

THE IMPACT OF YOGA ON FATIGUE, POSTURAL CONTROL AND DEPRESSION IN PEOPLE WITH MULTIPLE SCLEROSIS

Yoganın Multipl Sklerozlu İnsanlarda Yorgunluk, Postüral Kontrol ve Depresyon Üzerine Etkisi

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ABSTRACT

Objective: Multiple sclerosis (MS) is a chronic and progressive neurodegenerative disease that influences patients' physical, mental, and social functioning. Yoga is one of the most popular forms of mind-body approaches in people with MS (pwMS) to overcome the symptoms of the disease. This study aimed to investigate the effect of the yoga training program on fatigue, postural control, and depression level in pwMS.

Material and Methods: Ten pwMS aged between 22-42 years were included in the study. The structured yoga training program was applied an hour per session, five times a week over 5 weeks. The yoga program consisted of basic yoga poses, breathing and warming exercises. Each session was focused on strengthening, postural control, relaxation, and flexibility. The yoga poses were asked to maintain for 15 seconds to 2 minutes. Patients were evaluated with The Fatigue Severity Scale for fatigue level, with single leg stance test for postural control, and with Beck depression inventory for depression level. Patients were evaluated before and after the therapeutic yoga program.

Results: After 5 weeks of therapeutic yoga program, statistically significant improvements were detected in terms of fatigue, postural control, and depression level in pwMS ($p=0.005$; $p=0.005$; and $p=0.007$, respectively).

Conclusion: This study showed that a supervised therapeutic yoga program might be effective on fatigue, postural control, and depression level in pwMS.

Keywords: Fatigue, postural control, depression, multiple sclerosis, yoga

ÖZ

Objective: Multipl skleroz (MS), hastaların fiziksel, zihinsel ve sosyal işlevlerini etkileyen kronik ve ilerleyici nörodejeneratif bir hastalıktır. Yoga, MS'li bireylerde hastalığın semptomları ile başa çıkmak için uygulanan en popüler zihin-beden yaklaşımlarından biridir. Bu çalışmanın amacı; MS'li bireylerde yoga eğitim programının yorgunluk, postüral kontrol ve depresyon düzeyine etkisini araştırmaktır.

Gereç ve Yöntemler: Çalışmaya yaşları 22-42 yıl aralığında olan 10 MS'li birey dâhil edildi. Yapılandırılmış yoga eğitim programı, 5 hafta boyunca haftada beş kez, her seans bir saat olacak şekilde uygulandı. Yoga programı temel yoga pozlarını, solunum ve ısınma egzersizlerini içermekteydi. Her seansta kuvvetlendirme, postüral kontrol, gevşeme ve esnekliğe odaklanıldı. Yoga pozlarının 15 saniye ile 2 dakika arasında sürdürülmesi istendi. Hastaların yorgunluk şiddetini değerlendirmek için yorgunluk şiddet ölçeği, postüral kontrolünü değerlendirmek için tek ayak üzerinde durma testi, depresyon düzeylerini değerlendirmek için Beck depresyon envanteri kullanıldı. Hastalar hem terapötik yoga programı öncesinde hem de sonrasında değerlendirildi.

Bulgular: Beş hafta süren terapötik yoga programından sonra MS hastalarının yorgunluk, postüral kontrol ve depresyon düzeyinde istatistiksel olarak anlamlı gelişmeler tespit edildi (sırasıyla $p=0,005$; $p=0,005$ ve $p=0,007$).

Sonuç: Bu çalışma, MS'li bireylerde denetimli uygulanan terapötik yoga programının yorgunluk, postüral kontrol ve depresyon düzeyi üzerinde etkili olabileceğini göstermiştir.

