

Original Article

Effect of 8-week Aerobic Exercise and Yoga Training on Depression, Anxiety, and Quality of Life Among Multiple Sclerosis Patients

Fatemeh Ahadi

Semnan University of Medical Sciences and Health Services, Semnan, Iran

Seyed Mosa Tabatabaee

Payame Noor University, Semnan, Iran

Mojtaba Rajabpour¹

Mohaghegh Ardabili University, Ardabil, Iran

Ahmad Ghadamgahi

Shahid Chamran University, Ahvaz, Iran

Maghsoud Pouryosef Kaljahi

Semnan University, Semnan, Iran

Objectives: Multiple sclerosis (MS) is a disease of the central nervous system that results in many symptoms including mobility limitation, fatigue, cognitive dysfunction and reduced quality of life. The purpose of this study was to determine the effect of 8-weeks aerobic and yoga training on depression, anxiety and quality of life in individuals with MS.

Methods: 31 women with MS (mean of age of 34.15years) with Expanded Disability Status Scale scores 1.0 to 4.0, were randomly assigned to one of three groups lasting 8 weeks: treadmill training, yoga or a waiting-list control group. Treadmill training consisted of 8 weeks (24 sessions) of treadmill training (30 minutes), at 40 -75% of age-predicted maximum heart rate. Yoga group subjects participated in a thrice weekly 60-70 minute sessions of Hatha yoga intervention for 8 weeks. The control group followed their own routine treatment program. Depression, anxiety and quality of life were measured by Beck Depression Inventory (BDI), Beck Anxiety Inventory (BAI) and Multiple Sclerosis Quality of Life-54 questionnaire (MSQOL-54) respectively. Data were analyzed by MANOVA, Tukey and paired T tests.

Results: Results indicated that intervention has improved significantly BDI score, BAI score and some MSQOL-54 scale scores in the treadmill training group and yoga group. There were significant differences between treadmill training group and yoga group in BAI score and MSQOL-54 scale scores .

Conclusion: These results suggest that treadmill training and yoga practice improved depression, anxiety and quality of life in people with mild to moderate MS.

Keywords: multiple sclerosis, depression, anxiety, quality of life, treadmill training, yoga

Submitted: 20 Dec, 2012

Accepted: 12 March 2013

Introduction

Multiple sclerosis (MS) is a chronic disease of the central nervous system (1). This autoimmune disease is a progressive demyelinating disease of the white matter of the central nervous system (2,3).The symptoms vary widely across MS patients and can include loss of function, fatigue, muscular weakness, spasticity, ataxia, cognitive dysfunction and depression (1,4).With a prevalence rate of 110/100,000, MS is one of the most frequent neurological

diseases (2) and affects approximately 1,000,000 individuals worldwide (5). MS begins slowly, usually in young adulthood, and continues throughout life with periods of exacerbation and remission (6,7).Ability to participate in daily social and family activities may be affected by these impairments. Beside Prior researches represent that in individuals with MS, depression, anxiety and stress has been shown to be greater than in healthy individuals (8).Some studies found relationship

1- correspondances to Mojtaba Rajabpour, Phd. Student , email: < Mj_rajabpour@yahoo.com>

between involvement of specific areas of the brain and the occurrence of depression and anxiety (9). Up to 70% of multiple sclerosis (MS) patients experience cognitive dysfunction during the course of their disease (10). Studies showed near 50-60% of MS patients reported depression (11, 12) and about 25-40 percent experienced anxiety (13). These factors impress quality of life in the patients (14).

In other hand the risk of attempted or completed suicide in neurologic illness is strongly associated with depression feelings of hopelessness and social isolation (15).

Today, exercise is indicated in the treatment of a large number of medical disorders (16). Quality of life, fatigue, and mood, there are a number of cognitive changes often associated in MS that may be impacted by yoga or physical activity (17). In particular, yoga postures may be employed with great success to decrease fatigue, abnormally high muscle tone, spasticity, promote muscle relaxation and improving mood (17,18). Also there have been several controlled trials of aerobic exercise in MS suggesting improvement in quality of life, fatigue, and mood (2, 12).

Besides The quality of life in people with MS is severely affected by the fact that there is no known cure, the progression of the disease is uncertain and by the debilitating effects of the disease (15). Information on the response of MS patients to exercise is limited, and study findings appear to be influenced by the level of physical impairment in study samples (19). Thus, the purpose of this study was the comparison of effect of 8 weeks aerobic and yoga training on depression, anxiety and quality of life in individuals with MS.

