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COMPARATIVE EFFECT OF HIGH INTENSITY INTERVAL TRAINING OVER PROGRESSIVE RESISTANCE TRAINING ON LOWER LIMB FUNCTION IN MCA STROKE

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Elakkiya. R[1] , Jibi Paul[2*]

Author:

[1]MPT Student, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellappanchavadi, Chennai, Tamil Nadu, India

Corresponding Author:

*[2]Professor, Faculty of Physiotherapy, Dr. M.G.R. Educational and Research Institute, Vellapanchavadi, Chennai, Tamil Nadu, India, E-Mail- physiojibi@gmail.com

ABSTRACT

Background of the Study: Stroke is also commonly called a Cerebrovascular accident which is not a term Preferred by most stroke neurologists. Stroke is NOT an accident. High-intensity interval training (HIIT) is a strategy that maximizes exercise Intensity by using bursts of concentrated effort alternated with recovery periods. Its Effectiveness remains to be demonstrated after stroke. This study aimed to evaluate and compare the effectiveness of High Intensity Interval Training over progressive resistance training on lower limb function in MCA Stroke. The Comparative effect of High Intensity Interval Training over progressive resistance Training on lower limb function in MCA stroke. **Methodology:** This was an experimental study of comparative pre and post type with 30 subjects. MCA stroke patient. Both the male and female were included, Patients with stroke of age group 45-65 yrs, were included in the study. The group A [High intensity interval training] consisted of 15 subject s group B, with progressive resistance exercise] consisted of 15 subjects. The Modified Ashworth scale, Berg Balance scale, Lower Extremity functional scale and Coordination test for brain injury were used as the outcome measure. Outcome Measures are Balance, Lower limb function, muscle tone, coordination. Measurement tool are Berg balance scale, Lower extremity functional scale, Modified Asworth scale, Coordination test for brain injury **Result:** The comparative effect of Group A over Group B on MAS, BBS, LEFS and CTFBI shows significant difference on Post Test of MAS, BBS, LEFS and CTFBI with P value <0.0001. Group A intervention found more effective over Group B intervention on MAS, BBS, LEFS and CTFBI with mean score difference of 0.83, 14.60, 16.67 and 14.60 over 0.73, 8.87, 10.73 and 5.33 respectively. **Conclusion:** The study concluded that the High intensity interval training is more effective than the progressive resistance training in improving lower limb function independence in MCA stoke.

Keywords: MCA stroke patients, high intensity interval training, progressive resistance training, berg balance scale, lower extremity functional scale

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INTRODUCTION

The Stroke is defined as a condition characterized by rapidly developing symptoms and signs of a focal brain lesion with symptoms lasting for more than 24 hours or leading to death with no apparent cause other than vascular origin [1].

Cardiovascular diseases affecting the brain and heart share. A number of common risk factors are important to the development of atherosclerosis. Stroke is a second leading cause of death and third leading cause of disease burden. In India, it has the prevalence of 200–350 per every 100,000 people with the incidence of 1.9% in urban and 1.1% in rural areas [2].

Cognitive impairments, including attention, memory, executive functioning and information processing deficits, frequently contribute to reduce the quality of life, notably by doubling the risk of developing dementia. The physical effects of stroke are variable and may include impairment in motor, emotional, and sensory systems, language, perception, and cognitive function [3, 4] .

Upper and lower limb neuromuscular weakness occurs frequently after stroke with loss of muscle strength and dexterity together considered producing the largest impact on functional recovery.. Lifestyle changes can greatly reduce the risk of stroke. Recommendations include controlling BP, diet (cholesterol and lipids), weight loss, quitting smoking, and increasing physical activity, as well as effective disease Management [5,6].

In general, rehabilitation services are designed without fully considering the complexity in functional evolution of stroke survivors. It has been reported that up to 85% of stroke survivors Experience hemiparesis and that 55% to 75% of stroke survivors [7].

The middle cerebral artery (MCA) is one of the three paired arteries that supply blood to the Cerebrum. The MCA arises from the internal carotid and continue into the lateral sulcus where .It then branches and projects to many parts of the lateral cerebral cortex. It also supplies blood. To the anterior temporal lobe and insular cortices [8,9].

