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‘EVIDENCE BASED PHYSIOTHERAPY INTERVENTION FOR UPPER LIMB FUNCTIONAL RECOVERY AMONG STROKE SURVIVORS - A NARRATIVE REVIEW’

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We the undersigned certify that we have carefully read and recommended to the Faculty of Medicine, University of Dhaka, for the acceptance of this dissertation entitled

'EVIDENCE BASED PHYSIOTHERAPY INTERVENTION FOR UPPER LIMB FUNCTIONAL RECOVERY AMONG STROKE SURVIVORS - A NARRATIVE REVIEW'

Submitted by **Khadiza Islam**, for partial fulfilment of the requirement for the degree of Bachelor of Science in Physiotherapy (B.Sc. PT)

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DECLARATION

I declare that the work presented here is my own. All sources used have been cited appropriately. Any mistakes or inaccuracies are my own. I also declare that for any publication, presentation or dissemination of information of the study. I would be bound to take written consent from my supervisor.

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CONTENTS

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Acronyms

ADL	Activity of Daily Livings
AHA	American Health Association
BHPI	Bangladesh Health Profession Institute
BMRC	Bangladesh Medical Research Council
CIMT	Constraint-Induced Movement Therapy
CRP	Centre for the Rehabilitation of the Paralysed
ICH	Intracerebral Hemorrhage
IRB	Institutional Review Board
NHS	National Health Service (NHS)
NINDS	National Institute of Neurological Disorders and Stroke
RCT	Randomized Controlled Trials
UE	Upper extremity
WHO	World Health Organization

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Abstract

Purpose: To establish a review narratively on physiotherapy intervention for upper limb functional recovery among stroke survivors. **Objective:** To demonstrate the evidence -based physiotherapy intervention used in improving upper function of stroke patients, to explore the outcome measures used to assess upper limb function of stroke individual. **Methodology:** The study design was narrative review. I had reviewed 15 articles, which articles were randomized control trial (RCT). This studies purpose was to establish a review narratively on physiotherapy intervention for upper limb functional recovery among stroke survivors. **Result:** Upper limb functions (upper arm function, hand movements and advanced hand activities measured by function measurement tools. Then the performance score measured of stroke patients. The expected outcome is, may be maximal improvement of functional recovery of hemiplegic upper limb. My target is to explore of upper limb functional outcome by proper physiotherapy treatment and improve patient activities of daily living. **Conclusion:** In this study find out upper limb functional outcome of stroke patients and highlighted that without proper physiotherapy treatment the proper recovery of stroke patients cannot achieve.

Keywords: *Upper limb functional recovery, Stroke survivors, Physiotherapy intervention.*

CHAPTER-I: INTRODUCTION

1.1: Background

Stroke is a leading cause of mortality and long-term disability worldwide, which results in a global economic burden for health care (Johnson, Nguyen and Roth 2019, p.43). Among the surviving patients with stroke, only 5-20% fully recover their function (Jia 2016, p. 76), 70-80% of patients would have hand dysfunction in early stage of the disease, and 40% of them would have sequelae of hand dysfunction, which seriously affects their quality of life (Wu, Wu and Tian 2014, p. 94).

Impairment in the upper limb is a prevalent issue among individuals with neurological disabilities, impacting their activity, performance, quality of life, and independence which precise and prompt assessments are essential for effective rehabilitation and the creation of innovative interventions (Bertoni et al. 2015, p. 35). An international consensus on upper limb assessment is essential to enhance the significance of research findings, establish a quality benchmark for clinical practice, promote cost-effective neuro-rehabilitation, and ultimately enhance outcomes for neurological patients undergoing rehabilitation was argued Mozaffarian et al. (2016, p. 23).

Stroke patients frequently experience reduced strength and functional impairments, with upper limb paresis occurring in 77% of cases (Lawrence et al. 2001, p. 89).Muscle weakness can hinder daily activities, making tasks like writing or holding a glass of water challenging or even unachievable Bohannon et al. (1991, p. 67). Argyrides et al. (2015, p.84) argues that individuals who have experienced a stroke commonly face prolonged impairments. As a result, following hospital discharge, 41% require assistance with activities of daily living (ADL), and 20% rely on support from family members or friends who provide home nursing. Recent research indicates that interventions such as constraint-induced movement therapy (CIMT), mirror therapy, virtual reality training, and repetitive task training are proven to be effective in enhancing upper-limb function post-stroke (Pollock et al. 2014, p. 45).

It is essential to gain further insights into the efficacy of diverse interventions and training approaches in arm rehabilitation to enhance the independence of individuals affected by stroke. The choice of training methods can be guided by the specific needs of patients or their observed effects and training objectives Pollock et al. (2014, p. 78). Preliminary studies suggest that a higher intervention dose, defined by the number of repetitions or the duration of the intervention, appears to confer an advantage for functional recovery following a stroke Pollock et al. (2014, p. 45). Sterr and Freivogel (2004, p. 23) argues that a substantial duration of intervention or a higher number of repetitions proves effective in enhancing arm function. There are several possibilities to vary intensity of training, e.g. through using different numbers of repetitions, various complexity of tasks, different feedback modalities, or additional weights (Kwakkel et al. 2004, p. 67).

In 2010, the global prevalence of stroke was 33 million, and among them, 16.9 million individuals experienced their first stroke. Among these, 795,000 were Americans, and 1.1 million were Europeans was argued (Mozaffarian et al. 2016, p. 98). This holds significant implications for both individuals and society at large, as diminished upper limb function is linked to dependence and a lower quality of life for both patients and caregivers. (Morris et al. 2012, p. 90) and impacts on national economies (Sprigg et al. 2013, p. 87). Nichols et al. (2012, p. 76) argues that due to the enduring medical and social consequences of stroke, the economic burden is estimated at £8 billion annually in England alone. This comprises £3 billion in direct costs to the National Health Service (NHS) and the remaining amount in indirect costs.

Nichols et al. (2012, p. 76) argues that these indirect costs include £2.4 billion in informal home care and nursing expenses shouldered by families and £1.8 billion in income lost due to mortality, morbidity, and benefit payments. According to the Royal College of Physicians 2010, p. 34) In the past, stroke was often perceived as an inevitable risk of aging, despite the fact that 25% of strokes occur in individuals below the age of 65. Consequently, stroke received low priority within the NHS. However, the introduction of the Stroke Improvement Strategy in 2007 led to a reevaluation of the importance of stroke, initiating an ongoing improvement process endorsed by the Department of Health. The aim is to enhance the effectiveness and efficiency of delivering a person-centered stroke care service (Kwakkel et al. 2004, p. 67).

As a result, significant progress has been achieved in the medical management of stroke and the provision of acute stroke care services. This has led to a substantial reduction in hospital stays, decreasing from a mean of 23.7 days in 2008 to a mean of 19.5 days in 2010 Nichols et al. (2012, p. 34). Nichols et al. (2012, p. 65) discussed that nevertheless, achieving functional recovery remains a significant challenge. Additionally, levels of disability at the time of discharge have remained consistent since 2008, with 58% of patients exhibiting functional impairment upon leaving the hospital. The majority of these individuals specifically encounter upper limb motor impairment. Indeed, complete functional recovery of the upper limb was found to occur in only 5% to 34% of cases examined 6 months post-stroke (Kong, Chua, and Lee 2011, p. 69).

Cott et al. (2004, p. 87) argues that moreover, it has been observed that rehabilitation services primarily concentrate on enhancing mobility and basic activities of daily living to facilitate hospital discharge, rather than preparing individuals to resume activities they previously valued.

According to The National Stroke Strategy (2007, p. 98) recognized that the challenge of providing sufficient rehabilitation to improve the long-term outcome for patients with stroke-induced disability and highlights the limitations of rehabilitative support (only 50% of stroke patients receive rehabilitation to meet their needs in the first six months following discharge (The Stroke Association, 2010). However, recent studies have demonstrated that therapy induced improvements in motor abilities may occur in the chronically impaired paretic upper limb more than 6 to 12 months poststroke (Page et al. 2000, p. 23).

1.2 Rationale:

Stroke affects millions of individuals globally, causing various degrees of upper limb impairments. These impairments often result in a loss of independence and hinder participation in daily activities. Regarding physiotherapy and rehabilitation strategy for stroke defined randomized control trail shown that effectiveness of applied and supervised physiotherapy. There is no attempt of reviewing the existing literature through the review in upper limb stroke rehabilitation had been conducted. Narrative review offers the possibility to analyze the strength of evidence and extend of potential biases in the association between physical interventions in stroke rehabilitation and outcomes. Consequently, understanding the best physiotherapy management strategies is essential to mitigate these consequences. While extensive research exists on stroke rehabilitation, there is a noticeable gap in comprehensive narrative reviews focusing specifically on the physiotherapy interventions for upper limb function. This research topic aims to bridge this gap by summarizing and synthesizing the existing knowledge. Rehabilitation professionals, including physiotherapists, rely on evidence-based guidelines to design and implement effective interventions of upper limb for stroke patients. A narrative review can provide a comprehensive overview of the most current and effective physiotherapy strategies, which can directly impact clinical practice and improve patient outcomes. Upper limb impairments profoundly affect a patient's ability to engage in daily activities, impacting their overall quality of life. A comprehensive review can help tailor interventions to the individual needs of stroke survivors, thus promoting patient-centered care. Physiotherapy is just one component of stroke rehabilitation. This research topic can encourage multidisciplinary collaboration between physiotherapists, occupational therapists, and speech-language pathologists to develop holistic and integrated care plans. Stroke has significant economic implications due to the cost of care and lost productivity. Effective physiotherapy interventions can potentially reduce the long-term burden on healthcare systems and society, making this research topic economically relevant. A narrative review can also identify gaps in current knowledge and areas where further research is needed.