Anahtar Kelimeler: Yorgunluk, postüral kontrol, depresyon, multipl skleroz, yoga



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INTRODUCTION

Multiple sclerosis (MS) is a common, incurable, neurodegenerative disease affecting the central nervous system.¹ Chronic and progressive nature of the disease causes various physical, mental, and psychological symptoms.² Although the severity of symptoms can vary considerably among people with MS (pwMS); fatigue, balance disturbances, weakness of muscle, and pain are quite widespread. These impairments in physical function may lead to an increased level of depression and a decline in health-related quality of life in pwMS.¹ Since no definite treatment is available for MS, different rehabilitation modalities are identified and recommended as promising approaches for the management of the symptoms.³

Although the benefits of exercise and physical activity in the management of symptoms have been proven; the rates of participation in rehabilitation programs are low in pwMS.⁴ Therefore, there has been an increasing interest in complementary, applicable, and enjoyable integrative health practices to motivate patients to exercise and participate in programs.⁵ Yoga is widely used, which is an ancient mind-body practice in pwMS.⁶ Many different forms of yoga are defined with varying intensities, teaching styles, and crossover between practices.⁷ Hatha yoga is one of the yoga styles that is purported to quiet the mind, focus concentration, stretch, and strengthen exercises. Hatha yoga primarily emphasizes physical fitness.⁸ Yoga training incorporates breathing techniques, specific physical postures, meditation, and mindfulness to improve the participants' muscle strength, flexibility, mental status, sensory disturbances, balance, and quality of life.⁹ A number of researchers have reported that yoga could be a safe and feasible method to alleviate physical and mental symptoms among pwMS.^{6,10,11}

Although yoga has become increasingly popular in pwMS, there is a limited number of study about yoga in MS. Thus, this study aimed to investigate the effect of the therapeutic yoga program on fatigue, postural control, and depression level in pwMS.

MATERIALS AND METHODS

Participants

The pwMS with age ranges between 22 to 42 years (n=11) participated in the study from December to February 2021. The study participants were recruited from the Istanbul Atlas University Hospital. Inclusion criteria were defined as MS diagnosis according to the revised McDonald criteria, age between 18 to 45 years, walking 100 m independently, and volunteering to participate in the therapeutic yoga program for 5 weeks.¹² The exclusion criteria were any neurological disease other than MS, relapse within 3 months, orthopedic disorders that could negatively affect gait

and balance, cardiopulmonary problems which might influence recruit yoga exercises, diagnosed psychiatric problems or cognitive limitations to perform tests and yoga training, and current or recent (within the prior 6 months) participation in a regular exercise program and insufficiency to performed sitting to or and standing from the yoga mat without any support.

The study was approved by the Non-Interventional Clinical Research Ethics Committee of Istanbul Atlas University (Approval number: E-22686390-050.01.04-17611) and performed in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants.

Outcome Measurements

All the assessments were performed by the same physiotherapists at the beginning and the end of the therapeutic yoga program. The demographic characteristics of subjects were recorded using a standard form. The information regarding the diagnosis duration, type of MS, and history of falls in the prior 3 months were recorded.

The fatigue level was assessed using the fatigue severity scale (FSS) which contains 9-item self-report questionnaire to assess fatigue during the past week in people with MS. The scores for each item ranges from 1 to 7, with 7 pointing out strong agreement and 1 pointing out complete disagreement.¹³ The total scoring is obtained through the calculation of the sum scores of all the answers and dividing them by nine. A cut-off score of ≥ 4 and ≥ 5 for clinically relevant fatigue was accepted.^{14,15}

Single leg stance test (SLST) was used to assess static postural control under eyes open and eyes closed conditions. Before SLST, the dominant lower extremity was determined using the ball kick test. Then, participants were asked to stay as long as possible on their dominant foot which stands barefoot on the ground while the left leg was raised without touching the ankle of their stance leg.¹⁶ The chronometer was ended if the participant either moved the weight-bearing foot on the ground, or 60 and 30 seconds had elapsed for eyes opened and closed conditions, respectively. At least 2 minutes was allowed for resting between trials to avoid fatigue.

