ORIGINAL RESEARCH

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# The Relationship Between Urinary Incontinence and Motor Symptoms in Patients with Stroke

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## Abstract

### Objective

This study aims to evaluate the relationship between post-stroke urinary incontinence and the severity of spasticity, balance, and gait performance.

### Material and Method

This cross-sectional study was conducted with 46 patients with stroke. The Modified Rankin Scale (MRS) was used to determine the functional status of the participants. A 24-hour pad test was performed to assess urinary incontinence, and the Danish Prostate Symptom Score (DANN-PSS) was utilized to evaluate urinary function. Spasticity, as one of the motor symptoms, was assessed using the Modified Ashworth Scale (MAS), while balance and gait were evaluated through the Tinetti Balance and Gait Assessment.

### Results

The mean age of patients with urinary incontinence was significantly higher than that of those without incontinence ($p<0.05$). When comparing balance and gait performance between groups, the balance scores of the incontinent group were found to be significantly lower ($p<0.05$), whereas no significant difference was observed in gait scores ($p>0.05$). According to the Tinetti test results, both the balance and total scores were significantly lower in the group with urinary incontinence ($p<0.05$).

### Conclusion

While urinary incontinence in post-stroke patients was not associated with spasticity, it was negatively associated with balance and, to a lesser extent, walking performance. These findings suggest that UI may contribute to functional dependence by indirectly affecting motor functions.

**Keywords:** Stroke, urinary incontinence, spasticity, balance, gait.

## Introduction

Urinary incontinence (UI) is defined by the International Continence Society as the involuntary loss of urine that can be objectively demonstrated (1). UI is one of the most common and severe complications observed following stroke (2). It has been found that more than 80 % of stroke survivors experience at least one abnormal urinary symptom, and approximately 43.5 % report urinary incontinence at three months

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poststroke (3). Post-stroke UI may arise from both direct factors, such as damaged neural pathways, and indirect factors, such as motor, sensory, and cognitive impairments (4). It is known that UI after stroke hinders patients from performing physical functions like dressing and mobility, resulting in limitations in activities of daily living, delayed functional recovery, balance impairments, and an increased risk of falls (5,6). Consequently, patients with UI become more dependent on others and experience a decline in quality of life (7).

In patients with stroke, UI may be directly associated with the site of the cerebral lesion or may result from secondary motor symptoms such as difficulty in reaching the toilet (8). Additionally, increased tone in the lower extremities and external sphincter following stroke is presumed to exacerbate voiding dysfunction and incontinence (9). Prior studies have highlighted a relationship between urinary problems and lower extremity spasticity in stroke survivors, indicating that those with both spasticity and UI demonstrate lower levels of independence in daily activities (10,11).

The main factors affecting independence in daily life after stroke are motor problems such as increased tone, balance and walking disorders (12). Spasticity, defined as a motor disorder characterized by a velocity-dependent increase in muscle tone resulting from excessive stimulation of the stretch reflex (13), reaches its maximum level in the 1-3 month period after stroke and causes disorders such as muscle shortening and soft tissue contractures in the long term (9,14,15). Spasticity in the lower extremities most frequently presents with adduction at the hips, extension at the knees, and inversion at the ankles (16). Balance and gait disorders are observed in stroke patients as a result of increased tone, motor control deficiencies and muscle weakness (11). The physical disability that spasticity causes limits people's ability to perform basic activities such as self-care and ambulation (15,17).

Changes in muscle tone, loss of strength, and gait and balance disorders following stroke are among the primary factors influencing recovery and functional independence (18). Early identification and management of risk factors that may cause functional loss in stroke survivors are crucial (19). Motor symptoms such as tone abnormalities, balance, and gait dysfunctions, when accompanied by urinary symptoms, may negatively affect patients' ability to carry out daily activities and maintain independent living (15). Post-stroke UI also impacts the duration of treatment, patient participation in treatment and motivation during the rehabilitation process. Lower limb motor impairment has been suggested as a potential cause of UI in stroke patients (20). The literature indicates that post-stroke UI adversely affects functionality, including activity performance and mobility (21).

Evaluating UI and motor symptoms in stroke rehabilitation may help guide treatment approaches and improve functional outcomes of stroke survivors. This study aims to investigate the relationship between post-stroke UI and spasticity, balance, and gait functions.