1.3 Research Question

What are the available evidences on physiotherapy intervention for upper limb functional recovery among stroke survivors?

1.4 Objectives

1.4.1 General objective

i. To establish a review narratively on evidence based physiotherapy intervention for upper limb functional recovery among stroke survivors.

1.4.2 Specific objectives

i. To demonstrate the physiotherapy intervention used in improving upper function of stroke patients.

ii. To explore the outcome measures used to assess upper limb function of stroke individual.

1.5 List of variables

Independent variables

Dependent variable

- Socio economic conditions
  - Age
  - Sex
  - Education
  - Economy
- Type of stroke
  - Ischemic
  - Hemorrhagic

Functional recovery of affected upper limb

1.6 Operational definition

Stroke: According to World Health Organization Stroke defined as, rapidly developed clinical sign of focal disturbances of cerebral functions of presumed vascular origin and of more than 24 hours duration. Stroke occurs when the blood supply to part of the brain is suddenly interrupted or when a blood vessel in the brain bursts, spilling blood into the spaces surrounding brain cells.

Types of stroke: There are main two ways of "brain attack" can happen ischemic and hemorrhagic strokes.

Ischemic stroke: This takes place when a clot blocks vessels or become to narrow for blood to flow within the brain due to a reduction in blood supply, brain cell die from lack of oxygen.

Hemorrhagic stroke: This type of stroke happens when a blood vessel in the brain busts blood bleeds into the brain.

Functional recovery: Functional recovery means the improvement of function during perform a goal directed task and it helps to involve activities of daily living. In this study, upper arm function, hand movements and advanced hand activities are included as functional recovery measure.

Physiotherapy management: Physiotherapy as described by World Physiotherapy is a health care profession concerned with human function and movement and maximizing physical potential. It is concerned with identifying and maximizing quality of life and movement potential within the spheres of promotion, prevention, treatment/intervention, habilitation and rehabilitation (Jull and Moore, 2013). It uses physical approaches to promote, maintain and restore physical, psychological and social well-being, taking into account variations in health status. It is science-based, committed to extending, applying, evaluating and reviewing the evidence that underpins and informs its practice and delivery.

CHAPTER-II: LITERATURE REVIEW

Stroke stands as the most prevalent neurological condition leading to death and disability in the elderly population. Hemiparesis of the upper extremity (UE) is a commonly observed impairment post-stroke, significantly impacting both quality of life and daily activities (Lloyd-Jones et al. 2009, p.234). Adams (1998, p. 78) has argued that despite the availability of diverse rehabilitation programs for stroke patients, the persistence of impairment and disability persists for extended periods in the majority of cases. Kunkel et al. (1999, p. 98) discussed that the majority of stroke patients consider paretic UE function leading to apparent disability to be an important problem (Broeks et al. 1999, p. 34).

It stands as a primary contributor to disability, leaving approximately two-thirds of its survivors with substantial long-term impairments was argued (Langhorne, Coupar and Pollock 2009, p.343). The economic, individual, and societal costs are substantial, with estimated monetary expenses reaching as high as 69 billion dollars annually in the United States alone was argued (Lloyd-Jones et al. 2009, p. 65). Nakayama et al. (1994, p. 786) discussed that several approaches have been developed over the years to enhance limb function rehabilitation after a stroke. Regrettably, the benefits of all these approaches, especially in the upper extremity, are more restricted than desired.

Donnan et al. (2008, p. 45) argues that stroke places an immense socioeconomic burden, as the majority of patients who survive the acute phase of the disease continue to experience physical or mental disabilities. Approximately 5 out of 100 adults in developed countries endure a stroke, and stroke mortality rates, though variable, generally range from approximately 50 to 100 per 100,000 in the Western world was argued (Lloyd-Jones et al. 2009, p. 65).

According to the World Health Organization (WHO) estimates that in Europe stroke events will increase by 30% between 2000 and 2025. Truelsen et al. (2004, p. 34) discussed that the enduring impairment of limb function and resulting disability in daily activities significantly contribute to the social impact of stroke. Recovery for stroke survivors is typically partial, with 15%–30% of patients experiencing permanent disability and 20% requiring institutional care three months after the onset was argued (Roger et al. (2011, p. 37).

The frequency of stroke continues to be the primary cause of both mortality and long-term disability globally, and this occurrence has been steadily rising over the years (Feigin et al. 2017, p. 83). Howard and Goff (2012, p. 67) argues that in the United States, it is projected that by the year 2050, the number of stroke incidents will increase to a total of 1,334,000 cases each year. One of the most affected areas following stroke is the impairment of motor skill had argued (Meier, Rothen and Walter 2014, p. 31).

Suzuki et al. (2012, p. 87) argues that typical symptoms observed in stroke survivors with impaired motor function include abnormal muscle activation, coordination issues, spasticity, and a decline in dexterity and precision. Lambercy et al. (2011, p. 90) argues that in existing literature, the majority of studies on contemporary rehabilitation devices that integrate NMES and robotic systems have focused on the elbow and wrist joints and while very few focused on the hand and fingers was argued (Kwakkel et al. 2012, p. 98). Mehrholz, Platz, and Pohl (2009, p. 78) have argued that in addition, a comparison of the training effects for hand rehabilitation between the NMES robot and other hand rehabilitation devices has not yet been adequately conducted.

The development of effective rehabilitation devices to reduce compensatory movements for hand motor recovery holds particular significance in stroke rehabilitation (Suderland et al. 2012, p. 23). In our earlier research, we created an EMG-driven NMES robotic hand and proposed its application in post-stroke hand rehabilitation. This device provides fine control of hand movements and activates the target muscles selectively for finger extension/flexion, and its feasibility and effectiveness have been verified by a single group trial was argued (Rand et al. 2010, p. 54).

Rajeh et al. (1993, p. 76) argues that the majority of studies, cerebral infarctions were the most prevalent, representing 50% to 80% of cases, while intracerebral hemorrhage (ICH) occurred in 10% to 30%.

According to the National Institute of Neurological Disorders and Stroke (2004) "brain attack" can occur through two primary mechanisms: ischemic and hemorrhagic strokes. Ischemia refers to the insufficient blood flow leading to the loss of oxygen and nutrients for brain cells, typically caused by the blockage of a blood vessel that supplies the brain.

The initial impairment and the extent of motor recovery following ischemic stroke exhibit considerable variation, which is associated with factors such as lesion type, topography, and size (Feydy et al. 2002, p. 87). According to the National Institute of Neurological Disorders and Stroke (2004) this category of stroke constitutes around 80 percent of all strokes. In a hemorrhagic stroke, when an artery in the brain ruptures, blood is released into the surrounding tissue, disrupting both the blood supply and the delicate chemical balance necessary for neurons to function. Hemorrhagic strokes make up about 20 percent of all strokes (Stroke 2006).

Cerebral microbleeds are commonly found in stroke patients, particularly those who undergo intracerebral hemorrhage (Bokura et al. 2011, p. 87). Hemorrhagic strokes exclusively occur in deep brain regions, and they are linked to microbleeds within these areas. Hemorrhagic and ischemic strokes exhibit distinct patterns of initial recovery, with some recovery in hemorrhagic strokes attributed to inflammation resolution and there is a consensus that if stroke patients do not regain consciousness within the initial 24 hours, the majority may not regain consciousness. The physiotherapy management for these patients includes regular chest care, turning, and positioning (Strokes 2000).

Drake et al. (2005, p. 98) argues that the upper is associated with the lateral aspect of the lower portion of the neck and is suspended from the trunk by muscles and small skeletal articulation between the clavicle and the sternum, the sternoclavicular joint. Moore and Dally (2006, p. 56) argues that the upper limb is distinguished by its mobility, enabling grasping, striking, and performing fine motor skills and coordinated interaction among the joints of the upper limb is crucial for executing seamless, effective motions at an optimal distance for a given task and the functional recovery of the arm encompasses grasping, holding, and manipulating objects, requiring the recruitment and intricate integration of muscle activity from the shoulder to the fingers. Rehabilitation of the hemiplegic arm is often impeded by secondary complications like inferior subluxation of the glenohumeral joint, shoulder-hand syndrome, soft tissue lesions, and frequent shoulder pain was argued Dally (2006, p. 56).

The absence of spontaneous stimulation during functional activities can reduce the probability of restoring upper limb function and tasks such as transfers, attempts to stand, or walk necessitate bilateral leg engagement and upper limb activities, patients may exclusively rely on the non-affected side (Feys et al. 1998, p. 67). As a result, treating the upper extremity of individuals with hemiplegia continues to pose a challenging and at times frustrating endeavor for clinicians. According to the investigators in the Copenhagen Stroke Study, recovery of upper extremity function in over half of patients with severe upper extremity paresis post-stroke may only be accomplished through compensation using the unaffected upper extremity was agued (Blanton and Wolf 1999, p. 98).

