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# The Effects of Low and Severe Disability on Walking Abilities and Quality of Life in Multiple Sclerosis Patients: 6-Month Follow-up Study

## Multipl Skleroz Hastalarında Hafif ve Şiddetli Yeti Yitiminin Yürüme Yeteneği ve Yaşam Kalitesi Üzerine Etkisi: 6 Aylık Takip Çalışması

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### ABSTRACT

**Objective:** To explore the effects of 12-week supervised exercise program (SEP) on quality of life (QoL), walking abilities, balance impairment and fatigue in patients with multiple sclerosis (MS) and to compare these outcomes according to the severity of the disability.

**Methods:** Demographic characteristics and medical history of a total of 24 MS patients were recorded. Disability [The Expanded Disability Status Scale (EDSS)], functional balance [The Berg Balance Scale (BBS)], balance confidence [The Activities-specific Balance Confidence (ABC\_Scale)], walking difficulties [The 12-Item Multiple Sclerosis Walking Scale (MSWS-12)], fatigue [The Fatigue Impact Scale (FIS)], QoL [The MS International Quality of Life (MUSIQOL)] were evaluated before, at the end of the treatment (3rd month) and at the 6th month. Additionally, the effectiveness rate of the physiotherapy was calculated according to the disability and disease duration.

**Results:** The outcome results of the 17 participants with a mean age of 45.2±8.6 years (seven patients were excluded because of acute attacks) showed that the differences between the mean scores of MSWS-12, BBS and ABC\_Scale were resulted from the 2nd assessment (p<0.001), and this differences remained at the follow-up measurements (p<0.001, p=0.003, p=0.001, respectively). The differences between the MUSIQOL scores were resulted from the 3rd assessment at the follow-up (p=0.014). There were statistically significant and positive correlation between the scores of MUSIQOL significantly positively correlated with scores of FIS-total and subgroups, in addition, MSWS-12 significantly positively correlated with MUSIQOL, BBS, ABC\_Scale, FIS-total and subgroups, and EDSS scores (p<0.05).

**Conclusion:** 12-week SEP was resulted in similar improvements in QoL and walking abilities in both patients with low and severe disabilities. Additionally, these findings strongly suggest that treatment for walking abilities may also extend to improvements in QoL. Therefore, the rehabilitation team should consider the benefits of regular exercise and should focus and encourage people with MS to participate in exercise independent from the disease severity. (*Archives of Neuropsychiatry* 2013; 50: 23-29)

**Key words:** Multiple sclerosis, disability, exercise, walking ability, quality of life

**Conflict of interest:** The authors reported no conflict of interest related to this article

### ÖZET

**Amaç:** Multipl Skleroz (MS) hastalarında, 12 haftalık gözetimli egzersiz programının (GEP) yaşam kalitesi, yürüme yeteneği, denge bozukluğu ve yorgunluk üzerine etkisini saptamak ve hastaların yeti yitimi şiddetine göre bu sonuçları karşılaştırmaktır.

**Yöntemler:** Yirmi dört MS hastasının demografik ve tıbbi verileri kaydedildi. Yeti yitimi (EDSS), fonksiyonel denge (Berg Denge Skalası-BDS), aktivite içinde kendine güven (Aktiviteye Spesifik Denge Güvenlik Skalası-ABC\_S); yürüme güçlüğü (Multipl Skleroz Yürüme Skalası, MSYS-12), yorgunluk (Yorgunluk Etki Skalası (YES)), yaşam kalitesi (Multiple Sclerosis International Quality of Life questionnaire-MUSIQOL) tedavi öncesinde, tedavi bitiminde (3. ay) ve kontrolde (6.ay) değerlendirildi. Ayrıca yeti yitimi şiddeti ve hastalık yılına göre hastaların fizyoterapiden faydalanma oranları hesaplandı.

**Bulgular:** Yaş ortalaması 45,2±8,6 yıl olan 17 katılımcının (7 hasta akut atak nedeniyle çalışmadan ayrıldı), MSYS-12, BDS ve ABC Skalası ortalamaları arasındaki farkın tedavi bitiminde yapılan ikinci değerlendirmeden kaynaklandığı (p<0,001) ve bu farkın kontrol değerlendirmesinde de korunduğu saptandı (sırasıyla, p<0,001, p=0,003, p=0,001). MUSIQOL ortalamaları arasındaki farkın ise kontrol değerlendirmesinden kaynaklandığı saptandı (p=0,014). Ayrıca MUSIQOL ile YES total ve alt grup skorları arasında, MSYS-12 ile MUSIQOL, BDS, ABC Skalası ve YES total ve alt grupları ve EDSS arasında da anlamlı korelasyon vardı (p<0,05).

