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Research Article

EFFECT OF WHOLE BODY VIBRATION TRAINING ON SPASTICITY, ANKLE MOBILITY, BALANCE AND QUALITY OF LIFE IN SUBJECTS WITH STROKE - A RANDOMIZED CONTROLLED TRIAL

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A B S T R A C T

Background & Objective: In subjects with stroke quickly emerging medical signs are seen which can be focal or may be global if we consider coma and cerebral function problems that long-lasting for 24 hours and more than that. Vascular origin is the only possibility of death. Imbalance on right and left side is the major issue that causes reduction in movement even it affect posture control hence center of gravity (COG) drops and risk of fall increases. As spasticity pile up the ankle joint movement restriction may occurs regarding that balance issues increases. Whole-body vibration training (WBV) is newly launched but much evidences about its benefits are not yet proven. Hence this study aimed to find out whether whole body vibration trainingis effective on spasticity, ankle mobility, balance and QoL in subjects with stroke.

Methods: 32 subjects with stroke between 65-85years were randomly allocated into experimental group received whole body vibration training and conventional physiotherapy with balance training (n=16) and control group performed conventional physiotherapy with balance training (n=16). Outcome used were Modified ashworth scale, Ankle range of motion, Berg balance scale, and CASP-19.

Results: The result of the study states that the group A and group B both are statistically significance in terms of spasticity, ankle dorsiflexion mobility, balance and quality of life expect for ankle plantar flexion mobility in group A.

Conclusion: Both the groups were equally effective in terms of spasticity, ankle mobility dorsiflexion, and plantar flexion, balance and quality of life except plantar flexion mobility in group A was not improved in elderly subjects with stroke.

INTRODUCTION

A stroke or cerebrovascular accident or brain attack is a very commonest and severe neurological disorder. It can cause transitory and permanent damages in the brain and even death of the patient[1]. During aging, fall risk increases in older adults and they are more dependence on others because of loss of functional flexibility and decrease in muscle strength[2]. Chance of spasticity after stroke is more than 39%.[3]Because of spasticity in stroke the ankle joint movements restriction occurs regarding that balance issues increases. It automatically lead to decrease functional activities. Imbalance on both the sides is common in which affect posture control[4]. Hemiplegic patients have decreased balance control due to more spasticity. it can even effect gait pattern of stroke patients.

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Spastic ankle joint affect parameters of gait as well as balance, ankle dorsiflexion declines it might be reason for increase in double leg supporting time and swing phase in entire cycle of gait[6]. Hence walking velocity and mobility might decreases as a result of spastic ankle. Stroke patients may have both affected and non-affected side uneven weight distribution. It causes difficulties with controlling balance. Studies state that problems of hemiplegia which makes difficulty in balance the key factor responsible for that is soma to sensation loss. Contracture or pain occurs in stroke patients due to spasticity, it can restrict functional recovery. Because of that ankle mobility can reduce & balance problems can increase in subjects with stroke. Hence quality of life may decrease in those elderly.

It is important to reduce spasticity and increase ankle mobility. That can enhance balance and lead to better quality of life in subjects with stroke.WBV training has less evidences, also it is introduced in recent times. Exercises were performs by the

subjects on a platform which creates vibration in sinusoidal vertical manner[10]. The Platform transfers a stimulus like vibration from the touching base to other part of the body. These stimuli which is transmitted to whole body provokes the muscle spindles in primary endings, in which muscle contractions occurs by activating alpha motor neurons. So WBV is responsible for providing a solid sensory stimulus that muscle spindles gets activated and it may boost proprioception[2]. The individual stands or sits on a vibrating platform it is supposed to have multiple therapeutic effects[7]. There are studies stating that whole body vibration training is effective for preventing fall, increase stability & strength in elderly[2]. A study stating that in stroke whole body vibration can decrease postural sway. [3]In elderly with stroke a single sitting of whole body vibration training for plantar flexion spasticity is effective.[10]

There is paucity of studies in which states that the effectiveness of whole body vibration training on spasticity, ankle mobility, balance and quality of life in subjects with stroke hence present study is under taken.