## Material and Method

This study was designed as a cross-sectional clinical investigation and included patients in the chronic stage of stroke who applied to the Neurology Outpatient Clinic of Süleyman Demirel University Research and Practice Hospital between September 2023 and February 2024. Ethical approval was obtained from the Clinical Research Ethics Committee of the Faculty of Medicine, Süleyman Demirel University (Date: 16.11.2021, Protocol No: 72867572-050.01.04-320), and the study was registered on ClinicalTrials.gov (NCT06333119). Inclusion criteria were as follows: aged between 20–65 years, history of a single stroke at least three months prior, Modified Rankin Scale (MRS) score between 0–2, ability to stand and walk independently or with a walking aid, and proficiency in speaking and understanding Turkish. Patients with speech disorders impairing intelligibility, comorbid neurological conditions, orthopedic or cardiovascular disorders that could affect balance, pregnancy, or visual/hearing impairments were excluded (Figure 1).

While calculating the sample size of the study, the effect size was calculated according to the 24-hour pad test results in the stroke patient group in the study by Arkan et al. (22), a one-tailed power analysis was performed using G*Power 3.1.9.2 (Universität Kiel, Germany). With an effect size (d) of 0.438, 90% power, and a type I error rate of 0.05, the required sample size was determined as n = 46.

Patients who voluntarily agreed to participate in the study signed an informed consent form, their demographic information was recorded, and functional level was determined using the Modified Rankin Scale (MRS). Participants scoring 0–2 on the MRS underwent a 24-hour pad test for UI assessment. Patients who were objectively identified as having incontinence based on pad test results were included in the group with UI. The Danish Prostate Symptom Score (DANN-PSS)

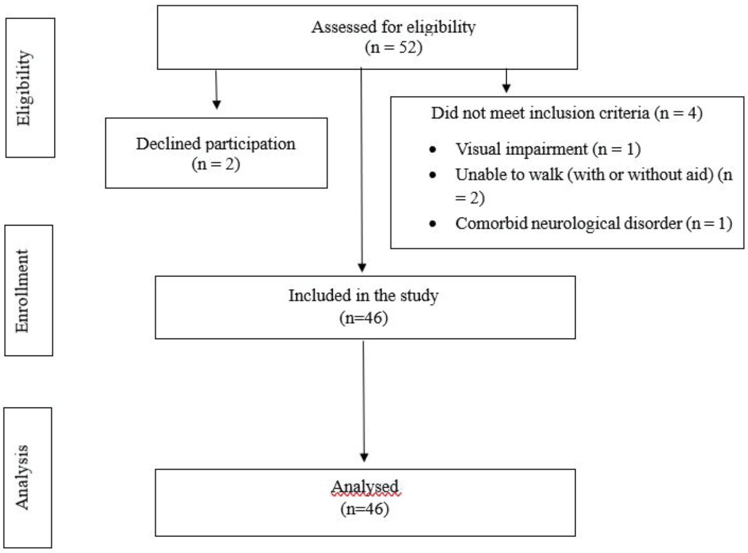


**Figure 1**
Flow chart

questionnaire was used to assess bladder storage and urinary function. Spasticity of hip musculature was assessed using the Modified Ashworth Scale (MAS), while balance and gait functions were evaluated via the Tinetti Balance and Gait Assessment.

Modified Rankin Scale (MRS): Used to assess functional status, ranging from 0 (no symptoms) to 6 (death) (23). Scores ≥4 indicate severe functional impairment. Only patients with MRS scores of 0–2 were included in this study (0: No symptoms; 1: No significant disability despite symptoms; able to carry out all usual duties and activities; 2: Slight disability; unable to carry out all previous activities but able to look after own affairs without assistance; 3: Moderate disability; requires some help but able to walk without assistance; 4: Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance; 5: Severe disability; bedridden, incontinent, and requires constant nursing care and attention; 6: Dead).

24-Hour Pad Test: Participants collected all pads used in the last 24 hours in an airtight bag and brought a clean identical pad for comparison. The used pad weight was calculated by subtracting the expected weight (number of used pads × clean pad weight) from the total collected weight. Incontinence severity was categorized as: Mild: 1.3–19 g; Moderate: 20–74 g; Severe: ≥75 g (24).

Danish Prostate Symptom Score (DANN-PSS): A 12-item questionnaire applicable to both sexes, evaluating urinary complaints and associated discomfort. Each question is scored between 0-3 points depending on the complaint and the discomfort felt due to this complaint. Each question has complaint and discomfort scores, these values are multiplied by each other to calculate the total score (the highest score is 9). If the complaint is serious but there is no discomfort, the total score is zero. Final score is the product of complaint and discomfort scores, with a total possible score ranging from 0–108. Turkish validity and reliability were established in 2017 (25).

