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An Investigation of Balance, Trunk Impairment, and Fear of Falling in Multiple Sclerosis Patients with Urinary Incontinence

Üriner İnkontinansı Olan Multipl Skleroz Hastalarında Denge, Gövde Bozukluğu ve Düşme Korkusunun İncelenmesi

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ABSTRACT Objective: To compare Multiple Sclerosis (MS) patients with and without urinary incontinence (UI) in terms of balance, trunk impairment, and fear of falling. **Material and Methods:** The study was conducted in 35 MS patients with an age range of 24-58 years. The patients were divided into two groups based on the diagnosis of urinary incontinence. UI was measured with the Incontinence Severity Index (ISI), balance was measured with a Technobody® stabilometric platform, trunk disorder was measured with the Trunk Impairment Scale (TIS), and fear of falling was measured with the Falls Efficacy Scale (FES). Independent Sample T Test and Mann Whitney U Test were used to compare the demographic data and measurement results of the MS patients with UI and without UI. **Results:** In the present study, 18 MS patients were with UI and 17 MS patients were without UI. The mean age was 42.38±8.26 years in MS patients with UI and 42.11±11.07 years in MS patients without UI. The median Expanded Disability Status Scale (EDSS) score was 3.5 (2.5-3.5) in patients with UI, and 2.5 (2.0-3.0) in patients without UI. In MS patients with UI, eyes open and closed, anterior-posterior and medial-lateral sway, trunk impairment, and fear of falling were found to be increased compared to those of continent MS patients ($p<0.05$). **Conclusion:** UI in MS patients causes trunk impairment and balance disorders, which result in increased fear of falling. Therefore, in the evaluation of balance, trunk impairment, and fear of falling from the early phase of the disease, the occurrence of UI should be considered.

Keywords: Multiple sclerosis; urinary incontinence; postural balance

ÖZET Amaç: Bu çalışmanın amacı üriner inkontinansı (Üİ) olan ve olmayan Multipl Skleroz (MS) hastalarında denge, gövde bozukluğu ve düşme korkusunun araştırılmasıdır. **Gereç ve Yöntemler:** Bu çalışma 24-58 yaş aralığında toplam 35 MS hastasının katılımı ile gerçekleştirildi. Hastalar inkontinansı olan ve olmayan olmak üzere 2 gruba ayrıldı. Üriner inkontinansın (Üİ) şiddeti İnkontinans Şiddet Ölçeği (İŞÖ) ile, denge Technobody® stabilometrik platform ile, gövde bozukluğu Gövde Bozukluk Ölçeği ile, düşme korkusu Düşme Etkinlik Ölçeği (DEÖ) ile değerlendirildi. Üİ olan ve Üİ olmayan MS hastalarının demografik verileri ve ölçüm sonuçlarını karşılaştırmak için Bağımsız örneklem T Testi ve Mann Whitney U Testi kullanılmıştır. **Bulgular:** Bu çalışma Üİ olan 18 MS hastası (12 kadın ve 6 erkek) ve Üİ olmayan 17 MS hastası (11 kadın ve 6 erkek) ile yapıldı. MS hastalarının yaş ortalaması Üİ olan grupta 42,38±8,26 yıl, üriner inkontinansı olmayan grupta 42,11 ± 11,07 yıldı. Ortalama Genişletilmiş Engellilik Durumu Ölçeği (GEDÖ) skorları Üİ olan MS hastalarının 3,5 (2,5-3,5), Üİ olmayan MS hastalarının 2,5 (2,0-3,0) di. Üİ olan MS hastalarında gözler açık ve gözler kapalı, ön-arka ve iç-dış salınım miktarları, gövde bozukluğu ve düşme korkusunun Üİ olmayan MS hastalarına göre arttığı bulundu. ($p<0,05$). **Sonuçlar:** MS hastalarında Üİ varlığı gövde bozukluğu ve denge bozukluğuna neden olmaktadır. Bu durum artan düşme korkusu ile sonuçlanmaktadır. Bu sebeple, hastalığın erken fazlarından itibaren dengenin, gövde bozukluğunun ve düşme korkusunun değerlendirilmesinde Üİ varlığı da hesaba katılmalıdır.

