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ORIGINAL ARTICLE

Effects of Core Stability Training on Gait and Quality of Lifestyle in Patients with Multiple Sclerosis

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ABSTRACT
Multiple Sclerosis (MS) is a chronic inflammatory disorder of the central nervous system associated with a variety of symptoms and functional deficits. People with MS endure gait limitations. Exercise training is a promising behavioral strategy with implications for disease progression, particularly for mitigating reduction in walking mobility and quality of life among them. So, the present study aimed to find out the effects of core stability training on gait and quality of lifestyle in patients with Multiple Sclerosis. 10 clinically diagnosed cases of MS patients between the ages of 20-45 years were allocated in a single quasi-experimental group. The participants received core stability training. The interventions were done thrice a week, alternate day for 8 consecutive weeks. The data was analyzed before and after the exercise training program.12-Item Multiple Sclerosis Walking Scale (MSWS-12), Timed Up and Go (TUG) Test, Dynamic Gait index (DGI) and Multiple Sclerosis Quality of Life-54 (MSQOL-54) were used. The values were statistically analyzed to find out their effects on gait and quality of lifestyle. From the mean and standard deviation values of the pretest- posttest result of all the outcome measures, this study shows that there is a significant improvement ($p < 0.000$) in core stability training program on gait and quality of lifestyle in patients with Multiple Sclerosis. Based on the result of the present study, it can be confirmed that those 8 weeks of core stability training program showed a positive and significant improvement on gait and quality of lifestyle for which this exercise program can be used as a non- invasive therapy along with the medication in MS patients.
Keywords: *Multiple Sclerosis, Gait, Quality of life, Exercise.*

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INTRODUCTION

Multiple Sclerosis is a neurologic disease affecting an estimated of 2.5 million adults around the world and is the commonest disabling neurological disease among young adults [1]. It occurs more in women as compared to men and is the third most common neurologic diagnosis mentioned as the cause of disability [2, 3]. Reduced stability and walking ability along with muscle weakness are the common symptoms of Multiple Sclerosis which affect the ability to perform daily motor activities and thus decrease the quality of life [4]. The progressive neuronal dysfunction and neuronal cell death may also lead to disability and eventually take the life of people [5].

Core stability training strategy is essential for everyday activities like sitting, standing and walking in an upright position. It is the exercise that helps in activation of the deep core muscles [6]. Anatomically, the core consists of the abdominals in the front, diaphragm as the roof, glutes and paraspinals in the back and the hip as well as pelvic floor musculature as the bottom [7]. The important factor for balance is postural stability of the trunk, also called core stability because it is considered as the kinetic link that transfer the torques and angular momenta between the upper and lower extremities during performing body movements which involves coordinated stabilization of the lumbo-pelvic hip complex through muscles, inert ligaments and capsules [2].

Gait maybe defined as proceeding on foot on the ground in bipedal locomotion. Gait dysfunction was recognized as an important feature of Multiple Sclerosis and currently represents a primary concept for monitoring patients with MS in clinical research and practice [8]. Impairment in gait is usually related to muscle weakness, spasticity, ataxia and balance disorders and can be noticed at the early stages and

increasing over the disease course [9]. 75% of patients are disturbed by gait limitations which maybe present even in early stages of the disease and in patient with mild disability which affect the quality of lifestyle [3]. Lubahn et al., stated that all joints of the lower extremity and muscular forces are interconnected and weakness at any point can affect the entire chain for which muscle weakness at any point should be ruled out [10]. Various measures of gait for walking ability are required for clinical trials and settings. This includes 12-item Multiple Sclerosis Walking scale (MSWS-12), Timed Up and Go (TUG) test, Dynamic Gait Index (DGI), etc. [11].

The progressive depletion of gait results in pact participation of social engagement, inactive and poorer quality of life [3]. Dysfunction of gait shows the most affected and burdensome factor for the active participation and quality of life [8]. Also, core instability is the common cause to limit their quality of lifestyle, on the other hand, strategy for core stability and strength training are the main components to maximize balance and posture during walking [2].

Multiple Sclerosis is incurable and few cost effective drugs agents are available for patients [5]. So, exercise is the key for the rehabilitation in Multiple sclerosis patients. But up to the present, there has been less investigation regarding the effect of core stability on gait and their quality of life [9]. Exercise is a promising behavioral strategy for improvement of neurological disease and the importance of maintaining and monitoring health related quality of life is increasingly recognized [12, 13].

Therefore, this study is intended to investigate the effects of core stability training on gait and quality of lifestyle in Multiple Sclerosis patients.