**Sonuç:** On iki haftalık GEP sonrasında hafif ve şiddetli yeti yitimine sahip olan tüm katılımcılarda yaşam kalitesi ve yürüme yeteneğinde benzer iyileşmelerin ortaya çıkması ve yürüme yeteneğindeki kazanımların yaşam kalitesindeki artışla ilişkili olması nedeniyle rehabilitasyon ekibinin yeti yitimi düzeyinden bağımsız olarak MS hastalarının fiziksel aktivite düzeylerini artırmaları için egzersiz programları içinde yer almaya teşvik etmeleri gerekmektedir. (*Nöropsikiyatri Arşivi* 2013; 50: 23-29)

**Anahtar kelimeler:** Multipl skleroz, yeti yitimi, egzersiz, yürüme yeteneği, yaşam kalitesi

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## Introduction

Difficulty in walking is the most common activity limitation in patients with multiple sclerosis (MS) and is considered as one of the most important functional losses limiting the patients' participation in social life (1). Spasticity, muscle weakness and imbalance which are among the causes of difficulty in walking may lead to limitation in daily life activities (DLA) and decreased quality of life (2,3). The common recommendation of the studies conducted to evaluate and decrease these effects is to participate in the follow-up and exercise program regularly. Studies have shown that regular participation of MS patients in physical activity has positive effects in decreasing the MS-related symptoms including loss of strength, fatigue, depression, spasticity and pain (3,4,5,6).

MS patients obtain substantial functional gain from physiotherapy. The main objectives of physiotherapy in MS patients include developing and improving functional level, increasing independence to the maximum level, preventing or delaying development of secondary disorders and helping the patient and family to attain emotional, psychological and social compliance (7). These objectives may not be appropriate for each patient or for each phase of rehabilitation. Determining the objectives and selection of the treatment program are specific for the patient. Decisions should be taken in accordance with the patient's individual abilities and requirements and the results of evaluation should be emphasized. When establishing an exercise program, straining, strengthening, balance and coordination exercises, aquatherapy and functional exercises may be used according to the level of disability and functional state of the patient (8,9).

Despite studies explaining the benefits of physiotherapy programs, a recent meta-analysis has found that the physical activity level of MS patients is lower compared to the healthy population (10,11). In addition, the patients included in the studies have frequently mild disabilities (12) and the effects of exercise program on functional gain has not been discussed adequately in patients with severe disabilities.

The aim of this study was to find the effect of supervised exercise program (SEP) on quality of life, walking ability, imbalance and fatigue in MS patients and compare these results according to the level of disability.

## Method

Patients who were diagnosed in Dokuz Eylül University, Medical Faculty, Department of Neurology, Multiple Sclerosis Outpatient Clinic between January 2010 and July 2010 and participated in the physiotherapy and rehabilitation program in Izmir Multiple Sclerosis Association Rehabilitation Center were included in the study.

Inclusion criteria: Patients 1) diagnosed as relapsing/remitting multiple sclerosis (RRMS) according to Poser criteria (13), primary progressive multiple sclerosis (PPMS) or secondary progressive MS (SPMS), 2) aged between 18 and 65 years, 3) who could stand independently/with assistive device, 4) who had an EDSS $\leq$ 6.5, 5) who were cooperated and 6) who were volunteers were determined. Patients whose diagnoses were not clear, who had

acute attacks during evaluation or treatment, who had cardiovascular, respiratory, orthopaedic, psychiatric or other medical comorbidities and who performed regular physical activity in the last 6 months were not included in the study. Participation in regular physical activity was described as 30 minutes of exercise and sportive activity at least 2 times a week in the last one month.

Informed consent was obtained from 24 MS patients who met the study inclusion criteria. Individual standardized exercise program was given to the patients by a physiotherapist three days a week for 3 months. In addition, the patients were given illustrated home exercise sheets to enhance continuance of exercise at home.