The hand is used to discriminate between objects on the basis of touch. The pads on the palmer aspect of the fingers contain a high density of somatic sensory receptors. Also the sensory cortex of the brain developed to interpreting information from the hand, particularly from the thumb, is disproportionately large relative to that for many other region of skin (Drake et al. 2005, p. 87). Stroke results disturbances touch, pain, temperature, pressure and proprioception, that is so important to the perceptual motor functioning of a person. For that, after stroke patient may disuse the affected extremities, even when motor recovery is apparently good (Pedretti 1996, p. 86).

Masiero et al. (2007, p.65) argues that recent studies have shown that in Europe there are 200 to 300 new stroke patients per 100,000 every year, of whom about 30% survive with important motor deficits. After the acute phase, all patients require continuous medical care and rehabilitation treatment, often necessitating one-on-one manual interaction with physiotherapists and optimal restoration of arm and hand motor function is essential in permitting stroke patients to independently perform activities of daily living. Measuring severity of stroke, motor impairment and recovery are necessary for upper limb rehabilitation (Lucca 2009, p. 34).

As a result of stroke, it produces serious functional impairments, particularly in motor function. Most patients with stroke have unilateral weakness, due to involvement of motor system at the level of motor cortices, the subcortical nuclei or the axons that project to the spinal cord and such patients typically have significant weakness in the extremities contra lateral to the brain infraction, which recovers over a period of time ranging from several months to several years (Small et al. 2002, p. 97). This experience-induced neuroplasticity includes greater excitability and recruitment of the neurons in both hemispheres of the brain that contribute to performance, sprouting of dendrites that communicate with other neurons, and strengthening of these synaptic connections was argued (Dobkin 2005, p. 45). Some neurons may not die, but cease functioning until their blood supply improves, mainly depends on tissue ischemia and resulting oedema was argued (Neylon 1991, p. 6).

Due to stroke, it increase muscle tone or hypo tonicity may apparent and loss of coordination, selective and isolated movement (Pedretti 1996, p. 32). More than 50% of patients being left with a residual motor deficit after stroke, especially a deficit affecting the hand (Calautti and Baron 2003, p. 43). Intact sensation and proprioception has good prognosis for functional recovery after stroke (Pedretti 1996, p. 65).

Davidson and Waters (2000, p. 87) have argued physiotherapy is a major component of rehabilitation for stroke patients and has been shown to have a statistically positive effect on outcome. Recoveries of upper limb in hemiparetic stroke patients are correlated to neurophysiological measures and the spasticity measure (Naghdi et al. 2010, p. 34). The physical management process aims to maximize functional ability and prevent secondary complications to enable the patient to resume all aspects of life in his or her own environment. In patients who regain consciousness within 24 hours, the first 3 months are a critical period when greatest recovery is thought to occur, although potential for improvement may exist for many months. Physiotherapy during this initial period should aim to maximize all aspect of recovery in order to limit residual disability and reduce handicap (Strokes, 2000).

Operating as a clinical movement scientist, the physiotherapist is able to identify and measure the disorders of movement, and to design, implement and evaluate appropriate therapeutic strategies (Strokes, 2000). Functional outcome enhanced when patient participate in multidisciplinary rehabilitation activity (Volpe et al. 2000, p. 31). With the multidisciplinary team of health care professional, the main role of physiotherapist include restoration of function, prevention of secondary complications, such as shortening of soft tissues and the development of painful shoulder (Strokes, 2000).

The goals of physiotherapy are to provide opportunities for an individual to regain optimal skilled performance of functional actions and to increase levels of strength, endurance, and physical fitness. For the able-bodied and the disabled, it is recognized that practice is the way to achieve these aims (Carr and Shepherd 2003, p. 98). Motor rehabilitation of adults with hemiplegia uses a number of physiotherapy approaches developed by authors such as Bobath, Rood, Kabat, Brunnstrom and Perfetti (Paci 2003, p. 49).

Stroke tends to result in a range of disabilities which have been shown to benefit from rehabilitation, in particular physiotherapy. Patients tend to have high expectations of the extent of recovery they can achieve through physiotherapy (Wiles et al. 2009). Functional disability is generally caused by hemiplegia after stroke. Physiotherapy used to be the only way of improving motor function in such patients (Scheidtmann et al. 2001, p. 52). Furthermore, careful handling, electrical stimulation, movement with elevation, strapping, and the avoidance of overhead pulleys could effectively reduce or prevent pain in the paretic upper limb (Wolf et al. 2003, p. 64).

If the patient spends more time in this activity than in exercising the impaired limbs, it is not hard to guess the probable outcomes. The intervention of an experienced physiotherapist can improve mobility and reduce disability in patients seen late after a stroke (Wade et al. 1992, p. 54). Albert et al. (2010, p. 43) reported that robot-assisted therapy improved outcomes over 36 weeks as compared with usual care but not with intensive therapy. Simple ways to increase exercise tolerance and endurance, even in early stages may include setting goals such as increasing the speed of movement and the number of repetitions (Carr and Shepherd 2003).

CHAPTER-III: METHODOLOGY

Criteria for considering studies for this review

3.1 Study Design

3.1.1 Types of studies

We included only randomized controlled trials (RCTs) in this review. We included trials with or without blinding of the participants, therapists and assessors.

3.1.2 Types of participants

We included stroke patients (no restrictions on age, gender, onset of stroke symptoms, or stage of stroke with upper limb dysfunction. We included participants with motor impairment, with or without the presence of sensory impairment.

3.1.3 Types of interventions

We included all trials establishing on physiotherapy intervention (manual therapy techniques), or treatment component schedules, for the upper limb functional recovery among the stroke patients, either as the experimental intervention or as the control group. We did not include pharmacological, electrical or psychological (for example, mental imagery or relaxation) techniques. We only reviewed trials with interventions that address physical impairment. We included interventions delivered during the acute and chronic stages of rehabilitation. Furthermore, we excluded task-oriented and occupation-based interventions, constraint-induced movement therapy and repetitive task training. This review focused on studies that included descriptions of specific physiotherapy interventions and techniques rather than packages or approaches to treatment. It was intended that, if they were described in the literature, this review would also investigate the effect of dose of intervention, the location of delivery (for example in-patient, out-patient community-based) and the mode of delivery of the intervention (for example, by qualified or non-qualified staff, by physiotherapists, occupational therapists, nurses, carers).

3.1.4 Types of outcome measures

The primary outcome reviewed was improvement in upper limb function as measured by validated tests of upper limb function, such as the Action Research Arm Test (Lyle 1981).Secondary outcomes were improvement in motor impairment (measured by validated tests such as the Motricity Index) and improvement in functional independence (as measured by validated tests of functional independence such as the Barthel Index (Mahoney 1965); we have also included differences in death rates and differences in adverse events.

3.2 Search strategy

The search was undertaken using PEDro, MEDLINE, PubMed, and Web of Science. Google Scholar was used for manual searching. The MeSH term was developed by evaluating keywords from PubMed, CINAHL, and earlier review studies for stroke patients, upper limb, and population, intervention, comparison, outcome, and study setting/design (PICOS) approach was used to define the eligibility criteria for relevant studies.

Population	(((((Stroke) OR (Hemorrhagic stroke)) OR (Ischemic stroke)) OR (Cerebrovascular accident) OR (Cerebral infarct)))
Intervention	AND (((((((((Physiotherapy) OR (Physical therapy)) OR (Upper limb physiotherapy)) OR (Upper limb rehabilitation)) OR (Upper limb rehabilitation exercise)) OR (Upper limb motor training)) OR (Upper limb task- oriented activity training)) OR (Upper limb virtual rehabilitation)) OR (Upper limb robotic therapy)))
Comparator	NOT ((((((only medication) OR (Post operative)) OR (Only surgery)) OR (Occupational therapy)) OR (Speech & language therapy)) OR (Orthosis & Prosthesis))
Outcome	AND ((((((Improved function) OR (Improved strength)) OR (Improve range of motion)) OR (Improve ADLs)) OR (Reduced spasticity))

Table 1: PICO

Date of Search	Data base	Years searched	Searched terms	Accessed articles
25/5/23 04/06/23 08/06/23	Google Scholar	2012-2023	•Cerebrovascular accident OR Stroke AND Physical Therapy •Cerebrovascular accident OR Stroke AND Rehabilitation •Guideline AND Cerebrovascular accident OR Stroke	804,000
25/5/23 04/06/23 08/06/23	PEDro	2012-2023	•Cerebrovascular accident OR Stroke AND Physical Therapy •Cerebrovascular accident OR Stroke AND Rehabilitation •Guideline AND Cerebrovascular accident OR Stroke	765
25/5/23 04/06/23 08/06/23	PubMed	2012-2023	•Cerebrovascular accident OR Stroke AND Physical Therapy •Cerebrovascular accident OR Stroke AND Rehabilitation •Guideline AND Cerebrovascular accident OR Stroke	6754