MATERIAL AND METHODS

This study was a quasi- experimental pretest- posttest investigation with no control group.10 subjects who were diagnosed cases of Multiple Sclerosis such as relapse- remitting MS; primary or secondary progressive MS were recruited in a home based, in and around Bangalore, India were chosen according to convenience. The study population consisted of 20-45 years old patients with a disability score according to EDSS between 4.0-6.5 [4, 14]. The patient should have the ability to walk independently with or without the use of intermittent or constant unilateral assistance such as walking stick or orthotic braces [14]. From their last relapse, at least 2 months should pass to include in the study and the subject will be terminated if relapse occur in the course of the study [4]. Patients with any history of cardiovascular disease, epilepsy, psychological disease, visual impairments, orthopedic diseases and other comorbidities which can make the participation in the exercise harmful were eliminated [4]. And also, patients with nerve root compression, or disc prolapse, previous back surgery, muscular tightness and systemic illness were excluded [15]. Approval was obtained from the Institutional ECM. All the subjects signed an informed consent form for participation and treatment execution.

Gait and quality of lifestyle were evaluated via different clinical ambulation tests and questionnaires such as 12-items Multiple Sclerosis Walking Scale (MSWS-12), Timed Up and Go (TUG) Test, Dynamic Gait Index (DGI) and Multiple Sclerosis Quality of Life-54 (MSQOL-54).

12-Items Multiple Sclerosis walking scale [16]**:** It is a patient rated measure of walking quality. It is performed satisfactorily in population with regard to data quality, scaling assumptions, reliability and acceptability. Each item is scored on a 1 to 5 scale. A total score is generated and reported on a 0 - 100 scale by subtracting the minimum score possible (12) from the Patient's score, dividing by the maximum score (60), and multiplying the result by 100. It was developed using recognized psychometric methods of scale construction and validated by the authors in community and hospital based samples.

Timed Up and Go (TUG) Test [17]**:** It is a test used to assess a person's mobility and requires both static and dynamic balance. Participants will be seated in a chair with two armrests, were instructed that at the word 'go' they have to rise from the chair, walk as quickly as possible but safely to a mark 10 feet away , turn around, walk back and sit down. Two trials were performed. The stopwatch was started at the verbal cue 'go' and was stopped when the patient was safely seated in the chair. Time was recorded in seconds, with the faster of the two trials used for the analysis.

Dynamic Gait Index (DGI) [18, 19]: It is a good construct validity and reliable clinical tool to assess and measure gait, balance and risk of fall. This scales helps in evaluating both the steady state walking as well as walking during more challenging tasks. It takes 10-15 minutes to finish 8 functional walking tests. Each item is rated on a 4 point scale ranging from 0-3 where 0 indicates severe impairment and 3 indicates normal walking ability without walking aid. The total score is 24 and patients who score 19 or less are considered to increase risk of fall.

Multiple Sclerosis Quality of Life-54 [20]: It is a disease specific self-reported measure for quality of life in Multiple Sclerosis. It is a reliable and valid questionnaire which consists of 54 items with 12 subscales along with two summary scores and two additional single item measure. The two total scores can be

described as Physical Mental Composite and Mental Health Composite scores. It takes 11-18 minutes to complete the test.

Procedure

The core stability exercise protocol was performed thrice a week alternate day for 8 consecutive weeks. The 10 participants were placed in a single group. MSWS-12, TUG, DGI and MSQOL-54 were used as pre-post intervention measurements. They underwent 5 minutes each of warm up and cool down phase. The exercise lasted for 45-50 minutes and 1 minute rest between each exercise set and 3 minute at the end [21]. Deep breathing exercise was also performed during the rest period [22]. The therapist observed and gave oral explanations and proper guidance throughout the whole exercise program.

Core stability exercise program: Based on Farid Razieh's protocol is as follows:

First and second week:

Contract the abdomen, in a supine position, prone position and squatting position (3 sets and 20 reps in each set)

Third week:

Contract the abdomen, in a supine and prone position with one leg in the abdomen (3 sets and 20 reps in each set). Bridging in side lying position for each side (6 reps, 10 seconds pause).

Fourth Week:

a) Contract the abdomen in supine position and lift both hands and feet close together.

b) Squatting with mild assistance, c) rotate the trunk with weights in each of the hand.

(a to c: 3 sets and 20 reps in each set).

Fifth Week:

Contract the abdomen while sitting on the Swiss ball (3 sets, 10 seconds). Placing Swiss ball on the shoulder and squat (3 sets and 15 reps for each side). Bringing up the arm and legs in prone position simultaneously (3 sets and 10 reps for each set).

Sixth Week:

Abdomen curls up in a supine lying position (3 sets and 12 reps for each set). Perform bridging i.e. bringing up the hip and foot while shoulder and hands rest on the ground (3 sets and 15 seconds pause for each set).

