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Effect of Endurance Training in Chronic Ischemic Stroke Survivors.

Dr Suraj B.Kanase* and Dr Tanishqa C.
Department of Neuro Physiotherapy, Krishna College of Physiotherapy, Krishna Vishwavidyapeeth, Karad, Maharashtra, India
*drsurajkanase7@gmail.com

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Abstract

Background: *Stroke is a leading cause of morbidity and mortality on a global scale. Chronic stroke is considered to be 6 months and older. The risk factors associated with stroke are high blood pressure, diabetes, high cholesterol, and obesity. Functional impairments in chronic stroke causes a various limitation and wide range of problems in functional mobility, gait and quality of life. However, once the patient goes into chronic phase dominant synergy pattern develops that make it difficult to establish an appropriate functional outcome. A positive effect is shown in the recovery of acute stroke with physiotherapy intervention. As the condition becomes chronic, functional capacity of survivors decreases. So there is need to have definite means to achieve these problems.*

Objectives: *This study aimed to find the efficacy of endurance training in chronic ischemic stroke survivors.*

Methods: 30 subjects were included in the study. The participants were selected based on the inclusion and exclusion criteria. They were the divided into 2 groups. Group A control group were given routine conventional intervention group B experimental group were given conventional along with endurance training. The treatment protocol was given for 3 weeks with duration of 40-50 mins. The pretest and posttest measurement analyzed based on functional independence measure and stroke specific quality of life outcomes.

Result:*Data was analyzed using the student-t-test with significant improvement in the outcome measures in both groups but Group B showed extremely statistically significant difference in terms of p value.*

Conclusion: *Endurance training given with conventional intervention has shown to have positive effect in functional capacity and quality of life chronic ischemic stroke survivors.*

Keywords *– Chronic ischemic stroke, Functional independence measure, Stroke Specific Quality of life, Endurance training, Physiotherapy.*

1. INTRODUCTION

Cerebrovascular accident (CVA), commonly referred to as a stroke, is characterized by the sudden onset of neurological deficits resulting from an abrupt interruption of blood flow to the brain [1][. The World Health Organization (WHO) defines a stroke as the immediate appearance of clinical manifestations indicative of either localized or diffuse disturbances in brain function that persist for more than 24 hours or lead to mortality, with the condition being attributed solely to a vascular event [2]. In India, the prevalence of stroke is alarmingly high and has experienced a significant upward trend over the last decade, escalating from 105 to 152 cases per 100,000 individuals, highlighting a growing public health concern that necessitates urgent attention and intervention strategies [3].

The primary risk factors associated with stroke encompass hypertension, diabetes mellitus, dyslipidaemia, and obesity. Furthermore, the prolonged use of oral contraceptive pills has been identified as a potential contributor to an elevated risk of stroke [4]. It is important to note that the clinical manifestations following a stroke can vary significantly based on the individual's characteristics, including their age and sex [5]. Notably,

the incidence of stroke is generally higher among older males, while younger females are also at an increased risk, suggesting that both age and gender play critical roles in the epidemiology of stroke and its associated outcomes [6].

Ischemic type of stroke, is the most common type and accounts for about 80% of cases and occurs when a blood clot obstructs or reduces blood flow, depriving the brain of oxygen and nutrients causing neurological damage and impairments [1]. Regaining functional independence is a crucial aim for stroke patients and a primary area of focus in stroke recovery. Despite the neurological damage and deficits caused by a stroke, many patients experience functional recovery over time [7]. This recovery is most evident within the first 3 months after the stroke and tends to stabilize between 3 and 6 months [8-11].

Chronic stroke is associated with diminished functional capacity, compromised joint integrity, falls resulting from dominant synergy patterns in the upper and lower extremities, and impaired coordination among other deficits. Studies have demonstrated that in cases of hemorrhagic stroke, there is no significant enhancement in quality of life [12]. The challenges encountered in chronic stroke differ from those in the acute phase. Established motor patterns become resistant to modification, and in many cases, patients reach a plateau where additional interventions have limited impact on functional outcomes. A reduction in endurance can adversely affect overall well-being, leading to diminished capacity for prolonged physical activity [13].

Functional impairments in chronic ischemic stroke patients often involve persistent motor, sensory, and cognitive deficits. These impairments can manifest as reduced strength, spasticity, coordination issues, and cognitive decline[14]. The severity and types of functional deficits vary widely, influenced by factors such as the lesion location, the initial severity of the stroke, and coexisting medical conditions like hypertension and diabetes[15].

