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Evaluation of the effectiveness of home based or hospital based calisthenic exercises in patients with multiple sclerosis

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Abstract. – OBJECTIVES: The aim of this study is to evaluate the effects of calisthenic exercises on balance, walking speed, fatigue, quality of life, and psychological status in patients with Multiple Sclerosis (MS).

PATIENTS AND METHODS: Forty patients diagnosed with MS were randomized into two exercise groups (group 1 = hospital-based, group 2 = home-based). Outcome measures including the MS International Quality of Life Scale, 10-meter walking test, Berg Balance Scale, Fatigue Severity Scale and the Hospital Anxiety Depression Inventory were assessed at the baseline and at 12-weeks.

RESULTS: Thirty-six participants completed the exercise programme (hospital based = 16, home based = 20). The mean age was 32.83 ± 3.64 years. The mean duration of disease was 6.97 ± 3.15 years. Hospital-based and home-based exercise groups had significant improvements in the balance, 10-meter walking test, anxiety, and the quality of life after the 12-week exercise programme. There was a significant improvement in the hospital-based patients in terms of the depression scores. No significant improvement was observed in terms of fatigue in any of the groups. When both groups were compared, the improvement in the balance and depression scores of the hospital-based patients was significantly higher than the home-based patients.

CONCLUSIONS: Calisthenic exercises can be easily performed both at home and in hospital setting. In patients with MS, calisthenic exercises performed at home or at the hospital may improve the balance, quality of life, and the functional and psychological status, while no significant effect has been observed on fatigue.

Key Words:
Multiple sclerosis, Calisthenic exercise, Quality of life, Balance, Fatigue, Depression, Anxiety.

Introduction

Multiple sclerosis (MS) is a chronic, inflammatory, demyelinating disease of the central nervous system that may result in significant damage in the neuromuscular system and lead to functional impairment[1]. In patients with MS, problems in mobility and balance, cognitive and autonomous function, and muscle weakness are the main factors leading to disability[2]. Besides the medical treatment, it is also important that the patients with multiple sclerosis also follow an exercise program. Since the majority of the patients need very long-term rehabilitation programs, incorporating exercise into the lifestyle may positively effect the course of the disease[1,3]. Exercise treatment is an easy method although it frequently lacks continuity.

Previous studies have shown that exercise treatment has positive effects on the quality of life, fatigue, and the psychological and functional status[3-6]. The outcome of the exercise performed at the hospital setting or at home in terms of the effectiveness, cost and psychosocial effects are controversial. Although the rehabilitation programs held in the hospital setting seem have a greater effect, various studies have reported that the rehabilitation carried out at home are also effective[3,4,7]. Although calisthenic exercises are a part of various rehabilitation programs, there is only a small number of studies focussing on their effectiveness in MS rehabilitation. In previous studies, the disease-related positive effects of calisthenic exercises on parameters such as functionality, balance, quality of life, fatigue and psychological state have already been demonstrated[8,9].

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The primary aim of this study is to evaluate the effectiveness of calisthenic exercises in terms of functionality, balance, quality of life, fatigue and psychological state in patients with MS. The secondary aim is the comparison of the exercise therapy and disciplines performed at home and in the hospital setting.

Patients and Methods

The Study Groups

Patients who presented to the Physical Medicine and Rehabilitation and Neurology Outpatient Clinics of the Bezmialem University Hospital in Istanbul/Turkey between January 2011 and May 2012 and diagnosed with MS were included in this prospective study. All of the patients had the relapsing-remitting type of MS and none of them was having an attack during the study period. All of them were mobile patients. The Expanded Disability Status Scale (EDSS) scores of all the patients were below 4.5. Twenty patients were enrolled in the hospital-based exercise group, while 20 further patients were enrolled in the home-based exercise group. The patients were between the ages of 18 and 50. All the recruited subjects signed informed consent forms before participating in the study and the approval of the local Ethics Committee was obtained. Using computer-generated random numbers, the subjects were randomized into two groups to participate in either the hospital-based (group 1), or home-based exercise programs (group 2). All the subjects gave their consent to the random assignment to the groups.