The left and right MCA rises from trifurcation of the internal carotid artery, and thus are connect to the anterior cerebral arteries and posterior Communicating arties, which connect to the cerebral arteries. In this study, we investigated the differences in efficacy between three rehabilitation programmes with emphasis on leg function[11].

Balance is the ability to of maintain the centre of gravity over the BOS, usually while in an upright position. Balance is a Dynamic phenomenon that involves a combination of stability and mobility. Balance is necessary to hold a position in space In a controlled and coordinated manner. (Carolyn Kisner) Balance control is a complex sensory and motor skill. It requires spatial and temporal integration of sensory input enabling the planning and execution of movement pattern that Are necessary for central body mass within the BOS[13,14] .

A primary goal for patients poststroke is to maximize locomotor capacity, typically defined as gait speed, which Is strongly associated with endurance, community mobility, quality of life, and mortality from a neuroplastic standpoint, a cascade of events at the molecular, biological,

and systemic level occurs almost immediately after stroke to limit any further damage to brain and initiate mechanisms for recovery [15-17].

There is evidence that high-intensity interval training (HIIT) can promote neuroplasticity and elicit significant improvements in aerobic fitness and peak capacity, as well as lower limb (LL) motor function (e.g., gait efficiency, walking speed and endurance) in persons post-stroke, when compared to lower intensity exercise [18].

The findings of several studies suggest that most patients Maintain their achieved gains of rehabilitation in terms of ADL, walking ability, and dexterity,6 months onwards looking at current evidence in walking recovery after stroke [(10)] Impaired upper extremity function is a common and often devastating problem for stroke Survivors.[(19,20)] In the population-based Copenhagen Stroke Study is 32% Stroke patients had severe arm paresis at admission and 37% had mild paresis [19].

In 64 out of 491 (13%) stroke survivors, the arm remained entirely non-functional despite comprehensive Rehabilitation efforts. Barecca et al., (2001) noted that "Rehabilitation of the hemiplegic upper Limb remains difficult to achieve, with only 5% of stroke survivors who have complete paralysis [22] Regaining functional use of their impaired arm and hand. Those showing some synergistic movement in UL within 4 weeks after stroke have 90% chance of improving. Therapies to restore upper limb function following stroke have been in practice for over 60 years. Many of these are traditional treatments which have focused on regaining control over[20].

Therapies to restore upper limb function following stroke have been in practice for over 60 years. Many of these are traditional treatments which have focused on regaining control over reflexive movement patterns using muscle activation techniques. However, these efforts have not resulted in favorable outcomes for regaining arm function. It has found that 50% of survivors [21].

Aim of the study: The objective of the study is to compare effect of High_Intensity Interval Training over progressive resistance Training on lower limb function in MCA stroke patients.

Need of the Study: Stroke is a most common clinical cerebrovascular disease with high rate of morbidity, mortality and disability that is sufficient enough to bring a huge economic burden to family as well as society. Stroke is one of the common conditions occurring in middle age and old age patient.

METHODOLOGY

This was an experimental study of comparative type [pre and post] with 40 Subjects. The study was carried out at ACS medical college and hospital for 6 months after three approvals from institution of review board [IRB]. The subject was selected for the study after getting consent for participation. An informed consent was signed from the patients. The subject was selected based on inclusion and exclusion criteria and they were assigned in to two groups by Randomized sampling method.

The group A (High-intensity interval training) consisted of 20 subjects, group B (progressive resistance exercise) consisted of 20 subjects. The modified Ashworth scale (MAS), Berg balance scale (BBS), Lower Extremity functional scale (LEFS) was used as the outcome measure.

Inclusion criteria was MCA stroke patient of both the male and female Patients with stroke of age group 45-65 yrs, Patient with a score of 42 above on berg balance scale were included in the study. utcome measures were Muscle tone, Balance, Lower limb function and Coordination. Measurement tools were Modified Ashworth scale, Berg balance scale, Lower Extremity functional scale and Coordination Test for Brain Injury. Materials used for the study was Treatment table, Swiss ball, Thera Band and Standard chair Stopwatch or wrist watch.

Intervention: The research approval will be obtained from the institutional review board of faculty of physiotherapy, outpatient department, Dr M.G.R Educational and Research Institute.