Table 2: Bibliography of searching

Intervention	**Author**
3 articles about Robotic training	Chang et al. 2021 Tijana et al. 2017 Rowe et al. 2017
4 articles about Transcranial direct current stimulation	Zhao et al. 2022 Llorens et al. 2021 Chang et al. 2021 Askin et al. 2017
4 articles about Virtual reality based therapy	Llorens et al. 2021 El- kafy et al. 2021 Brunner et al .2017 Lee et al. 2016
5 articles discuss about SMART arm training	Zhao et al. 2022 Barker et al. 2017 Lee et al. 2017 Lee et al. 2016 Han et al. 2012
Mirror therapy	Zhuang et al. 2021
Functional electrical stimulation & neuromuscular electrical stimulation	Knutson et al. 2012
Repetitive peripheral magnetic stimulation	Jiang et al. 2022

Table 3: Different physiotherapy intervention on 15 articles

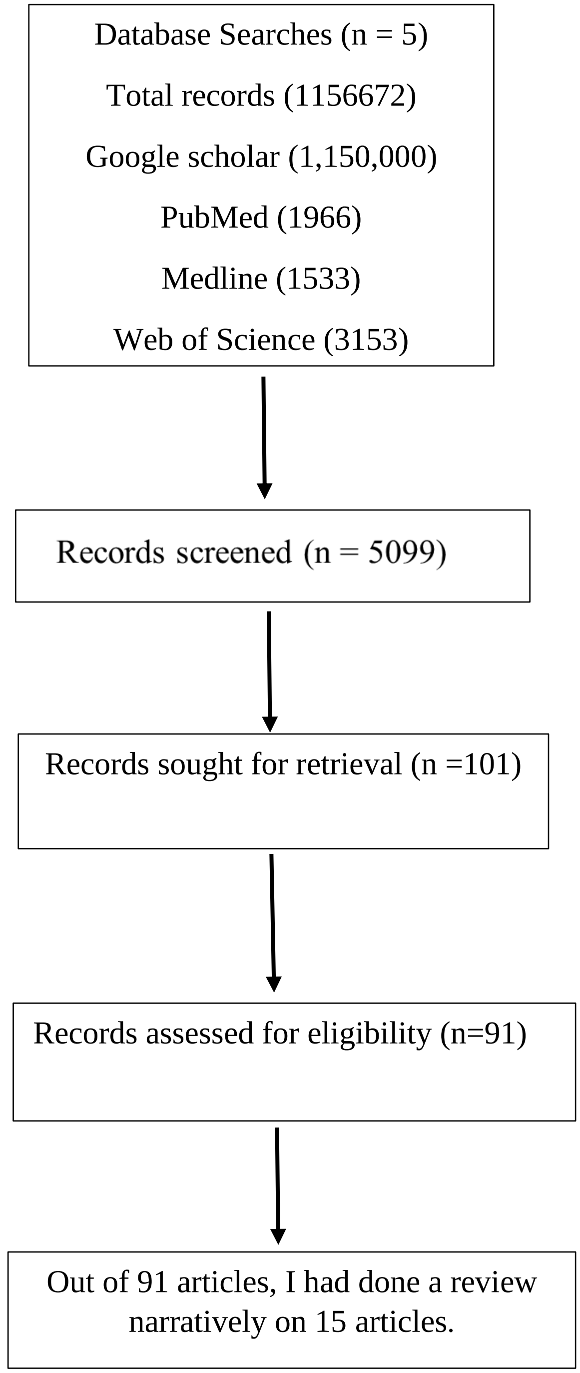

Table 4: Search strategy according to PRISMA

3.3 Eligibility Criteria

The following criteria were used to determine whether or not the study should be included in the evaluation:

3.3.1 Inclusion criteria

The inclusion criteria were –

- Population: stroke patients (no restrictions on age, gender, onset of stroke symptoms, or stage of stroke),
- Only included upper limb functional recovery related articles.
- participants with motor impairment, with or without the presence of sensory impairment were included.
- Intervention: upper limb training
- Comparison: standard rehabilitative treatment, conventional arm therapy, or conventional occupational therapy,
- Outcome: upper limb functional recovery (shoulder and elbow or wrist and hand),
- All articles were randomized controlled trial.

3.3.2 Exclusion criteria

- Pain related articles were excluded.
- Those articles were excluded about the functional recovery of lower extremely.
- Balance, co-ordination and proprioception related articles were excluded.
- Cross-over trails, pilot trails were excluded.

3.4 Study selection and data extraction

Authors independently assessed the titles and abstracts of records using the PICOS approach. Relevant studies that met the inclusion criteria were evaluated for full-text publication by assessing their PICOS and continuous data given. Any disagreements during the process were resolved by mutual agreement with the corresponding author. The data were then retrieved from each included RCT: the citation; country; participant characteristics such as age in the experiment and control groups; total numbers in both groups; stroke stage; intervention characteristics, such as types of intervention in each group, duration of intervention delivered, and follow-up of the outcome; outcomes; and continuous data.

3.4.1 Selection

Following completion of the searches, two review authors assessed the trials independently. They initially screened trial titles and abstracts according to the inclusion criteria; each trial was assigned as either 'potentially relevant' or 'definitely not relevant'. We immediately excluded any trial rated by both assessors in the latter category. The same two review authors subsequently reviewed full copies of the remaining trials and independently graded these papers as 'relevant', 'not relevant' or 'unclear'. We excluded any trials rated 'not relevant' by both review authors at this stage. We included all trials reviewed as 'relevant' by both review authors. Discussion between the review authors and, as appropriate, the rest of the review team resolved any disagreement between the authors and assisted with decisions regarding any trials rated as 'unclear'.

3.4.2 Data extraction

The two review authors undertook data extraction independently using a data extraction. We contacted trial authors as necessary to request missing information. We documented the following information where possible:

- Participants (e.g. Age, gender, site of lesion, length of time post)
- Stroke, stroke classification);
- Trial inclusion and exclusion criteria; and
- Assessed outcomes.

We resolved any disagreements by discussion and by contacting trial authors for clarification as appropriate.

3.5 Methodological quality

Two review authors independently recorded and documented the methodological quality of the trials following the guidance in the Cochrane Handbook for Systematic Reviews of Interventions (Higgins 2009). We recorded the following indicators on the data extraction:

1. Method of randomization;

2. Concealment;

3. Blinding of participants;

4. Blinding of providers of care to the intervention group;

5. Blinding of outcome assessor;

6. Reliability and validity of outcome measures used;

7. Any potentially confounding factors; and

8. Statistical analysis performed (if any).

We used these indicators in the review as an indicator of overall quality of the trials, and we have reported the information gained in the results.

3.6 Ethical considerations

To conduct this research project the formal permission was taken from BHPI (Bangladesh Heath Profession Institute) research ethical committee. Participants will explain exactly and clearly about the whole research process. For this study, the researcher will not interfere with their clients and clinical practice. They will inform that their participation is fully voluntary. Confidentiality of information was maintained and participant code was used to make participants personal identity invisible. After completion all of ethical issue started to collect data and completed within the allocated time frame.

3.7 Limitation of the study

- As it was the first research of the researcher, so the researcher might overlook some mistakes.
- Resources are limited have a great deal of impact on the study. For better it would take more time.
- There is no control group.
- The researcher could not compare the study with other due to lack of studies about present practice for stroke.
- The researcher looks small numbers of article sample 30, which was very small for generalize the result and not find out the relation among dependent and independent variables due to time limitation.
- The researcher collect data from the Neurology out door in CRP, so the result of this study can not generalized of all stroke patients in Bangladesh.

CHAPTER- IV	**RESULTS**

4.1 Physiotherapy Management Protocol:

The aim of physiotherapy for patients with stroke is to improve health related quality of life. This is achieved by improving patient's ability to participate in activities of daily life. Physiotherapy interventions can help to overcome the barriers to perform maximum functional independency that are directly or indirectly related to upper limb motor and sensory loss. During the acute phase, immediately after injury when patients are restricted to bed, the key impairments physiotherapists can prevent or treat are pain, poor motor function, tone, loss of joint mobility and weakness. Once patients commence rehabilitation physiotherapists can also address impairments related to poor skill and fitness. Physiotherapists play a vital role in community integration of stroke patients.

A stroke is a brain injury that results from bleeding or a blockage in the brain. The effects can be sudden or gradual, and the damage may affect various aspects of mental and physical health. These include- motor skills, the senses, including reactions to pain, language, thinking and memory, emotions.

A stroke can affect a person's use of language in a variety of ways. For example, it can impair the processing of language. Also, paralysis or weakness in the face, tongue, or throat muscles can make it hard to swallow, control breathing, and form sounds. The type and extent of difficulties communicating depend on the form of stroke and the kind of injury.

The onset of a stroke, four phases *(*hyperacute, acute, subacute, and community reintegration phase*)* are recognized, although there is no consensus for the duration of each phase.

Hyperacute phase:

The first 24 h after stroke onset is known as the hyperacute phase. It includes emergency care, diagnosis, the decision to offer thrombolysis therapy or not, an assessment of stroke severity, and the presence of dysphagia and hospital admission for further stroke care or discharge home with a referral for further evaluation and secondary prevention counseling.