Both groups were applied exercise programs 5 days a week for 12-weeks. The 5-day exercise program consisted of calisthenic exercises for 3 days and relaxation exercises for 2 days. Calisthenic exercises were focused on the large muscles and were applied rhythmically and in combination with breathing exercises. Calisthenic exercises are consecutive and repetitive exercises aimed at training large muscle groups through aerobic and step routines that also include regional training sequences and end with a 5-minute rest[8,9] (Figure 1). Calisthenic exercises were performed 3 days a week, in 1-hourly sessions including 15 mins. of warm-up, 20 mins. Intensive training, 10 mins. Cooling and 15 mins. of relaxation. The relaxation exercises were given in 20-minute sessions twice a week. The patients were advised to rest in the remaining two days of the week. In the hospital-based group, all the exercises were conducted by a physiatrist at the hospital, the home-based group were asked to perform the exercises at home and their exercise schedule was followed up through telephone every day.

The demographic and clinical characteristics of the patients such as age, sex, height, weight, educational level, disease duration (since the onset of the first symptoms of MS), organ involvement; cardiovascular, gastrointestinal, pulmonary (dyspnoea), urogenital, nervous and musculoskeletal symptoms and current treatment modalities were recorded. The erythrocyte sedimentation rate (ESR) was measured through the Westergren method (mm/h) and the serum C-reactive protein (CRP) level was determined with the help of nephelometry (mg/dl).

Patients with an acute exacerbation of their MS symptoms, an Ashworth spasticity score over two, EDSS (Expanded Disability Status Scale) score over 4.5, thyroid disorders, infections; chronic diseases such as diabetes mellitus, heart- or renal failure, and those with a history of serious psychiatric disorders or alcohol abuse were excluded from the study.

Assessments were made at the baseline and after 12-weeks of exercise; using a 10-m walking test, Berg Balance Scale (BBS), Multiple Sclerosis International Quality of Life Scale (MusiQoL), Hospital Anxiety and Depression Scale (HADS), and Fatigue Severity Scale (FSS).

Measurement of the Quality of Life and Physical Functioning

Mild or moderate MS was assessed through the EDSS. EDSS is a method for quantifying disability in 8 functional systems in MS. EDSS scores 1.0-4.5 refer to patients with MS who are fully ambulatory, while scores 5.0-9.5 are defined by the impairment on ambulation[10].

Balance was assessed using the Berg Balance Scale and 14 functional balance items were evaluated on a 0-to-4 scoring scale. The total scores vary between 0 and 56 and higher scores indicate better dynamic balance[11].

Walking speed was determined by measuring the time the participants needed to walk 10 meters (10-m walking test). Patients were asked to walk as fast as they could. Walking speed measurement has a high retest reliability and can serve as an indication of the functional impairment in the patients with neurologic impairment. This measurement was repeated three times and the mean value of the three measurements was calculated[12].

