be stored on any local computer/server/ network, website/ share drive or portable device for access by any individual.

(5) An accurate count of the total number of administrations using the translation will be kept.

(6) Payment of a royalty fee of $60.00 USD. This fee includes a 40% student discount.

Licensing fees paid to PAR will be payable in US Dollars drawn on a US bank. Any taxes levied on fees by Licensee's government, or fees deducted by Licensee's bank (originating or intermediary) and/or financial institution, shall be paid by Licensee and shall not reduce the amount due to PAR.

(7) One copy of any of the material reproduced will be sent to PAR to indicate that the proper credit line has been used.

TWO COPIES of this Permission Agreement should be signed and returned to me, along with your payment for **$60.00 USD** for the royalty fee, to indicate your agreement with the above restrictions. I will then sign it for PAR and return a fully executed copy to you for your records.

Sincerely,

Andrea Butler Fernandez
Jr. Permissions Specialist
afernandez@parinc.com
1-800-331-8378 (phone)
1-800-727-9329 (fax)

Creating Connections. Changing Lives. PAR

ACKNOWLEDGED, ACCEPTED AND AGREED:

Licensee:

By: _____
Khadijah A. Alfaleh

Date: 03/04/2022

PAR:

By: _____
Andrea Butler Fernandez

Date: April 11, 2022

Payment Received: VISA
PAR Customer No.: CU-10011503

SIGNATURE OF PROFESSOR REQUIRED:

I hereby agree to supervise this student's use of these materials. I also certify that I am qualified to use and interpret the results of these tests as recommended in the *Standards for Educational and Psychological Testing*, and I assume full responsibility for the proper use of all materials used per this Agreement.

BY: _____
Dr. Sheikh Abdulrahim

16204 N. Florida Ave. | Lutz, FL 33549 | 813.968.3003 | parinc.com

مجموع النقاط الخام لاختبار الحالة العقلية المصغر-BV:2

(16 نقطة حد أقصى)

الإنتباه والحساب (تسلسل 7s)

الآن أود منك أن تطرح 7 من 100، ثم إستمر بطرح 7 من كل إجابة حتى أطلب منك أن تتوقف.

ما حاصل طرح 7 من 100 (93)	0	1
إذا لزم الأمر قل **إستمر** (86)	0	1
إذا لزم الأمر قل **إستمر** (79)	0	1
إذا لزم الأمر قل **إستمر** (72)	0	1
إذا لزم الأمر قل **إستمر** (65)	0	1

إحسب نقطة لكل جواب صحيح. الجواب يعتبر صحيحا إذا كان اقل بـ7 من الجواب السابق، حتى إذا كان الجواب السابق غير صحيح.

التسمية

ما هذا؟ (أشر إلى العين)	0	1
ما هذا؟ (أشر إلى الاذن)	0	1

التكـــرار

الآن سوف اسالك أن تكرر ما سوف أقول. جاهز؟ إنه يوم جميل ومشمس ولكن دافئ جداً. الآن كرر ذلك.

(إنتظر إجابة المفحوص وسجل الإجابة حرفيا. كرر مرة واحدة).

إنه يوم جميل ومشمس ولكن دافئ جداً	0	1

أفصل الصفحة الأخيرة من هذه الإستمارة. فرق الصفحة المفصولة عند النصف على طول الخط الافقي المثقوب. إستعمل النصف الأعلى من الصفحة المفصولة، والتي عليها ثلاثة أشكال، كإستمارة تحفيز لمهمة الفهم. إستعمل النصف الأسفل من الصفحة كإستمارة تحفيز لمهمة القراءة (إغمض عينيك). إستعمل ظهر النصف الأعلى من الصفحة المفصولة كاستمارة تحفيز وإجابة لمهمة الرسم (شكلين خماسيين متقاطعين) والنصف الأسفل من الصفحة (بيضاء) كإستمارة إجابة لمهمة الكتابة.

الفهـــــم

إستمع بعناية لأنني سوف أسالك أن تفعل شيئا. (اظهر للمفحوص صفحة تحفيز الأشكال الهندسية). **انظر إلى هذه الصور وأشر إلى الدائرة، ثم أشر إلى المربع، ثم أشر إلى المثلث.**

الإجابة الصحيحة	الإجابة الملاحظة		
○		0	1
□		0	1
△		0	1

القـــراءة

(إظهر للمفحوص صفحة تحفيز الكلمة). **من فضلك إفعل ما تقوله هذه أن تفعل.**

إغلق عينيك	0	1

الكتابـــة

(ضع الجزء الفارغ من الورقة امام المفحوص وزوده بقلم حبر أو قلم رصاص).