### Assessment

The demographic characteristics (age, gender, body weight, height, body mass index, marital status, education level, occupation, use of assistive device, MS type, disease years, drugs used) and medical histories of the patients were recorded

### Disability

The disability of the patients was examined in two groups as mild disability (EDSS $\leq$ 3.5) and severe disability (EDSS 4.0-6.5) according to the result of EDSS (14) evaluated by a neurologist (15).

### Walking Ability

The Multiple Sclerosis Walking Scale (MSWS-12) was used to evaluate the walking ability. This scale evaluates the limitations encountered by the MS patient in walking with 12 questions (1= almost none, 5= excessively). A high score shows that the walking ability is affected or the patient has difficulty in walking (16,17).

### Health Related Quality of Life

Multiple Sclerosis International Quality of Life (MUSIQOL) questionnaire is a disease-specific scale of quality of life. It is composed of a total of 31 questions including 3 subtitles (psychological, physical and psychosocial). Low scores indicate high levels of quality of life. The validity and reliability of this scale have been shown in MS patients (18,19).

### Functional Balance

The Berg Balance Scale (BBS) which is used in evaluation of balance is ordered with 4 scores grading balance from easy to difficult (0= can not perform the task, 4= can perform the task independently) (20). High scores indicate good balance function (41-56= independent, 21-40= walks with assistance, 0-20= dependent). A total score below 45 increases the future risk of falling by 2.7 fold. The validity and reliability of this scale have been proved in MS patients (21).

### Balance Self-confidence

The Activity Specific Balance Confidence Scale (ABC) which consists of 16 questions was used to evaluate (%0-100) the self-confidence while performing daily-life activities. The validity and reliability of this scale have been determined in MS patients (22).

### Fatigue

The Fatigue Impact Scale of which the Turkish version was proved to be valid and reliable was used to evaluate the reflection of fatigue to daily activities in MS patients (23). This scale evaluates the physical, cognitive and social effects of fatigue in the last one month in a total of 40 questions (0= no problem, 4= excessive). The total score ranges between 0 and 160 and high scores mean a high level of impact of fatigue (24).

### Exercise Program

Before the study was started, basic information about the exercises was given to the patients included in the study. All patients were included in the 12-week standardized exercise program under the supervision of a physiotherapist. The exercise program was arranged as 60-minute sessions three times a week. Progression in exercises was realized with increase in the number of sets and repetitions (from 2 sets/10 repetitions to 3 sets/15 repetitions). The exercise program was composed of 5-10-minute warmup and cooling periods and 35-40-minute strengthening, balance and coordination and functional exercises. The participation of the patients in the exercise program was recorded for 12 weeks.

### Data Analysis

The data obtained from the assessment of the patients were recorded in the SPSS 15.0 (Statistical Package for the Social Sciences Software) statistical analysis program. All results were given as mean ± standard deviation. The Friedman Variance Analysis was used in comparison of the assessment scales (EDSS, FIS, BBS, ABC, MUSIQOL, MSWS-12) before treatment, after treatment and at the 6th month-follow-up. A p value of <0.05 was considered statistically significant. The Bonferroni correction and Wilcoxon Signed Rank Test were used to determine the origin of significant differences. Accordingly, corrected significance level was accepted to be 0.05/3=0.016. The Mann Whitney U Test was used in comparison of the results of the patients by the severity of disability and disease years.

The benefit ratio for physiotherapy was calculated with the following formula: Benefit Ratio=[(final value-first value)/first value]\*100. The Mann Whitney U Test was used in comparison of the benefit ratios by the variables of disability severity and disease years and a p value of <0.05 was considered statistically significant.

According to Pearson correlation analysis used to determine the relation between the assessment parameters, ≤0.4 was recorded as weak correlation, 0.41-0.69 was recorded as moderate correlation and ≥0.7 was recorded as strong correlation.