Anahtar Kelimeler: Multipl skleroz; üriner inkontinans; postural denge

Multiple Sclerosis (MS) is a chronic inflammatory disease causing progressive neuronal loss and demyelination in the central nervous system.[1] Clinical symptoms of the MS patients are heterogeneous. They vary according to the lesion levels and disease duration and type. In MS, problems occurring in the cortex, which is responsible for the sphincter control, as well as in the spinal pathways, may cause symptoms in the lower urinary system similar to other neurological diseases.[2,3] These symptoms may surface at

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any phase of the course of the disease as storage (e.g., frequent urination, urgency, urinary incontinence, nocturia) or voiding symptoms (e.g., hesitancy, urinary retention); however, the relationship between the patient's disability level and urinary symptoms is not clear.[4-7]

Pelvic floor muscles contribute to continence by stabilizing the bladder neck and increasing the intraurethral pressure. Furthermore, they mechanically support the spine and the pelvis.[8] This mechanical support is attained through an increase in sacroiliac joint stiffness and intra-abdominal pressure changes, which are important for spinal control.[9,10] Along with urinary incontinence (UI), this mechanical support deteriorates, resulting in some problems. By this way, postural functions of the pelvic floor muscles may alter in individuals with UI, and thus, lumbopelvic stabilization may be negatively affected.[11] In addition, the activity of the trunk muscles changes in individuals with UI, which may result in spinal movement, and affect the posture. As a result, balance disorders may develop.[12] Postural sways caused by balance disorders and the decrease in postural corrections have been listed among the risk factors associated with falling.[13,14]

UI in MS patients causes decreased mobility and restrictions on daily living activities, and affects the rehabilitation process.[15] Therefore, pelvic floor muscle strength training was given importance in the presence of UI in MS patients and their effects on quality of life in patients were adequately discussed in the literature.[5,16] However, we think that the presence of incontinence may have an impact not only on the quality of life of the patients but also on the balance, trunk disorder and risk of falling.

It is observed that studies examining the relationship between UI and balance mostly involved healthy subjects.[17-19] In the neurologic group, especially in MS patients, UI is observed even at early stages, however, even though falling is indicated as a risk factor in the presence of UI, to the best of our knowledge, there exist limited studies in the literature examining the effects of UI on balance, trunk impairment, and fear of falling in MS patients.[20] The aim of the present study was to examine balance, trunk impairment, and fear of falling in MS patients with UI.

MATERIAL AND METHODS

SAMPLE SIZE CALCULATION

Because no reference data were available for such a comparison in MS patients, trunk impairment pre-assessment data were used to calculate the sample size and power. For 5% Type I error, 80% power, and 1.13 standard effect size, it was calculated that 13 participants were needed for each group. For each group, 17 participants were decided to be included in the study, which was 25% more than the calculated number due to the risk of loss.[21]

PARTICIPANTS

The study was carried out at of the university Physiotherapy and Rehabilitation Department. The study included 35 MS patients with an age range of 24-58 years (42.25±9.58 years). Inclusion criteria were having a score of 24 or more in the Mini Mental Status Test, being in 1.5-5.5 (Early Phase) according to the EDSS (Expanded Disability Status Scale) score, and not having another neurologic problem other than MS, any lower extremity orthopedic problems, and a history of attack in the previous 6 months.

The participants were informed about the aim and content of the study, and those who read and signed the informed consent form were included in the study. This study was performed according to the principles of the Declaration of Helsinki and approval was granted by the ethics committee. (Approval number: 15.03.2019-72).