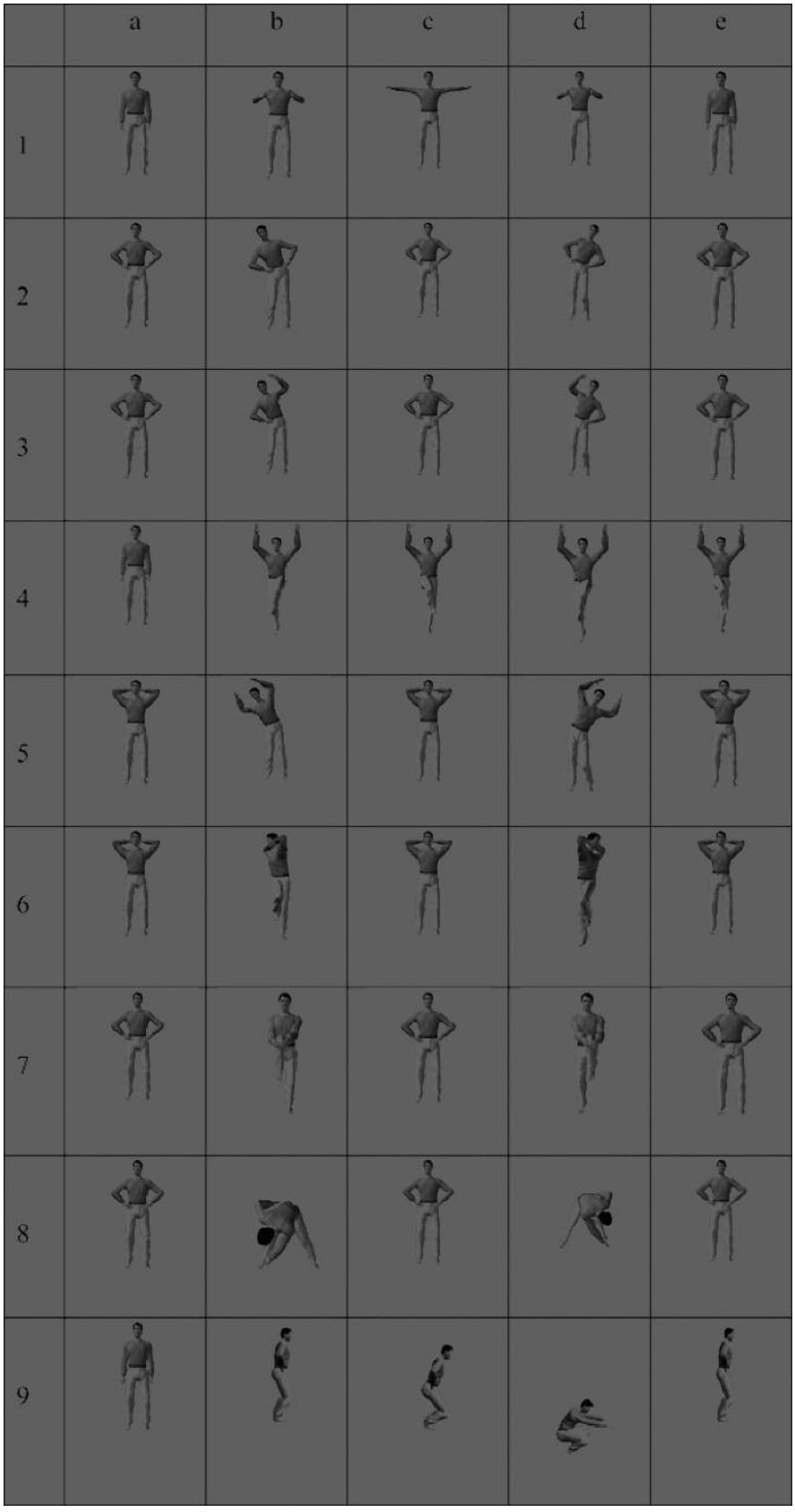

Figure 1. The calisthenic exercises which conducted in patients with multiple sclerosis[8]. *Figure continued*