### Results

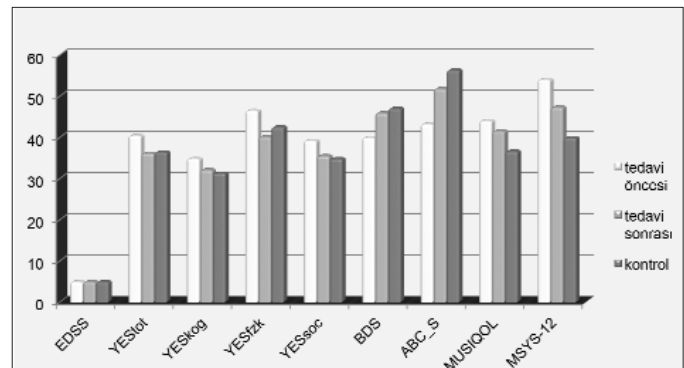
7 of 24 MS patients who were included in the study were excluded because of acute attack. The demographic and clinical properties of 17 patients (13 female/4 male) who completed the study are given in Table 1. The mean age of the participants was 45.2±8.6 years. The disease duration was 1-10 years in 7 patients (41.2%) and longer than 10 years in 10 patients (58.8%). 47% of the patients were married (n=8), 23.5% (n=4) were working, 58.8% (n=10) had an education period of longer than 11 years and 41.2% (n=7) had an education period of 5-11 years (Table 1). The participants participated in 84,7% of a total of 36 exercise sessions (mean 30,5±3,9 sessions). The ratio of the patients who used assistive device (single crutch) was found to be 70.5% (n=12).

The mean values of the assessment scales are given in Picture 1. The assessments of the patients before treatment, after treatment and in the follow-up were compared using Friedman Variance Analysis. Accordingly, no statistically significant difference was present between the mean values of EDSS scores (4.9±1.7, 4.85±1.5, 4.85±1.4, respectively) (p=0,85). FIS mean total and cognitive, physical and social subgroup scores were recorded before treatment (40.4±16.7, 34.8±20.2, 46.5±18.5, 39.2±16.7, respectively); after treatment (36.1±18.1, 32.1±18.6, 40.2±19.9, 35.5±18.3, respectively); in the follow-up (36.4±18.3, 31.3±20.6, 42.5±19.8,

34.8±18.2, respectively) and no statistically significant difference was found between these mean values except for FIS-physical subgroup (p=0.133, p=0.045, p=0.180, respectively). However, statistically significant difference was found between the mean values of MSYS-12 (p<0.001), MUSIQOL (p=0.005), BBS (p<0.001), ABC (p<0.001), FIS-total (p=0.008) and FIS-physical (p=0,04) (Table 2).

The Bonferroni correction and Wilcoxon Signed Rank Test were used to determine the origin of these differences. Accordingly, the corrected significance level was accepted to be p<0,016 (0.05/3=0.016). No significant difference was found between the mean values of FIS-total and FIS-physical scores (p>0.016). It was found that the difference between the mean values of MSWS-12, BBS and ABC Scales originated from the second assessment made at the end of the treatment (p<0.001) and this difference was maintained during the follow-up assessment (p<0.001, p=0.003, p=0.001, respectively). The difference between the mean MUSIQOL values was found to have arisen from the follow-up assessment (p=0.014, p<0.016), but not from the second assessment at the end of treatment (p=0.019, Bonferroni Correction p>0.016) (Table 3).

The disability severity of the patients was evaluated in two groups as mild disability (Group 1, EDSS≤3.5, n=5) and severe disability (Group 2, EDSS 4.0-6.5, n=12) according to the EDSS result assessed by a neurologist. In the process of treatment and follow-up assessment, EDSS results of the patients in group 1 and 2 stayed



Picture 1. The assessment results of the patients before treatment, after treatment and in the follow-up

Table 1. Demographic and clinical properties of the patients (n=17)

Age (years)	Gender (F/M)	Body weight (kg)	45.2±8.6
Height (m)	BMI (kg/m <sup>2</sup> )		13/4
Marital status			65.5±14.5
Married/ single			1.63±0.1
Education			24.5± 5.0
5-11 years/ >11 years			8/9
Employment status			7/10
Retired /working / other			
Assistive device			10 / 4 / 3
Single crutches /none			12/5
Disease period			
1-10 years / > 10 years	EDSS Group		7/10
Mild disability (≤3,5)			5
Severe disability (4,0-6,5)			12