من فضلك إكتب جملة. (إذا لم يستجب المفحوص، قل: **اكتب عن أين تعيش**). إحسب نقطة واحدة إذا كانت الجملة مفهومة وتحتوي على فعل وفاعل. تجاهل أخطاء قواعد النحو أو التهجئة.

0 1

الرســـم

(إعرض الشكلين الخماسيين المتقاطعين على إستمارة التحفيز وزوده بقلم حبر أو قلم رصاص). **من فضلك إنسخ هذا التصميم.** إحسب نقطة واحدة إذا تألف الرسم من شكلين ذوي خمسة جوانب تتقاطع لتشكل شكلا ذو أربعة جوانب.

0 1

مجموع النقاط الخام لاختبار الحالة العقلية المصغر – 2: الإصدار القياسي

(30 نقطة حد أقصى)

Appendix 9: Motor Assessment Scale

MOTOR ASSESSMENT SCALE

Agency:_____ PID #: _____ Date: _____ CPT #:_____

Patient Name: _____ Therapist: _____

If the patient cannot complete any part of a section score a zero (0) for that section. There are 9 sections in all.

Supine to Side-lying onto intact side (starting position: supine with knees straight)

1. Uses intact arm to pull body toward intact side. Uses intact leg to hook impaired leg to pull it over.
2. Actively moves impaired leg across body to roll but leaves impaired arm behind.
3. Impaired arm is lifted across body with other arm. Impaired leg moves actively & body follows as a block.
4. Actively moves impaired arm across body. The rest of the body moves as a block.
5. Actively moves impaired arm and leg rolling to intact side but overbalances.
6. Rolls to intact side in 3 seconds without use of hands.

Supine to Sitting over side of bed

1. Pt assisted to the side-lying position: Patient lifts head sideways but can't sit up.
2. Pt may be assisted to side-lying & is assisted to sitting but has head control throughout.
3. Pt may be assisted to side-lying & is assisted with lowering LEs off bed to assume sitting.
4. Pt may be assisted to side-lying but is able to sit up without help.
5. Pt able to move from supine to sitting without help.
6. Pt able to move from supine to sitting without help in 10 seconds.

Balance Sitting

1. Pt is assisted to sitting and needs support to remain sitting.
2. Pt sits unsupported for 10 seconds with arms folded, knees and feet together & feet on the floor.
3. Pt sits unsupported with weight shifted forward and evenly distributed over both hips / legs. Head and thoracic spine extended.
4. Sits unsupported with feet together on the floor. Hands resting on thighs. Without moving the legs the patient turns the head and trunk to look behind the right and left shoulders.
5. Sits unsupported with feet together on the floor. Without allowing the legs or feet to move & without holding on the patient must reach forward to touch the floor (10 cm or 4 inches in front of them) The affected arm may be supported if necessary.
6. Sits on stool unsupported with feet on the floor. Pt reaches sideways without moving the legs or holding on and returns to sitting position. Support affected arm if needed.

Sitting to Standing

1. Pt assisted to standing – any method.
2. Pt assisted to standing. The patient's weight is unevenly distributed & may use hands for support.
3. Pt stands up. The patient's weight is evenly distributed but hips and knees are flexed – No use of hands for support.
4. Pt stands up. Remains standing for 5 seconds with hips and knees extended with weight evenly distributed.
5. Pt stands up and sits down again. When standing hips & knees are extended with weight evenly distributed
6. Pt stands up and sits down again 3 x in 10 seconds with hips & knees extended & weight evenly distributed

Walking

1. With assistance the patient stands on affected leg with the affected weight bearing hip extended and steps forward with the intact leg.
2. Walks with the assistance of one person.
3. Walks 10 feet or 3 meters without assistance but with an assistive device.
4. Walks 16 feet or 5 meters without a device or assistance in 15 seconds.
5. Walks 33 feet or 10 meters without assistance or a device. Is able to pick up a small object from the floor with either hand and walk back in 25 seconds.
6. Walks up and down 4 steps with or without a device but without holding on to a rail 3 x in 35 seconds.