Method

Participants

31 women with MS (19-54 years old) were screened from a waiting list for a rehabilitation program in the physiotherapy clinic, and obtained physician clearance prior to study enrolment. Subject inclusion criteria consisted of physician-diagnosed MS with a self-assessed Kurtzke Expanded Disability Status Scale (EDSS) score of between 1 and 4. Additionally, individuals were required to be able to walk on the treadmill with or without hand support (without human assistance) and to be able to walk at a constant speed on a treadmill for 5 minutes. No subjects had participated in physical activity for three months prior to the study. Subjects using MS disease-modifying drugs were included. Individuals

who were with cardiovascular disease, liver or kidney failure, symptomatic lung disease, diabetes, thyroid disorders, gout or orthopedic limitations were excluded. Individuals pregnant and addict (i.e. cigarette smokers or drug addicts) were also excluded. All subjects provided written informed consent for the study. After completion of the baseline evaluations, subjects were randomized to one of the three experimental groups lasting 8 weeks.

Assessments: After medical history screening, participants were asked to complete Beck Depression Inventory (BDI) (20,21), Beck Anxiety Inventory (BAI) (22,23) and Multiple Sclerosis Quality of Life-54 questionnaire (MSQOL-54) (24,25) to assess their depression and anxiety level and quality of life. BDI was chosen for modification because it has been utilized more than any other depression self-report measure over the last four decades and changes in clinical ratings of depression have been found to be appropriately paralleled by changes in BDI score (20). BAI has been designed to differentiate between behavioral, emotional, and physiological symptoms in individuals with anxiety and depression (23). Studies suggested that the BAI can be used to measure anxiety treatment outcome (26). All participants were then assessed immediately prior to (baseline) and following the 8-week intervention,

Interventions

Training group subjects completed supervised treadmill training (thrice weekly) exercises for eight consecutive weeks. Each training session consisted of 30-min treadmill exercise training. The exercise class began and ended with about 10 minutes of stretching of muscles and flexion and rotation movements of the trunk and lower limb. Training Intensity was between 40-75% age predicted maximal heart rate which measured on a Polar Electro OY type PE-3000 heart rate monitor. Initial speed was based on baseline comfortable walking speed and increased as directed by participants. To monitor exercise intensity, HR, time, speed and ratings of perceived exertion using the modified Borg 15-point scale, were recorded.

Ten patients in the yoga group completed an 8-weeks yoga class. Yoga classes were 60-70 minutes in duration and three sessions per week. The postures started with stretching techniques followed by standing, supine and prone-lying and sitting postures. Our yoga teacher was familiar about problems common to the persons with MS. In this

regard, she employed the previous studies to design a Hatha yoga program with the following techniques: breathing techniques, arms overhead stretches (static), eagle pose (garudāsana), side bending triangle posture (trikonasana), forward bending (padahastāsana), side lateral bending (ardhakatichakrasana), ankle on knee forward bend, warrior II (on chair) (vīrabhadrāsana II), side angle pose (parshvakonāsana), seated twist (bharadvajāsana I), tree pose (supported by wall) (vrikshāsana), reclining bound angle (suptabaddhakonāsana), supported downward dog (adhomukhashvanāsana), cat pose, pose of a child (balāsana), hand to toe (supta-padāngushthāsana), supported back bend, rising sun twist, variation of jathara-parivartanāsana, legs up the wall (viparīta-karanāmudrā) and followed by relaxation technique in supine posture with closed eyes and relaxation of every part of the body (17, 27, 28, 29). Each pose was held for approximately 10 to 30 seconds (even 8 seconds for subjects who were unable to maintain some techniques) with rest periods between poses lasting 30 seconds to 1 minute. Patients were supported for majority of poses, with a chair or Swiss ball or wall. Usually class began with calmative music. The yoga class set up in a physiotherapy clinic and was supervised by a neurologist and physiotherapist. Because overheating problem associated with the disease would aggravate the symptoms of MS,

temperature was kept about 25-30 centigrade in the training time.

Data Analysis

Pre-test data were examined at first reassessment for between group differences. Comparisons between pre and post-training were analyzed using a paired t-test. Analysis of variables was examined using the MANOVA and Tukey test used for analysis between-group differences. Data were analyzed with SPSS version 16.0, using a significance level of $p < 0.05$.