in group classification. Three measurements including the assessments of group 1 and 2 patients before treatment, after treatment and in the follow-up were compared. When pre-treatment, post-treatment and follow-up ABC scores were compared, no statistically significant difference was found between the groups ( $p=0.102$ ,  $p=0.291$ ,  $p=0.154$ , respectively). When pre-treatment, post-treatment and follow-up MUSIQOL scores were compared, no statistically significant difference was found between the groups ( $p=0.673$ ,  $p=0.342$ ,  $p=0.225$ , respectively). When pre-treatment, post-treatment and follow-up FIS-total scores were compared, no statistically significant difference was found between the groups ( $p=0.527$ ,  $p=0.752$ ,  $p=0.492$ , respectively). However, a statistically significant difference was found between the groups in terms of pre-treatment BBS and MSWS-12 scores ( $p=0.013$ ,  $p=0.035$ , respectively). While this difference disappeared after treatment ( $p=0.113$ ) and in the follow-up evaluation ( $p=0.101$ ) for MSWS-12, it was maintained after treatment for BBS ( $p=0.026$ ), but disappeared in the follow-up evaluation ( $p=0.288$ ) (Picture 2).

When pre-treatment, post-treatment and follow-up assessments were compared according to MS duration (1-10 years,  $n=7$ ;  $\geq 10$  years,  $n=10$ ), no statistically significant difference was

found between the measurements of FIS-tot ( $p=0.379$ ,  $p=0.526$ ,  $p=0.305$ , respectively), FIS-cognitive ( $p=0.170$ ,  $p=0.240$ ,  $p=0.142$ ), FIS-physical ( $p=0.220$ ,  $p=0.883$ ,  $p=0.591$ ), FIS-social ( $p=0.155$ ,  $p=0.624$ ,  $p=0.328$ ), BBS ( $p=0.524$ ,  $p=0.377$ ,  $p=0.403$ ), MUSIQOL ( $p=0.884$ ,  $p=0.494$ ,  $p=0.464$ ) and MSYS-12 ( $p=0.558$ ,  $p=0.305$ ,  $p=0.433$ ).

Benefit ratios which were calculated based on follow-up assessments performed after the treatment was completed were compared according to the EDSS group (Group 1, EDSS  $\leq 3.5$ ,  $n=5$  and Group 2, EDSS 4.0-6.5,  $n=12$ ) and disease duration (Group 1, 1-10 years,  $n=7$ ; Group 2,  $\geq 10$  years,  $n=10$ ). Accordingly, the benefit ratios were not found to be statistically significant in terms of FIS total and subgroups, ABCS, MUSIQOL and MSYS-12 ( $p>0.05$ ), while they were found to be significantly higher ( $p=0.018$ ) in terms of BBS scores in patients with severe disability (Group 2). No statistically significant difference was found when the benefit ratios were compared in terms of FIS total and subgroups, BBS, ABCS, MUSIQOL and MSYS-12 by MS duration groups ( $p>0.05$ ) (Table 4).

In the analysis of correlation between assessment parameters, a positive and significant correlation was found between MUSIQOL and FIS total, cognitive, physical and social scores ( $p<0.001$ ). A significant correlation was found between MUSIQOL and MSYS-12 ( $p=0.015$ ). In addition, a significant correlation was found between MSYS-12 and BBS, FIS total, cognitive, physical and social

**Table 2.** Hastaların tedavi öncesi, tedavi sonrası ve kontrol değerlendirme ortalamaları ( $n=17$ )

	BEFORE TREATMENT X $\pm$ SD(Mean )	AFTER TREATMENT (3RD MONTH) X $\pm$ SD(Ort)	FOLLOW-UP (6TH MONTH) X $\pm$ SD(mean)	Friedman p
EDSS	4.9 $\pm$ 1.7 (1.5-6.5)	4.85 $\pm$ 1.5 (2.0-6.5)	4.85 $\pm$ 1.4 (2.0-6.5)	0.85
FIS-tot	40.4 $\pm$ 16.7 (15-66)	36.1 $\pm$ 18.1 (9-68)	34.6 $\pm$ 18.3 (11-62)	0.008*
FIS-cog	34.8 $\pm$ 20.2 (5-70)	32.1 $\pm$ 18.6 (5-68)	31.3 $\pm$ 20.6 (5-65)	0.133
YES-phys	46.5 $\pm$ 18.5 (20-70)	40.2 $\pm$ 19.9 (15-73)	42.5 $\pm$ 19.8 (13-68)	0.045*
YES-soc	39.2 $\pm$ 16.7 (11-64)	35.5 $\pm$ 18.3 (5-65)	34.8 $\pm$ 18.2 (3-58)	0.180
BBS	39.9 $\pm$ 9.4 (18-50)	45.9 $\pm$ 6.9 (32-54)	47.0 $\pm$ 5.4 (38-54)	<0.001*
ABC_S (%)	43.2 $\pm$ 19.9 (14.5-76.0)	51.8 $\pm$ 19.4 (20-78)	56.3 $\pm$ 20.0 (25-87.5)	<0.001*
MUSIQOL	44.0 $\pm$ 16.3 (22.8-69.2)	41.5 $\pm$ 13.8 (21.0-64.5)	36.6 $\pm$ 12.7 (17.0-55.6)	0.005*
MSWS-12	54.0 $\pm$ 18.0 (20.3-77.6)	47.3 $\pm$ 17.4 (13.3-72.6)	39.9 $\pm$ 15.8 (10-68)	<0.001*