Cognitive impairments, particularly in domains like attention and memory, are also common in chronic ischemic stroke. This can lead to difficulties in performing activities of daily living, affecting the quality of life[15]. Moreover, post-stroke depression and fatigue further exacerbate these challenges, making rehabilitation and functional recovery more complex[16]. Muscular adaptations occur, posing a significant barrier to functional independence. These adaptations primarily involve morphological changes, alterations in muscle metabolism, and modifications in electromechanical properties. Over time, these changes become permanent, reducing the muscle's responsiveness to therapeutic interventions [13].Thus the current study aims to find the effect of endurance training in chronic ischemic stroke survivors.

MATERIALS AND METHODS

Study Type: Comparative Study

Sampling Technique: Simple random sampling. A total of 30 subjects were selected based on the inclusion and exclusion criteria. Age group selected was between 30-60 years. Subjects with any other systemic illness were excluded. The objective of the study was to see the effect of endurance training on chronic ischemic stroke survivors.

Outcome Measures: Functional Independence Measure (FIM) and Stroke Specific Quality of Life were the two outcomes used for the study. FIM is used to assess the functional mobility and Stroke Specific Quality of Life were used to assess the quality of life of stroke survivors.

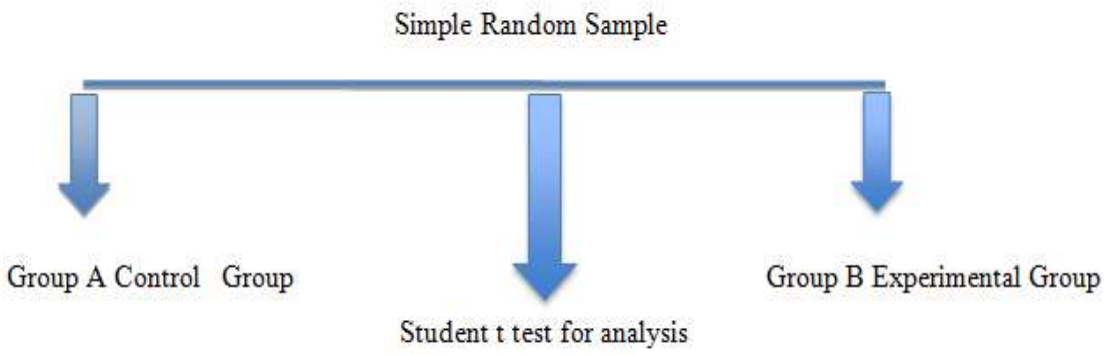
Procedure: The study began following the ethical approval from the Institutional Ethical Committee at Krishna Institute of Medical Sciences, a deemed university in Karad. In this study, the effect of endurance training was seen on the functional mobility and quality of life in chronic ischemic stroke survivors. 30 subjects selected on the basis of the inclusion and exclusion criteria. On the first day, participants were informed about the treatment, including its potential benefits and risks, the duration for each session. They were also asked to follow food timing that is 30-40 mins break prior and post the session. They were also informed that they could discontinue the treatment if any discomfort felt.

The participants were then divided into two groups Group A control group and Group B experimental Group. The duration of the study was 3 weeks. Outcome measures like stroke specific quality of life scale used to assess the quality of life of chronic ischemic stroke survivors and functional independence measure was used to assess the functional mobility in chronic ischemic stroke survivors. The patient was assessed pre and post to the study.

Group A- In control group conventional exercises were given which included. Each session was for about 40-50 mins

Group B- In experimental group along with conventional exercises along with endurance training which include. Each session was about for 40-50 mins

Total number of subjects 30



RESULTS:

In this study the 30 subjects were divided into two groups 15 in each group. Group A control group received conventional exercises while, group B experimental group received conventional exercises along with additional endurance training. The analysis was made within and between the groups. To find out which treatment was better among both groups unpaired t test was used. Functional independence measure (FIM) and stroke specific quality of life were used to pre and post the treatment session. Table 1 represents analysis of quality of life within control group. Table 2 represents analysis of quality of life within experimental group. Table 3 represents analysis of quality of life between control and experimental group by using unpaired t test. Table 4 represents analysis of functional mobility within control group. Table 5 represents analysis of functional mobility within experimental group. Table 6 represents analysis of functional mobility between control and experimental group. The analysis states that both control and experimental group were statistically significant in improving functional mobility and quality of life among chronic ischemic stroke survivors. But the experimental group shows more statically significant difference in terms of p value stating that there was better improvement in functional mobility and quality in experimental group that received conventional intervention along with endurance training. Statistical analysis was done by the statistics software's SPSS version 16.0.