METERIALS AND METHODS

Approval from the Institutional ethical committee was obtained for the study (KIPT/346/03.07.19). Permission taken from oldage homes for the research purpose. Candidates were informed about the aims and procedure of the study. All the subjects screened for inclusion and exclusion criteria prior. A written informed consent form was acquired from all the subjects willing to participate. After the recruitment of subjects in the study 32 subjects met inclusion criteria were randomly allocated to two groups using envelope method, 16 subjects in each groups. Baseline demographic details were noted.

GROUP A: Whole body vibration training and conventional physiotherapy with balance training.

Whole body vibration training by using Galileo®Fit for 30 minutes.ie vibration for 10 minutes with 1 minute relaxation continuous for 30 minutes with frequency of 10Hz to 40Hz in which patient can tolerate and conventional physiotherapy for 25 minutes with balance training for 25 minutes in-between conventional and balance training 10 minutes rest interval i.e. total 60 minute program given thrice a week for 4 weeks.

GROUP B: Conventional physiotherapy with balance training

60 minutes program divided into 25 minutes of conventional physiotherapy and after 10 minutes interval period, session of 25 minutes of balance training starts. This training was thrice a week for 4 weeks focused on conventional physiotherapy includes initiate movements on affected side, stretching exercises, range of motion exercises, strengthening exercises for lower limb and balance training (one foot stance, tandem standing, weight shifting, tandem walking, stepping up & low rises, side stepping, stepping over obstacles). Baseline and Post (4th week) using Modified ashworth scale, Ankle range of motion, Berg balance scale, and CASP-19.

RESULTS

When comparing within the group changes of the MAS plantar flexion within the groups analysis, p value of group A was p=0.005 and group B was p value = 0.008. Which stated that the both group exercise had a beneficial effect on the spasticity i.e. ankle plantar flexion of the participants. In between the group analysis for the MAS PF, pretest mean scores p value was 0.302 and 1.000 was p value for posttest mean scores between the groups which was not statistically important (Table 6).Within the group analysis for MAS dorsiflexion group A p value was 0.001(Table 4), group B p value was 0.011(Table 5).In which the experimental group and control group showed statistical significance. Hence both groups are effective on ankle dorsiflexion spasticity of subjects. In between the group analysis for the MAS dorsiflexion, pretest mean scores p value was 0.557 and posttest meanscores p value between the groups was 0.742 i.e. statistically insignificant (Table 6).

In the ankle ROM plantar flexion p value of group A was 0.063 (Table 4) and group B p value = 0.027(Table 5). Thus this showed that no statistical significance was achieved by group A which states that the control group i.e. group B had better effect in improving the ankle plantar flexion ROM in elderly with stroke. Between the group analysis p value for the pretest mean scores between the groups was equal to 0.757 which was of no statistical significance and the posttest mean scores between the groups had a p value of 0.930 (Table 6). Within the two groups analysis for ankle dorsiflexion ROM group A p value = 0.033(Table 4) and group B p value = 0.002 (Table 5). Thus this showed statistical significance was achieved by both groups hence both are effective in improving the ankle dorsiflexion ROM in elderly with stroke. Between the groups analysis p value for the pretest mean scores between the groups was equal to 1.000 which was of no statistical significance and the posttest mean scores between the groups had a p value of 0.461 which is insignificant (Table 6).

Within the group comparison of berg balance scale scores group A p value was 0.001 and group B was 0.006 (Table 4) (Table 5). Group A and B both p values reached statistically significance which showed that the both group are helpful on improving balance. Between the group analyses of balance showed that pre-intervention scores of mean of both the groups' p value were equal to 0.498 and for post intervention scores of the means of both the clusters was 0.826. Which was not statistically significant (Table 6).