Modified Ashworth Scale (MAS): A reliable scale for assessing spasticity, scored from 0 to 4 [0: No increase in tone; 1: Slight increase at end of range; 1+: Slight increase through <50% of range; 2: Marked increase through most of the range; 3: Considerable increase, passive movement difficult; 4: Affected joint(s) rigid] (11).

Tinetti Balance and Gait Assessment: Consists of 16 items: 9 for balance and 7 for gait. Total score interpretation: ≤18: High fall risk; 19–24: Moderate fall risk; ≥25: Low fall risk (26). Turkish validation was conducted by Ağırcan in 2009 (27).

### Statistical Analysis

All statistical analyses were performed using SPSS 24.0 (IBM Corporation, Armonk, NY, USA). Normality of data was evaluated using the Kolmogorov-Smirnov test, with $p < 0.05$ considered statistically significant. Continuous variables are presented as mean ± standard deviation, and categorical variables as counts and percentages. Due to non-normal distribution, Mann-Whitney U test was used for group comparisons and Spearman's correlation analysis to evaluate relationships among variables.

## Results

Out of 52 women evaluated for eligibility, four did not meet the inclusion criteria and two declined participation, resulting in a final sample of 46 participants. The duration of stroke in the group with UI was 25.25±28.01 years, while the duration of stroke in the group without UI was 22.63±24.91 years. The mean age of participants with urinary incontinence (UI) was 64.00 ± 12.92 years, significantly higher than the 53.73 ± 13.74 years observed in those without UI ($p < 0.05$; Table 1).

When grouped according to UI status, participants without UI demonstrated significantly higher balance scores and total scores on the Tinetti test compared to those with UI ($p < 0.05$; Table 2).

Table 3 presents the correlations between UI and motor symptoms. There is a low negative correlation between UI and balance and gait in the group with UI ($r = -0.312^*$, $p = 0.035$). Similarly, a weak negative correlation was found between UI severity and the total Tinetti score ($r = -0.329^*$, $p = 0.026$).

**Table 1** Demographic characteristics of participants with and without UI

| | Group with UI (n=16) Mean ±Sd | Group without UI (n=30) Mean ± Sd | p |
|---|---|---|---|
| **Age** | 64.00±12.92 | 53.73±13.74 | **0.013** |
| **BMI** | 27.87±2.75 | 27.90±3.74 | 0.75 |
| **Stroke duration** | 25.25±28.01 | 22.63±24.91 | 0.75 |
| | **Group with UI n (%)** | **Group without UI n (%)** | **p*** |
| **Dominant side** | | | |
| Right | 16 (100) | 27 (90) | 0.542 |
| Left | 0 | 3 (10) | |
| **Affected side** | | | |
| Right | 8 (50) | 10 (33.3) | 0.347 |
| Left | 8 (50) | 20 (66.6) | |
| **Gender** | | | |
| Female | 8 (50) | 10 (33.3) | 0.347 |
| Male | 8 (50) | 20 (66.6) | |
| **Education** | | | |
| Primary school | 11 (68.8) | 16 (53.3) | |
| Secondary school | 2 (12.5) | 4 (13.3) | |
| High school | 2 (12.5) | 5 (16.6) | 0.321 |
| University graduate | 0 | 5 (16.6) | |
| Postgraduate | 1 (6.3) | 0 | |
| **Marital status** | | | |
| Married | 12 (75) | 24 (80) | |
| Widowed | 3 (18.8) | 3 (10) | 0.665 |
| Single | 1 (6.3) | 3 (10) | |
| **MRS** | | | |
| 0 | 6 (37.5) | 20 (66.6) | |
| 1 | 6 (37.5) | 7 (23.3) | 0.146 |
| 2 | 4 (25) | 3 (10) | |

UI: Urinary Incontinence, MRS: Modified Rankin Scale, n: number, p*: Chi-square test, p: T-test, SD: Standard Deviation.