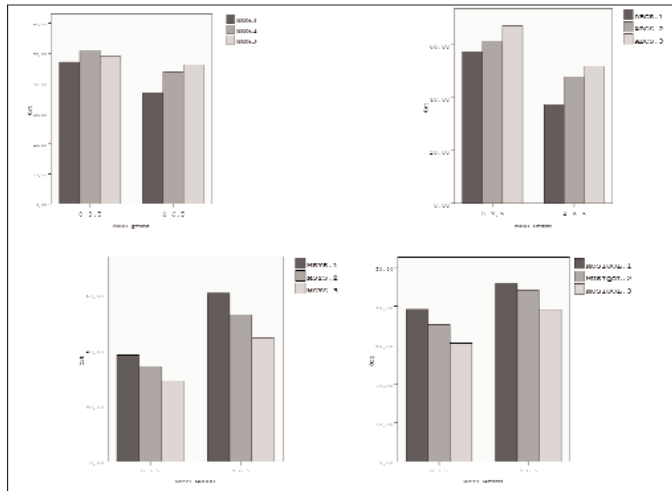
EDSS, Expanded Disability Status Scale; FIS, Fatigue Impact Scale, total, cognitive, physical, social; BBS, Berg balance Scale; ABC\_S, Activity Specific Balance Confidence Scale; MUSIQOL, Multiple Sclerosis International Quality of Life questionnaire; MSWS-12, Multiple Sclerosis Walking scale;

\*Friedman test p value

**Table 3.** Comparison of the mean assessment values of the patients before treatment, after treatment and in the follow-up by Wilcoxon signed rank test

	BT.-AT.	BT-F	AT-F
FIS-tot	0.024	0.075	0.609
FIS-cog	0.032	0.266	0.683
BDS	<0.001*	0.003*	0.276
ABC_S (%)	<0.001*	0.001*	0.006*
MUSIQOL	0.019	0.014*	0.028
MSYS-12	<0.001*	<0.001*	<0.001*

BT.,before treatment;AT.,after treatment;F, follow-up, EDSS, Expanded Disability Status Scale; FIS, Fatigue Impact Scale, total, cognitive, physical, social; BBS, Berg Balance Scale; ABC\_S, Activity Specific Balance Confidence Scale; MUSIQOL, Multiple Sclerosis International Quality of Life questionnaire; MSWS-12, Multiple Sclerosis Walking Scale; \*Wilcoxon Signed Rank test, Bonferroni Correction, significance level p<0.016



**Picture 2.** 1=Before treatment; 2=After treatment; 3=Follow-up assesment; BBS, Berg Balance Scale; ABC\_S, Activity Specific Balance Confidence Scale; MSWS-12, Multiple Sclerosis Walking Scale; MUSIQOL, Multiple Sclerosis International Quality of Life questionnaire

subgroups, ABC Scale and EDSS (p<0.01, p=0.002, p=0.002, p=0.001, p=0.009, p<0.001, p=0.001, respectively) (Table 5).

**Discussion**

The results of this study which was conducted to determine the effects of physiotherapy in MS patients and compare these results according to the level of disability support that the 12-week standardized supervised exercise education program focused on strenghtening, balance and functional mobility caused improvement in the quality of life and walking ability. Another finding of the study was that similar improvements occurred in the quality of life and walking ability in all participants with mild and severe disability and gain in walking ability was related with the increase in the quality of life.