Acute phase:

The acute phase begins about 24 h after stroke onset and for medically stable patients, lasts 5–7 days. Ideally, the patient is hospitalized in a dedicated stroke unit staffed with an interdisciplinary professional team experienced in the treatment of persons poststroke. Members of the team ensure that the patient is medically stable, initiate early rehabilitation (which in the first few days may consist of positioning to protect the paretic upper extremity and early mobilizations for medically stable persons) shown to be both safe and beneficial (Bernhardt et al. 2013; Cumming et al. 2011). They evaluate the patient using a battery of standardized, reproducible, and valid outcome measures, including a measure of rehabilitation triage on day 3–5 in the unit. The triage scores are used by the professionals, in consultation with the stroke victim and family or caregivers, to recommend optimal rehabilitation trajectories. The duration of the rehabilitation offered in the different trajectories is variable and related to, for instance, stroke severity, patient goals, and availability of rehabilitation personnel. The ESD program (an intensive rehabilitation program offered by an interprofessional team 5 days per week) can be expected to last 6–8 weeks (Henderson and Knox 2012), and is often followed by outpatient rehabilitation of variable duration and intensity. Inpatient rehabilitation can vary from a few weeks to up to 16 or more weeks for very severely affected patients and may be followed by outpatient rehabilitation for variable periods. Arrows in the figure indicate how patients can move among the trajectories and benefit from outpatient rehabilitation, while the outlines of persons indicate the need for patient navigators to ensure seamless transfers among the trajectories.

Community reintegration phase:

The community reintegration phase begins once the person is discharged home, be it with the support of an ESD program or outpatient rehabilitation. For optimal results, it requires the collaboration of home care services, community organizations, and stroke associations (Mayo et al. 2014; Richards and Clément 2013). The duration of this community-dwelling phase is dependent on factors such as the person's health, caregiver support, periodic reevaluations, and access to maintenance rehabilitation services and community services that encourage participation in meaningful activities (Mayo et al. 2002; Richards and Clément 2013). It is not a well-known fact that the average survival poststroke is 7 years (Brønnum-Hansen et al. 2001).

Article No	Author	Therapeutic strategy/ Intervention	Function measurement tools	Participants	Dose and Description	Outcome
1	Jiang et al. 2022	Experimental group received Repetitive Peripheral Magnetic Stimulation (rPMS) along with conventional physiotherapy and control group received conventional physiotherapy.	Fugl-Meyer Assessment (FMA)	44 eligible patients were assigned into the experimental group (EG) receiving rPMS group (n=24) and the control group (CG) (n=20)	Experimental group received Repetitive Peripheral Magnetic Stimulation (rPMS) along with conventional physiotherapy for 20 mins each time, once a day, for 14 consecutive days and control group received conventional physiotherapy for 40 mins/session, 1 session/day, for 14 consecutive days.	In patients with no functional arm movement, rPMS of upper limb extensors improves arm function and muscle strength for grip and elbow flexion and extension, decreases the upper limb impairment, and improves daily living ability. rPMS could quickly induce muscle strength recovery, and its effect of increasing muscle tension is controllable. These findings would contribute to the justification for specific treatment parameters to maximize upper limb recovery after stroke.

2	Zhuang et al. 2021	Experimental group received Associated Mirror Therapy and control group conventional stroke rehabilitation.	Fugl-Meyer Assessment (FMA), Box and Block Test (BBT).	Thirty-six eligible patients were equally assigned into the experimental group (EG) receiving AMT and the control group (CG) receiving bimanual training without mirroring.	All two groups of patients were treated with received Mirror therapy (experimental group) and Conventional therapy (control group). All enrolled patients received the conventional stroke rehabilitation program for four weeks, five days/week, and around four hours/day. The conventional stroke program consisted of physiotherapy, occupation therapy, speech therapy, and respiratory management. The Fugl-Meyer	This is the first study to propose a novel and advantageous MT paradigm achieving bimanual cooperation under camera technique-based MVF. The present study demonstrates that AMT is a feasible and effective method to improve motor impairment of the paretic arm, enhance daily function, and may increase the ability of manual dexterity after stroke.

					Assessment Upper Limb subscale (FMA-UL) for upper extremity motor impairment was used as the primary outcome. The secondary outcomes were the Box and Block Test (BBT) and Functional Independence Measure (FIM) for motor and daily function. All patients participated in trials throughout without adverse events or side effects.		

3	Llorens et al. 2021	The experimental group received combined transcranial direct current stimulation and VR-based therapy and control group received Conventional therapy.	Fugl-Meyer Assessment (FMA), Wolf Motor Function Test (WMFT).	Twenty-nine participants were randomized into an experimental group	The experimental group received combined transcranial direct current stimulation and VR-based therapy and control group received Conventional therapy for both group 25 one-hour sessions, 3-5 times a week, using the upper extremity subscale of the Fugl-Meyer Assessment, the time and ability subscales of the Wolf Motor Function Test.	A clinically meaningful improvement of the upper limb motor function was consistently revealed in all motor measures after the experimental intervention, but not after conventional physical therapy. The combined tDCS and VR-based paradigm provided not only greater but also clinically meaningful improvement in the motor function in comparison to conventional physical therapy.
4	Chang et al. 2021	Experimental group received Active Transcutaneous auricular branch vagus nerve	Fugl-Meyer Assessment (FMA), Wolf Motor	Thirty-six patients with chronic, moderate-	Experimental group received Active Transcutaneous auricular branch vagus	The study demonstrates that Motor improvements, on all clinical scales, were significant for both the active and sham taVNS groups and robust

		stimulator (taVNS)+ robotic training and control group received Sham Transcutaneous auricular branch vagus nerve stimulator (taVNS) + robotic training	Function Test (WMFT).	severe upper limb hemiparesis.	nerve stimulator (taVNS)+ robotic training for 1 hour in length ,3x/week for 3 weeks and control group received Sham Transcutaneous auricular branch vagus nerve stimulator (taVNS) + robotic training for 500 ms brusts,frequency 30 HZ, pulse width 0.3 ms ,max intensity 5mA. Significant motor improvements were measured for both the active and sham taVNS groups, and these improvements were	through follow-up and are indicative of a benefit from robot training. This study also shown that taVNS delivered prior to extension movements in a shoulder/elbow robotic training task significantly reduced spasticity in the affected arm, and significantly changed bicep peak sEMG amplitudes during extension.

					robust at 3 month follow-up.	
5	El-Kafy et al. 2021	Experimental group received Conventional functional training program + virtual reality based therapy and control group received Conventional functional training program.	Action Research Arm Test (ARAT), Wolf Motor Function Test (WMFT)	A total of 62 chronic stroke patients were screened for inclusion in this study, with only 40 participants meeting the inclusion criteria.	Participants were randomly assigned into two groups, experimental and control, with the experimental group undertaking a conventional 1-h functional training program, followed by another hour of virtual reality based therapy using Armeo Spring equipment and the control group received 2 h of a conventional functional training	The use of combined treatment of virtual reality-based therapy and conventional functional training program is more effective for improving upper limb functions in individuals with chronic stroke than the use of the conventional program alone.

					program. The treatment program was conducted three times per week for three successive months. Both groups showed significant differences (all, P < 0.05) in all measured variables after 3 months of the treatment. Individuals with stoke in the experimental group had a better improvement in ARAT (P < 0.01), WMFT (P < 0.01) and WMFT-Time	

6	Zhao et al. 2022	Experimental group received Smart hand joint training device group and control group received Smart hand joint training device combined with tDCS group.	Fugl-Meyer Assessment (FMA).	60 patients diagnosed with early stroke hand dysfunction were selected.	Experimental group received Smart hand joint training device group for Once per day, 6days/week ,for 2weeks and control group received Smart hand joint training device combined with tDCS group for Once per day, 6days/week ,for 2weeks	Both the smart hand joint training device alone and tDCS combined with the smart hand joint training device can improve hand function of patients with early stroke to varying degrees, but the treatment effect of tDCS combined with the smart hand joint training device is more significant.
7	Askin et al. 2017	Experimental group received Low-frequency repetitive transcranial magnetic stimulation and control group received Physical therapy (PT).	Fugl-Meyer Assessment (FMA), Functional independence measure (FIM), Functional	40 eligible patients were equally assigned into the experimental group (EG) and the control group (CG).	Experimental group received Low-frequency repetitive transcranial magnetic stimulation for 10 sessions in 2 weeks (5 days/week) and control group received Physical therapy (PT) for 10	LF-rTMS can safely facilitate upper extremity motor recovery in patients with chronic ischemic stroke. TMS seems to be a promising treatment for motor, functional, and cognitive deficits in chronic stroke. Further studies with a larger number of patients with longer follow-up periods are needed to establish its