Seventh Week:

a) Rotate the trunk while lying down on the Swiss ball in supine position. b) Rotate the trunk while lying down on the Swiss ball with weights in hands. (Both a & b: 3 sets and 15 reps for each set). Bridging in side lying position with leg up (6 reps for each side of the body and 10 seconds pause).

Eight Week:

a) Contract the abdomen with one leg up while lying in supine position on a Swiss ball. b) Squatting with hands raise up. (Both a & b: 3 sets and 15 reps for each set). Bridging with one leg on the Swiss ball and raise up other foot (3 sets and 15 minutes pause).

Statistical Analysis

Data was gathered and statistical analysis was done. MSWS-12, TUG, DGI and MSQOL-54 were considered as primary outcome variables.

The demographic characteristics of age and gender of the study participants were carried out by cumulative frequency distribution. Mean and standard deviation was calculated for continuous outcomes. Paired 't'test was used to compare the pre- test and post- test results of the MSWS-12, TUG, DGI and MSQOL-54 to find out the significant effects of the interventions on gait and quality of lifestyle. p-value <0.05 was considered as evidence for statistically significant findings. IBM SPSS Software Version 22 was used for statistical analysis. A total of 10 subjects were included in the final analysis.

RESULTS

At the end of 8 weeks, the study yielded the following result.

Table 1: Cumulative frequency distribution of age (N=10)

Age	Frequency	Percent	Valid Percent	Cumulative Percent
25	1	10.0	10.0	10.0
27	1	10.0	10.0	20.0
29	2	20.0	20.0	40.0
32	2	20.0	20.0	60.0
35	1	10.0	10.0	70.0
37	1	10.0	10.0	80.0
40	1	10.0	10.0	90.0
45	1	10.0	10.0	100.0
Total	10	100.0	100.0	

As per Table 1, Cumulative frequency was used to characterize the age among the participants. The result showed that there are 7 participants between the age group of 25-35 years and 3 participants between the age group of 35-45 years. Hence, it shows that there is a high prevalence in young adults.

Table 2: Cumulative frequency distribution of gender (N=10)

Gender	Frequency	Percent	Valid Percent	Cumulative Percent
F	6	60.0	60.0	60.0
M	4	40.0	40.0	100.0
Total	10	100.0	100.0	

As per Table 2, Cumulative Frequency distributions was used to characterize the gender among the participants. Out of 10 MS patients, the participants consisted of 6 (60%) females and 4 (40%) males between 20 to 45 years of age with Multiple Sclerosis. As Multiple Sclerosis is universally found more affected in women than in men, female participants are likely to increase in number.

Table 3: Comparison between Pre and Post Intervention scores of MSWS-12, TUG, DGI and MSQOL-54 (PHC&MHC) in the participants (N=10).

Variables		Mean	Mean difference	Standard Deviation	Standard Deviation Difference	95 % CI of mean difference		P Value
						Lower	Upper	
MSWS-12	**Pre**	67.20	8.302	10.08	3.410	5.862	10.741	.000
	Post	58.89		10.25				
TUG	**Pre**	11.58		1.19		1.881	3.294	.000
	Post	9.00	2.588	1.65	.987			
DGI	**Pre**	16.10		2.51				
	Post	18.70	-2.600	2.66	1.174	-3.440	-1.760	.000
MSQOL-54 (PHC)	**Pre**	55.72	1.623	7.17	.365	1.361	1.884	.000
	Post	54.10		7.25				
MSQOL-54 (MHC)	**Pre**	59.28	1.552	6.34	.262	1.364	1.739	.000
	Post	57.72		6.22				

Abbreviations: SD: Standard Deviation; PHC: Physical Health Composite; MHC: Mental Health Composite.

MSWS-12: There was a great significant difference ($p<0.000$) in the scores for the Pre MSWS-12 (M=67.20, SD=10.08) and Post MSWS-12 (M=58.89, SD=10.25). This shows that after core stability exercise program, the mean scores decreased which means that the exercise is effective and have a great improvement in the walking ability.

TUG: There was a high significant difference ($p<0.000$) in the scores for Pre TUG (M=11.58, SD=1.19) and Post TUG (M=9.00, SD=1.65). This result presents the mean scores decreased showing the improvement before and after core stability exercise program.

DGI: There was a high significant difference ($p<0.000$) in the scores for Pre DGI (M=16.10, SD= 2.51) and Post DGI (M=18.70, SD=2.66). The mean scores increased thereby showing that the interventions have a positive impact on gait.

MSQOL-54 (PHC): There was a significant difference ($p<0.000$) in the scores for Pre MSQOL-54 (PHC) (M= 55.72, SD=7.17) and Post MSQOL-54(MHC) (M=54.10, SD=7.25). There is a decreased in the mean score for MSQOL-54(PHC) after the interventions showing that there is a positive impact on the quality of life.