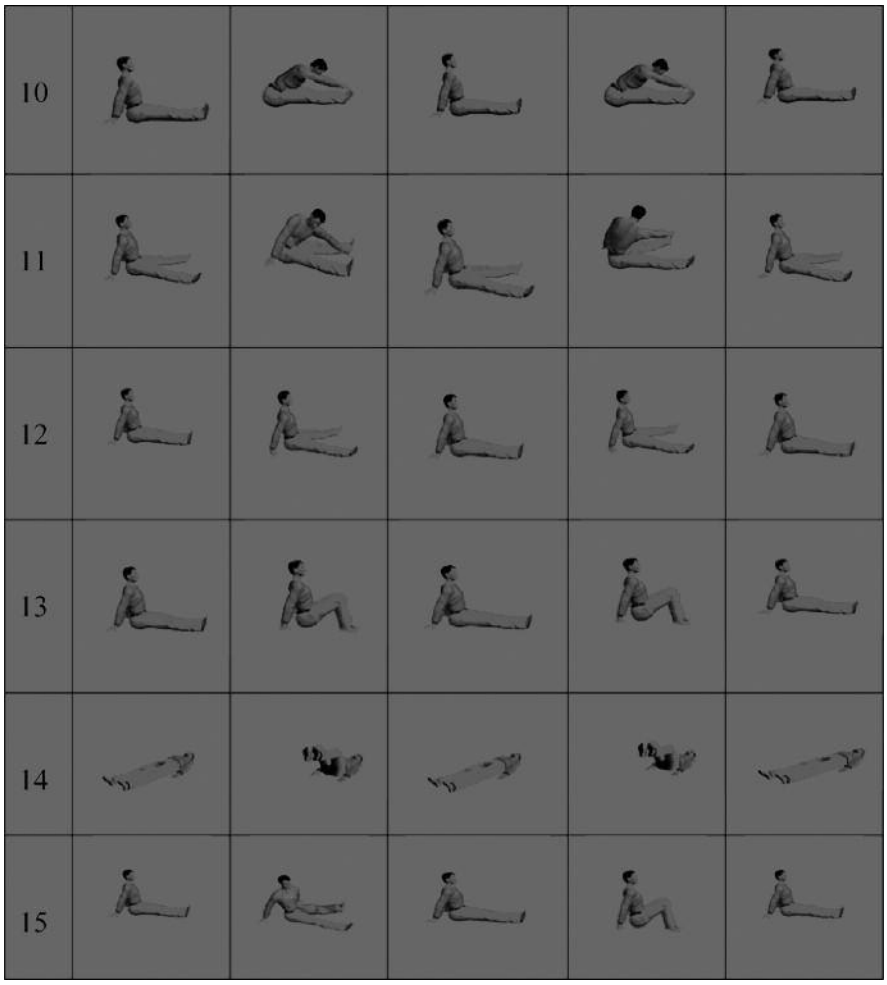

Figure 1 *(Continued)*.

FSS is a self-report validated questionnaire scale designed to assess the impact of fatigue on daily functions through nine fatigue-related questions. The participants rate themselves on a seven-point Likert scale and a total score between 0-7 is obtained, where lower scores indicate lower levels of fatigue[13].

The quality of life was assessed using the MusiQoL validated questionnaire, which is a self-administered, multi-dimensional, patient-based health related QoL instrument that includes 31 items and describes nine dimensions including the activities of daily living, psychological well-being, relationships with friends, symptoms, relationships with family, relationship with the healthcare system, sentimental and sexual life, coping, and rejection. MusiQoL also yields a global index score, which is calculated as the mean of the individual dimension scores. MusiQoL yields scores on a 0-100 scale. Higher scores indicate higher quality of life[14].

Measurements of the Psychological Variables

HADS was developed by Zigmond and Snaith[17] and the Turkish version of this scale has been verified in terms of its validity and reliability by Aydemir et al[18]. HADS is a Likert-type self evaluation scale which consists of 14 items; 7 to investigate the depression symptoms (HADS-D) and the other 7 to investigate anxiety symptoms (HADS-A). Higher scores indicate poor psychological status[15,16].

Statistical Analysis

The calculations were performed using the Statistical Package for Social Sciences for Windows software version 16.0 (SPSS Inc., Chicago,

IL, USA). The Kolmogorov-Smirnov test was used to confirm that data within the ranges of normal distribution in both groups. A non-parametric test was employed for the variables outside the normal distribution. The comparison of the data between the groups was carried out through the Mann-Whitney U-test. The Wilcoxon Signed Ranks test was used to examine the pre- and post exercise differences within groups. Statistical significance was based on a value of $p < 0.05$ with a 95% confidence interval.

Results

Two patients in the hospital exercise group discontinued the study due to the failure to adapt to the exercise, while 2 further patients discontinued the study due to transportation problems. No exacerbation has been observed in any of the patients. A total of 36 patients completed the study (16 hospital-based, 20 home-based).

The clinical and demographic characteristics of the patients and the healthy controls are listed in Table I. The majority of the MS patients were female (58.3%) and 72.9% among them were married. The mean age was 32.83 ± 3.64 years. The mean disease duration was 6.97 ±3.15 years. Among the patients, 62.5% had depressive symptoms (HADS-D > 7) and 52.7% had anxious symptoms (HADS-A > 8) at the baseline (Table I).

After the 12-week exercise programme, the home-based and hospital-based exercise groups showed significant improvements in terms of the BBS, HADS-A and MusiQoL scores. There was a significant improvement in the hospital-based patients and a significant deterioration in the home-based patients according to HADS-D score. No significant difference was observed in the FSS score ($p < 0.05$) (Table II).

In the inter-group comparison, the BSS change score was observed to be significantly higher in the hospital-based group. A significant difference was also found in the post-exercise HADS-D and HADS-D change scores. No significant difference was observed in the other parameters (Table II).

