ORIGINAL ARTICLE

Effect of Home-based Task-oriented Training on the Lower Extremity Function in Chronic Stroke

Kaur Gulnaaz[1], Kapoor Gaurav[1]*, Chib Aunradha[2], Jeya Singh Raj Immaneual[3]

[1]Department of Physiotherapy, Chandigarh University, Mohali, Punjab, India, [2]Department of Physiotherapy, Rayat Bahra University, Mohali, Punjab, India, [3]Department of Physiotherapy, Lovely Professional University, Jalandhar, Punjab, India

ABSTRACT

Background: There have been many researches on task-oriented training for the lower extremity function in the stroke subjects which have proven to improve the function of lower extremity. Home-based exercises have not been evaluated by researchers that much for the chronic stroke patients. This study investigated the function of lower extremity on account of home-based task-oriented training in chronic stroke subjects.

Materials and Methods: This study is a one group pre-test and post-test quasi-experimental design, in which with the convenience sampling, 16 chronic stroke subjects were included in the study. They all were given home-based task-oriented training for 2 times/day morning and evening, 6 days in a week, and for a total of 4 weeks. Patients were supervised on alternative days and were assessed after every week. The outcome measures used are step test, 10 m walk test, and 5 times sit-to-stand test which were measured after every week. The data were analyzed using repeated ANOVA test to analyze the difference between pre-test and post-test and within the weeks and unpaired t-test for the comparison of paretic and non-paretic limb in step test.

Results and Discussion: The results of this showed that home-based task-oriented training has improved the function of lower extremity in chronic stroke subjects which leads to improved locomotion of the patient which results to improved and independent activities of daily living.

Conclusion: Results indicate that home-based task-oriented training should be taught to chronic stroke patients as it improves the lower extremity function which leads to the higher level of quality of living in chronic stroke patients.

Key words: 10 m walk test, 5 times sit-to-stand test, home based, lower extremity functions, step test, task-oriented training

INTRODUCTION

Movement performed by humans is complex in nature, it requires the involvement of multiple segments and forces to develop a movement.[1,2] The production of force in the muscles is controlled by recruitment of motor unit and by regulation of firing rate of recruited motor units.[3,4] Nervous system plays an important role in control of movement.

The interaction of both the systems, musculoskeletal and neuromuscular system, leads to a resultant motion which is required to accomplish the task. To produce normal action for a particular task, a normal muscle synergy is required. Muscle synergy is activation of the group of muscles to produce a particular movement.[5] Locomotion is also an important activity of daily living such as for bathing, transportation, toileting, earning bread, and butter.[6] To perform these activities, tasks normal walking is required, this is possible due to normal functioning of musculoskeletal and nervous system.[7] In many neurological diseases such as cerebrovascular assault, traumatic brain injury, spinal cord injury, and multiple sclerosis activities of daily living are affected due to the abnormal synergy pattern. This abnormality occurs due to abnormal recruitment of motor units.[8]

Stroke is a major factor for this disability in India. The guesstimated adjusted occurrence rate of stroke in India ranges 84–262/100,000 in rural and 334–424/100,000 in urban areas.[9,10] In stroke, motor control of all the four or any of the four extremities is typically affected, showing a mixture of physical symptoms such as hypertonia or hypotonia, muscular weakness, and impaired coordination. Muscles which are affected in stroke patients often show developing changes in their intrinsic mechanical properties, involving muscle contraction, and adjustments in muscle internal structure, such as decreased muscle fibers, an increase of interstitial connective tissue, and changes in the viscoelastic muscle.[11,12]

Muscle weakness in the post-stroke population occurs due to decreased size, firing rate, and atrophy of muscle

***Corresponding author:**
Email: gaurav_kapoor2000@yahoo.com

ISSN 2320-138X © 2019

fibers with increased fatigue, reduced and altered motor unit number, and recruitment. The most often occurring impairment is in lower limb, resulting difficulty to balance and walking ability.[13,14]