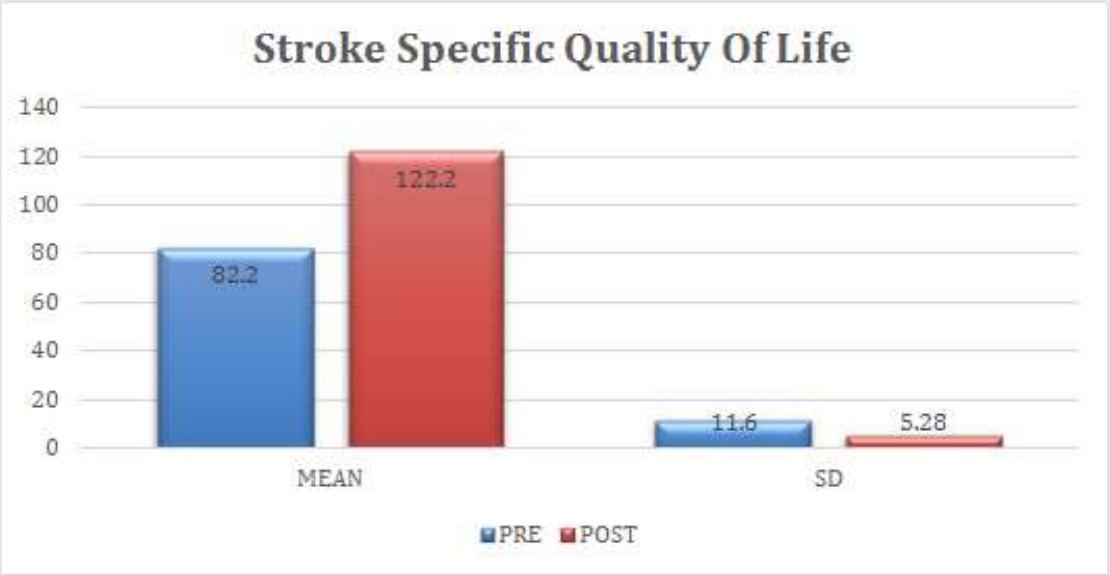


Table1- Within Group Comparison of Pre and Post of Group A (control group)
t=12.14* and p value is 0.005*

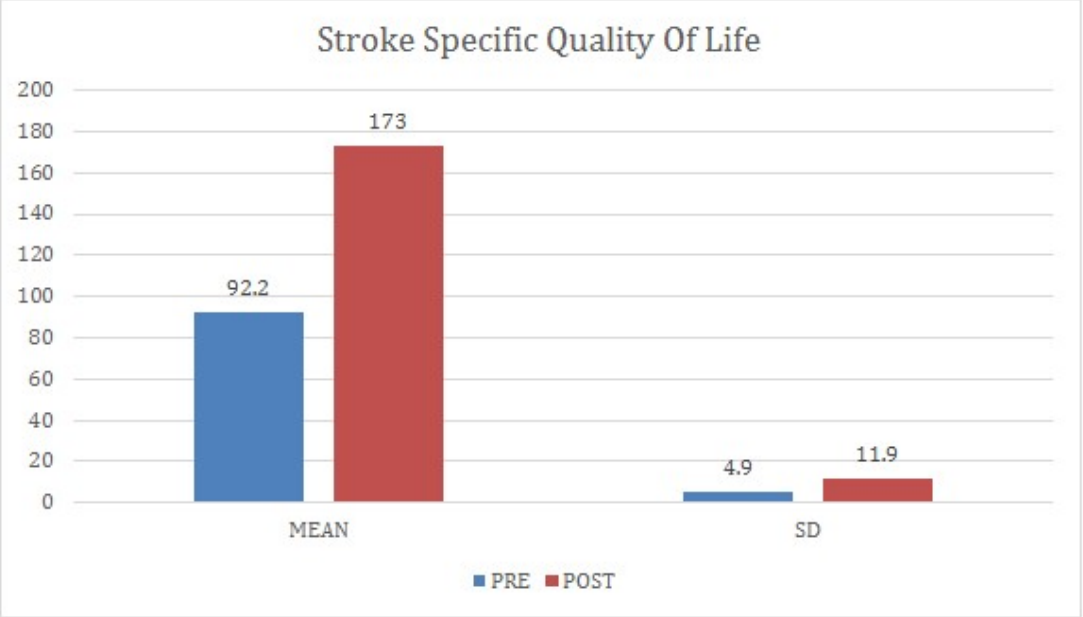


Table 2- Within Group Comparison of Pre and Post of Group B (experimental group)
t=24.14* and p value is 0.002*