Discussion

In the previous studies, balance, functional status, quality of life, fatigue and psychological disorders like depression have been demonstrated as factors influenced by regular exercises in multiple sclerosis[5,17]. However, there are only a limited number of exercises conducted on the effectiveness of calisthenic exercises in patients with MS[8,9]. In a controlled study, calisthenic exercises have been demonstrated to improve the fatigue, muscle strength and balance scores as well as a conventional neurorehabilitation programme. Also, although the anxiety score measured through the HADS scale in the calisthenic exercise group was observed to improve significantly, no significant difference was observed in the depression score. The difference in terms of the functionality, quality of life [measured with Short Form (SF)-36, fatigue, and BBS parameters was not significant between the groups[8].

In our study, although the quality of life was improved in both groups, the difference between the groups was not significant. Cakit et al[3] evaluated the effects of cycling progressive resistance training combined with balance exercises for 8 weeks and revealed that the combined hospital-based programme including cycling progressive resistance training and balance exercises led to an improvement in the physical functioning and the role-physical functioning scales; while the home-based exercises led to an improvement on-

Table I. Clinical and demographic characteristics of the patients with MS (mean ± SD or n, %).

Disease characteristics	Hospital-based (n: 16)	Home-based (n: 20)	p
Age (years)	32.62 ± 3.15	33.00 ± 4.06	0.764
Female patients (n,%)	9 (56.25)	11 (55)	0.738
Disease duration (years)	6.43 ± 2.78	7.40 ± 3.43	0.360
Education (less than high school)	25.54%	24.46%	0.446
BMI (cm/kg^2)	26.12	25.25	0.415
Marital status (married patients)	72.9%	69.4%	0.265
EDDS	3.6 ± 1.3	3.4 ± 2.1	0.530

MS: Multiple Sclerosis; BMI: Body Mass Index; EDDS: Expanded Disability Status Scale; SD: Standard Deviation.

Table II. Pre- and post exercise scores and the differences in the scores within the groups, and the pre- and post exercise inter-group comparison of the groups (mean ± SD).

	Hospital-based (n: 16)	Home-based (n: 20)	p^2
Fatigue FSS			
Pre-exercise	4.79 ± 1.18	4.44 ± 1.43	0.678
Post-exercise	4.86 ± 1.16	4.37 ± 1.43	0.355
Difference	0.08 ± 0.21	-0.07 ± 0.26	0.154
P^1	0.213	0.322	
MusiQoL			
Pre-exercise	63.69 ± 17.00	59.75 ± 14.06	0.293
Post-exercise	76.00 ± 18.81	69.00 ± 15.11	0.119
Difference	12.31 ± 7.45	9.25 ± 6.99	0.146
P^1	0.001	< 0.001	
BBS			
Pre-exercise	47.56 ± 6.57	48.95 ± 5.38	0.369
Post-exercise	50.94 ± 4.97	50.40 ± 5.27	0.700
Difference	3.38 ± 2.78	1.45 ± 1.85	0.031
P^1	0.001	0.003	
10 m walking test			
Pre-exercise	10.81 ± 2.15	9.95 ± 1.92	0.211
Post-exercise	9.47 ± 1.56	9.02 ± 1.78	0.386
Difference	1.34 ± 1.26	0.93 ± 1.12	0.442
P^1	< 0.001	0.001	
HADS-D			
Pre-exercise	8.50 ± 3.74	6.75 ± 3.23	0.212
Post-exercise	6.13 ± 3.26	8.60 ± 2.41	0.011
Difference	-1.94 ± 2.35	1.85 ± 1.60	< 0.001
P^1	0.003	< 0.001	
HADS-A			
Pre-exercise	10.63 ± 7.33	11.05 ± 5.73	0.762
Post-exercise	8.69 ± 6.11	10.00 ± 5.36	0.482
Difference	-1.94 ± 2.35	-1.05 ± 1.32	0.412
P^1	0.002	0.004	