To overcome these deficits, many physiotherapy programs have been designed which may include Bobath, Brunnstrom, Roods, and Proprioceptive neuromuscular facilitation approaches and strengthening exercises.[15,16] Self home-based exercises provide significance with numerous aspects of sustaining development and managing with setbacks after the stroke, it is a self-management program which motivates individuals with chronic stroke to take dynamic part in the management of their condition.[17,18] To provide the optimal exercise program to chronic stroke patients, task-oriented training can be used. Task-oriented training has been developed from science of movement and motor learning skill literature, in which it is defined as a therapy in which patients rehearse situation definite motor task and gain some kind of feedback. It focuses on the progress of performance in the functional task though aim-directed practice of task and repetition of task. The attention is on functional task not on the impairment. Neural plastic changes have been evident with this training where neural plasticity is ability of the brain to reorganize itself according to the task given. Walking capacities are divided into short and long walking test where short walking test is to evaluate speed and long walking test is to evaluate walking endurance.[19] The 10 m walk test is a type of short walking test in subject needs to give brief or maximal effort which is associated with muscle strength but, on the other hand, 6 min waking test is long walking test which is associated with endurance due to strain on cardiorespiratory system on the completion of test. To measure the strength, 10 m walk teat has good reliability and validity for the subjects with stroke.[20]

For stepping activity and dynamic standing balance, step test is used in subjects with stroke. In this test, evaluator needs to count the number of times person is able to step up and step down from the stepper in 15 s. To perform this test, there should be adequate strength of lower limb to stabilize the body in stance phase as the other leg is stepping. The step test has a good reliability and validity for subjects with stroke.[21,22] Sit to stand is a functional strength test usually done to measure the muscle performance where individual has to perform sit to stand for 5 times from the given surface as fast as possible and time is measured, in which the task is complete. Sit-to-stand test also has good reliability and validity for the subjects with stroke.[23,24]

Hence, the main aim of this study is to determine the effect of home exercises based on task-oriented training on the lower limb function in stroke patients. Physiotherapy of stroke patients is long term and patients need to go for their treatment on the daily basis to the physiotherapy center and for chronic stroke patients, it becomes very difficult to travel daily.[25,26] It is very essential for the patient to perform exercise daily to improve their functional mobility. Many patients face difficulty in traveling because it is tiring and some people does not have that much funds to spend so the need of the study is to determine the effect of home exercises based on task-oriented training as these exercises can be performed by patients easily because they mimic the activities which we generally perform for our daily living and the result of these exercises based on motor learning and neural plasticity of the brain.[27] Hence, by this study, patient will be benefitted as the patient has to remain at home and can perform his exercises by himself as the patient gets less dependent on the therapist and become more dependent on himself to perform the task of daily living. The interventions which will be given are goal oriented which are easy to achieve.

MATERIALS AND METHODS

Study Design

This is a one group pre-test post-test design-quasi-experimental design.

Study Setting

Home based.

Population and Sampling

- Sampling method – Convenient sampling
- Sample size – 16.

Criteria

Inclusion criteria

Subjects should meet these criteria to be included in the study.

- Age group 45–65 years
- Stroke more than 6 months
- Patient is able to walk 6 m
- Ischemic and hemorrhagic stroke
- Both male and female
- Patient should understand verbal commands
- Left and right hemiplegia.

Exclusion criteria

Subjects with the following criteria should be excluded from the study.

- Unstable medical condition
- Patient with cognitive impairment
- Patients who were unable to perform the exercise protocol due to any other medical condition.

Parameters

- Step test
- 10 m walk test
- 5 times sit-to-stand test.

Instruments and Tools

- Stepper
- Chairs of different heights
- Inch tape.

Procedure

Subjects with age 45–65 years old of both the genders will be recruited with the use of neurological evaluation and with the help inclusion and exclusion criteria they will be included and excluded. The functional activities of the subject will be measured with step test, 10 m walk test, and sit-to-stand test after which they will be given 4-week task-oriented training program which will perform for 2 times/day and 6 days/week, in which they will be supervised on the alternative days whether they are performing exercises or not and will be assessed once in the week. The total of six exercises will be given which may include further modifications.

- Standing – quiet standing
  - Reaching activities
  - Narrow standing
  - Tandem standing
  - Heel off.
- Sit to stand – chairs used to perform are of different heights
- Walking – stand up and go exercise and sideways walking
- Stepping on stepper – sideways and forward
- Walk on different surfaces
- Kicking while sitting.

Each exercise will be repeated 10 times as the caregiver will be educated with all the exercise and a record book will be provided to record if the patient is performing exercises or not.

Statistical Analysis and Results

There was a statistically significant difference in step test (paretic extremity) on performing the home-based task-oriented training for 4 weeks pre-test and post-test, F = 186.58, *P* = 2.525. In addition, in all the weeks also, it showed the improvement.