Within the group comparison of the CASP-19 score for quality of life showed p value of group A was 0.001(Table 4) and group B 0.002 was p value (Table 5). That means both the groups reached statistical significance. So A group and B group are effective to enhance QoL in elderly with stroke. In between the group analysis, the pre-intervention mean scores of both groups p value was 0.965 and the p value for post-treatment mean of both groups was 0.809. Neither of the p values were statistically significant. Overall changes from pretest to posttest were non-significant across groups (Table 6).

Table 1 Distribution of male and females in group A and group B

GENDER	GROUP-A		GROUP-B		Chi Square	p-value
	Frequency	Percent	Frequency	Percent		
MALE	7	46.67	6	42.85	0.042	0.837
FEMALE	8	53.33	8	57.15		

Table 2 Comparison of group A and group B in terms of mean age and BMI

Particular	GROUP-A	GROUP-B	t-value	p-value
	Mean ±SD	Mean ±SD		
AGE	73.53 ±8.42	71.92±6.68	0.570	0.573
BMI	25.15 ±2.69	25.91 ±2.44	0.798	0.432

Table 3 Kolmogorov-Smirnov Test of Normality

Variable	Time Frame	Group A		Group B	
		Stat	p-value	Stat	p-value
MAS PF	Pre	0.328	0.000	0.266	0.008
	Post	0.283	0.002	0.359	0.000
MAS DF	Pre	0.271	0.004	0.265	0.009
	Post	0.316	0.000	0.359	0.000
ANKLE ROM PF	Pre	0.154	0.200	0.147	0.200
	Post	0.180	0.200	0.101	0.200
ANKLE ROM DF	Pre	0.301	0.001	0.233	0.039
	Post	0.216	0.059	0.227	0.049
BBG	Pre	0.121	0.200	0.155	0.200
	Post	0.191	0.145	0.231	0.042
CASP-19	Pre	0.177	0.200	0.266	0.008
	Post	0.269	0.005	0.190	0.184

Table 4 With in group comparison of Group A pre and post using Wilcoxon paired sample test

Variable	Pre Test	Post Test	Difference	% of effect	z-value	p-value
	Mean ± SD	Mean ±SD	Mean±SD			
MAS PF	1.93 ± 0.96	1.20±0.68	0.73±0.70	37.82	2.840	0.005*
MAS DF	1.93±0.70	1.13 ±0.64	0.80±0.56	41.45	3.207	0.001*
ANKLE ROM PF	35.33±10.60	37.60±12.15	-2.27±4.45	6.42	1.860	0.063
ANKLE ROM DF	13.67±3.96	14.67±2.97	-1.00±4.17	7.31	2.137	0.033*
BBG	25.93±5.57	29.47±5.05	-3.53±2.70	13.61	3.215	0.001*
CASP-19	27.33±4.70	29.60±5.19	-2.27±1.79	8.30	3.208	0.001*

*Significant at 5% level, *p<0.05,
All values in absolute form [ignored negative sign for statistical convenience]

Table 5 Within group comparison of Group B pre and post using Wilcoxon paired sample test

Variable	Pre Test	Post Test	Difference	% of effect	z-value	p-value
	Mean±SD	Mean±SD	Mean±SD			
MAS PF	1.71±0.73	1.21±0.58	0.50±0.52	29.40	2.646	0.008*
MAS DF	1.79±0.80	1.21±0.58	0.57±0.65	31.84	2.530	0.011*
ANKLE ROM PF	36.50±10.60	38.79±10.65	-2.29±2.89	8.64	2.211	0.027*
ANKLE ROM DF	13.50±3.61	15.71±3.36	-2.21±1.37	16.37	3.106	0.002*
BBG	27.79±9.66	29.93±7.76	-2.14±3.06	7.70	2.754	0.006*
CASP-19	27.57±4.43	29.79±3.51	-2.21±1.53	8.01	3.090	0.002*