MS: Multiple Sclerosis; FSS: Fatigue Severity Scale; MusiQoL: MS international Quality of Life; BBS: Berg Balance Scale; HADS-D: Hospital Anxiety Depression Scale-Depression; HADS-A: Hospital Anxiety Depression Scale-Anxiety; SD: Standard Deviation; P^1 Pre- and post exercise intra-group comparison, P^2 inter-group comparison. $*p < 0.05$; $**p < 0.01$.

ly in the physical functioning scale of the SF-36. In another study[4], fifty ambulatory patients with MS were admitted to the hospital for a three-week physical rehabilitation programme, while another group performed the exercises at home. No significant difference was observed in terms of the impairment as measured by the EDSS. Also, at the end of the rehabilitation programme, a significant difference was reported only in the mental score of the SF-36 in the hospital exercise group. In another study focusing on the effects of aerobic exercises in MS[18], a four-week aerobic training was performed. The control group that did not receive any exercise training followed the normal rehabilitation programme. The exercise group demonstrated a significant improvement in terms of the health related QoL as measured with the SF-36. Romberg et al[19] reported that progressive resistance exercises have led to an improvement in the functional status in patients with MS. However, the exercise intervention had no significant effect on the health-related QoL measured by the MSQoL-54. In a study comparing calisthenic exercises with classic neurorehabilitation[8], no significant improvement was observed in any of the groups regarding the functionality and the quality of life. The duration of the exercise applied to both groups in the said study was 6 weeks and even the Authors themselves have emphasized that this duration was too short to bring about an improvement in the quality of life and functionality. In various studies, different exercise programs were applied to different patient groups and they were evaluated through different criteria. Nevertheless, when both these results and the results of our study are taken into consideration, calisthenic exercises performed at home or in the hospital setting may improve the quality

of life and functionality in patients with MS, although different exercise programs performed at home or in the hospital do not seem to show any clear superiority to each other in terms of the quality of life.

In our study, the BBS (Berg Balance Scale) and 10-meter walking test results were significantly improved in both groups. Also in the inter-group comparison, the BBS difference scores were significantly higher in the hospital group, although the difference between the groups was insignificant in terms of the 10-m walking test. The results of the previous studies on the effect of exercise in terms of balance in patients with multiple sclerosis are controversial. In the study by Learmonth et al[20] where the effects of a 12-weeks balance and resistance exercise program in the patients with MS are investigated, it has been suggested that the balance confidence significantly improved through exercise intervention, although there was no statistically significant improvement in the dynamic balance according to the BBS. Freeman et al[21] found a significant improvement in the BBS scores at the end of 10 weeks of combined exercise intervention. Cattaneo et al[22] studied three groups of people with MS who had balance problems where the first group received inpatient motor and sensory balance exercises; the second group received only motor exercises, and the third group performed received conventional therapy. They have found that the BBS scores significantly decreased in the first and second groups at the end of the three-weeks intervention. De Bolt and Mc Cubbin[7] revealed that home-based resistance exercise was well tolerated and no inter-group effects of exercise therapy on balance were observed after the exercise. In the study conducted by Cakit et al[3], the combination of cycling progressive resistance training and balance exercise was found to have a greater effect than home-based balance and lower-limb strengthening exercise on static and dynamic balance and the 10 m walking test. Another report[23] has revealed that the combination of resistance training and balance exercise intervention led to an improvement in the 10-m walking test in patients with MS. Controlled researches could not yet clearly reveal the effects of different exercise programs on the balance and functional status. However, Cakıt et al[3] concluded that the improvement in the balance parameters is mainly based on the cycling progressive resistance training exercise. The functional status of the MS patients in these studies was different from our patient group. The conflicting result may be associated with the different exercise programs applied to different patient groups. In our work, besides the significant improvement in the BBS scores in both groups, our comparison has also pointed out a significant difference in the hospital group. This result may indicate a benefit of the calisthenic exercises performed in the hospital setting. Keser et al[8] have evaluated balance using BBS in the groups receiving classical rehabilitation or calisthenic exercises and observed that although there is improvement in the balance in both groups, no superiority was observed in favour of calisthenic exercises compared to classical neurorehabilitation. The results of our study agree with these results.