MOTOR ASSESSMENT SCALE – page 2

Agency:_____ PID #: _____ Date: _____

Patient Name: _____ Therapist: _____

Upper Arm Function

1. Supine: Therapist places affected arm in 90 degrees shoulder flexion and holds elbow in extension – hand toward ceiling. The patient protracts the affected shoulder actively.
2. Supine: Therapist places affected arm in above position. The patient must maintain the position for 2 seconds with some external rotation and with the elbow in at least 20 degrees of full extension.
3. Supine: Patient assumes above position and brings hand to forehead and extends the arm again. (flexion & extension of elbow) Therapist may assist with supination of forearm.
4. Sitting: Therapist places affected arm in 90 degrees of forward flexion. Patient must hold the affected arm in position for 2 seconds with some shoulder external rotation and forearm supination. No excessive shoulder elevation or pronation.
5. Sitting: Patient lifts affected arm to 90 degrees forward flexion - holds it there for 10 seconds and then lowers it with some shoulder external rotation and forearm supination. No pronation.
6. Standing: Have patient's affected arm abducted to 90 degrees with palm flat against wall. Patient must maintain arm position while turning body toward the wall.

Hand Movements

1. Sitting at a table (Wrist Extension): Affected forearm resting on table. Place cylindrical object in palm of patient's hand. Patient asked to lift object off table by extending the wrist – no elbow flexion allowed.
2. Sitting at a table (Radial Deviation of Wrist): Therapist should place forearm with ulnar side on table in mid-pronation / supination position. Thumb in line with forearm and wrist in extension. Fingers around cylindrical object. Patient is asked to lift hand off table. No wrist flexion or extension.
3. Sitting (Pronation / Supination): Affected arm on table with elbow unsupported at side. Patient asked to supinate and pronate forearm (¾ range acceptable).
4. Place a 5 inch ball on the table so that the patient has to reach forward with arms extended to reach it. Have the patient reach forward with shoulders protracted, elbows extended, wrist in neutral or extended, pick up the ball with both hands and put it back down in the same spot.
5. Have the patient pick up a polystyrene cup with their affected hand and put it on the table on the other side of their body without any alteration to the cup.
6. Continuous opposition of thumb to each finger 14 x in 10 seconds. Each finger in turn taps the thumb, starting with the index finger. Do not allow thumb to slide from one finger to the other or go backwards.

Advanced Hand Activities

1. Have the patient reach forward to pick up the top of a pen with their affected hand, bring the affected arm back to their side and put the pen cap down in front of them.
2. Place 8 jellybeans, (beans), in a teacup an arms length away on the affected side. Place another teacup an arms length away on the intact side. Have the patient pick up one jellybean with their affected hand and place the jellybean in the cup on the intact side.
3. Draw a vertical line on a piece of paper. Have the patient draw horizontal lines to touch the vertical line. The goal is 10 lines in 20 seconds with at least 5 lines stopping at the vertical.
4. Have the patient pick up a pen/pencil with their affected hand, hold the pen as for writing, and position it without assistance and make rapid consecutive dots (not strokes) on a sheet of paper. Goal: at least 2 dots a second for 5 seconds.
5. Have the patient take a dessert spoon of liquid to their mouth with their affected hand without lowering the head toward the spoon or spilling.
6. Have the patient hold a comb and comb the back of their head with the affected arm in abduction and external rotation, forearm in supination.

General Tonus (check one – add "6" to score if tone on affected side is normal)

____Flaccid, limp, no resistance when body parts are handled.
____Some resistance felt as body parts are moved.
____Variable, sometimes flaccid, sometimes good tone, sometimes hypertonic.
____Hypertonic 50% of the time
____Hypertonic all of the time
6 = Consistently normal response

This test is designed to assess the return of function following a stroke or other neurological impairment. The test looks at a patient's ability to move with low tone or in a synergistic pattern and finally move actively out of that pattern into normal movement.