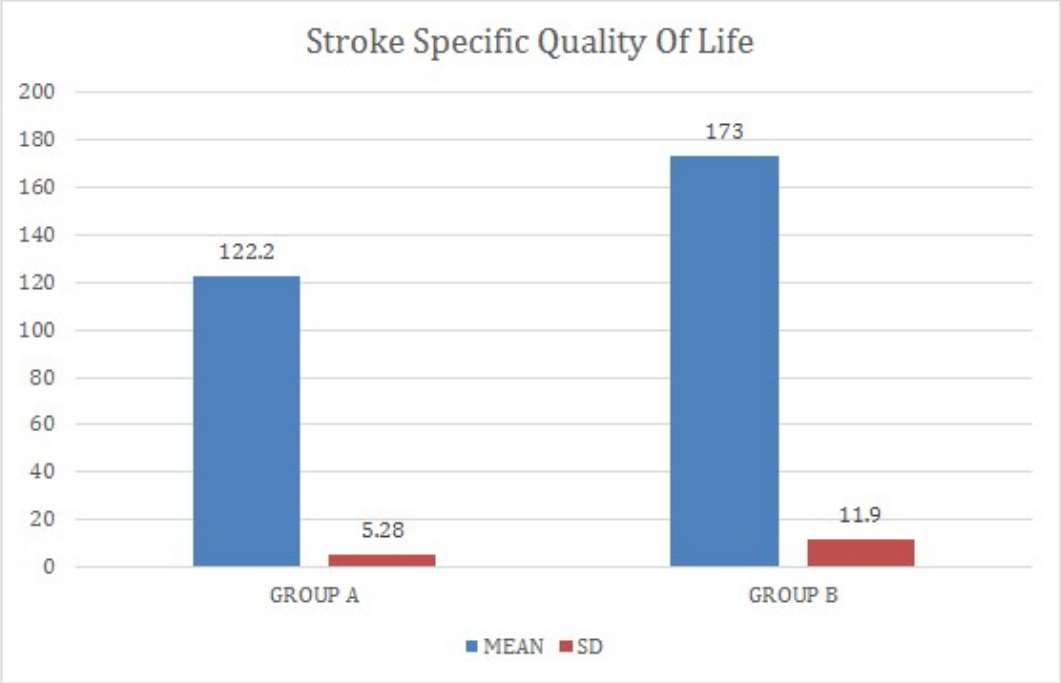


Table 3- Between Group Comparison of Group, A post and Group B Post
t=15.06* and p value is 0.004*

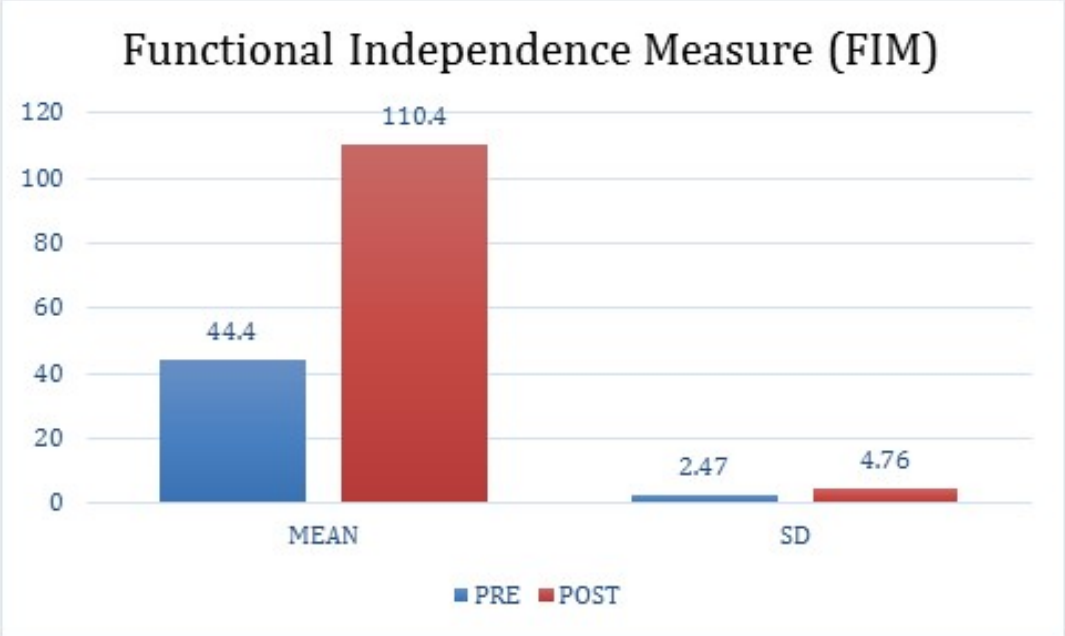


Table 4- Within Group Comparison of Pre and Post of Group A
t=47.97* and p value is 0.02*