			Ambulation Scale (FAS), Motor Assessment scale (MAS), Box and Block Test (BBT).		sessions in 2 weeks (5 days/week) .	effectiveness in stroke rehabilitation. No statistically significant difference was found in baseline demographical and clinical characteristics of the subjects including stroke severity or severity of paralysis prior to intervention. There were statistically significant improvements in all clinical outcome measures except for the Brunn strom Recovery Stages.
8	Barker et al. 2017	Experimental group received SMART Arm with outcome-triggered electrical stimulation and usual therapy and control Usual therapy.	Motor Assessment scale (MAS), Stroke Impact Scale (SIS).	Fifty inpatients within 4 months of stroke with severe upper limb disability	Participants were randomly allocated to 60 min/day, 5 days a week for 4 weeks of (1) SMART Arm with OT-stim and usual therapy, (2) SMART Arm alone and usual therapy, or (3) usual therapy.	SMART Arm training supported a clinically significant improvement in arm function, which was similar to usual therapy. This study assessed with respect to usual therapy alone, the effect on arm function of SMART Arm training, when used with and without OT-stim in combination with usual therapy, in

						stroke survivors with severe upper limb disability participating in inpatient rehabilitation. All groups exhibited higher levels of function following the training period, yet contrary to our hypothesis there were no differences in the degree of change between groups.
9	Brunner et al. 2017	Experimental group received Virtual Reality Training and control usual therapy.	Action Research Arm Test (ARAT), Box and Block Test (BBT).	120 participants with upper extremity motor impairment within 12 weeks after stroke were consecutively included	Participants were randomized to either VR or CT as an adjunct to standard rehabilitation and stratified according to mild to moderate or severe hand paresis. Participants received sixteen 60-minute sessions over 4 weeks in experimental group and 60 min/day, 5 days a	Additional upper extremity VR training was not superior but equally as effective as additional CT in the subacute phase after stroke. VR may constitute a motivating training alternative as a supplement to standard rehabilitation. Patients in VR improved 12 (SD 11) points from baseline to the postintervention assessment and 17 (SD 13) points from baseline to follow-up, while patients in CT

				at 5 rehabilitation institutions.	week, 4 weeks dose received in control group.	improved 13 (SD 10) and 17 (SD 13) points, respectively. Improvement was also similar for our subgroup analysis with mild to moderate and severe upper extremity paresis.
10	Tijana et al. 2017	Experimental group received arm assisted robotic training and control manual therapy.	Fugl-Meyer Assessment (FMA), Wolf Motor Function Test (WMFT).	Twenty-six hemiparetic subacute stroke subjects were recruited for this study	Experimental group received arm assisted robotic training for 30 min per day 5 days in week in 3 weeks and control manual therapy (rom exercise, functional exercise) for 30min/day 5 days in week in 3 week.	The primary outcome measure was Fugl-Meyer Assessment-Upper Extremity (FMA-UE) motor score, and the secondary outcomes were Wolf Motor 12Function Test-Functional Ability Scale (WMFT-FAS). The AA group, in comparison to the Control group, showed significantly greater increases in FMA-UE score (18.0 ± 9.4 versus 7.5 ± 5.5, p = 0.002) and WMFT-FAS score (14.1 ± 7.9 versus 6.7 ± 7.8, p = 0.025) after 3 weeks of treatment. The study

						conclude that arm training using the AA robotic device is safe and able to reduce motor deficits more effectively than matched conventional arm training in subacute phase of stroke.
11	Lee et al, 2017	Experimental group received Bilateral Arm Training and control group received General occupational therapy.	Fugl-Meyer Assessment (FMA), Box and Block Test (BBT).	Thirty patients were equally assigned into the experimental group (EG) and the control group (CG).	The study included 30 hemiplegic stroke patients. The patients were randomly divided into an experimental group (n = 15) and a control group (n = 15). All patients received a uniform general occupational therapy session lasting 30 minutes 5 times a week for 8 weeks. The experimental group	In both the experimental and control groups, the FMA & BBT scores were significantly higher after the intervention than before the intervention ($P < .05$). The changes in the FMA & BBT scores were greater in the experimental group than in the control group ($P < .05$). Bilateral arm training along with general occupational therapy might be more effective than occupational therapy alone for improving upper limb function and ADL

					received an additional session of bilateral arm training lasting 30 minutes, and the control group received an additional session of general occupational therapy lasting 30 minutes.	performance in hemiplegic stroke patients.
12	Lee et al. 2016	Experimental group received Virtual reality-based bilateral upper extremity training (VRBT) and control group received Bilateral	Jebsen-Taylor Hand Function Test, Box and Block Test (BBT).	18 patients were assigned into the experimental group (EG) (n=10) and the	Subjects in the VRBT group performed bilateral upper extremity training in a VR environment for 30 minutes per session, 3	These results suggest that VRBT is a feasible and beneficial means of improving upper extremity function and muscle strength in individuals following stroke.

		Upper Extremity Training (BT).		control group (CG) (n=8)	days a week, for 6 weeks. Subjects in the BT group watched an irrelevant video in a VR environment with bilateral upper extremity training for 30 minutes per session, 3 days a week, for 6 weeks. Both groups received conventional occupational therapy for 30 minutes per session, 5 days a week, for 6 weeks.	
13	Rowe et al. 2017	Experimental group received High assistance robot training and control group received Low assistance robot training.	Box and Block Test (BBT), Fugl-Meyer Assessment	Participants (n = 30) with a chronic stroke and moderate hemiparesis.	The participants were randomized to receive high assistance (causing 82% success at hitting targets) or low assistance	Both groups improved significantly at the 1-month follow-up on functional and impairment-based motor outcomes, on depression scores, and on self-efficacy of hand

			(FMA), Action Research Arm Test (ARAT), Motor activity log (MAL).		(55% success). Participants performed ~8000 movements during 9 training sessions.	function, with no difference between groups in the primary endpoint (change in Box and Blocks). High assistance boosted motivation, as well as secondary motor outcomes (Fugl-Meyer and Lateral Pinch Strength) particularly for individuals with more severe finger motor deficits. Individuals with impaired finger proprioception at baseline benefited less from the training. Robot-assisted training can promote key psychological outcomes known to modulate motor learning and retention. Furthermore, the therapeutic effectiveness of robotic assistance appears to derive at least in part from proprioceptive stimulation, consistent with a Hebbian plasticity model.

14	Han et al. 2012	Experimental group received Arm training (Group A=1hr) and Arm training (Group A=2hr) and control group Arm training (Group C=3hr).	Fugl-Meyer Assessment (FMA), Action Research Arm Test (ARAT).	Thirty-two stroke patients meeting the enrolment criteria were randomly divided into three groups: group A (*n* = 11), group B (*n* = 10) and group C (*n* = 11).	Thirty-two stroke patients meeting the enrolment criteria were randomly divided into three groups: group A (*n* = 11), group B (*n* = 10) and group C (*n* = 11). Each group received arm training for 1 hour, 2 hours and 3 hours a day respectively, 5 days per week, for a period of six weeks.	An increase in the intensity of arm training might improve the motor function of the arm after stroke. In this study, we found that there is a weak dose–response relationship between intensity and change in functional recovery of hemiplegic upper extremity. The main difference in each group is the total time of arm training.
15	Knutson et al. 2012	Experimental group received Contralaterally Controlled Functional Electrical Stimulation (CCFES) and control group received Cyclic	Fugl-Meyer Assessment (FMA), Arm Motor Ability Test (AMAT).	Twenty-one participants were randomized to CCFES or cyclic NMES	Twenty-one participants were randomized to CCFES or cyclic NMES. Treatment for both groups consisted of daily stimulation-assisted repetitive hand-opening	The results favor CCFES over cyclic NMES though the small sample size limits the statistical power of the study. The effect size estimates from this study will be used to power a larger trial.

		Neuromuscular Electrical Stimulation (cNMES).			exercise at home plus twice-weekly lab sessions of functional task practice. Cyclic NMES: 15 min/set × 4 sets × (2 sets/d × 5 d/wk +1 set/d × 2 d/wk) = 12 h/wk. CCFES: 15 min/set × 3 sets × (2 sets/d × 5 d/wk + 1 set/d × 2 d/wk) + 90 min/lab × 2 labs/ wk = 12 h/wk.	

Table-5: Therapeutic strategies and results of clinical studies related to the rehabilitation of patients with Stroke patients

CHAPTER-V	DISCUSSION

In the 15 studies, 11 function measurement tools are used which are Fugl-Meyer Assessment (FMA), Arm Motor Ability Test (AMAT), Action Research Arm Test (ARAT), Jebsen-Taylor Hand Function Test, Box and Block Test (BBT), Motor Assessment scale (MAS), Stroke Impact Scale (SIS), Functional independence measure (FIM), Functional Ambulation Scale (FAS), Wolf Motor Function Test (WMFT), Brunn storm Motor Function Staging. In this study we show the overall Physiotherapy treatment protocol in stroke patients during rehabilitation service and beside it we summarized 15 article in which 3 article discuss about Mirror therapy, Wearable vibrotactile stimulation 4 article about effect of virtual reality, 2 Functional Electrical Stimulation, 3 article discuss about Arm Training, 2 article about robotic assisted gait training. Other strategic include-conventional therapy, occupational, speech therapy.

Jiang et al. 2022 shown that The Repetitive Peripheral Magnetic Stimulation (rPMS) group showed more significant improvements in the Fugl-Meyer Assessment (12.5) (2.5) vs. 7.0 (1.4), $P < 0.001$) compared with the control group (conventional physiotherapy). In patients with no functional arm movement after stroke, early application of rPMS on the upper extremity extensors increases muscle strength of grip and elbow flexion and extension, decreases the upper limb impairment, and improves daily living ability. rPMS could quickly induce muscle strength recovery, and its effect of increasing muscle tension is controllable. These findings would contribute to the justification for specific treatment parameters to maximize upper limb recovery after stroke.