The higher the score – the higher functioning the patient is on the affected side.
High Score: 54
Low Score: 0

Appendix 10: Barthal Index

THE BARTHEL INDEX

Patient Name: _____
Rater Name: _____
Date: _____

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

Provided by the Internet Stroke Center — www.strokecenter.org

The Barthel ADL Index: Guidelines

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

References

Mahoney FI, Barthel D. "Functional evaluation: the Barthel Index."
Maryland State Medical Journal 1965;14:56-61. Used with permission.

Loewen SC, Anderson BA. "Predictors of stroke outcome using objective measurement scales."
***Stroke*. 1990;21:78-81.**

Gresham GE, Phillips TF, Labi ML. "ADL status in stroke: relative merits of three standard indexes."
***Arch Phys Med Rehabil*. 1980;61:355-358.**

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

Copyright Information

Appendix 11: Data Collection Sheet

The Effect of Motor Relearning Program on functional mobility in Stroke Rehabilitation.
PI: Khadijah Abdulrahman Alfaleh
Group: ☐ Experimental ☐ Control

A/ Demographic characteristics:

Gender distribution	☐ Male ☐ Female
Age	
Duration of stroke	
Height (cm)	
Weight (Kg)	
Body mass index	
Type of stroke	☐ Ischemic ☐ Hemorrhagic
Stroke onset (in months)	
Affected side	☐ Right ☐ Left
Hypertensive	☐ Yes ☐ No
Diabetes	☐ Yes ☐ No
Smoking	☐ Yes ☐ No

B/ Assessment tools:

Assessment Tools	Score
Mini-Mental State Exam (MMSE)	
Motor Assessment Scale (MAS)	

C/ Outcome measures :

Outcome measures	Pre test	Post test
Barthel Index (BI)		
Motor Assessment Scale (Sit to Stand Section)		

Appendix 12: The pre, post-mean and standard deviations of the Barthel Index and sit-to-stand components of the MAS in previous literature.

S. No	Author name and Year	Group	Pre BI (Mean ± SD)	Post BI (Mean ± SD)	Pre MAS-Sit to stand (Mean ± SD)	Post MAS-Sit to stand (Mean ± SD)
1	Raval, 2020	Experimental	33.23 ± NM	91.17 ± NM	Sit to stand was not mentioned	
2	Singha, 2017	Experimental	BI was not used in this study		3.26 ± 0.67	5.46 ± 0.51
		Control (PNF)			3.00 ± 0.70	4.06 ± 0.70
3	Bhalerao et al., 2011	Experimental	17 ± 6.75	86.5 ± 12.03	Sit to stand was not mentioned	
		Control (Bobath)	16.9 ± 3.72	64.4 ± 1.00		
4	Langhammer & Stanghelle, 2011	Experimental	BI was not used in this study		2.7 ± 1.9	3.8 ± 1.9
		Control (Bobath)			2.0 ± 1.9	3.0 ± 2.2
5	Sherin U, 2022	Experimental (MRP with Motor Imagery)	BI was not used in this study		0.47 ± 0.51	3.47 ± 0.51
6	Kanase, 2020	Experimental	16.214±7.54	80±12.5.	0.78±0.42	4.5±0.51.
		Control	9.6±3.66	47.66±5.5	0.8±0.41	2.8±0.41
7	Current study	Experimental	58.75±15.22	71.56.17.86	2.43±1.03	4.5±1.21
		Control	63.12±15.04	65±17.22	3.43±1.20	3.62±1.36