**Table 2** Comparison of balance, gait and hip spasticity between with UI and without UI groups

| | Group with UI n:16 | Group without UI n:30 | p |
|---|---|---|---|
| **Tinetti balance test** | 12.75±3.37 | 13.86±3.07 | **0.09** |
| **Tinetti gait test** | 8.81±2.50 | 10.06±2.25 | 0.058 |
| **Tinetti total score** | 21.56±5.58 | 23.93±4.96 | **0.044** |
| **Right add. spasticity** | 0.37±0.88 | 0.06±0.25 | 0.191 |
| **Left add. spasticity** | 0.12±0.50 | 0.23±0.62 | 0.526 |
| **Right Hip Extensor Spasticity** | 0.06±0.25 | 0.06±0.25 | 0.958 |
| **Left Hip Extensor Spasticity** | 0.00±0.00 | 0.13±0.43 | 0.103 |

UI: Urinary Incontinence, add: adductor muscle, p<0.05. Mann Whitney U test.

**Table 3** Correlation between urinary incontinence severity and motor function in participants with UI

| | | Right hip add. | Left hip add. | Right hip ext. | Left hip ext. | Tinetti balance | Tinetti gait | Tinetti total |
|---|---|---|---|---|---|---|---|---|
| **DANN-PSS** | r<br>p | 0.264<br>0.077 | -0.153<br>0.310 | 0.260<br>0.081 | -0.063<br>0.675 | -0.229<br>0.125 | -0.112<br>0.460 | -0.200<br>0.182 |
| **Pad test** | r<br>p | 0.188<br>0.211 | -0.112<br>0.460 | 0.043<br>0.777 | -0.187<br>0.212 | **-0.312*<br>0.035** | **-0.304*<br>0.040** | **-0.329*<br>0.026** |
| **Right hip add.** | r<br>p | 1.000<br>. | -0.122<br>0.421 | 0.743**<br>0.000 | -0.092<br>0.543 | **-.0422**<br>0.004** | -0.195<br>0.194 | -0.367<br>0.012 |
| **Left hip add.** | r<br>p | -0.122<br>0.421 | 1.000<br>. | -0.092<br>0.542 | **0.774**<br>0.000** | **-0.308*<br>0.038** | **-0.329*<br>0.025** | **-0.315*<br>0.033** |
| **Right hip ext.** | r<br>p | **0.743**<br>0.000** | -0.092<br>0.542 | 1.000<br>. | -0.070<br>0.645 | **-0.355*<br>0.016** | -0.213<br>0.155 | **-0.334*<br>0.023** |
| **Left hip ext.** | r<br>p | -0.092<br>0.543 | **0.774**<br>0.000** | -0.070<br>0.645 | 1.000<br>. | **-0.354*<br>0.016** | **-0.386**<br>0.008** | **-0.371*<br>0.011** |
| **Tinetti balance** | r<br>p | **-0.0422**<br>0.004** | **-0.308*<br>0.038** | **-0.355*<br>0.016** | **-0.354*<br>0.016** | 1.000<br>. | **0.772**<br>0.000** | **0.928**<br>0.000** |
| **Tinetti gait** | r<br>p | -0.195<br>0.194 | **-0.329*<br>0.025** | -0.213<br>0.155 | -0.386**<br>0.008 | 0.772**<br>0.000 | 1.000<br>. | **0.939**<br>0.000** |
| **Tinetti total** | r<br>p | -0.367<br>0.012 | **-0.315*<br>0.033** | **-0.334*<br>0.023** | **-0.371*<br>0.011** | **0.928**<br>0.000** | **0.939**<br>0.000** | 1.000<br>. |

Add: Adductor muscles, ext: extensor muscles, DANN-PSS: Danish Prostate Symptom Score, **: Spearman correlation analysis.

## Discussion

This study examined the relationship between UI and motor symptoms in patients who had experienced a stroke. Findings revealed significantly lower balance and gait abilities among patients with UI. These results support the hypothesis that fear of leakage and urgency associated with UI may lead to hurried movements, thereby contributing to balance disturbances. Furthermore, disruptions in normal gait patterns and shortened stride lengths due to UI concerns may compromise walking ability. No significant relationship was found between UI and spasticity.

While the exact cause of UI in stroke patients remains unclear, both neurological and functional impairments may contribute (8). Wang et al. (2024) reported that UI is 40% more prevalent in post-stroke women than in men, potentially due to anatomical differences, childbirth history, and obesity (2,28). In addition, when the relationship between the lesion side and UI is examined, it has been stated in the literature that the UI rate is higher in patients with left brain involvement. In our study, no gender or lesion-side differences were noted between groups, likely due to the limited number of participants with UI.

