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The Comparison of Sensorimotor Integration Effects Towards the Change in Standing Balance Level Between Hemiparesis Post Non-Hemorrhagic and Hemorrhagic Stroke Patients

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Abstract

Stroke is a brain functional disorder both focal and global acute, this is a sudden, progressive, and rapid illness by dint of the inhibition of bloodstream to the brain due to either the hemorrhage/hemorrhagic stroke or the blockage/non-hemorrhagic stroke with symptoms and signs corresponding to the affected part of the brain. The sensorimotor exercise is an activity involving sensory and motor coordination aimed at enhancing the sensorimotor ability which consists of such as visual, tactile, proprioceptive, vestibular, auditory and kinesthetics/motor movement capabilities to achieve a directed, purposeful and functioning motion. The research employed experimental research methods with two group pre-test and post-test. There were two groups of patients in this research namely Non-Hemorrhagic stroke Patients and Hemorrhagic stroke patients.

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The sample was determined by Slovin formula which amounts to 20 people. Each group amounted to 10 people by utilizing purposive sampling as the sample selection technique. The result of the paired sample t-test shows that p = 0,000 for each NHS group and HS group. The value is smaller than α = 0.05, which means there is a noticeable effect of sensorimotor integration to the changes in standing balance level in hemiparesis post NHS and HS patients. Then, the outcome of an independent sample t-test indicates that the value p = 0,023 (p <0,05). It signifies that there is an obvious distinction from the provision of sensorimotor integration toward the alteration in standing balance level to hemiparesis post NHS and HS patients i.e. the NHS group given sensorimotor integration is more effective than the HS group.

Keywords: Standing Balance Disorder; Non-Hemorrhagic Stroke; Hemorrhagic Stroke; Sensorimotor Integration; Berg Balance Scale (BBS)

1. Introduction

Stroke is a sudden attack that occurs in the brain involving blood vessels in the brain either blocked or ruptured. Impairment in the brain is mainly caused by two things: the blockage or known as non-hemorrhagic stroke (NHS) and the presence of blood vessels that break in the brain or known hemorrhagic stroke (HS). Both of these will eventually cause interference in certain brain regions that are supplied by the ruptured or blocked blood vessels [1].

Data from the World Health Organization (WHO) shows that death from vascular disease is more than other diseases, which is around 15 million per year and stroke contributes 4.5 million per year to the total mortality rate [2]. The death rate caused by stroke reaches 9.7% of the total causes of death. This number is ranked second highest in the world [3].

Sensory and motor loss in post-stroke patients results in balance disorders including muscle weakness, decreased soft tissue flexibility, and impaired motor and sensory control. The loss of function occurs due to impaired motor control in stroke patients which in turn causes loss of coordination, and decreased ability to feel body balance and the ability to maintain certain positions [4].

Balance disorders when standing in stroke patients are related to the inability to regulate weight loss and decreased muscle control so that the body's equilibrium decreases. Patients with recurrent strokes have problems with postural control, thus inhibiting their movements. Balance is also an important parameter of successful rehabilitation in stroke patients [5].

Various physiotherapy intervention methods such as electrotherapy, hydrotherapy, and exercise therapy such as Bobath, proprioceptive neuromuscular facilitation (PNF), neuro-developmental treatment (NDT), sensory motor integration (SMI), constraint induced movement therapy (CIMT) have been shown to provide great benefits in reversing motion and function in patients post stroke [6].

The most important sensorimotor function is the function of coordination and balance [7]. Therefore, one of the treatments to improve the balance of standing of post-stroke patients is to provide sensorimotor integration

training. Sensorimotor training is an exercise that involves sensory and motor coordination which aims to enhance sensorimotor abilities consisting of visual, tactile, proprioceptive, vestibular, auditory, kinesthetic and motoric abilities [8].

Although studies on the effect of sensorimotor integration on balance in post-stroke patients have been widely carried out, studies on sensorimotor integration effects on changes in standing balance between NHS and HS patients are still limited. In addition, there is still debate about the prognosis between NHS and HS related to survival and disability outcomes. The aim of this study was to compare the effects of sensorimotor integration on changes in standing balance between NHS and HS patients.