There was a statistically significant difference in step test (non-paretic [NP] extremity) on performing the home-based task-oriented training for 4 weeks pre-test and post-test, F = 315.81, *P* = 2.525. In addition, in all the weeks also, it showed the improvement.

An independent samples t-test was conducted to compare paretic and NP extremity in step test. There was a significant difference in the scores for paretic and NP extremity in all the weeks except week 3; there was no significant difference between paretic and NP extremity in week 3.

There was a statistically significant difference in 10 m walk test (in seconds) on performing the home-based task-oriented training for 4 weeks pre-test and post-test, F = 450.78, *P* = 2.525. In addition, in all the weeks also, it showed the improvement.

There was a statistically significant difference in 5 times sit-to-stand test (in seconds) on performing the home-based task-oriented training for 4 weeks pre-test and post-test, F = 152.53, *P* = 2.525. In addition, in all the weeks also, it showed the improvement.

RESULTS

Table 1 determines the demographic distribution of subjects that were included in the study. In this study, a total number of 16 subjects with chronic stroke who met the inclusion criteria participated. Out of 16 subjects, there were 10 males and 6 females; the ratio of male versus female was 5:3. The mean age for males was 54.5 years and females was 58.8 years. There were nine hemorrhagic stroke subjects, of which six subjects were affected with the left hemiparesis and three subjects were affected with the right hemiparesis. There were seven ischemic stroke subjects, of which four subjects were affected with the left hemiparesis and three subjects were affected with the right hemiparesis.

Step Test (Paretic Side)

The result of step test is shown in Table 2, by the use of repeated ANOVA test, the difference between pre- and post-readings and difference within the weeks of the

Table 1: Demographic data

Age	Male	Female
Mean age	54.5	58.8
Type of stroke (%)		
Ischemic	31.3	12.5
Hemorrhagic	31.3	25
Side of hemiparesis (%)		
Left hemiparesis	37.5	31.3
Right hemiparesis	25	6.25
Sample size	16	
Total number of subjects	10	6
Percentage	62.5	37.5
Ratio	Male:female – 5:3	

step test were calculated. For the paretic side lower limb within the week, the mean value and standard deviation of pre-test is 1.88 ± 0.619, week 1 is 3.06 ± 0.772, week 2 is 4.24 ± 1.000, week 3 is 6.13 ± 1.025, and week 4 is 7.50 ± 0.730 with F = 186.58 and *P* = 2.525. Pre-test and post-test showed a significant improvement as the difference between their mean values was 5.63 which showed improved stepping activity. It showed a significant difference within the weeks; in pre-test and week 1, the difference is 1.18; in week 1 and week 2, the difference is 1.19; in week 2 and week 3, the difference is 1.88; and in week 3 and week 4, the difference is 1.38 which shows an improvement of stepping activity in all the weeks.

Step Test (NP Side)

The results of step test NP extremity are shown in Table 3, by the use of repeated ANOVA test, the difference between pre-test and post-test readings and difference within the weeks of the step test were calculated. For the paretic side lower limb within the week, the mean value and standard deviation of pre-test is 12.50 ± 0.816, week 1 is 3.81 ± 0.834, week 2 is 5.25 ± 0.856, week 3 is 6.88 ± 1.088, and week 4 is 8.75 ± 0.683 with F = 315.81 and *P* = 2.525. Pre-test and post-test readings were compared where the difference between there mean values was 6.25 which shows a significant improvement in the NP lower limb of chronic stroke patients. In addition, it showed a significant difference within the weeks; in pre-test and week 1, the difference is 1.31; in week 1 and week 2, the difference is 1.44; in week 2 and week 3, the difference is 1.63; and in week 3 and week 4, the difference is 1.88 which shows an improvement of stepping activity in all the weeks.

Comparison of Paretic and NP Lower Limb in Step Test [Table 4]

Using unpaired *t*-test, a comparison between both the limbs paretic and NP was done. The mean and standard deviation of paretic (P) and NP lower limb for step test are; for pre-test are *P* = 1.88 ± 0.619 and NP = 2.50 ± 0.816, for week 1 are *P* = 3.06 ± 0.0772 and NP = 3.81 ± 0.834, for week 3 are *P* = 6.13 ± 1.025 and NP = 6.88 ± 1.088, and for week 4 are P = 7.50 ± 0.730 and NP = 8.75 ± 0.683. When compared paretic and NP lower limb in pre-test, week 1, week 2, and week 3 showed improvement in the NP side than paretic, but week 3, there was no significant difference in paretic and NP lower limb.