All participants who fulfilled the inclusion criteria enrolled in the study after getting prior informed consent. Total 40 participants randomly assigned in two groups. Group A received High intensity interval training (HIIT). Group B received progressive resistance training (PRT).

Following this a baseline assessment of Modified Ashworth scale (MAS) is the most Universal accept the clinical tool used to measure the increase of muscle tone. The original Ashworth scale was 5 point numerical scale that graded spasticity from 0 to 4, with 0 being no resistance and 4 being a limb rigid in flexion or extension.

The balance evaluation was based on the berg balance scale (BBS). The BBS quantitatively asses the ability of patient to maintain balance and postural control during the performance of daily functional activities as well as determine risk factors for loss of independence and falls. The scale evaluates the functional balance based on 14 common item of daily life such a reaching, turning, standing, and getting up. The maximum score that can be achieved was 56 points. Each of the 14 items that has five possible punctuation alternatives. Zero refer to a situation of incapacity or extreme need to a third party to perform the activity. While score five demonstrates total independence.

Lower extremity functional scale (LEFS) is to measure patient initial function. Ongoing progress and outcome was for wide range of lower extremity conditions. The maximum possible score is 80 points Indicating very high function and minimum possible score and 0 point indicating very low function.

Coordination test for brain injury (CTBI) is ability to perform a series of movement in a specific pattern to achieve a desired action. It involves the simultaneous activation of multiple muscles to produce an accurate task-oriented movement. In this test the coordinator movement of upper and lower limb is tested. Both test or performed in sitting position in specific time duration.

The total score of forty (40) is considered normal. For the person who can perform the action in a minimum time period. If the person unable to perform the action after maximum time considered to the score is (0) and lower limb activities calculated based of time (seconds) taken for the specific movement performance.

Procedure

High intensity interval training: Group A was undergoing high intensity interval training for about 45 minutes. The subject was started with 5 minutes of warm up was given to the subject

such as neck rolls, shoulder roll, arm swing and marching on the both sides.

HIIT can promote neuroplasticity and elicit significant improvements in aerobic fitness and peak capacity, as well as lower limb (LL) motor function. (e.g., gait efficiency, walking speed and endurance) in persons post-stroke, when compared to lower intensity exercise.

The intervention of conducted 3days per week for about 12weeks 36 session. The training is given for about 45 minutes to a participant which includes 5 exercises such as: High knees running to place, Lunges, Plank and Duck walking

Progressive resistance training:

GROUP B The participate ofwas given progressive resistance training for about 45 minutes. The intervention was conducted 3days per week for about 12weeks 36 sessions.

Progressive resistance training is a well-established form of exercise for increasing muscle strength. Additionally, the exercise is systematically progressed, for example, by increasing the amount of resistance. The training is given for about 45 minutes to a participant which includes 5 exercises such as: Single leg lift (With ankle weight or band), Single knee lift (With ankle weight or band), Clam shells, Single leg back and Swiss ball squat.

Data Analysis: The collected data were tabulated and analyzed using both descriptive and inferential statistics. All the parameters were assessed using Graph Prism Pad version 8.4.3, with a significance level of p value less than 0.05 and a 95% confidence interval set for all analysis. The Shapiro Wilk test was used to determine the normality of the data. In this study, Shapiro Wilk test showed that the data was normally distributed on the dependent values at $P > 0.05$. Hence parametric test was adopted. Paired t-test was adopted to find the statistical difference within the groups & Independent t-test (Student t-Test) was adopted to find statistical difference between the groups.

Group A: High Intensity Interval Training

Table 1: Paired t test within Group Aon MAS, BBS, LEFS and CTFBI

Group A	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
MAS	15	0.83	0.24 0.06	14	13.23	<0.0001	****
BBS	15	14.60	3.68 0.95	14	15.37	<0.0001	****
LEFS	15	16.67	6.47 1.67	14	9.98	<0.0001	****
CTFBI	15	14.60	3.14 0.81	14	18.04	<0.0001	****

The above table 1 shows significant difference in MAS, BBS, LEFS and CTFBI within Group A with P value <0.0001 respectively.