A study conducted by Zhao et al. (2022) After treatment, compared with control group, the results in intervention group of Brunnstrom six-level staging and hemiplegic hand function classification evaluation showed obvious improvement ($p = 0.000$), and the result of hemiplegic fingers' functional evaluation also improved ($p = 0.026$). After treatment, Fugl-Meyer motor function scores were 6.73 ±6.65 (control group) and 9.8 ±6.66 (intervention group). Both the smart hand joint training device alone and transcranial direct current stimulation (tDCS) combined with the smart hand joint training device can improve hand function of patients with early stroke to varying degrees, but the treatment effect of tDCS combined with the smart hand joint training device is more significant.

Zhuang et al. (2021) stated that Thirty six eligible patients were equally assigned into the experimental group (EG) receiving associated mirror therapy (AMT) and the control group (CG)receiving bimanual training without mirroring for five days/week, lasting four weeks. The Fugl-Meyer Assessment Upper Limb subscale (FMA-UL) for upper extremity motor impairment was used as the primary outcome. The secondary outcomes were the Box and Block Test (BBT). All patients participated in trials throughout without adverse events or side effects. The scores of FMA-UL improved significantly in both groups following the intervention. Compared to CG, the scores of FMA-UL was improved more significantly in EG after the intervention. The BBT scores were improved significantly for EG following the intervention, but no differences were found in the BBT scores of CG after the intervention. However, no differences in BBT scores were observed between the two groups. The study suggested that AMT was a feasible and practical approach to enhance the motor recovery of paretic arms and daily function in stroke patients. Furthermore, AMT may improve manual dexterity for poststroke rehabilitation.

Llorens et al. (2021) shown that the results showed that using the upper extremity subscale of the Fugl-Meyer Assessment, the time and ability subscales of the Wolf Motor Function Test, a clinically meaningful improvement of the upper limb motor function was consistently revealed in all motor measures after the experimental intervention, but not after conventional physical therapy. The combined tDCS and VR-based paradigm provided not only greater but also clinically meaningful improvement in the motor function in comparison to conventional physical therapy. The improvement detected in motor function after a combined tDCS and VR-based intervention, together with the good acceptance of the intervention and the potential to provide long-term benefits.

A study conducted by Chang et al. (2021) this study used Fugl-Meyer Assessment (FMA), Wolf Motor Function Test (WMFT) scale There were significant motor improvements after robotic training for both sham and active ta VNS groups, and these improvements were robust at follow-up. Specifically, UE-FM scores improved for each group (Friedman RM-ANOVA, sham $P < 0.001$, Chi-square = 20.920; active $P < 0.001$, Chi-square = 16.453).

Motor improvements, on all clinical scales, were significant for both the active and sham taVNS groups and robust through follow-up and are indicative of a benefit from robot training. Motor improvements on the UE-FM, the MRC motor power scale, and the Wolf Motor Function Test were significant for both the sham and active taVNS groups and robust through follow-up. results showed that 3 weeks of upper limb robotic training combined with taVNS delivered selectively during extension movements demonstrated significant reductions in spasticity at the wrist and hand and significant changes in bicep sEMG peak amplitude during extension movements. Similar improvements in clinical scales were seen in both active and sham groups. Changes in bicep peak sEMG amplitude may be a sensitive early biomarker of taVNS-induced improvements.

El-katy et al. (2021) stated that the treatment program was conducted three times per week for three successive months. The change in the scores of Action Research Arm Test (ARAT), Wolf Motor Function Test (WMFT). Both groups showed significant differences (all, $P < 0.05$) in all measured variables after 3 months of the treatment. Individuals with stoke in the experimental group had a better improvement in ARAT ($P < 0.01$), WMFT ($P < 0.01$) and WMFT-Time ($P < 0.01$) scores after completion of the treatment compared to the control group. No significant difference in HGS scores was detected between groups after completion of the treatment ($P = 0.252$). The use of combined treatment of virtual reality-based therapy and conventional functional training program is more effective for improving upper limb functions in individuals with chronic stroke than the use of the conventional program alone.

Askin et al. (2018) shown that There were statistically significant improvements in all clinical outcome measures. Fugl–Meyer Assessment, Box and Block test, motor and total scores of Functional Independence Measurement (FIM), and Functional Ambulation Scale (FAS) scores were significantly increased in both groups, however, these changes were significantly greater in the rTMS group except for FAS score. FIM cognitive scores and standardized mini-mental test scores were significantly increased and distal and hand Modified Ashworth Scale scores were significantly decreased only in the rTMS group ($p < .05$). LF-rTMS can safely facilitate upper extremity motor recovery in patients with chronic ischemic stroke. TMS seems to be a promising treatment for motor, functional, and cognitive deficits in chronic stroke. Further studies with a larger number of patients with longer follow-up periods are needed to establish its effectiveness in stroke rehabilitation.

A study conducted by Barker et al. (2017) All groups demonstrated a statistically ($P < .001$) and clinically significant improvement in arm function at post training (MAS6 change ≥1 point) and at 52 weeks (MAS6 change ≥2 points). There were no differences in improvement in arm function between groups ($P = .367$). There were greater odds of a higher MAS6 score in SMART Arm groups as compared with usual therapy alone post training (SMART Arm stimulation generalized odds ratio [GenOR] = 1.47, 95%CI = 1.23-1.71) and at 26 weeks (SMART Arm alone GenOR = 1.31, 95% CI = 1.05-1.57). SMART Arm training supported a clinically significant improvement in arm function, which was similar to usual therapy. All groups maintained gains at 12 months. This study assessed with respect to usual therapy alone, the effect on arm function of SMART Arm training, when used with and without OT-stim in combination with usual therapy, in stroke survivors with severe upper limb disability participating in inpatient rehabilitation. All groups exhibited higher levels of function following the training period, yet contrary to our hypothesis there were no differences in the degree of change between groups.

Brunner et al. (2017) stated that Mean time from stroke onset for the VR group was 35 (SD 21) days and for the CT group was 34 (SD 19) days. There were no between-group differences for any of the outcome measures. Improvement of upper extremity motor function assessed with ARAT was similar at the postintervention (p 5 0.714) and follow-up (p 5 0.777) assessments. Patients in VR improved 12 (SD 11) points from baseline to the postintervention assessment and 17 (SD 13) points from baseline to follow-up, while patients in CT improved 13 (SD 10) and 17 (SD 13) points, respectively. Improvement was also similar for our subgroup analysis with mild to moderate and severe upper extremity paresis. Additional upper extremity VR training was not superior but equally as effective as additional CT in the subacute phase after stroke. VR may constitute a motivating training alternative as a supplement to standard rehabilitation.

Tijana et al. (2017) shown that Both groups were trained 5 days per week for 3 weeks. The primary outcome measure was Fugl-Meyer Assessment-Upper Extremity (FMA-UE) motor score, and the secondary outcomes were Wolf Motor Function Test-Functional

Ability Scale (WMFT-FAS). The AA group, in comparison to the Control group, showed significantly greater increases in FMA-UE score (18.0 ± 9.4 versus 7.5 ± 5.5, $p = 0.002$) and WMFT-FAS score (14.1 ± 7.9 versus 6.7 ± 7.8, $p = 0.025$) after 3 weeks of treatment, whereas the increase in BI was not significant (21.2 ± 24.8 versus 13.1 ± 10.7, $p = 0.292$). There were no adverse events. The study concluded that arm training using the AA robotic device is safe and able to reduce motor deficits more effectively than matched conventional arm training in subacute phase of stroke.

Lee et al. (2017) stated that The Fugl Meyer assessment (FMA), Box and Block Test (BBT) were used for evaluation. Results: In both the experimental and control groups, the FMA and BBT scores were significantly higher after the intervention than before the intervention ($P < .05$). The changes in the FMA and BBT scores were greater in the experimental group than in the control group ($P < .05$). Bilateral arm training along with general occupational therapy might be more effective than occupational therapy alone for improving upper limb function and ADL performance in hemiplegic stroke patients. Thus, bilateral arm training should be considered as an important clinical intervention in hemiplegic patients.

Lee et al. (2017) stated that All training was conducted for 30 minutes day 1, 3 days a week, for a period of 6 weeks. Patients were assessed for upper extremity function and hand strength. Compared with the BT group, the VRBT group exhibited significant improvements in upper extremity function and muscle strength ($p < 0.05$) after the 6-week training programme. The Box and Block test results revealed that upper extremity function and elbow flexion in hand strength were significantly improved in terms of group, time and interaction effect of group by time. Furthermore, the VRBT group demonstrated significant improvements in upper extremity function, as measured by the Jebsen Hand Function Test and Grooved Pegboard test, and in the hand strength test, as measured by elbow extension, grip, palmar pinch, lateral pinch and tip pinch, in both time and the interaction effect of group by time. These results suggest that VRBT is a feasible and beneficial means of improving upper extremity function and muscle strength in individuals following stroke.