Results

Ten MS women in the Treadmill training group, eleven patients in the yoga group and ten MS women in the control group, took part in this study's test procedures. No subject exacerbations were reported during the eight-week training program. There were no differences between the groups at baseline for age, EDSS score, disease duration, BDI score and BAI score.

After 8 weeks BDI score was improved significantly in the treadmill training group ($P=0.00$) and decreased from 8.50 to 5.60 whereas BAI score in this group reduced significantly from 7.90 to 6.10 ($P=0.01$). In the yoga group average BDI score and BAI score decreased significantly from 17.36 to 11.09 ($P=0.00$) and 12.54 to 6.45 ($P=0.00$) respectively. Both BDI score and BAI score increased in the control group (table 1).

Table 1. Pre and post intervention (Post) BDI score and BAI score in subjects with multiple sclerosis.

Variable	Treadmill training group			Yoga group			Control group			F	P**
	Pre	post	P*	Pre	post	P*	Pre	post	P*		
BDI score range	8.50±3.06 3-13	5.60±3.40 1-10	0.00	17.36±12.42 4-45	11.09±12.46 1-39	0.00	11.90±9.39 3-35	12.50±8.12 4-30	0.53	8.80	0.00
BAI score range	7.90±5.91 1-20	6.10±4.95 0-17	0.01	12.45±4.54 7-20	6.45±3.61 1-13	0.00	7.50±6.77 1-22	8.20±7.39 0-26	0.52	11.30	0.00

p*: p values assessed by paired t-test

p**: p values assessed by MANOVA

BAI score after 8 weeks improved in the yoga group more than treadmill training group, this difference were significant ($P=0.01$). The analysis did not show

difference between treadmill training group and yoga group for BDI score ($P=0.11$) (table 2).

Table 2. Mean Difference between groups (treadmill training -TT, yoga group-Y and control-C)

Variable	BDI score range		BAI score range	
	Mean Difference	P	Mean Difference	P
TT-Y	3.37	0.11	4.20	0.01
TT-C	3.50	0.11	2.50	0.22
Y-C	6.87	0.00	6.70	0.00

The MSQOL-54 scores before and after the eight week intervention is shown in Table (3) and (4). After the treadmill training program, the subjects showed a significant increase in physical function (P=0.00), pain (P=0.01), energy (P=0.02), health distress (0.02), overall quality of life (P=0.02) and physical health composite (0.00). The yoga group showed a significant increase in physical function (P=0.01), role limitations emotional (P=0.01), emotional well-being (P=0.04), energy (P=0.04),

cognitive function (P=0.00), overall quality of life (P=0.02), physical health composite (P=0.02) and mental health composite (P=0.00). After analysis between three groups, differences were found in physical function, pain, energy, health perception, cognitive function, physical health composite and mental health composite that pain and health perception were improved in the treadmill training group more than yoga group (P=0.03, P=0.00 respectively).

Table 3. Pre and Post intervention Multiple Sclerosis Quality of Life-54 Questionnaire (MSQOL-54)