Group B: Progressive Resistance Exercise

Table 2: Paired t test within Group Bon MAS, BBS, LEFS and CTFBI

Group B	Number of Pairs	Mean Diff.	SD, SEM	df	t	P value	Sig. Diff. (P < 0.05)
MAS	15	0.73	0.26 0.07	14	11.00	<0.0001	****
BBS	15	8.87	5.64 1.46	14	6.09	<0.0001	****
LEFS	15	10.73	3.96 1.02	14	10.51	<0.0001	****
CTFBI	15	5.33	3.44 0.89	14	6.01	<0.0001	****

The above table 2 shows significant difference in MAS, BBS, LEFS and CTFBI within Group B with P value <0.0001

Comparative Test between Group A and Group B

Table 3: Independent t test between Group A and Group B

Group A&B		Number of Pairs	Mean Diff. ± SEM	R	DF	t	P value	Sig. Diff. (P < 0.05)
Pre test	**MAS**	30	0.10 0.09	0.04	28	1.12	0.271	NS
	BBS	30	0.40 0.81	0.01	28	0.49	0.625	NS
	LEFS	30	1.73 1.83	0.03	28	0.95	0.351	NS
	CTFBI	30	1.33 0.88	0.08	28	1.51	0.143	NS
Post test	**MAS**	30	0.13 0.06	0.15	28	2.26	0.032	*
	BBS	30	6.73 1.06	0.59	28	6.36	<0.0001	****
	LEFS	30	4.20 1.44	0.23	28	2.93	0.007	**
	CTFBI	30	7.93 0.81	0.77	28	9.78	<0.0001	****

The above table 3 shows NO significant difference on Pre Test of MAS, BBS, LEFS and CTFBI between Group A and Group B with P value 0.271, 0.625, 0.351 and 0.143, Post Test of MAS, BBS, LEFS and CTFBI between Group A and Group B shows significance with P value 0.032, <0.0001, 0.007 and <0.0001 respectively.

RESULTS

Total 30 participants, 20 male and 10 female subjects were included in the study based on specific selection criteria and divided in to 15 samples in each Group A and Group B. Participants were with age group between 45 and 65 years.

In this study, the comparative effect of Group A over Group B on MAS, BBS, LEFS and CTFBI shows NO significant difference on Pre Test of MAS, BBS, LEFS and CTFBI between Group A and Group B with P value 0.271, 0.625, 0.351 and 0.143, Post Test of MAS, BBS, LEFS and CTFBI between Group A and Group B shows significance with P value 0.032, <0.0001, 0.007 and <0.0001 respectively.

Group A found effective on MAS, BBS, LEFS and CTFBI with mean score difference of 0.83, 14.60, 16.67 and 14.60 respectively with P value <0.0001, respectively.

Group B also found effective on MAS, BBS, LEFS and CTFBI with mean score difference of 0.73, 8.87, 10.73 and 5.33 respectively with P value <0.0001 respectively.

Group A intervention found more effective over Group B intervention on MAS, BBS, LEFS and CTFBI with mean score difference of 0.83, 14.60, 16.67 and 14.60 over 0.73, 8.87, 10.73 and 5.33 respectively.

DISCUSSION

The purpose of the study is to compare the effect of two different therapeutic interventions which can be enhancing the motor function after stroke. High intensity interval training and progressive resistance exercise for were compared 8 weeks in 30 stroke patients.

Stroke is one of the top causes of long-term disability and mortality in many countries throughout the world, with a high potential of this population increasing further due to the ageing population. According to the disability-adjusted life years, stroke disease stands in fourth place among the disease burden. In 2005, there were 5.7 million deaths globally and 87% of them came from developing countries. Gait is one of the most important functions after stroke[66,67]. Motor imagery (MI) is a cognitive function paradigm that involves the mental imitation of the movement without actual execution[68]. Motor imagery (MI) has been used as part of training programs for a number of clinical conditions to improve motor ability, and has been shown to produce similar brain activity to real movement actions[22].

The result of the study supported by another study Sunee 2020 “A randomized controlled trial of motor imagery combined with structured progressive circuit class therapy on gait in stroke survivors. The result shows that both groups showed Forty stroke survivors participated in the study, 26 males and 14 females. There was no significant difference ($p > 0.05$) in all demographic data including age, height, body weight, sex or other baseline data

such as time since stroke, Functional Ambulation Category (FAC), Mini-Mental State Exam (MMSE), National Institute of Health Stroke Scale (NIHSS), MI ability, type of stroke, side of involvement, and severity. "The combined interventions of MI and SPCCT provided benefits with improvements in the spatiotemporal gait variables and affected muscle strength over the use of HE and SPCCT. We recommend physiotherapists to use MI combined with exercise than exercise alone in the management of stroke survivors [23].