المستخلص

المقدمة: تُعرَّفُ السكتة الدماغية بأنها بداية تلف عصبي بؤري مفاجئ، يحدث لأسباب تتعلق بالأوعية الدموية، وتستمر لأكثر من ٢٤ ساعة. وتعد السكتة الدماغية السببَ الرئيسَ الثانيَ للإعاقة الجسدية لدى البالغين، وثانيَ سببٍ رئيسٍ للوفاة في العالم في البلدان المتقدمة اقتصاديًّا. وعند الإصابة بالسكتة الدماغية يصبح النشاط الجسدي محدودًا جدًا، بالإضافة الى ذلك؛ وبسبب التأثر الإدراكي والجسدي، فإن الأشخاص الذي أصيبوا بسكتة دماغية يواجهون صعوبة في أداء مهامهم اليومية؛ كالأكل، والاستحمام، والمشي. وعليهِ، فإنَّ برنامج إعادة التعلم الحركي (MRP) يُعَدُّ طريقة تم تطويرها من خلال نظريات التعلم الحركي، إذ افترض هذا البرنامج أن الدماغ لديه القدرة على التعافي بعد الإصابة، من خلال تطبيق بعض المهام الوظيفية وتكرارها. **الهدف:** هدفت الدراسة الى استكشاف فاعلية برنامج إعادة التعلم الحركي (MRP) في تحسين الحركة الوظيفية للأطراف السفلية بين المصابين بمرض الشلل النصفي الطولي المزمن. **المنهج:** تمت هذه الدراسة المنضبطة على (٣٢) مصابًا بالشلل النصفي، وتم تقسيمهم عشوائيًّا إلى مجموعتين: المجموعة الضابطة (ن = ١٦)، والمجموعة التجريبية (ن = ١٦). تم إخضاع المجموعة الضابطة للعلاج الطبيعي التقليدي، أما المجموعة التجريبية فقد خضعت للعلاج الطبيعي التقليدي مع استخدام برنامج إعادة التعلم الحركي (MRP). وكانت مدة التدخل العلاجي (٤٥) دقيقة لكل جلسة، بواقع ثلاث جلسات في الأسبوع، واستمرت الجلسات ستةَ أسابيع لكِلا المجموعتين. وقبل البدء بعملية العلاج، تم تقييم جميع المصابين باستخدام اختبار الحالة العقلية المصغر (MMSE-2)، ومقياس تقييم الحركة (MAS). وكانت مقاييس النتائج المستخدمة في بداية ونهاية العلاج هي مؤشر بارثل (BI)، ومكون الجلوس والوقوف لمقياس تقييم الحركة (MAS). **النتائج:** بينت النتائج أن من بين (٣٢) مصابًا، بواقع (٢٣) من الذكور، و(٩) من الإناث، أنَّ (٢٥) كانوا يعانون من السكتة الدماغية الإقفارية، في حينِ إنَّ سبعة مصابين بسكتة دماغية نزفية، كما بينت النتائج أن (١٩) من بين هؤلاء المصابين أصيبوا في الجهة اليسرى، في حينِ إن (١٣) منهم أصيبوا في الجهة اليمنى، وكذا كشفت النتائج أنه لم يظهر تحسّن على كِلا مقياسي النتائج في العلاج الطبيعي التقليدي للمجموعة الضابطة، ومع ذلك، ومن الناحية الإحصائية، لوحظ وجودُ فروقٍ ذاتِ دِلالةٍ إحصائيَّةٍ في المجموعة التجريبية على كِلا مقياسي النتائج مع قيمة p، التي كانت أقل من ٠,٠٠١. **الاستنتاج:** توصلت هذه الدراسة إلى أن الأسابيع الستة التي اشتملت على (١٨) جلسةً من (٤٥) دقيقة من العلاج باستخدام برنامج إعادة التعلم الحركي (MRP)، بالإضافة الى العلاج الطبيعي التقليدي، كانت فعالة في تحسين وظيفة الجلوس والوقوف التي تم تقييمها بواسطة مقياس تقييم الحركة (MAS)، والوظيفة العامة التي تم تقييمها بوساطة مؤشر بارثل (BI). **الكلمات الرئيسية:** برنامج إعادة التعلم الحركي، السكتة الدماغية، الوظيفة، العلاج الطبيعي.

المملكة العربية السعودية
وزارة التعليم
جامعة المجمعة
عمادة الدراسات العليا
كلية العلوم الطبية التطبيقية
قسم العلاج الطبيعي والتأهيل الصحي

جامعة المجمعة
Majmaah University
كلية العلوم الطبية التطبيقية

تأثير برنامج إعادة التعلم الحركي على الحركة الوظيفية في تأهيل مرضى السكتة الدماغية.

رسالة مقدمة إلى كلية العلوم الطبية التطبيقية – جامعة المجمعة كجزء من متطلبات الحصول على درجة الماجستير في علوم العلاج الطبيعي

إعداد:
خديجة عبد الرحمن مبارك الفالح
٤٢١٢٠٣٨٢٣

المشرف:
د. شيخ عبد الرحيم قادر
أستاذ مشارك – قسم العلاج الطبيعي – كلية العلوم الطبية التطبيقية

١٤٤٤هـ – ٢٠٢٣ م