10 m Walk Test

The results of 10 m walk test are shown in Table 5, by the use of repeated ANOVA test, the difference between the pre-test and post-test and difference between within the weeks were calculated for 10 m walk test (in seconds). The mean and standard deviation for pre-test is 37.63 ± 3.828, week 1 is 32.56 ± 4.016, week 2 is 27.25 ± 3.606, week 3 is 20.88 ± 2.473, and week 4 (post-test) is 15.00 ± 2.280 with F = 450.78 and *P* = 2.525. Comparison of pre-test and post-test shows a significant improvement. The difference between pre and post is 22.63 which is a marked improvement in 10 m walk test in chronic stroke subjects. It also indicated a significant difference in weeks; the difference between pre-test and week 1 is 5.06, week 1 and week 2 is 5.31, week 2 and week 3 is 6.38, and week 3 and week 4 is 5.88, thus shows a significant improvement throughout the week.

Table 2: Repeated ANOVA and Tukey's method for pairwise comparison of step test in paretic extremity

Repeated ANOVA	**Step test (paretic)**				
	Pre	**Week 1**	**Week 2**	**Week 3**	**Week 4**
Mean	1.88	3.06	4.25	6.13	7.50
SD	0.619	0.772	1.000	1.025	0.730
Median	2	3	4	6	7.5
n	16	16	16	16	16
Maximum	3	4	6	8	9
Minimum	1	1	2	4	6
DF1			4		
DF2			60		
F test			186.58		
P			2.525		
Table value			<0.001		
Result			Significant		
Tukey's method for pairwise comparison		Pre			
Mean difference and result>	Week 1	1.18	Week 1		
	Week 2	2.38 sig.	1.19 sig.	Week 2	
	Week 3	4.25 sig.	3.06 sig.	1.88 sig.	Week 3
	Week 4	5.63 sig.	4.44 sig.	3.25 sig.	1.38 sig.

Table 3: Repeated ANOVA and Tukey's method for pairwise comparison of step test for non-paretic extremity

Repeated ANOVA	Step test (non-paretic)				
	Pre	Week 1	Week 2	Week 3	Week 4
Mean	2.50	3.81	5.25	6.88	8.75
SD	0.816	0.834	0.856	1.088	0.683
Median	2	4	5	7	9
n	16	16	16	16	16
Maximum	4	5	7	8	10
Minimum	1	2	4	5	8
DF1			4		
DF2			60		
F test			315.81		
P			2.525		
Table value			<0.001		
Result			Significant		
Tukey's method for pairwise comparison		Pre			
Mean difference and result>	Week 1	1.31 sig.	Week 1		
	Week 2	2.75 sig.	1.44 sig.	Week 2	
	Week 3	4.38 sig.	3.06 sig.	1.63 sig.	Week 3
	Week 4	6.25 sig.	4.94 sig.	3.5 sig.	1.88 sig.

Table 4: Unpaired t-test to compare the step test between paretic and non-paretic extremity

Unpaired *t*-test	Step test									
	Pre		Week 1		Week 2		Week 3		Week 4	
	Paretic	Non-paretic	Paretic	Non-paretic	Paretic	Non-paretic	Paretic	Non-paretic	Paretic	Non-paretic
Mean	1.88	2.50	3.06	3.81	4.25	5.25	6.13	6.88	7.50	8.75
SD	0.619	0.816	0.772	0.834	1.000	0.856	1.025	1.088	0.730	0.683
Mean difference	−0.63		−0.75		−1.00		−0.75		−1.25	
n	16	16	16	16	16	16	16	16	16	16
Maximum	3	4	4	5	6	7	8	8	9	10
Minimum	1	1	1	2	2	4	4	5	6	8
Range	2	3	3	3	4	3	4	3	3	2
Unpaired *t*-test	2.440		2.640		3.038		2.007		5.000	
P	0.0208		0.0130		0.0049		0.0538		0.0000	
Table value at 0.05	2.04		2.04		2.04		2.04		2.04	
Result	Significant		Significant		Significant		Not significant		Significant	

5 Times Sit-to-Stand Test [Table 6]

The results of 5 times sit to stand are shown in Table 6, by the use repeated ANOVA test, the difference between the pre-test and post-test and between within the weeks was calculated for 5 times sit to stand (in seconds). The mean and standard deviation for pre-test is 38.56 ± 3.723, week 1 is 34.25 ± 3.606, week 2 is 28.94 ± 4.328, week 3 is 24.56 ± 4.980, and week 4 (post-test) is 19.44 ± 2.828 with F = 152.53 and *P* = 2.525. Comparison of pre-test and post-test shows a significant improvement. The difference between pre and post is 19.13 which is a marked improvement in 5 times sit-to-stand test in chronic stroke subjects. It also indicated a significant difference within the weeks; the difference between pre-test and week 1 is 4.31, week 1 and week 2 is 5.31, week 2 and week 3 is 4.38, and week 3 and week 4 is 5.13, thus shows a significant improvement throughout the week.