ASSESSMENTS

The Assessment of the Severity of Incontinence

The Incontinence Severity Index (ISI) was used to assess the MS patients' UI severity. The validity and reliability study of the Turkish version of the ISI, which is an easy-to-use, short, and simple index, was conducted by Hazar and Şirin in 2008.[22] The index is composed of just two items, one item is about the frequency of UI and the other item is about the amount of leakage at each UI. The first item is scored between 1 and 4 and the second item is scored between 1 and 3. The total score is calculated by the multipli-

cation of these two answers. The index score is classified as 1-2 slight, 3-6 moderate, 8-9 severe, and 12 very severe. UI severity is recorded based on the answers of the patients.

Balance Assessment

The patients were assessed while their bladders were empty. The static balance of the patients was measured with a Technobody® stabilometric platform. Prior to the test, the patients' physical data (age, height, weight) were entered into the system. Stabilometric balance mode was selected to measure the static balance. Patients stepped on the device whose platform stability was calibrated. To identify the ideal position for the patients, the feet were positioned using a V-shaped frame with a 3-cm distance between each malleolus and a 12° rotation off the sagittal axis. The test was performed as the patients' arms on the sides, eyes open and closed, and on two feet.[23] The ellipse area was recorded in mm^2, and the anterior-posterior sway and medial-lateral sway were recorded in mm. Higher sway scores indicate increased balance disorders.

The Assessment of the Trunk Impairment

Trunk impairment was assessed with the Trunk Impairment Scale (TIS) while the participants' bladders were empty. The validity and reliability study of the Turkish TIS was conducted by Demir and Yıldırım in 2018.[24] The scale evaluates static and dynamic sitting balance and trunk coordination through 17 items. Each item is scored between 0 and 3. The total score ranges between 0 and 23, and higher scores indicate a better balance performance. The patients were asked to sit on the edge of a bed with the hip parallel to the floor, 90° knee flexion, and hands and forearms on the hip, no hand or back support, and feet in full contact on the floor. The test was administered three times and the best score was recorded. During the test, the patients were provided with verbal or visual feedbacks. Those who could not keep the initial position for 10 secs received zero.

The Assessment of the Fear of Falling

Fear of falling was assessed using the Falls Efficacy Scale, whose Turkish validity and reliability studies were conducted by Ulus et al. in 2012.[25] It has 10 items assessing the effect of fear of falling on the confidence level of the individuals while performing activities of daily living. The patients were asked to mark the items that reflect their fear of falling while performing activities. Each item is scored between 0 (not at all concerned) and 10 (very concerned), and the total of the score ranges between 0 (low fall efficacy) and 100 (high fall efficacy). Higher scores indicate increased fear of falling.

STATISTICAL ANALYSIS

The data were analyzed using SPSS (Statistical Package for Social Sciences Inc., Chicago, IL, USA) for Windows Release 22.0. The variables were investigated using visual (histograms, probability plots) and analytical methods (Shapiro-Wilk test) to determine whether they were normally distributed. Descriptive statistics were calculated for all variables, and normally distributed data are shown as mean ± standard deviation (SD), non-normal distributions as median (minimum-maximum), and ordinal variables as frequency. For the non-normally distributed data, the Mann Whitney U test was used. A t-test was used for normally distributed data. Gender differences were compared using the Chi-square Test. Statistical significance was set at alpha <0.05.

RESULTS

In the present study, 18 MS patients (51.4%) were with UI and 17 MS patients were without UI (48.6%). 12 female and 6 male MS patients with UI and 11 female and 6 male MS patients without UI participated in the study. Patients' sex, age, height, body weight, duration of illness and EDSS score were recorded (Table 1). The median EDSS score was 3.0 (1.0-4.5) in all patients, 3.5 (2.5-3.5) in patients with UI, and 2.5 (2.0-3.0) in patients without UI. Based on the ISI results, 2 participants had slight, 6 had moderate, 6 had severe, and 4 had very severe UI. Balance, trunk impairment, and fear of falling scores of the participants are presented in Table 2.