Table 6 Between group analyses using Mann Whitney test

Variable	Group	Mean±SD	z-value	p-value	Result
MASPFPRE	GROUP-A	1.93±0.96	1.032	0.302	Insignificant
	GROUP-B	1.71±0.73			
MASPFPOST	GROUP-A	1.20±0.68	0.001	1.000	Insignificant
	GROUP-B	1.21±0.58			
MASDFPRE	GROUP-A	1.93±0.70	0.588	0.557	Insignificant
	GROUP-B	1.79±0.80			
MASDFPOST	GROUP-A	1.13±0.64	0.330	0.742	Insignificant
	GROUP-B	1.21±0.58			
ANKLEROMPFPRE	GROUP-A	35.33±10.60	0.309	0.757	Insignificant
	GROUP-B	36.50±10.60			
ANKLEROMPFPOST	GROUP-A	37.60±12.15	0.088	0.930	Insignificant
	GROUP-B	38.79±10.65			
ANKLEROMDFPRE	GROUP-A	13.67±3.96	0.001	1.000	Insignificant
	GROUP-B	13.50±3.61			
ANKLEROMDFPOST	GROUP-A	14.67±2.97	0.737	0.461	Insignificant
	GROUP-B	15.71±3.36			
BBGPRE	GROUP-A	25.93±5.57	0.678	0.498	Insignificant
	GROUP-B	27.79±9.66			
BBGPOST	GROUP-A	29.47±5.05	0.219	0.826	Insignificant
	GROUP-B	29.93±7.76			
CASP19PRE	GROUP-A	27.33±4.70	0.044	0.965	Insignificant
	GROUP-B	27.57±4.43			
CASP19POST	GROUP-A	29.60±5.19	0.242	0.809	Insignificant
	GROUP-B	29.79±3.51			

DISCUSSION

The analysis for gender distribution in the study states that male subject's percentage in group A was 46.67% and percentage of female subjects was 53.33%. In group B male and female subject's percentage were 42.85% and 57.15% respectively. This shows that the percentage of female subjects in both the groups were comparatively higher than the male participant. A similar study in 2009 stroke occurrence in male was 33% and higher incidence was 41% in female there was big differences between age groups and among people. Severe fatality in women was inclined to 24.7%compared with 19.7% for men with stroke[22].Same as present study this literature corresponds to gender distribution having higher percentage of female subjects as compared to male subjects. Because studies suggest that overall incidence of stroke is more in female than that of male.

The mean BMI of the subjects in the experimental group was 25.15kg/m2. The mean BMI of the subjects in the control group was 25.91kg/m2. These values showed that all the subjects in both the groups belonged to the obese body mass index range. Certain literature i.e. a systemic review suggest that almost162'921 patient'smortality rates was reported lesser than BMI values higher. After 5 years of stoke mortality rate was inversely related to BMI. Death rate was more inunder-weight patients[23].This suggest there can be other influencing factors for increased occurrence of stroke rather than BMI of the individual. Hence this study and previous study found difference.

In the present study, the spasticity in subjects with stroke was tested using the MAS i.e. for ankle plantar flexors and dorsiflexors, before and after intervention. In comparison between both group A and B post-intervention score suggested that they had better improvement in spasticity. On a vibrating platform both static and dynamic movement can be performed i.e. is WBV. Few studies examined spasticity after whole body vibration training[24].A previous literature found that single sitting of WBV training will diminish plantar flexion spasticity in chronic stroke, thereby gradually walking capacity increases in patients[10].In our present study found similar effects. Even another study proved WBV training for 6 weeks might be safe and practicable to increase control of posture and lower limb strength of muscles in chronic stroke but except spasticity[25].Results obtained in this study in context to improvement in spasticity in subjects with stroke.