2. Materials and Methods

2.1. Description of the Study Area

This study was an experimental study with a pre-test and posttest two groups design. This research was conducted at the Physio Sakti Clinic and Salewangang Maros Hospital.

2.2. Population and Sample

A total of 20 stroke patients were willing to participate in this study.

2.3. Inclusion Criteria

The inclusion criteria were NHS and HS patients based on MRI or CT scan results, which were being treated at the Physio Sakti Clinic and Salewangang Maros Hospital and have balance problems when standing. Subjects were divided equally into two groups: NHS and HS.

2.4. Exclusion Criteria

The exclusion criteria were:

1. Patients with recurrent stroke
2. Patients with normal balance

2.5. Collecting Data and Procedure Intervention

Data collection was carried out by researchers using measurement instruments and interview guidelines. Information about the characteristics and general condition of the subjects, including name, age, status, occupation, and history of injury is obtained through interviews. Berg Balance Scale (BBS) was used to measure the balance of stroke patients conducted at baseline and after 6 times given sensorimotor integration training.

2.6. Data Analysis

The collected data were tested for normality then paired t test was conducted to determine whether there was a

difference between the baseline and after 6 treatments. To find out the differences in sensorimotor integration effects between NHS and HS, an independent t test was carried out. All statistical tests were carried out with computerized.

2.7. Ethical consideration and clearance

Ethical approval for this study was obtained from the Ethics Committee, Hasanuddin University, Department of Nursing, Makassar, Indonesia.

3. Results

Based on the characteristics of the study subjects, the majority of subjects were over 51 years of age (Table 1) and the number of men and women was equal, each of 10 people.

Table 1: Characteristics of Respondents

Characteristic of Respondents		**Group of NHS dan HS** N	%
Age			
	41-51	6	30
	52-62	10	50
63-73		4	20
	Total	20	100
Mean		54,60	
Sex			
	Male	10	50
	Female	10	50
	Total	20	100

Information: n = number of samples;

Statistical tests showed that there were significant differences ($p < 0.01$) between BBS scores before and after sensorimotor integration training in both the NHS and HS groups where the BBS score after the sensorimotor integration exercise was higher than before the sensorimotor integration exercise. The results of the independent t test showed that there were significant differences in BBS scores ($p < 0.05$) between NHS and HS after sensorimotor integration training (Table 2).

Table 2: Distribution of Mean, Standard Deviation, Minimum, Maximum, Median on Pre-Test and Post Test Group NHS and HS

		n	**Mean**	**SD**	**Min**	**Max**	**Median**	**Change**	**p**	**Pp**
NHS	**Pre-Test**	10	24,10	5,859	15	32	24,50	15,80	0,000	0,023
	Post Test	10	39,90	9,550	21	51	41,50			
HS	**Pre-Test**	10	18,50	3,375	14	25	19,00	11,20	0,000	
	Post Test	10	29,70	5,716	21	42	30,00			

Information: SD = Standard Deviation; p = *Paired Sample T test*; pp = *Independent Sample T test*

4. Discussion

The more a person ages, the higher the risk of stroke. After 55 years of age, the risk will double every 10 years and also cause blood vessels to become stiff due to plaque.[9] Men are more at risk of stroke than women, with a ratio of 1.3: 1, except in elderly men and women almost no difference. Stroke in men occurs at a young age, so the survival rate is also higher than that of women. In other words, even though women are less likely to have a stroke, generally, women have a stroke at an older age, so the chances of dying are greater [10].

Improved balance when standing in the NHS and HS groups after receiving sensorimotor integration training 6 times occurs because the exercise integrates a variety of sensory and motor systems that are carried out gradually and repeatedly so that the patient is easy to understand and perform the movement properly and correctly. This is in line with the research conducted by Wijaya on 19 respondents who showed that 6 times the treatment gave significant changes to the balance level of stroke patients, in which as many as 16 respondents experienced an increase in balance [11].

This was also reinforced by research conducted by Jang & Lee that sensory integration is an important factor to maintain balance in stroke patients who experience balance disorders [12]. Research conducted by Doyle et al shows that there is a relationship between sensory and motor functions that affect motion recovery after stroke including recovery of balance [13]. Sensorimotor exercise uses several combinations of sensory input and motor activity to facilitate the expected normal motor response and improve motor skills [14].