A study conducted by Rowe et al. (2017) Both groups improved significantly at the 1-month follow-up on functional and impairment-based motor outcomes, on depression scores, and on self-efficacy of hand function, with no difference between groups in the primary endpoint (change in Box and Blocks). High assistance boosted motivation, as well as secondary motor outcomes (Fugl-Meyer and Lateral Pinch Strength)— particularly for individuals with more severe finger motor deficits. Individuals with impaired finger proprioception at baseline benefited less from the training. Conclusions. Robot-assisted training can promote key psychological outcomes known to modulate motor learning and retention. Furthermore, the therapeutic effectiveness of robotic assistance appears to derive at least in part from proprioceptive stimulation, consistent with a Hebbian plasticity model.

Han et al. (2012) shown that When comparing the three groups, the Fugl-Meyer Assessment improvement was more significant in group C (20.50 ± 7.84) than that in group A (11.90 ± 6.52) and group B (13.80 ± 6.41) after four weeks of treatment ($P < 0.05$). The Action Research Arm Test score improvement was more significant in group C (7.30 ± 2.95) than in group A (3.30 ± 2.91) ($P < 0.05$). After six weeks of treatment, the Fugl-Meyer Assessment and Action Research Arm Test score improvements were more significant in group C (24.50 ± 7.96, 10.90 ± 3.60) and group B (19.70 ± 7.09, 8.70 ± 4.62) than in group A (13.00 ± 6.38, 5.30 ± 3.40) ($P < 0.05$). There were no significant differences of Barthel Index among the three groups ($P > 0.05$). In each group, Fugl-Meyer Assessment, Action Research Arm Test and Barthel Index scores increased significantly after six weeks of treatment ($P < 0.05$). An increase in the intensity of arm training might improve the motor function of the arm after stroke.

Knutson et al. (2012) shown that seventeen patients completed the treatment phase (9 CCFES, 8 cyclic NMES). At all posttreatment time points, CCFES produced larger improvements than cyclic NMES on every outcome measure. Maximum voluntary finger extension showed the largest treatment effect, with a mean group difference across the posttreatment time points of 28° more finger extension for CCFES. The results favor CCFES over cyclic NMES though the small sample size limits the statistical power of the study. The effect size estimates from this study will be used to power a large.

5.1 Limitations

100% accuracy was not possible in any research so that some limitation may exist. Regarding this study, there were some limitations or barrier to consider the result of the study. Limited Research Experience, time Constraints and available resources had a significant impact on the overall study. The research project was conducted within a very limited timeframe, which further constrained the collection of a sufficient number of articles for the study. The limitations of time and available resources had a significant impact on the overall study. The researcher was a 4th year B.Sc. in physiotherapy student and this was his first research project. He had limited experience with techniques and strategies in terms of the practical aspects of research. As it was the first survey of the researcher so might be there were some mistakes that overlooked by the researcher. As the study was conducted at some specific area which may not represent the whole country.

CHAPTER-VI: CONCLUSION AND RECOMENDATION

6.1 Conclusion

This narrative review provides valuable insights into the landscape of physiotherapy interventions for upper limb recovery among stroke patients. The comprehensive exploration of diverse interventions, including exercise programs, technology-assisted therapies, and neurorehabilitation techniques, underscores the evolving strategies in the field. The review emphasizes the multifaceted challenges encountered in upper limb rehabilitation post-stroke, ranging from mobility issues to the intricate coordination required for fine motor skills. Despite the substantial progress in physiotherapy approaches, the review underscores existing gaps, such as the need for more extensive research on the long-term effectiveness of interventions and the identification of optimal intervention strategies tailored to individual patient needs. Furthermore, the review highlights the significance of early and sustained rehabilitation efforts to enhance functional outcomes and minimize long-term disability. Ultimately, this narrative review contributes to the collective understanding of physiotherapy interventions for upper limb recovery after stroke, paving the way for future research directions and informed clinical practices. The synthesis of current evidence serves as a valuable resource for healthcare professionals, researchers, and policymakers engaged in enhancing the rehabilitation outcomes and overall quality of life for stroke survivors. Stroke is one of the leading causes of morbidity, mortality and a socioeconomic challenge. This is particularly true for developing countries like Bangladesh, where health support system including the rehabilitation system is not within the reach of ordinary people. Bangladesh is very poor country in the world. Education, economy and other social aspects are very low level. People are not fully concerned about basic health care. Heath services in Government and Non- Government sector are not sufficient, for that most of the people in our country not get proper treatment facilities. Some private clinic and hospitals are now trying to provide latest medical services, but nothing to be mentioned about physiotherapy treatment. People in our country think physiotherapy treatment is some form of exercise. But it plays a great role in medical sector and many people become disable due to lack of awareness of physiotherapy. Physiotherapy is considered as an important treatment process in the developed countries. Stroke is a major cause of disability, and there is a need to identify effective physiotherapy interventions that will increase upper limb functioning in patients with hemiparesis. The main aim of this study is to find out upper limb functional outcome of stroke patient. This study highlighted the significant improvement of upper limb outcome measures after rehabilitation of stroke patients. Without proper physiotherapy treatment the proper recovery of stroke patients cannot achieve. Physiotherapy provides opportunities for an individual to regain optimal skilled performance to functional actions, increase levels of strength and effective to improve functional independency.

6.2 Recommendation

The objective of this study was to find out the functional recovery of affected upper limb followed by stroke patient during discharge and the result that the researcher found from the study has fulfilled the target of this research project. The researcher recommended the following things-

- The next generation of Physiotherapy members continue regarding this area which may involve of survey study of functional recovery of affected upper limb followed by stroke patient.
- Should take more samples for generalizing the result and make the research more valid and reliable.
- Should take more samples for pilot study to establish the accuracy of questionnaire.
- Sample should collect from different hospital, clinic, institute and organization in different area of Bangladesh to generalize the result.

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Appendix

IRB Application letter

Date: 22th February 2023
The Chairman
Institutional Review Board (IRB)
Bangladesh Health Professions Institute (BHPI), CRP
Savar, Dhaka-1343.Bangladesh.

Subject: Application for review and ethical approval.

Dear Sir,

With due respect, I am Khadiza Islam, student of B.Sc in physiotherapy program at Bangladesh Health Professional Institute (BHPI) the academic institute of Centre for the Rehabilitation of the Paralysed (CRP) under the Faculty of Medicine, University of Dhaka. As per the course curriculum, I have to conduct a dissertation entitled **"A narrative review on physiotherapy management for upper limb functional recovery among the stroke patients"** under the supervision of Ehsanur Rahman, Assistant Professor, Department of Physiotherapy and Rehabilitation, Jashore University of Science and Technology (JUST).

The purpose of the study is to established on physiotherapy management for upper limb functional recovery among the stroke patients. The study involves different studies or literatures related to stroke to established on physiotherapy management for upper limb functional recovery among the stroke patients in Bangladesh.

Therefore, I look forward to having your kind approval for the dissertation proposal and to start data collection. I can also assure you that I will maintain all the requirements for study.

Sincerely,

Dissertation presentation date: 9th January 2023

Khadiza Islam
Khadiza Islam
4th Year B.Sc. in Physiotherapy
Session: 2017-2018 Student ID: 112170413
BHPI, CRP, Savar, Dhaka-1343, Bangladesh

Sdh 27/08/23
Head, Department of Physiotherapy, BHPI

Recommendation from the dissertation supervisor

Shazal Kumar Das
Lecturer
Dept. of Physiotherapy
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E. Rahman
Ehsanur Rahman
Assistant Professor
Department of Physiotherapy and Rehabilitation, JUST

IRB Approval letter

BANGLADESH HEALTH PROFESSIONS INSTITUTE

বাংলাদেশ হেল্থ প্রফেশন্স ইনস্টিটিউট (বিএইচপিআই)

Bangladesh Health Professions Institute (BHPI)

(The Academic Institute of CRP)

Ref: CRP/BHPI/IRB/03/2023/687

Date: 13/03/2023

To
Khadiza Islam
B.Sc. in Physiotherapy,
Session: 2017-2018, DU Reg. No: 8625
BHPI, CRP, Savar, Dhaka- 1343, Bangladesh

Subject: Approval of the dissertation proposal **"A narrative review on physiotherapy management for upper limb functional recovery among the stroke patients"**- by ethics committee.

Congratulations
Dear
Khadiza Islam,
The Institutional Review Board (IRB) of BHPI has reviewed and discussed your application to conduct the above-mentioned dissertation, with yourself, as the Principal Investigator Ehsanur Rahman Robin, Assistant Professor, Department of Physiotherapy & Rehabilitation, JUST as dissertation supervisor. The following documents have been reviewed and approved:

Sr. No.	**Name of the Documents**
1	Dissertation Proposal
2	Questionnaire (English and Bengali version)
3	Information sheet & consent form

The purpose of the study is to establish on physiotherapy management for upper limb functional recovery among the stroke patients. Should there any interpretation, type, spelling, grammatical mistakes in the title, it is the responsibilities of the investigator. The study involves different studies or literatures related to stroke to establish on physiotherapy management for upper limb functional recovery among the stroke patients in Bangladesh. The members of the Ethics committee approved the study to be conducted in the presented form at the meeting held at 09:00 AM on January 9, 2023 at BHPI, 34th IRB Meeting.

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

Best regards,

[signature]

Muhammad Millat Hossain
Associate Professor, Dept. of Rehabilitation Science Member
Secretary, Institutional Review Board (IRB) BHPI, CRP,
Savar, Dhaka-1343, Bangladesh

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