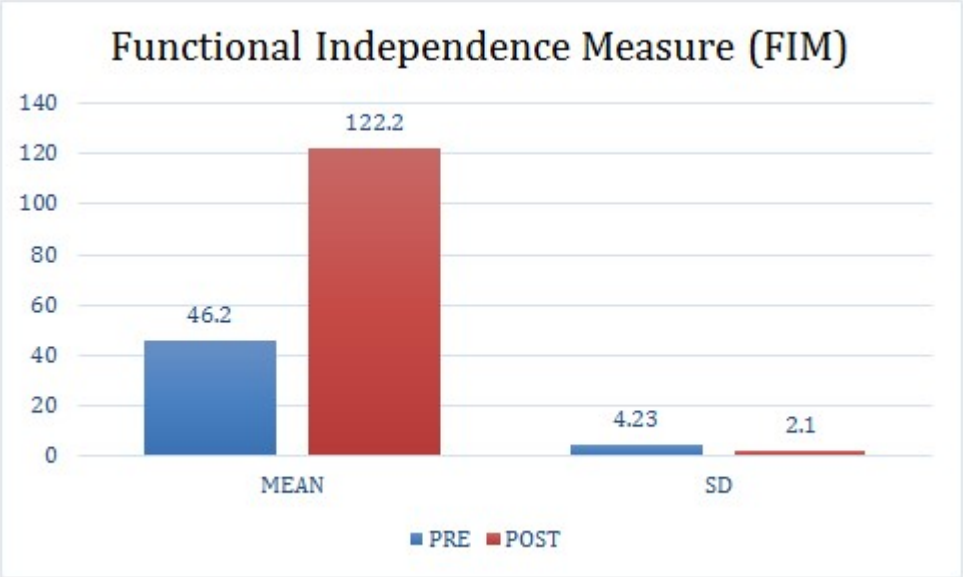


Table5- Within Group Comparison of Pre and Post of Group B
t=63.55* and p value is 0.004*

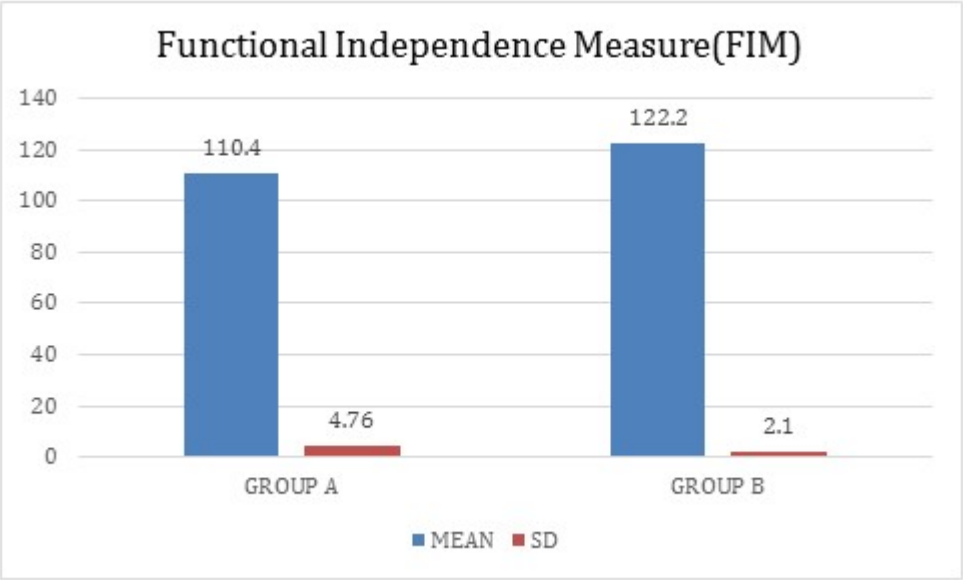


Table 6- Between Group Comparison of Group, A post and Group B Post
t=8.86* and p value is 0.001*

DISCUSSION

Stroke is a primary contributor to global morbidity and mortality.It not only affects musculoskeletal system, nervous system but also the cardiovascular system gets compromised directly or indirectly in chronic ischemic stroke survivors. About one-third of stroke survivors present with depression which affect their quality of life. Thus, the present aimed to focus on the effect of endurance training in chronic ischemic stroke survivors.