Beck depression inventory (BDI) which is generally used for pwMS, was utilized to evaluate depression.^{17,18} It consists of the three main components of depression: mood (sadness, pessimism, dissatisfaction, and tearfulness), cognitive changes (guilt, worthlessness, or feelings of failure), and vegetative signs (changes in sleep or appetite). The inventory included of 21-item which are scored between 0 and 3 for each. The sum of all items' scores presents the total score in which the cut-off value is 17. Higher scores point out worse depression

symptoms.¹⁹ The Turkish versions of all the scales were used and permissions were obtained from the authors.

Intervention

After the assessment session, a progressive, therapeutic yoga program was performed for all participants for an hour, 5 weeks, and 5 times/per week. All sessions included breathing and warming exercises, and different yoga poses which were focused on strengthening, postural control, relaxation, and flexibility in each

session. The participants were asked to stay in each yoga pose for 15 seconds to 2 minutes. Half wheel pose, standing backward bend, hand to foot pose, hero pose, seated forward bend, twisted pose, tree pose, and warrior pose were some of the yoga asanas that were used throughout the therapeutic yoga program (Table 1). All therapeutic yoga programs were performed under the supervision of the same physiotherapist.

Table 1: Therapeutic yoga protocol applied in the present study

Session Component	Yoga Pose / Technique	Description	Duration / Repetitions
Warm-up & breathing	Diaphragmatic breathing	Slow nasal inhalation with prolonged exhalation	3-5 min
	Ujjayi Breathing (mild)	Gentle constriction of glottis during exhale	2-3 min
	Joint mobility exercises	Cervical, shoulder, thoracic and hip mobility	5 min
Strength & postural control	Warrior pose (virabhadrasana 1/II)	Standing lunge position with trunk upright	15-30 sec × 2
	Tree pose (vrksasana)	Single-leg standing with foot placed on inner thigh	15-30 sec × 2
	Half wheel pose (ardha chakrasana)	Standing backward bend with controlled extension	15-20 sec × 2
	Hero pose (virasana)	Kneeling position with extended spine	1-2 min
Flexibility training	Seated forward bend (paschimottanasana)	Long sitting with trunk flexion	20-30 sec × 2
	Twisted pose (ardha matsyendrasana)	Seated spinal rotation	20-30 sec × 2
Balance & neuromotor control	Hand-to-foot pose (Padahasthasana)	Forward bending with hands reaching feet	15-20 sec
	Standing backward bend	Hip-trunk extension in standing	10-15 sec × 2
Relaxation & cool-down	Guided relaxation	Supine or seated breathing + body scan	5 min
	Meditation / mindfulness	Awareness of breath/body sensations	3-5 min

Statistical Analysis

The statistical procedure was carried out by using SPSS software (Version 16.0; SPSS; Chicago, IL, USA). The normality of all variables was tested using the Kolmogorov-Smirnov test. The paired sample t-test or Wilcoxon signed-rank test was used to compare differences in parameters between pre- and post-treatment, depending on the distribution. Effect sizes for pre-post changes were calculated using Cohen's d. A p-value of less than 0.05 was considered statistically significant with a 95% confidence interval. A post hoc power analysis was conducted for SLST using G*Power 3.1.9.7 to evaluate the achieved statistical power based on the observed effect size. The analysis was performed using the Wilcoxon signed-rank test (matched pairs) model, with a one-tailed α level of 0.05 and a total sample size of 10 participants. The effect size calculated from the pre- and post-intervention SLST values was large ($d_z = 1.78$). Based on this effect size, the achieved power ($1-\beta$) was 0.99, indicating that the study was sufficiently powered to detect the observed change in static postural control.

RESULTS

A total of 10 participants completed the 5-week supervised therapeutic yoga program. One of the participants left the study because of individual problems. The demographic and clinical characteristics are presented in Table 2. All participants were women diagnosed primarily with relapsing-remitting MS (RRMS), with a mean age of 34.0 ± 6.5 years and a mean disease duration of 4.2 ± 3.1 years.