In MS patients with UI, eyes open and eyes closed ellipse area, anterior-posterior sway, and medial-lateral sway were higher ($p<0.05$). In addition, trunk impairment and fear of falling were found to be increased in the same group ($p<0.05$).

TABLE 1: Demographic features of the patients (n=35).

	Patients with UI (n=18) (X ± SD)	Patients without UI (n=17) (X ± SD)	p
Sex (Male/Female)	6/12 (%33.3/%66.7)	6/11(%35.3/%64.7)	0.90[c]
Age (years)	42.38±8.26	42.11±11.07	0.93[a]
Body weight (kg)	72.66±11.87	70.58±12.39	0.61[a]
Height (m)	165.27±10.51	166.11±6.20	0.77[a]
BMI (kg/m²)	26.71±5.04	25.56±4.16	0.46[a]
Duration of illness (year)	7.80±4.71	7.90±6.09	0.95[a]
	Median (IQR 25-75)	**Median (IQR 25-75)**	
EDSS (score)	3.5 (2.5-3.5)	2.5 (2.0-3.0)	0.83[b]

p<0,05; X: Mean; SD: Standard deviation; IQR: Interquartile range; UI: Urinary Incontinence; BMI: Body mass index; EDSS: Expanded Disability Status Scale; a: Independent Samples T Test; b: Mann Whitney U test; c: Chi-squared test.

TABLE 2: Comparison of balance, trunk impairment, and fear of falling between MS patients with and without UI

PARAMETERS			Patients with UI Median (IQR 25-75)	Patients without UI Median (IQR 25-75)	p
BALANCE	Eyes open	Ellipse area (mm²)	1149.1 (823.5-1486.5)	476.1 (285.0-933.6)	**0.004***
		A/P sway (mm)	7.8 (6.5-9.6)	6.2 (5.0-7.4)	**0.026***
		M/L sway (mm)	7.0 (5.1-9.8)	4.5 (3.7-6.3)	**0.013***
	Eyes closed	Ellipse area (mm²)	1572.3 (1305.2-2236.8)	883.7 (372.6-1307.3)	**0.001***
		A/P sway (mm)	9.1 (7.2-11.8)	7.5 (6.0-9.1)	**0.041***
		M/L sway (mm)	8.8 (6.4-13.8)	6.3 (3.7-7.5)	**0.008***
Trunk impairment (score)			12.0 (9.7-16.2)	19.0 (16.5-21.5)	**0.004***
Fear of falling (score)			37.5 (17.5-45.5)	20.0 (12.5-29.0)	**0.017***

*p<0.05; UI: Urinary İncontinence; A/P: Anterior/Posterior; M/L: Medial/Lateral; IQR: Interquartile range; Mann Whitney U test.

DISCUSSION

The present study aimed to investigate balance, trunk impairment, and fear of falling in MS patients with UI. The hypothesis of the study was that balance disorder, trunk impairment, and fear of falling would be higher in MS patients with UI. Our findings supported the hypothesis of the study.

Even though pelvic floor muscle strength, endurance, and thickness have been shown to be decreased in individuals with UI, in recent studies, pelvic floor muscle activity has been shown to be increased by EMG (Electromyography).[17,26,27] In a study conducted in women with UI, increased pelvic floor muscle EMG activity was shown to cause an increase in abdominal muscle EMG activity.[18] Furthermore, since the activity of this muscle is not adjusted to meet the increased demand, it was also reported that it may cause deterioration in postural control. Smith et al. investigated the differences in balance and muscle activity while the bladder is empty and half full in healthy women with UI.[17] They reported that when the bladder is half full, in both groups, center of pressure (COP) swayed and EMG muscle activity increased. When the bladder is empty, similar to the findings of the present study, in women with UI,