The result of the study supported by another study Kevin 2024" Cardiorespiratory Fitness Benefits of High-Intensity Interval Training After Stroke: A Randomized Controlled Trial. Background of the study Limited evidence supports the effects of short-interval high-intensity interval training (HIIT) for improving cardiorespiratory fitness ($\dot{V}O_{2peak}$) after stroke. We aimed to compare the effects of 12 weeks of short -interval HIIT versus moderate -intensity continuous training (MICT) on $\dot{V}O_{2peak}$, cardiovascular risk factors, and mobility outcomes among individuals ≥ 6 months poststroke. Short-interval HIIT may be an effective alternative to MICT for improving $\dot{V}O_{2peak}$ at 12 weeks postintervention[24].

Bout of High-Intensity Interval Training Improves Motor Skill Retention in Individuals with Stroke. Twenty-two patients with different levels of motor impairment were recruited. On the first session, the effects of a maximal graded exercise test on corticospinal and intracortical excitability were assessed from the affected and unaffected primary motor cortex representational area of a hand muscle with transcranial magnetic stimulation. On the second session, participants were randomly assigned to an exercise or a nonexercised control group. The Conclusions the performance of a maximal graded exercise test triggers only modest neuroplastic changes in patients with chronic stroke. However, a single bout of highintensity interval training performed immediately after motor practice improves skill retention, which could potentially accelerate motor recovery in these individuals [25].

The result of the study supported by another study Alimental 2022"Reduced Middle Cerebral Artery Blood Velocity Response during Low-Volume High-Intensity Interval Exercise in Chronic Stroke. Results Individuals post-stroke demonstrated a reduced MCAv response during HIIT compared to CON ($p = 0.03$) and MCAv remained lower immediately following HIIT and 30-minutes after HIIT. MCAv decreased below BL immediately following HIIT in both groups ($p \leq 0.04$) and returned to BL at 30minutes after HIIT. No between differences were found for MAP, HR, and PETCO2. The Conclusions The key finding from this study suggests a reduced MCAv response during low-volume HIIT in individuals post-stroke compared to age and sex-matched sedentary adults and these differences remained up to 30 minutes following HIIT. Future work is needed to better understand the reduced MCAv response during HIIT despite increased metabolic demand [26].

The result of the study supported by Progressive resistance training increases strength after stroke but this may not carry over to activity: a systematic review. Progressive resistance training compared with no intervention or placebo. The Conclusion is after stroke, progressive resistance training has

a large effect on strength compared with no intervention or placebo. There is uncertainty about whether these large increases in strength carry over to improvements in activity[27].

Ethical Clearance: Ethical clearance has obtained from Faculty of Physiotherapy, Dr. MGR. Educational and Research Institute, Chennai, Tamil Nadu, India. Reference number: No: MPT (NEUROLOGY) 03/ PHYSIO/ IRB/ 2024-2025, dated: 21/12/ 2023.

Conflict of interest: There was no conflict of interest to conduct and publish this study.

Fund for the study: It was a self-financed study.

CONCLUSION

In this study, the comparative effect of Group A over Group B on MAS, BBS, LEFS and CTFBI shows NO significant difference on Pre Test of MAS, BBS, LEFS and CTFBI between Group A and Group B with P value 0.271, 0.625, 0.351 and 0.143, Post Test of MAS, BBS, LEFS and CTFBI between Group A and Group B shows significance with P value 0.032, <0.0001, 0.007 and <0.0001 respectively.

Group A found effective on MAS, BBS, LEFS and CTFBI with mean score difference of 0.83, 14.60, 16.67 and 14.60 respectively with P value <0.0001, respectively.

Group B also found effective on MAS, BBS, LEFS and CTFBI with mean score difference of 0.73, 8.87, 10.73 and 5.33 respectively with P value <0.0001 respectively.

Group A intervention found more effective over Group B intervention on MAS, BBS, LEFS and CTFBI with mean score difference of 0.83, 14.60, 16.67 and 14.60 over 0.73, 8.87, 10.73 and 5.33 respectively.

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