Table 2: The demographic and clinical characteristics of the participants

	X±SD (n=10)
Age (year)	34.0±6.5
Body mass index (kg/m²)	21.1±2.3
Type of multiple sclerosis (n)	9 RRMS, 1 SPMS
Disease duration (years)	4.2±3.1

X: Mean, SD: Standard deviation.

After participating in the structured therapeutic yoga program, significant improvements were observed across all primary outcome measures. FSS scores demonstrated a notable reduction from a pre-treatment mean of 6.87 ± 0.31 to 5.11 ± 0.55 post-treatment, indicating a decrease in perceived fatigue severity

among participants ($p=0.005$). Although all participants initially exhibited clinically relevant fatigue ($FSS \geq 4$), post-treatment values showed that several participants approached the lower limit of clinically relevant fatigue levels, reflecting a meaningful shift in symptom intensity. Static postural control, assessed via the SLST under eyes-open conditions, also improved markedly. The mean SLST duration increased from 13.70 ± 5.38

seconds at baseline to 29.30 ± 10.12 seconds after 5 weeks of yoga training ($p=0.005$). Similarly, depressive symptoms assessed by the BDI showed a statistically significant reduction from 28.1 ± 10.5 (moderate-severe range) before the intervention to 19.7 ± 8.40 (mild-moderate range) after the yoga program ($p=0.007$) (Table 3).

Table 3: Comparison of the differences between pre-tests and post-tests

	Pre-treatment (X±SD) (n=10)	Post-treatment X±SD (n=10)	Cohen's d	p	95% CI
The fatigue severity scale	6.87±0.31	5.11±0.55	3.942	0.005*	(1.3406) - (2.1794)
Single leg stance test	13.70±5.38	29.30±10.12	1.924	0.005*	(-23.2145) - (-7.9855)
Beck depression inventory	28.1±10.5	19.7±8.40	0.883	0.007*	(-0.5335) - (17.3335)

X: Mean, SD: Standard deviation. * $p < 0.05$

DISCUSSION

The present study investigated the effect of a therapeutic yoga program on fatigue, postural control and depression level of pwMS. Our study revealed that therapeutic yoga program under the supervision of a physiotherapist for 5 weeks and 5 times a week may improve fatigue, postural control and depression level of the pwMS.

The pwMS show a wide spectrum of symptoms such as muscle weakness, cognitive impairments, spasticity, increased fall risks, and excessive fatigue. Fatigue is exhibited in a very high rate, approximately two-thirds of pwMS.²⁰ Both physical and mental deconditioning have a potential effect on the development or persistence of fatigue. Therefore, improving physical and mental health using physiotherapy techniques can provide effective management of fatigue in pwMS.^{21,22} A Cochrane analysis showed that different types of exercise therapies have beneficial effects on fatigue compared with no intervention in pwMS.²¹ Another current systematic review revealed that while balance exercise and cognitive behavioral therapies have higher efficiency, other exercise therapies such as aerobic and resistive exercise and combined exercise (balance, aerobic, strength, and flexibility) also improve fatigue in the short term.²² On the other hand, the origin of the fatigue in pwMS is associated with both physical and psychosocial reasons, yoga is known as a body-mind therapy technique and may enhance both physical and mental health.²³⁻²⁵ In line with all these findings, the progression of the fatigue in our study may be related to the contents of our therapeutic yoga program which included postural control, strength, flexibility, breathing, and relaxation components. The magnitude of improvement observed in fatigue levels in our study is noteworthy, particularly given that fatigue is one of the most disabling and treatment-resistant symptoms in pwMS. The substantial reduction in FSS scores suggests

that therapeutic yoga may address both physical and psychological contributors to fatigue more effectively than expected.