In our investigation, no significant difference occurred in the fatigue scores in either of the groups subsequent to the exercise and no difference was observed in the intra-group comparison. In the study of Petajan et al[24] where they compared the group of arm-leg ergometry exercisers with the group of nonexercisers, an effect was observed on the FSS score after 10 weeks, which did not persist in the final assessment after 15 weeks. Rasova et al[25] enrolled patients with MS in three training groups to receive endurance training, endurance training and physiotherapy, together with a control group that did not receive any intervention, and assessed the fatigue using the Modified Fatigue Impact Scale (MFIS) which pointed out a decrease. Geddes et al[26] investigated the effect of a 12-week home-based walking programme 3 days a week and found no significant improvement in the fatigue scores compared to the controls. Stroud et al[5] revealed that exercisers reported less fatigue on the Physical and Psychosocial scales and lower overall scores in the Multidimensional Fatigue Inventory Scale (MFIS). Also Trojan et al[27] found that physical activity was weakly correlated with the Physical, but not the General or Mental scales of the MFIS. In patients with MS, the fatigue may be primarily associated with the disease, it may also be the result of secondary factors such as insomnia, depression or pain associated with the disease. Hypofunction of the central nervous system, reduction in the cortical glucose metabolism and reduced cytokines profile are primary factors associated with fatigue[28-32]. Besides these data, there are also articles demonstrating that especially resistance exercises reduce the fatigue in patients with MS[33,34]. Cakıt et al[3] have reported that the combination of cycling progressive resis-

tance training and balance exercise was found to be more effective than the home-based balance and lower-limb strengthening exercises on the fatigue scale assessed by FSS. Resistance-based exercise programs have been found to alter cytokine profiles in MS patients[35]. The results of the previous reports seem to underline the positive effect of especially the endurance and strength exercises on the patients with MS more clearly. In our study, no significant change was observed in the fatigue score. Our findings may be explained by the fact that calisthenic exercises do not build up muscle strength to an extent matching the endurance and strength exercises. Also, the baseline fatigue scores of our patients were lower than the other investigation and this may explain the lack of a significant improvement in the fatigue scores following the exercise therapy.

In our research, there was a significant improvement in the hospital-based patients and a significant deterioration in the home-based patients in terms of the depression scores. The anxiety scores were significantly decreased in both groups. In the inter-group comparison, a significant difference has been observed in the post-exercise HADS-D scores. Wiles et al[6] have reported that significant effects were found in the home-based and hospital-based exercise groups in terms of the mood, reduction in anxiety and depression measured with the HADS scale after the 8 weeks of exercise therapy. Petajan et al[24] observed that the depression scores at the Profile of Mood States were significantly reduced after 15 weeks of aerobic training. Romberg et al[19] reported that progressive resistance exercises have led to an improvement in the functional status. However, they have also found that the exercise program used had no effect on depression. The effects of exercise therapy on the psychological state in the patients with MS in unclear yet. Still, the positive effects of exercise on the psychological status have been reported in a number of reports. Various theories about the effects of exercise on the psychological status in patients with MS have been proposed. The hypothalamic-pituitary axis, brain derived neurotrophic factor and serotonin are factors influenced during the pathogenesis of MS[36,37]. Exercise can improve these factors affected by MS through the regulation of the hypothalamic-pituitary axis and central monoamines, increased β-endorphin levels, and the normalisation of the hippocampal brain-derived neurotrophic factor mechanisms[38,39]. Through these mechanisms, regular exercise may reduce the depressive symptoms in the patients with MS. In the inter-group comparison in our study, significant improvement has been observed in the HADS-D scored of the hospital-based group. Although the home-based exercises were followed-up regularly, they may not be able to provide a social support as in the hospital setting. The lack of this social support may have led to the increase in the HADS-D scores of the home-based group. This may also be the reason that brought about the significant difference in the depression scores of the hospital-based exercise group.

Conclusions

The calisthenic exercises performed at home or in the hospital setting may improve the balance, quality of life, and the psychological status in the patients with MS, while no significant effect has been observed on fatigue. The inter-group comparison revealed that the exercises in the hospital setting are effective only on the depression and balance. Calisthenic exercises are simple and economical exercises which do not require any devices and can be performed both at home and in the hospital setting. Prospective studies in larger patient groups may shed light on the effects of calisthenic exercises in MS in more detail.

Conflict of Interest

The Authors report no conflict of interest.

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