Result shows improvement in all outcome measures – step test, the number of steps taken by the subject in 15 s increased from the pre-test to post-test, the time taken in 10 m walk test to complete the task decreased from pre-test to post-test, and in 5 times sit-to-stand test, the time taken to complete the task also reduced from pre-test to post-test.

In addition, in all the weeks also, subjects showed improvement in all the outcome measures and in comparison of paretic and NP in the step test, NP showed improvement in all the weeks excluding week 3.

Table 5: Repeated ANOVA and Tukey's method for pairwise comparison of 10 m walk test (in seconds)

Repeated ANOVA	10 m walk test				
	Pre	Week 1	Week 2	Week 3	Week 4
Mean	37.63	32.56	27.25	20.88	15.00
SD	3.828	4.016	3.606	2.473	2.280
Median	38.5	33	27	21	14.5
n	16	16	16	16	16
Maximum	44	40	34	25	19
Minimum	32	26	22	17	12
DF1			4		
DF2			60		
F test			450.78		
P			2.525		
Table value			<0.001		
Result			Significant		
Tukey's method for pairwise comparison		Pre			
Mean difference and result>	Week 1	5.06 sig.	Week 1		
	Week 2	10.38 sig.	5.31 sig.	Week 2	
	Week 3	16.75 sig.	11.69 sig.	6.38 sig.	Week 3
	Week 4	22.63 sig.	17.56 sig.	12.25 sig.	5.88 not sig.

Table 6: Repeated ANOVA and Tukey's method for pairwise comparison of 5 times sit-to-stand test

Repeated ANOVA	5 times sit-to-stand test				
	Pre	Week 1	Week 2	Week 3	Week 4
Mean	38.56	34.25	28.94	24.56	19.44
SD	3.723	3.606	4.328	4.980	2.828
Median	38	34	28	22.5	19
n	16	16	16	16	16
Maximum	46	42	38	36	28
Minimum	33	30	24	18	16
DF1			4		
DF2			60		
F test			152.53		
P			2.525		
Table value			<0.001		
Result			Significant		
Tukey's method for pairwise comparison		Pre			
Mean difference and result>	Week 1	4.31 sig.	Week 1		
	Week 2	9.63 sig.	5.31 sig.	Week 2	
	Week 3	14 sig.	9.69 sig.	4.38 sig.	Week 3
	Week 4	19.13 sig.	14.81 sig.	9.5 not sig.	5.13 sig.

DISCUSSION

This is a pre- and post-test quasi-experimental study to examine the effectiveness of home-based task-oriented training on the lower extremity in chronic stroke patients. We found that task-oriented training improves the lower extremity function when given as home exercises with the supervision on alternative days. More importantly, it improves the lower extremity strength and functional performance. Lower extremity strength gain is associated with gain in functional test such as step test, 10 m walk test, and 5 times sit-to-stand test.

Home-based exercises are important for the patients who had suffered stroke and are in the chronic stage of stroke, as the patients experience physical deconditioning and lead to sedentary lifestyle which results in decreased quality of life, physical functioning, depression, and difficulty in ADLs; most of the patients have left the rehabilitation program and they are dependent on the others.[27]

Task-oriented training is the training which can be learned by patients easily and is associated with activities of daily living. It has been found that strengthening of the muscles can be accomplished by the task-oriented training, more importantly, task-oriented training can improve the lower extremity strength and its functional program.[28,29]