MSQOL-54 (MHC): There was a significant difference ($p<0.000$) in the scores for Pre MSQOL-54 (MHC) (M=59.28, SD=6.34) and Post MSQOL-54 (MHC) (M=57.72, SD=6.22). There is a decreased in the mean score for MSQOL-54 (MHC) after the interventions showing that there is a positive impact on the quality of life.

Therefore, from the results it can be concluded that after 8 weeks of exercise protocol, there is a difference in the result showing improvement in gait and quality of lifestyle in Multiple Sclerosis patients ($p<0.000$) (Table 3).

DISCUSSION

The aim of this study was to investigate the effects of core stability training on gait and quality of lifestyle in patients with Multiple Sclerosis. It is a common immune- mediated multifocal demyelinating disease of the CNS that results in a cycle of physical inactivity, significant mental and physical symptoms, deconditioning and gait impairment holding third most neurologic diagnosis cited as a cause of disability [3, 9, 23].

Gait limitations are a key component of disability in patients with Multiple Sclerosis. Francois et al., stated that 75% patients experience clinically significant walking disturbance, which may present in early stages of disease and in patients with mild disability [3]. Amin et al., considered fatigue (80%) as one of the most identified risk factors for falls in MS patients which is associated with reduced in core muscle strength and endurance, the fact that core muscles impairment was observed in MS patients [2]. And in further studies done by Andersan et al., deficits in core strength were associated with hip muscles such as hip flexors, extensors, abductors along with knee flexors and extensors [2]. Patients with greater lower limb strength perform better on functional activities demonstrating that lower limb strength attributes to functional performance of the body [24]. The core exercise produces marked increase in health and skill related (i.e. balance, co-ordination, speed) components of physical fitness. Improvement was seen in core muscles such as rectus abdominis, external and internal oblique, abdominal and erecter spinae muscles based on the outcome of core stability test [7]. The increase in the performance and activities closely related to a good quality of lifestyle.

In the present study, out of 10 participants, there were 6 female and 4 male. The difference in the age showed that it was statistically not significant. And also, the difference in the proportion of gender (Male-40%, Female-60%) was statistically not significant. The mean of MSWS-12 improved from 67.20 to 58.89 and the mean difference is 8.302 showing a significant improvement ($p<0.000$). The mean of TUG improved from 11.58 to 9.00 and the mean difference is 2.588 showing a significant improvement ($p<0.000$). The mean of DGI improved from 16.10 to 18.70 and the mean difference is -2.600 showing a significant improvement ($p<0.000$). The mean of MSQOL-54 (PHC) improved from55.72 to 54.10 and the mean difference is 1.623 showing a significant improvement ($p<0.000$). The mean of MSQOL-54 (MHC) improved from 59.28 to 57.72 and the mean difference is 1.552 showing a significant improvement ($p<0.000$). This shows that the interventions marked positive effects and all the outcome measures have a significant improvement among the participants.

Based on the present study findings, the meaningful gait and quality of lifestyle improvements after the interventions was observed. The exercise program for the core improves neuromuscular system, reduces displacement of Centre of gravity from supporting surfaces, and reduces its fluctuations, improves endurance, balance, co-ordination of muscles [25]. Therefore, exercise exerted on this area leads to better neutralize the generated torques during reach action and thus achieve greater distance, maintaining orientation of postural muscles for postural control which will strengthen lower limb muscles for better stability for gait, independence and improving quality of lifestyle [26]. Thus, the study proves that participants gained knowledge of using their core muscles and transferred core muscle activation into everyday life activities.

According to the results of this study, core stability exercise program emphasizing gait and quality of lifestyle appeared to be effective in patients with Multiple Sclerosis. The efficacy of the training program is remarkable, especially with regard to its practicability. Thus, physical therapy and other health care personnel can use this exercise program as an effective, routine therapeutic intervention in a home-based and clinical setting.

The limitations noted in this study were small sample size, no follow up program and lastly, there was no control group. Nevertheless, the aim of the study was to investigate the whole exercise training program effects in MS patients. Future research should explore the benefits of similar program in a larger population for yielding more reliable results, and including the follow up program for long term effects with the control group.

CONCLUSION

The result of the present study illustrate that the core stability exercise program is a feasible and safe (i.e. no injuries reported) training that produces marked significant improvement in gait and quality of lifestyle which consists of physical health composite and mental health composite in Multiple Sclerosis patients between the age of 25-45 years. Moreover, walking improvement was achieved despite the level of disability. After 8 weeks of the interventions, it appears that these exercises can be used as a non-invasive therapy along with medication in MS patients. Given study limitations, further studies are required to confirm these results.

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