It is established that the activity levels of MS patients decrease gradually every day because of unstable state of MS and its negative effects on many systems and these patients are less active compared to the healthy individuals in the same age group (10,11). Therefore, inactivity should be avoided in this patient group and their functional levels should be increased by appropriate exercise programs (25).

The most common activity limitation in MS patients is difficulty in walking. Ability to walk is considered one of the most important functions in participation in social life. As a recent review demonstrated, exercise education is a very important treatment option directed to walking disorders (26). In a meta-analysis in which the effects of exercise education on walking in MS patients were evaluated, cumulative evidence showed that exercise education programs caused a small but clinically significant improvement in walking (4). In another study in which the effects of two physiotherapy approaches were compared, significant improvement was found in balance functions (2). The changes in the walking ability in the patients included in our study were evaluated with the MS-specific walking scale (MSWS-12) with which walking limitations are evaluated by the patient himself/herself. It was found that limitations determined before treatment decreased after treatment and this attainment was maintained in the follow-up evaluation. These results were reflected to the level of dependence in daily life activities in MS patients. This functional attainment in

**Table 4.** Comparison of the rates (%) of utilization of physiotherapy programs of the patients by variables of disability severity and disease years

	Disability severity			Hastalık Yılı		
	EDSS (0-3.5) X±SD	EDSS (4.0-6.5) X±SD	MWU p	1-10 years X±SD	>10 years X±SD	MWU p
FIS-Tot	-17.25±10.3	11.61±22.3	0.792	-15.97±18.7	11.38±20.6	0.884
FIS-cog	14.34±10.04	-8.14±34.81	0.673	-23.36±33.3	13.74±12.2	0.205
FIS-phys	4.35±51.36	-11.33±27.30	0.562	1.56±46.5	-12.51±25.4	0.733
FIS-soc	-21.31±22.71	-10.33±33.50	0.343	-6.39±31.0	-18.58±30.6	0.626
BBS	4.06±10.7	33.17±37.9	0.018*	26.33±48.8	23.41±23.3	0.157
ABC_S	20.60±24.4	52.35±66.0	0.171	28.02±30.5	53.50±71.2	0.558
MUSIQOL	-22.53±17.4	-8.5±30.5	0.399	-22.32±14.3	-5.82±33.0	0.380
MSYS-12	-27.58±13.2	-26.87±12.0	0.752	-31.03±13.1	-24.31±10.9	0.435

BT.,before treatment;AT.,after treatment; F, follow-up; EDSS, Expanded Disability Status Scale; FIS, Fatigue impact scale, total, cognitive, physical, social; BDS, Berg Balance Scale; ABC\_S, Activity Specific Balance Confidence Scale; MUSIQOL, Multiple Sclerosis International Quality of Life questionnaire; MSWS-12, Multiple Sclerosis Walking Scale; \* p<0.05

**Table 5.** Correlation coefficients between the assessment results of the patients

Variable	BBS	FIS-tot	FIS-cog	FIS-phys	FIS-soc	ABC	MUSIQOL	MSWS-12	EDSS
1. BDS									
2. FIS-tot	0.047								
3. FIS-cog	0.010	0.940**							
4. FIS-phys	0.012	0.939**	0.850**						
5. FIS-soc	0.083	0.957**	0.875**	0.875**					
6. ABC	0.575**	-0.589**	-0.584**	-0.597**	-0.542**				
7. MUSIQOL	-0.181	0.719**	0.710**	0.624**	0.716**	-0.494**			
8. MSYS-12	-0.506**	0.417**	0.452**	0.452**	0.364**	-0.756**	0.340*		
9. EDSS	-0.610**	0.03	0.138	-0.82	-0.11	-0.359	0.245	0.449**	

BDS, Berg Balance Scale; FIS, Fatigue Impact Scale, total, cognitive, physical, social; ABC, Activity Specific Balance Confidence Scale; MUSIQOL, Multiple Sclerosis International Quality of Life questionnaire; MSWS-12, Multiple Sclerosis Walking Scale; EDSS, Expanded Disability Status Scale.