The present study evaluated the ankle mobility includes plantar flexion movement and dorsiflexion in subjects with stroke using range of motion with universal goniometer before and after intervention. The results suggested that there was a better result noted in the dorsiflexion in both experimental group and control group but plantar flexion percentage of change in the group A was not significant but in group B plantar flexion movement was having significant effect. Hence whole body vibration and conventional physiotherapy with balance training and group B only conventional physiotherapy with balance training was effective in improving ankle mobility except plantar flexion mobility in group A in subjects with stroke.

Previous literature stated similar to present study that only ankle dorsiflexion not plantar flexion predicts the functional mobility of people with spastic hemiplegia. Ankle plantar flexors mainly produce most of the energy required in walking after stroke. Decline in ankle dorsiflexion strength is usually observed in hem paretic gait. While a drop in descending voluntary commands to the paretic dorsiflexors i.e. tibialis anterior could be a primary cause and spastic ankle plantar flexors might also act as an active restraint which limit ankle dorsiflexion[26]. In another trial, strokepatients were given ROM

and flexibility exercises which was accepted in classes and combined with resistance or aerobic training of 90 min every day for 6 months showed an outstanding rise in ROM[27]. In this present study terms of improvement in ankle ROM corresponds to ankle mobility performing conventional physiotherapy with balance training same as this trial. A literature suggest that ankle and foot impairments has better effect in between stroke and conservative group. Overall outcome of mobility and balance after an episode of stroke can predict as a result of impairments such as reduction in strength and ROM accompanied by events of forceful loading on foot[28]. Analysis of the pre and post intervention for berg balance score values indicated that participants in experimental and control group both upgraded in balance in subjects with stroke. Furthermore, few initial data that WBV enhances role of proprioception by perceiving muscle stretching which activate reflex like vibration. It may show benefits onimproving balance through decreasing disability, mobility and performance of gait in subjects with stroke[29].

As the present study have stated there is improvement in balance of subjects after the intervention of whole body vibration training, it can be assumed that this improvement in balance can be associated with decrease spasticity and increase in ankle mobility. In previous literature had analyzed the effect of Regular periods of whole-body vibration training for6 weeks were not affective in post stoke patients regarding balance recovery and daily living activities than the similar exercise program on music[30]. Present study does not go hand in hand with previous literature.

A randomised controlled trial showed similar results in this study which suggested that by balance training combined plantar flexor stretching, plantar flexor stretching passively can improve range of motion in ankle joint dorsiflexion and balance regaining. So, this intervention will be effective in therapeutic way for stroke patient's rehabilitation purpose in a clinical settings. Even this specific intervention will be better for stroke patient's rehabilitation in the clinical setting. The present study found that conventional physiotherapy such as range of motion, stretching strengthening exercises for lower limb and balance including tandem standing, tandem walking, one leg standing, weight shifting, stepping up & low rises, side stepping, stepping over obstacles found a better result terms improving balance in elderly with stroke.

The analysis for quality of life was done using the CASP-19. In both group A and B found effective in QoL after intervention. As per age advancing lasting disability happens by means of stroke is a common issue in most of the countries. Hence Quality of Life assessment could be an assessor and post treatment indicator. This review is a state's how to do assessment of QoL after stroke. The importance placed in terms of factors of post-stroke persons and their caregivers[31].The improvement in most of variables such as spasticity, ankle mobility and balance hence betterment was found in QoL in this study.

Limitations

1.Type of stroke was not considered. 2. We didn't considered Postural sway, ambulatory function and physical performance in elderly with stroke. It would help quantify the amount of enhancement activities of daily living.

CONCLUSION

The study concluded both groups were improved in terms of spasticity, ankle mobility, balance and enhance quality of life in elderly subjects with stroke except group A couldn't prove its effectiveness in ankle plantar flexion mobility in subjects with stroke.

Future Scope

Evaluate prolonged effect of whole body vibration training on spasticity, ankle mobility, balance and QoL association with ADL in older adults with stroke.2. Fear of fall could be assessed.3.Individually compare the whole body vibration training with any other therapeutic equipment for ankle mobility and its association with postural sway and functional balance in elderly with stroke.

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