In this study, home-based task-oriented training was given for two sessions for every day and 6 times a week where after 6 days, 1 day was given as a relaxation day to all the patients. All the patients successfully completed the study. In the exercise program, patient was given functional activities such as sit to stand, standing with narrow base of support, standing with wide base of support, tandem standing, and reaching activities in standing and walking and adding different surfaces to it and kicking the ball. Basically, repetition of these tasks resulted in improved muscle strength and transfer of the task to the real life. The previous studies also show improvement in muscle strength and transfer of task, but no study is done to see the effect of task-oriented training for lower limb when they are done on the basis of self-home exercises which were supervised on alternative days and were assessed after each week to note the improvement in the functional activity of subjects with chronic stroke. A date and time chart were given to all the patients to mark the day and time at which they have done exercise and are kept as a record and a feedback to the patient that he has done exercise and all the patients marked the chart and recorded the time and date of exercises.[30]

The functional activity tests were performed to evaluate the task-oriented training. Step test was done to evaluate the stepping activity and the lower limb strength. With the help of data analysis, the difference between the pre-test and post-test showed marked improvement with significant difference of the mean values is 5.63 for the paretic side and 6.25 for NP side. There was also improvement within the weeks when both sides of lower extremity, paretic and NP were compared, NP showed more improvement than the paretic side only in week 3, it was not significant result. The 10 m walk test also showed marked improvement as the time taken to complete the task decreases from the pre- to post-test, thus there is a significant difference of mean values 22.63 between the pre- and post-test. There was an improvement within the weeks with the 10 m walk test and then, 5 times sit-to-stand test was performed which also showed significant improvement in pre- and post-test as the time taken to perform the task reduced with the difference of mean values is 19.13 in between the pre- and post-test with an improvement within the weeks.

The improvement in these outcome measures shows the improvement in the lower extremity function. Improvement of the step test indicates improved lower extremity muscle strength, coordination, walking speed, and balance. The reduction in time taken to cover the given distance shows improvement in the 10 m walk test which indicates better ambulation ability which results to higher level of quality of life as the patient can walk with increased speed and can perform his activities of daily living easily like transportation, toileting, bathing, taking small things at home like a glass of water. Improvement of 5 times sit-to-stand test shows improved sit-to-stand activity of the patient as it is part of daily living activities, lower limb strength, and balance with weight shifting to the paretic limb while standing up and sitting down.

Thus, this study shows improved lower extremity function when compared to the pre- and post-test readings of the task-oriented training as self-home exercises in subjects with chronic stroke.

Limitations

1. The study encountered some of the limitations as there should have been videography for the step test to count the number of steps,
2. The evaluation of lower limb muscle strength should have been done with the use of handheld dynamometer and,
3. Computerized gait analysis could have been used in the study.

CONCLUSION

Most of the chronic stroke patients usually stop their rehabilitation program due to traveling or there is no one to bring them to rehabilitation center due which they are unable to perform the exercises by their own which results in reduced muscle strength which leads to reduced activities of daily living and increased dependence. To improve the strength and function of lower extremity in chronic stroke patients, home-based task-oriented training is given. Thus, this study concluded that home-based task-oriented training improves the lower extremity function which improved the functional activity of stroke subjects which makes them more independent and the level of depression also decreases.

REFERENCES

1. Levangie P. Joint Structure and Function. Philadelphia, PA: F A Davis; 2015.
2. De Luca CJ, Erim Z. Common drive of motor units in regulation of muscle force. Trends Neurosci 1994;17:299-305.
3. Winter D. Biomechanics and Motor Control of Human Movement. Hoboken, NJ: John Wiley and Sons; 2009.
4. Karpati G. Disorders of Voluntary Muscle. Cambridge: Cambridge University Press; 2010.
5. Wojtara T, Alnajjar F, Shimoda S, Kimura H. Muscle synergy