COP sways increased during static balance tests compared to those without UI. In another study, Chmielewska et al. assessed eyes open and eyes closed postural stability with full and empty bladder in women with or without UI, but with no neurological problem.[19] They reported an eyes closed, empty bladder COP sway of 4.02 in women with UI and of 3.11 in continent women. They concluded that women with UI had more difficulty in maintaining postural balance when eyes closed with full bladder as well as with empty bladder compared to continent women. In the present study, in MS patients with UI, eyes closed empty bladder ellipse area was 1149.1 mm^2, while it was 476.1 mm^2 in continent MS patients. In parallel with the results of the studies involving healthy individuals, balance disorders and trunk impairment were found to be increased in the present study, which can be interpreted in various ways. First, it is considered that pelvic floor muscles support the trunk from the bottom and in individuals with UI, the decrease in pelvic floor muscle strength may adversely affect balance due to deteriorated stability. Secondly, it may be due to the individuals' decreased concentration caused by the fear of UI during balance measurements.

In the literature, ellipse area and anterior-posterior and medial-lateral sways were reported to be more affected in MS patients compared to healthy individuals.[23] In addition, studies investigating the effect of incontinence on balance are mostly performed in individuals without neurological problems. Chmielewska et al. showed that these sway values in individuals with UI did not differ from those of the continent individuals.[19] Smith et al. reported an increase only in the anterior-posterior sway. In the present study, in MS patients with UI, in addition to the increase in the ellipse area, eyes open and eyes closed anterior-posterior and medial-lateral sway values also increased substantially.[17] Accompanying UI is considered to be contributing to these increases in MS patients.

In MS patients, neuromuscular control mechanisms are affected according to the size and location of the affected site in the brain stem and the spinal cord, and balance and trunk disorders and incontinence problems are observed accordingly.[3,28] In MS patients, in relation with the increase in sways caused by deteriorations in postural control and the decrease in postural balance reactions result in an increase in the fear of falling as well as the risk of falling.[29] Sung et al. examined the relationship between bladder function and the number of falls while controlling mobility in individuals with MS.[30] They reported that bladder dysfunction is associated with the number of falls in individuals with MS and this relationship is independent of mobility. However, even though UI has been listed among the risk factors for falling in MS patients in the literature, balance and fear of falling have not been examined sufficiently in MS patients with or without UI.[1,31] In the present study, fear of falling was found to be higher in MS patients with UI compared to those without UI.

The present study has a few limitations. First, the patients were evaluated for balance, trunk impairment, and fear of falling only with empty bladder.[32] Second, although there was an equal number of male and female MS patients in both groups, an assessment specific to a single gender was not performed. However, menopause and giving birth have an effect on UI development and severity. Therefore, further studies should investigate the effects of UI on balance, trunk impairment, and fear of falling considering the participant's sex.

CONCLUSION

In conclusion, MS patients with UI were found to experience a greater increase in trunk disturbance, balance disorders, and fear of falling compared to MS patients without UI in this study. Therefore, in the evaluation of balance, trunk impairment, and fear of falling from the early phase of the disease, the occurrence of UI should be considered, which is also very important in the design of the content of the rehabilitation programs in such patient groups.

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Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Nezehat Özgül Ünlüer, Yasemin Ateş;* ***Design:*** *Nezehat Özgül Ünlüer;* ***Control/ Supervision:*** *Nezehat Özgül Ünlüer;* ***Data Collection and/or Processing:*** *Ertuğrul Yaşa, Yasemin Ateş;* ***Analysis and/or Interpretation:*** *Nezehat Özgül Ünlüer, Yasemin Ateş.* ***Literature Review:*** *Yasemin Ateş;* ***Writing the Article:*** *Yasemin Ateş, Nezehat Özgül Ünlüer;* ***Critical Review:*** *Nezehat Özgül Ünlüer;* ***References and Fundings:*** *Nezehat Özgül Ünlüer, Ertuğrul Yaşa;* ***Materials:*** *Ertuğrul Yaşa.*

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