Although spasticity tends to increase with age within the first year post-stroke, prior research suggests no consistent relationship with age, gender, or lesion side (15). In our study, there was no significant relationship between spasticity and UI. Pizzi et al. (2014) found that incontinence was more common in older patients, indicating a potential age-related decline in continence mechanisms (29). Our findings also reflect higher mean age among participants with UI. This may be considered as a result of the increased risk of UI with age.

After a stroke, both motor functions and the autonomic nervous system are affected. Abnormal contractions reflected in the pelvic region with lower extremity spasticity can increase pressure on the bladder, make it difficult to control bladder emptying, and lead to UI (30). Previous studies have linked increased lower limb spasticity with greater severity of urinary dysfunction and lower quality of life (9). Combined spasticity and UI have been associated with reduced independence in daily activities (10). Similarly, in multiple sclerosis, UI and spasticity are known to negatively affect quality of life and functional abilities (31,32). While one of our hypotheses posited a relationship between post-stroke UI and increased tone in hip adductors, no such link was identified. However, patients with UI demonstrated worse outcomes in balance and gait.

While trunk control and balance problems are common in stroke patients, UI is also known to be common in these patients. UI may negatively affect postural stability and balance by increasing the compensatory activity of the trunk and pelvic floor muscles (33). It is reported that balance skills may be weak in women with stress UI and that advanced age may further negatively affect this condition. Similarly, the higher mean age of the group with UI in our study suggests that the weakness in balance skills may be partly due to the age factor. It was also observed that balance skills were better in patients with lower UI severity. This suggests that decreasing physical activity levels due to concerns about experiencing incontinence may have negative effects on balance over time. Therefore, it should be kept in mind that UI may affect not only pelvic floor health but also balance and physical functions.

Effective functional movement and postural control require coordinated muscular effort across the ankles, knees, hips, and trunk (34). Increased spasticity negatively affects lower limb function (14,15). Khiabani et al. (2017) found that patients with higher spasticity had poorer frontal plane balance control (35). Consistent with this, our findings suggest that spasticity in the hip adductors may impair balance by altering lower extremity alignment and center of gravity.

This study has certain limitations. Notably, the uneven distribution of participants between groups is a methodological constraint that may impact the reliability and generalizability of the findings. Additionally, the relatively small sample size limits the extrapolation of results to broader populations. Future studies with larger, preferably multicenter samples are warranted to enhance the scientific validity and clinical relevance of the findings.

This study aimed to explore the relationship between post-stroke urinary incontinence and motor symptoms. UI in post-stroke patients was not significantly associated with spasticity but was negatively associated with balance and, to a lesser extent, gait performance. Furthermore, patients with UI were older, a factor that may exacerbate balance impairments. These results suggest that UI may indirectly negatively impact motor function and contribute to functional dependence. Consequently, UI should be addressed as a multifactorial problem in stroke rehabilitation programs, with a particular focus on improving postural control and walking ability.

**Clinical Implications**

Post-stroke urinary incontinence (UI) should be routinely screened as it may negatively affect balance and gait, even in the absence of a relationship with spasticity.

Rehabilitation programs should integrate continence care with balance and gait training to reduce fall risk and functional dependence.

Incorporating pelvic floor muscle training, postural control exercises, and mobility strategies into stroke rehabilitation may improve participation, motivation, and functional recovery.

Addressing UI as a multifactorial condition provides a more holistic rehabilitation approach and may enhance quality of life and independence in stroke survivors.

## Conflict of Interest Statement

The authors declare no conflicts of interest.

## Ethical Approval

Ethical approval was obtained from the Clinical Research Ethics Committee of the Faculty of Medicine, Süleyman Demirel University (Date: 16.11.2021, Protocol No: 72867572-050.01.04-320). Informed consent forms were obtained from the participants in accordance with the principles of the Declaration of Helsinki.

## Consent to Participate and Publish

Following the provision of detailed information regarding the study, written informed consent was obtained from all participants.

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## Availability of Data and Materials

Data can be requested from the authors.

## Artificial Intelligence Statement

The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript, nor for the creation of images, graphics, tables, or their corresponding captions.

## Authors Contributions

PY: Conceptualization; Formal analysis; Investigation; Visualization; Writing-review & editing.

MD: Conceptualization; Formal analysis; Methodology; Writing-original draft. Supervision; Writing-review & editing.

SK: Data curation.

VAY: Data curation.

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