stability and human balance maintenance. J Neuroeng Rehabil 2014;11:129.
6. Ting LH, McKay JL. Neuromechanics of muscle synergies for posture and movement. Curr Opin Neurobiol 2007;17:622-8.
7. Calbom C, Clever L, Phillips H. Fatigue (Medical) Public Health Scribd. Ch. 16; 2017. Available from: https://www.scribd.com/document/42959124/garp-chapter16. [Last accessed on 2017 Nov 16].
8. World Health Organizationc. Neurological Disorders. Geneva: World Health Organization; 2006.
9. Banerjee TK, Das SK. Epidemiology of stroke in India. Neurol Asia 2006;11:1-4.
10. Langhorne P, Coupar F, Pollock A. Motor recovery after stroke: A systematic review. Lancet Neurol 2009;8:741-54.
11. Sullivan KJ, Brown DA, Klassen T, Mulroy S, Ge T, Azen SP, *et al*. Effects of task-specific locomotor and strength training in adults who were ambulatory after stroke: Results of the STEPS randomized clinical trial. Phys Ther 2007;87:1580-602.
12. Li X, Wang YC, Suresh NL, Rymer WZ, Zhou P. Motor unit number reductions in paretic muscles of stroke survivors. IEEE Trans Inf Technol Biomed 2011;15:505-12.
13. Yang YR, Wang RY, Lin KH, Chu MY, Chan RC. Task-oriented progressive resistance strength training improves muscle strength and functional performance in individuals with stroke. Clin Rehabil 2006;20:860-70.
14. Salbach NM, Mayo NE, Robichaud-Ekstrand S, Hanley JA, Richards CL, Wood-Dauphinee S, *et al*. The effect of a task-oriented walking intervention on improving balance self-efficacy poststroke: A randomized, controlled trial. J Am Geriatr Soc 2005;53:576-82.
15. De Bujanda E, Nadeau S, Bourbonnais D, Dickstein R. Associations between lower limb impairments, locomotor capacities and kinematic variables in the frontal plane during walking in adults with chronic stroke. J Rehabil Med 2003;35:259-64.
16. Pollock A, Baer G, Pomeroy V, Langhorne P. Physiotherapy treatment approaches for the recovery of postural control and lower limb function following stroke. Physiotherapy 2003;89:336.
17. Jones F, Riazi A. Self-efficacy and self-management after stroke: A systematic review. Disabil Rehabil 2011;33:797-810.
18. Hubbard IJ, Parsons MW, Neilson C, Carey LM. Task-specific training: Evidence for and translation to clinical practice. Occup Ther Int 2009;16:175-89.
19. Wevers L, van de Port I, Vermue M, Mead G, Kwakkel G. Effects of task-oriented circuit class training on walking competency after stroke: A systematic review. Stroke 2009;40:2450-9.
20. Dalgas U, Severinsen K, Overgaard K. Relations between 6 minute walking distance and 10 meter walking speed in patients with multiple sclerosis and stroke. Arch Phys Med Rehabil 2012;93:1167-72.
21. Hong SJ, Goh EY, Chua SY, Ng SS. Reliability and validity of step test scores in subjects with chronic stroke. Arch Phys Med Rehabil 2012;93:1065-71.
22. Mong Y, Teo TW, Ng SS 5-repetition sit-to-stand test in subjects with chronic stroke: Reliability and validity. Arch Phys Med Rehabil 2010;91:407-13.
23. Wang RY, Tseng HY, Liao KK, Wang CJ, Lai KL, Yang YR, *et al*. RTMS combined with task-oriented training to improve symmetry of interhemispheric corticomotor excitability and gait performance after stroke: A randomized trial. Neurorehabil Neural Repair 2012;26:222-30.
24. Yang YR, Wang RY, Chen YC, Kao MJ. Dual-task exercise improves walking ability in chronic stroke: A randomized controlled trial. Arch Phys Med Rehabil 2007;88:1236-40.
25. Beck S, Taube W, Gruber M, Amtage F, Gollhofer A, Schubert M, *et al*. Task-specific changes in motor evoked potentials of lower limb muscles after different training interventions. Brain Res 2007;1179:51-60.
26. Ng SS, Hui-Chan CW. Transcutaneous electrical nerve stimulation combined with task-related training improves lower limb functions in subjects with chronic stroke. Stroke 2007;38:2953-9.
27. Paolucci S, Antonucci G, Grasso MG, Bragoni M, Coiro P, De Angelis D, *et al*. Functional outcome of ischemic and hemorrhagic stroke patients after inpatient rehabilitation: A matched comparison. Stroke 2003;34:2861-5.
28. Dean CM, Richards CL, Malouin F. Task-related circuit training improves performance of locomotor tasks in chronic stroke: A randomized, controlled pilot trial. Arch Phys Med Rehabil 2000;81:409-17.
29. Duncan P, Richards L, Wallace D, Stoker-Yates J, Pohl P, Luchies C, *et al*. A randomized, controlled pilot study of a home-based exercise program for individuals with mild and moderate stroke. Stroke 1998;29:2055-60.
30. Billinger SA, Arena R, Bernhardt J, Eng JJ, Franklin BA, Johnson CM, *et al*. Physical activity and exercise recommendations for stroke survivors: A statement for healthcare professionals from the American Heart Association/American stroke association. Stroke 2014;45:2532-53.