Variable	Treadmill training group			Yoga group			Control group			F	P**
	Pre	post	P*	Pre	post	P*	Pre	post	P*		
Physical function	57.6±20.18 20-90	70.50±15.71 45-100	0.00	57.27±20.04 20-90	66.45±16.65 45-100	0.01	70±24.72 25-95	67.50±24.63 25-100	0.44	6.65	0.00
Role limitations Physical	40±29.34 0-100	55±38.72 0-100	0.08	31.81±31.8 0-100	27.27±32.5 0-100	0.58	55±36.89 0-100	57.5±40.9 0-100	0.84	1.06	0.35
Role limitations Emotional	60±34.42 0-100	63±42.88 0-100	0.79	48.48±34.52 0-100	78.78±37.33 0-100	0.01	39.99±40.97 0-100	56.66±41.72 0-100	0.17	1.40	0.26
Pain	65.66±26.43 15-93.3	82.99±17.26 55-100	0.01	64.69±25.28 15-93.33	68.03±22.23 30-93.33	0.13	64.83±18.15 40-93.33	62.33±22.01 30-93.33	0.37	6.82	0.00
Emotional wellbeing	50.40±16.56 24-80	55.20±16.50 24-76	0.28	51.63±16.24 24-80	66.36±19.15 12-84	0.04	58.40±19.88 24-84	57.20±19.41 24-80	0.61	2.82	0.07
Energy	46.80±13.43 28-56	56.80±16.34 48-72	0.02	44.36±9.54 28-56	57.45±17.27 8-68	0.04	50±16.24 28-72	48.40±18.22 8-68	0.75	5.60	0.00
Health perception	54.25±17.64 30-75	62.35±14.47 50-85	0.06	52.27±13.48 35-75	48.18±12.89 35-70	0.20	61±18.07 35-90	59±16.79 30-85	0.72	7.99	0.00
Social function	70.83±28.93 16.6-100	75±20.78 41.67-100	0.32	71.9±27.7 16.67-100	82.6±17.26 41.67-100	0.06	81.66±19.16 50-100	80.83±28.61 16.67-100	0.86	1.49	0.24
Cognitive Function	52±20.57 25-95	58.50±18.11 35-85	0.09	53.63±20.25 25-95	73.63±10.5 60-90	0.00	64.5±23.14 30-100	66.50±27.39 25-100	0.68	5.25	0.01
Health distress	71.50±21.73 40-100	78.50±22.24 40-100	0.02	71.36±20.62 40-100	80.9±14.45 60-100	0.09	81±22.08 40-100	82.50±20.84 40-100	0.19	1.29	0.29
Sexual function	64.16±34.49 0-100	73.33±33.52 0-100	0.20	67.42±34.45 0-100	75.75±32.8 0-100	0.20	81.67±19.16 49.97-100	58.01±17.90 58.35-100	0.30	0.30	0.73
Change in health	40±37.63 0-100	52.50±27.51 25-100	0.21	40.9±34.04 0-100	52.27±23.59 25-100	0.24	50±2.57 25-100	5.50±27.51 25-100	0.78	0.35	0.70
Satisfaction with sexual function	67.50±29.35 0-100	80±23.78 25-100	0.16	65.9±35.83 0-100	77.27±26.11 25-100	0.13	72.50±21.88 50-100	80±22.97 50-100	0.43	0.21	0.80
Overall quality of life	61.99±24.98 18.3-100	75.83±18.02 41.65-100	0.02	63.8±24.4 18.35-100	76.35±17.18 41.6-100	0.02	71.83±9.88 55-86.65	76.82±11.33 55-91.65	0.22	1.11	0.34
Physical health Composite	56.62±12.30 39.3-72.8	71.19±10.16 52.5-90.87	0.00	58.95±13 35.36-74.7	65.7±11.5 46.2-86.98	0.02	67.24±12.87 39.4-81.7	66.64±12.30 41.6-84.09	0.79	9.16	0.00
Mental health Composite	57.98±13.88 38.55-86	64.62±15.12 39.7-85.8	0.15	56.12±9.7 38.55-68.7	74.3±15.34 40.73-91.6	0.00	60.48±15.53 33.4-83.56	65.54±14.89 41-84.6	0.71	3.96	0.03

p* : p values assessed by paired t-test

p** : p values assessed by MANOVA

Table 4. Mean Difference to analyzed between groups (TT), (Y) and (C) by Tukey test

Variable	Physical function		Pain		Energy		Health perception		Cognitive function		Physical health composite		Mental health composite	
	ΔMean	P	ΔMean	P	ΔMean	P	ΔMean	P	ΔMean	P	ΔMean	P	ΔMean	P
TT-Y	3.71	0.66	13.99	0.03	8.50	0.44	22.29	0.00	13.50	0.06	6.79	0.10	11.50	0.08
TT-C	15.40	0.00	19.83	0.00	23.20	0.00	20.20	0.00	4.50	0.73	14.18	0.00	1.57	0.95
Y-C	11.68	0.03	5.83	0.53	14.69	0.09	2.09	0.93	18.00	0.01	7.39	0.07	13.08	0.04

Discussion

Several studies have explained on cognitive impairment in the MS patients. Recent reports have shown that depression and fatigue are commonly seen with cognitive dysfunction (10). Some studies indicated that anxiety and depression correlated with disability in people with multiple sclerosis (9).

Our study revealed that, in subjects with MS, 8 weeks treadmill training improved BDI score and to the same yoga practice. The treadmill training program produced no significant changes compared with the control group on the BDI score. Perhaps this outcome is related to complexity of depression in MS and different factors example of pain, sexual dysfunction, physical impairment, stress, drugs, demyelination and relation of depression with fatigue in the MS patients (13, 14, 31).

Subjects participating in the yoga group showed significantly improvement in this factor compared with the control group. To our knowledge, to date literature is witness of lack of project to study the effect of yoga or treadmill training intervention on depression or anxiety in the MS patients. Oken et al. no observed improvement of cognitive function and mood after 6 month yoga and aerobic program (17). Although some studies reported that Hatha yoga produces improvements in mood (32) and calming of mind (28).