Functional Mobility

Endurance training exercises, including walking, jogging, swimming, cycling, and rope jumping, aim to enhance cardiovascular and respiratory function by elevating heart rate and breathing. These activities activate both tonic (postural) and phasic (dynamic) muscle groups, potentially influencing motor patterns and mobility.

Circuit-based training has been shown to produce greater improvements in gait parameters, particularly in spatial and temporal aspects such as step length, stride width, and cadence[17]. On the other hand, treadmill training also has demonstrated superior outcomes in enhancing specific gait characteristics in individuals with chronic stroke, particularly those presenting with hemiplegic gait, by facilitating more symmetrical and coordinated movement patterns through repetitive, task-specific practice [18]. This approach has led to a reduction in the compensatory overactivation of the quadratus lumborum muscle, thereby promoting more efficient neuromuscular coordination between the spine and lower limbs. This improved integration enhances overall movement synergy, contributing to better biomechanical alignment and functional stability during dynamic activities. From a physiological perspective, endurance exercises induce an increase in mitochondrial density and enhance the oxidative capacity of muscle fibers, leading to improved cellular respiration and energy production. As a result, these adaptations elevate overall metabolic efficiency, allowing for sustained performance of physical tasks with reduced fatigue and greater endurance during prolonged activities. Also, endurance training has minimum chances of injury. Thus, regular implementation of low-intensity, polarized endurance training, focusing on enhancing functional stability and core muscle strength, that likely led to significant improvements in functional performance and motor recovery in individuals with chronic stroke by promoting better postural control and overall mobility. Thus, endurance training had positive impact in improving functional mobility in both groups. However, in group B it showed extremely statistically significant difference.

QUALITY OF LIFE

The quality of life in individuals who have survived chronic ischemic stroke is often significantly impaired, primarily due to the resulting physical limitations and functional disabilities that hinder their ability to engage in daily activities and exercise. These restrictions can lead to decreased mobility, increased dependence on caregivers, and a lower overall level of physical activity, ultimately impacting their physical, psychological, and social well-being. Approximately 30% of individuals who have survived chronic ischemic stroke experience depression, a psychological condition that can profoundly impact their overall quality of life[19]. This comorbidity not only exacerbates physical limitations and functional impairments but also contributes to diminished emotional well-being, reduced social engagement, and an overall decline in health-related quality of life, ultimately complicating their rehabilitation and recovery process. Regular endurance training has a direct and beneficial impact on blood pressure regulation, which is recognized as a significant risk factor for stroke[20].Maintaining normal blood pressure levels has been demonstrated to enhance physical performance, thereby contributing to improved functional capacity and overall quality of life in individuals, particularly those recovering from cerebrovascular events. This relationship underscores the importance of incorporating endurance training into rehabilitation programs for stroke survivors to mitigate cardiovascular risks and promote optimal health outcomes. Significant improvements in inspiratory muscle strength have been noted in individuals with chronic conditions. Additionally, also the strength in the knee muscle serves as a predictor of walking ability in patients with chronic mild to moderate hemiparesis[21]. Implementing Progressive Resistance Exercises (PRE) has proved to be an effective intervention for enhancing muscle strength in individuals who have experienced chronic stroke, thereby potentially improving their functional mobility and overall rehabilitation outcomes. Physiotherapy has shown to improve quality of life in stroke survivors with power and endurance training.[22,23]. Thus, endurance training plays a crucial role in enhancing cardiovascular stamina, thereby enabling individuals to sustain longer durations of physical activity. This increased endurance may facilitate the performance of activities of daily living (ADLs) and contribute to an overall improvement in lifestyle and functional independence, promoting better health outcomes and quality of life in patients, particularly those undergoing rehabilitation.

Thus, endurance training positively influenced the quality of live in both groups. However, Group B demonstrated an exceptionally statistically significant improvement compared to the other group.

CONCLUSION

The study concluded that endurance training had positive impact on the functional mobility and quality of life of chronic ischemic stroke survivors of both groups. However, it showed better results in group B receiving both conventional as well as endurance training thus better results in functional mobility and quality of life.

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