Most people with MS have impaired postural control and increased fall accidents and risks.^{26,27} The weak postural control is associated with impairments of both the vestibular, visual, and proprioceptive inputs in MS. Additionally, MS-related hypotonia or spasticity of lower limbs also causes postural imbalance.^{28,29} In our study, an improvement in postural control was determined after 25 yoga sessions. It is known that yoga training naturally includes strengthening, stability, concentration, stretching, weight-bearing, relaxation, and light-intensity exercise via asanas and breathing methods.^{10,30} Furthermore, it is a bare-foot exercise method that may enhance cutaneous afferent inputs from the sole of the foot.^{31,32} On the other hand, yoga provides opportunities to focus attention on oneself, which may be a factor to enhance postural control performance in our study.¹⁰ In the literature very limited number of the study compares the effect of yoga with other exercise techniques on postural control.³³⁻³⁵ Abasiyanik et al. presented that both yoga and Pilates improved postural control and respiratory muscle strength, which is also a part of the core, but Pilates found that they are more effective on balance in subjects with MS.³⁴ A previous study also showed that 24-week Qigong and yoga exercise groups enhanced trunk movement, postural control, and balance ability than the control group while Qigong was superior in pwMS.³³ However, improvements in the present study should be interpreted cautiously, because of the lack of the control group to distinguish the specific effects of yoga from natural fluctuations in postural performance. Beyond statistical significance, the more than twofold increase in single-leg stance duration highlights a clinically meaningful enhancement in postural control, indicating that even a

relatively short, 5-week yoga program can produce robust neuromotor adaptations in pwMS.

Because depression is a common symptom of MS, thus the management of it is frequently investigated, current narrative review of meta-analyses and systematic reviews concluded that there is no gold-standard, single treatment for depression in MS, combinatory treatments which include pharmacological, behavioral and exercise therapies may be efficient.³⁶ However, there are limited number of studies that evaluated yoga in aspects of depression. The researchers have always thought that yoga may promote mood and reduce stress thanks to mindfulness and meditation aspects of yoga in patients of MS.^{37,38} Velikonja et al. did not find any improvement in depression level after 10-weeks of yoga training.³⁵ Similarly, a meta-analysis and systemic review revealed that insufficient evidences exist on the effect of yoga on depression or mood of pwMS.³⁹ Contrarily, an improvement for depression was determined after therapeutic yoga program in our study. We speculated that the participants who have a regular exercise program were excluded from the study, thus the effect of exercise on mood was clearly seen. Additionally, this result may be related to the decrease in fatigue because the depression level was found highly correlated with fatigue in pwMS in the literature.⁴⁰ The clear reduction in BDI scores further reinforces the holistic impact of yoga, demonstrating that the intervention not only targeted physical symptoms but also produced meaningful changes in emotional well-being.

The most notable limitation is the absence of a control group, which prevents us from distinguishing the true effects of the yoga program from natural variations or regression to the mean. This is particularly relevant for pwMS, as symptoms such as fatigue and depression may fluctuate independent of interventions. Additionally, the small sample size and the predominance of individuals with relapsing-remitting MS limit the generalizability of our findings. Taken together, these improvements across fatigue, balance, and depressive symptoms underscore the potential of therapeutic yoga as a multidimensional intervention capable of addressing several core challenges faced by pwMS.

In conclusion, the present study showed that therapeutic yoga program under the supervision of a physiotherapist for 5 weeks and 5 times a week may improve fatigue, postural control, and depression level of pwMS. On the other hand, the results of our study cannot be generalized to all MS populations because of the small sample size and non-variety of MS types. Further studies are needed to determine the possible benefits of yoga among pwMS.

Conflict of interest: The authors have no conflicts of interest to declare.

Researchers' Contribution Rate Statement:
Concept/Design: HDK, MK, HU, BK;
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Data Collection: MK, HU, BK; Writer: HDK, MK, HU, BK;
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