\*= significant correlation  $p < 0.05$ , \*\*= significant correlation  $p < 0.01$

walking obtained in a short time may be related with the fact that the specific exercise program was based on balance, strengthening and activity. In many studies supporting this, balance disorders were found to be related with functional limitations and dependence in daily life activities in MS patients (27,28). Another finding which supports these results obtained in our study is that balance and balance functions in activity were found to be related with improvement in the ability of walking. Improvement in balance functions was found in the patients in the assessment performed using the Berg Balance Scale. While the functional balances of the patients before treatment were below 40, this value increased approximately 5 points and reached above 45. A score above 45 is reported to reflect significant improvement in balance functions. In addition, this improvement resulted in an increase in the sense of confidence in activity (ABC scale) which is thought to be a significant attainment. While the sense of confidence before treatment in different conditions including walking at home and outside home, going up and down the stairs, bending, extending and getting on-off a car expressed by the patients during treatment was 43%, it was 52% after treatment and 56% during the follow-up evaluation. This improvement was found to be statistically significant. This increase in the sense of confidence has a supportive role in allowing the patients to perform their functional abilities in different conditions. Therefore, it should also be planned to evaluate the sense of confidence during activity while establishing the treatment program directed to increase balance and mobility in MS patients (29).

One of the most commonly reported complaints reported by MS patients is excessive fatigue (30). The common conclusion of the recent studies examining the effects of exercise education on the perception of fatigue is that exercises including short-term or long-term aerobic or strengthening exercises were related with a decrease in fatigue (30,31,32,33). In this study, the significant relation found between fatigue scale and quality of life, walking ability and confidence in balance may be associated both with the physical and functional results of fatigue and the social and cognitive results of the disease. However, it was found that the severity of fatigue found in all subgroups of fatigue scale were similar at the end of treatment

and in the 3rd month-follow-up and exercise program had no significant effect on fatigue, although the patients included in the study expressed improvement in their functional capacity with regular exercise.

Motivation and informing of the patient is important in increasing activity participation as shown in a randomized controlled study performed by Mc Auley et al. (6). Therefore, education of the patients primarily in this area is significant. In our study, all patients were informed about the benefits of exercise and the points which should be paid attention by a physiotherapist and the patients' questions were answered individually. Thus, it was aimed to increase awareness of exercise and participation in exercise. Obtaining a high value of 84.7% for the participation rate of the patients showed the significance of exercise education.

In cross-sectional studies, the importance of physical activity was emphasized and it was found that exercise was related with a decrease in problems associated with inactivity and improvement in the quality of life (33,34,35,36). In this study, the effects of exercise program on the quality of life were evaluated by using the MUSIQOL questionnaire. As a result of the evaluation, a significant improvement in the quality of life was observed at the end of the exercise program. This improvement was found to be maintained in the follow-up evaluation. In addition, the significant improvement in the functional levels of the patients after the exercise program were found to be related with the improvement in the quality of life in accordance with the literature (10,11). This relation reflects the cumulative results of the positive effects of exercise.

The fact that no relation could be found between the quality of life and disability in our study might have arisen from the shortness of the follow-up period. However, it may also indicate that the quality of life should be evaluated independently of the disease severity. Studies with larger samples and longer follow-up times are needed to answer these questions.

As a result of this study it was demonstrated that similar improvements occurred in participants who had a diagnosis of MS for longer than 10 years and an EDSS score of 4.0-6.5 with severe disability and in participants who had a diagnosis of MS for 1-10 years with mild disability independent of the disease time and severity. These improvements were also compared by calculating

the rates of benefits obtained by the patients from treatment. Conclusively, it was found that all patients benefited from the 12-week physiotherapy program with similar rates independent of the disability severity except for balance functions. This outcome proves that MS patients with severe disability can display significant improvement compared to the patients with mild disability contrary to what is expected. In the comparison made according to disease duration, the rates of treatment benefit were found to be similar independent of years. In light of all these results, it is thought that significant attainments can also be obtained in MS patients with a disease time of longer than 10 years and severe disability.

Exercise programs have a very important role in increasing the physical activity levels of MS patients. Supervised exercises provide treatment advantages in many aspects. With these kinds of exercises the participation of the patients and exercise compliance can be controlled and the patients' motivation can be increased (37). One of the most important findings of these studies is the fact that similar improvements in the quality of life and walking ability occurred in all participants with mild and severe disability after the 12-week supervised exercise program and the attainments in walking ability were related with the increase in the quality of life. Therefore, the rehabilitation team should encourage MS patients to participate in exercise programs to increase their physical activity levels independent of the level of disability.

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