Our findings in this study, by BAI scale showed that treadmill training and yoga practice led to a significant decrease of anxiety in MS patients. This improvement was in the yoga group more than treadmill training group. But this factor in the control group increased by 8.53% after 8 weeks. Also Petajan et al. found reduced scores for anxiety and fatigue measured with the Profile of Mood

Status in their training group after 5 weeks of bicycle exercise (12).

We also found that treadmill training and yoga programs significantly induced improve in some MSQOL-54 scale scores. There is a possibility that mood improvements contributed to these improvements in quality of life (17). Our findings showed a significant difference between treadmill training group and yoga group in the pain and health perception.

The same researchers showed energy and fatigue (vitality) dimensions of the SF-36 (Short Form health-related quality of life) improved after 6-month yoga intervention in the home by once per week (17). Nevertheless, other exercise programs can also led to improve in quality of life. Previous studies of MS individuals showed beneficial effects on health-related quality of life after, 4 weeks of bicycle exercise training (2), or 5 weeks of aerobic and strength exercise (33). In this connection, Rampello et al, found after the 8-weeks bicycle exercise training program, the subjects showed a significant increase in 3 MSQOL-54 scale scores (emotional well-being, energy and health distress) (24). However, the mechanism of action of these changes in the quality of life is not completely clear but probably is affected by improvement of mood for subjects participating in this study.

Conclusions

Based on these observations it can be suggested that treadmill training and short period of yoga practice would be beneficial for people with MS in improving of depression, anxiety and quality of life.

References

1. Motl R, McAuley E, Snook E. Physical activity and multiple sclerosis: a meta-analysis. *Multiple Sclerosis* 2005; 11: 459-463.
2. Mostert S, Kesselring J. Effects of a short term exercise training program on aerobic fitness, fatigue, health perception and activity level of subjects with multiple sclerosis. *Multiple Sclerosis* 2002; 8: 161-168.
3. Prakash R, Snook E, Erickson K, Colcombe S J, Voss M W, Motl R W, Kramer A F. Cardiorespiratory fitness: A

predictor of cortical plasticity in multiple sclerosis. *NeuroImage* 2007; 34: 1238-1244

4. Svensson B, Gerdle B, Elert J. Endurance training in patients with multiple sclerosis: Five case studies. *Physical Therapy* 1994; 11: 1017-1026.
5. Kantarci, O, Wingerchuk, D. Epidemiology and natural history of multiple sclerosis: new insights. *Current Opinion in Neurology* 2006; 19: 248-254.
6. Sandyk R. Treatment with electromagnetic fields improve dual-task performance (talking while walking) in multiple