In addition, the basis of sensorimotor integration theory is based on neurophysiological research, in which the ability of the central nervous system to adapt to more sensory input (plasticity). Synapse plasticity is associated with functional improvement after stroke. Under normal conditions, synapse activity in the central nervous system is divided into long term potentiation (LTP) and long-term depression (LTD). The difference between these two types of synapse activity depends on activity. If activity is repeated more frequently, an LTP will be formed in synapse relationships, can lead to synapse remodeling and the formation of new circuits; this remodeling process can be temporary or permanent [15].

Stroke causes limited recovery of brain function, even though the peri-infarct area is neuroplastic which allows the improvement of sensory function to remap the damaged brain area. In the study of the brain states that the brain that is damaged can recover if the brain is stimulated. It is this amount of experience and sensory input that will facilitate the development of synaptogenesis in the brain [15]. There is evidence that in certain situations, healthy parts of the brain can take over the function of damaged parts. In other words, parts of the brain will learn new abilities. This is the most important mechanism that plays a role in recovery post stroke [10].

Increased standing balance can occur because the sensorimotor integration exercises contain combining exercises with verbal and visual feedback, understanding the right movements, motor learning, repetition, and patient independence so that neural adaptation occurs. After neural adaptation, a multi-synapse latent path activation process will occur which can be activated if the dominant path fails to experience damage. Furthermore, there will be an increase in the sensitivity of neural connections, and axonal regeneration will

occur [11]. Of the various mechanisms of neuroplasticity, there will be an increase in sensory perception, motor learning, and cognitive improvement. Sensory apperception, motor learning, and cognitive improvement combine stimulation and movement learning when doing balance exercises when standing. This is what causes changes in the level of balance standing in patients post NHS and HS.

Balance control requires complex mechanisms, where sensory information derived from the somatosensory, visual, and vestibular systems must be integrated. If information from certain sensory systems is inaccurate or confusing, information from other sensory systems must be integrated in the central nerve to maintain body balance. Sensory reweighting can be defined as the ability to choose the most appropriate information that can maintain posture stability. Most studies report that patients with strokes tend to depend on one sense like vision. Recovery of the patient's proprioception with stroke is an important factor for the ability to maintain balance [12].

In this study, the initial severity of the patient also influenced the level of balance. From the results of the HS group pre-test, the average level of balance was in the category of high-risk falls, whereas in the NHS group, the results of the pre-test showed that the average subject was in the category of moderate risk of falling. Factors that might influence the difference between NHS and HS groups are the interval between stroke onset and physiotherapy.

Research conducted by Perna and Temple suggested that those who suffer from non-hemorrhagic stroke have a better chance of surviving than those who experience hemorrhagic stroke, because hemorrhagic strokes not only damage brain cells but can also cause increased pressure on the brain or spasms in the blood vessels [16].

In addition, a study put forward by Chiu et al showed that among stroke patients, intracerebral hemorrhage (ICH) was a precipitating factor in poor neurological outcomes which was almost double the likelihood of long-term disability compared to NHS [17].

But to date, the prognosis between NHS and HS is still debated, because several other studies have found that the HS prognosis for increased functional activity is greater than NHS patients. According to Franke, the severity and level of brain lesions, not the type of stroke, that determines survival and disability in stroke patients [17].

The level of lesions from the brain itself is also a determining factor in the results of those who survive the first two days after a stroke [16]. Symptoms of local deficits in hemorrhagic stroke will be severe symptoms, whereas in non-hemorrhagic strokes can be severe or mild [18]. Similarly, in manifestations stroke depends on the size of the lesion and can also depend on the location of the lesion [19].

5. Conclusions

In conclusion, there is an effect of sensorimotor integration training on changes in balance levels when standing in NHS and HS patients. However, from this study, sensorimotor integration training had a more significant effect on the NHS group than the HS group. This method is expected to be used more effectively against post

stroke in dealing with standing balance disorders.

6. Recommendations

This method is expected to be used more effectively against post stroke in dealing with standing balance disorders.

Abbreviations

NHS: Non-Hemorrhagic Stroke; HS: Hemorrhagic Stroke.

Competing interest

The authors declare that they have no competing interest

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