- sclerosis. *International Journal of Neuroscience* 1997; 92 (1-2): 95-102.
7. Schulz K, Gold S, Witte J, Bartsch K, Lang U, Hellweg R, Reer R, Braumamm K M, Heesen CH. Impact of aerobic training on immune-endocrine parameters, neurotrophic factors, quality of life and coordinative function in multiple sclerosis. *Journal of the Neurological Sciences* 2004; 225: 11-18
 8. McCabe PM. Mood and self-esteem of persons with multiple sclerosis following an exacerbation. *Journal of Psychosomatic Research* 2005; 59: 161-66.
 9. Zorzon M, Masi R, Nasuelli D, Ukmar M, Mucelli R P, Cazzato G, Bratina A, Zivadinov R. Depression and anxiety in multiple sclerosis. A clinical and MRI study in 95 subjects. *Journal of Neurology* 2001; 284 (5): 416-42
 10. Wallin M T, Wilken J A, Kane R. Cognitive dysfunction in multiple sclerosis: Assessment, imaging, and risk factors. *Journal of Rehabilitation Research & Development* 2006; 43 (1): 63-72
 11. Donna JB, Cathy B. An overview of assistive technology for persons with Multiple Sclerosis. *Journal of Rehabilitation Research & Development* 2002; 39 (2): 299-312.
 12. Petajan JH. Impact of aerobic training on fitness and quality of life in Multiple Sclerosis. *Annals of Neurology* 1996; 39 (4): 432-41.
 13. Chwastiak AL, Gibbons EL, Ehde MD, Sullivan M, Bowen DJ, Bombardier HC, et al. Fatigue and psychiatric illness in a large community sample of persons with multiple sclerosis. *Journal of Psychosomatic Research* 2005; 59: 291-98.
 14. Janardhan V, Bakshi R. Quality of Life in patients with multiple sclerosis: The impact of fatigue and depression. *Journal of the Neurological Sciences* 2002; 205: 51-58.
 15. Jaime K. The effects of a 10 week yoga intervention on balance, mobility, spasticity and quality of life in people with multiple sclerosis. A Thesis presented to the School of kinesiology Lakehead University (Canada) 2006.
 16. Pedersen B K, Saltin B. Evidence for prescribing exercise as therapy in chronic disease. *Scand J Med Sci Sports* 2006; 16 (1): 3-63
 17. Oken B.S, Kishiyama S, Bourdette D, et al. Randomized controlled trial of yoga and exercise in multiple sclerosis. *Neurology* 2004; 62: 2058-64
 18. Zwick D. Yoga and multiple sclerosis: Consortium of MS Centers. 10/4/2004. Available from: <http://www.ms-care.org>.
 19. Yates H, Vardy T, Kuchera M, Ripley B D, Johnson J C. Effects of osteopathic manipulative treatment and concentric and eccentric maximal-effort exercise on women with multiple sclerosis: A pilot study. *Journal of the American Osteopathic Association* 2002; 5 (102). 267-275
 20. Dori G A, Overholser J C. Evaluating depression severity and remission with a modified Beck Depression Inventory. *Personality and Individual Difference* 2000; 28: 1045-1061
 21. Lok I H, Yip S K, Lee D T S, Shek D, Tam W H, Chung T K H. Application of Beck's Depression Inventory for screening post-miscarriage psychiatric morbidity. *International Congress Series* 2004; 1271: 325-328
 22. Beck A T, Steer R A. Beck Anxiety Inventory Manual. San Antonio, TX: The Psychological Corporation Harcourt Brace & Company, 1993.
 23. Leyfer O T, Ruberg J L, Woodruff-Borden J. Examination of the utility of the Beck Anxiety Inventory and its factors as a screener for anxiety disorders. *Anxiety Disorders* 2006; 20: 444-458
 24. Rampello A, Franceschini M, Piepoli M, Antenucci R, Lenti G, Olivieri D, Chetta A. Effect of aerobic training on walking capacity and maximal exercise tolerance in patients with multiple sclerosis: A randomized crossover controlled study. *Physical Therapy* 2007; 5: 1-11.
 25. Solari A, Filippini G, Mendozzi L, Ghezzi A, Cifani S, Barbieri E, Baldini S, Salmaggi A, Mantia L L, Farinotti M, Caputo D, Mosconi P. Validation of Italian multiple sclerosis quality of life 54 questionnaire. *Journal of Neurology, Neurosurgery, and Psychiatry*. 1999; 67: 158-162.
 26. Beck A T, Epstein N, Brown G, Steer R A. An inventory for measuring clinical anxiety: psychometric properties. *Journal of Consulting and Clinical Psychology* 1998; 56: 893-897.
 27. Kishiyama S, Carlsen J, Lawrence J, Small E, Zajdel D, Oken B. Yoga as an Experimental Intervention for Cognition in Multiple Sclerosis. *International journal of yoga therapy* 2002; 12: 57-62.
 28. Chaya MS, Kurpad AV, Nagendra, HR, Nagarathna R. The effect of long term combined yoga practice on the basal metabolic rate of healthy adults. *BMC Complementary and Alternative Medicine* 2006; 6 (28): 1-6.
 29. Nagarathna R, Nagendra HR. Combined approach of yoga therapy for positive health. 2nd edition. Bangalore, Swami Vivekananda yoga Prakashana; 2004.
 30. Beck A T, Steer R A, Brown G K (1996). Beck Depression Inventory manual. 2nd edition. San Antonio, TX: Psychological Corporation.
 31. Kesselring J, Beer S. Symptomatic therapy and neurorehabilitation in multiple sclerosis. *Lancet Neurol* 2005; 4: 643-52.
 32. Berger B, Owen D. Stress reduction and mood enhancement in four exercise modes: swimming, body conditioning, Hatha yoga, and fencing. *Res Q Exerc Sport* 1988; 59: 148-159.
 33. Bjarnadottir O H, Konradsdottir A D, Reynisdottir K, Olafsson E. Multiple sclerosis and brief moderate exercise. A randomized study. *Multiple Sclerosis* 2007; 6: 776-782.