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Original Research

Kinesiophobia in Women with Stress and Mixed Urinary Incontinence: Associations with Severity and Quality of Life Using a Novel Scale

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ABSTRACT

Objective: This prospective study explored the connections between kinesiophobia traditionally defined as an irrational fear of movement due to expected pain or harm in chronic conditions, but in this study defined as the avoidance of movement due to fear of urinary incontinence, the severity of urinary incontinence (UI), the severity of urinary incontinence, and UI-related quality of life (QoL) among women with stress urinary incontinence (SUI) or mixed urinary incontinence (MUI), utilizing a newly developed UI-specific kinesiophobia scale.

Methods: Between August and November 2024, 55 women aged 18–65 with SUI and MUI were recruited from a urology outpatient clinic. Participants completed the International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF), Incontinence Quality of Life Questionnaire (I-QOL), and a novel three-item UI-specific kinesiophobia scale. Pearson correlation analysis assessed relationships between kinesiophobia, UI severity, and QoL.

Results: Kinesiophobia showed a moderate positive correlation with UI severity ($r = 0.548$, $p < 0.001$) and a moderate negative correlation with QoL ($r = –0.447$, $p = 0.001$). Mean scores were 13.82 ± 4.57 for ICIQ-SF, 59.55 ± 20.60 for I-QOL, and 14.09 ± 8.27 for kinesiophobia.

Conclusion: UI severity significantly influences kinesiophobia, which in turn diminishes QoL in women with SUI and MUI. The UI-specific kinesiophobia scale offers a concise tool to measure movement-related fears, emphasizing the importance of holistic interventions, such as pelvic floor therapy and psychological support, to address both physical and emotional challenges in UI management.

Keywords: urinary incontinence, kinesiophobia, quality of life, stress incontinence, mixed incontinence, UI-specific kinesiophobia scale

INTRODUCTION

Urinary incontinence (UI) involves the unintentional leakage of urine, a condition that predominantly impacts women, with prevalence rates ranging from 25% to 55% among those aged 15–64 years, depending on diagnostic and reporting variations [1,2]. Stress urinary incontinence (SUI) results in urine leakage during actions that increase abdominal pressure, like coughing or exercise, whereas mixed urinary incontinence (MUI) merges features of both stress and urge incontinence [1]. Stress-dominant mixed urinary incontinence is characterized by the predominance of stress incontinence symptoms over urgency symptoms [3].

UI creates significant physical, emotional, and social challenges, frequently leading to reduced quality of life (QoL), social isolation, and mental stress [3]. Tools like the International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF) and the Incontinence Quality of Life (I-QOL) scale provide reliable measures to evaluate UI severity and its impact on well-being [5].

Main Points

- A novel, UI-specific kinesiophobia scale was developed to measure fear of movement in women with stress or mixed urinary incontinence (SUI/MUI). This concise, three-item scale addresses movement avoidance due to leakage concerns—an aspect previously underexplored with standard kinesiophobia tools.
- Kinesiophobia demonstrated a moderate positive correlation with urinary incontinence severity ($r = 0.548$, $p < 0.001$). Women with more severe UI symptoms reported greater fear of movement, suggesting symptom burden contributes to psychological avoidance behaviors.
- Kinesiophobia showed a moderate negative correlation with quality of life ($r = –0.447$, $p = 0.001$). Increased movement-related fear is linked to decreased well-being, emphasizing the psychological toll of UI beyond its physical symptoms.
- The study supports integrating psychological assessment and intervention into UI treatment plans. Addressing kinesiophobia through targeted strategies—such as pelvic floor therapy combined with cognitive-behavioral approaches—may improve both continence outcomes and overall health.

Kinesiophobia, traditionally defined as an irrational fear of movement due to anticipated pain or harm in chronic conditions [6], is adapted in this study to describe avoidance of movement due to fear of urinary leakage in women with UI. This adaptation reflects the unique psychological barriers associated with UI. In the context of UI, women with SUI and MUI may avoid physical activities due to concerns about triggering leakage, exhibiting behaviors akin to kinesiophobia. Although UI literature frequently notes movement avoidance, few tools quantify its extent or its relationship with UI severity and QoL. General kinesiophobia scales, such as the Tampa Scale, are tailored for musculoskeletal issues and may not fully capture the unique fears associated with UI [7].

This study introduces a novel three-item kinesiophobia scale specifically designed for women with SUI and MUI, targeting fears related to movement and leakage. The research aims to examine the associations between kinesiophobia, UI severity (via ICIQ-SF), and QoL (via I-QOL), hypothesizing that movement avoidance correlates with symptom severity and impacts well-being. By quantifying these relationships, the study seeks to enhance understanding of psychological barriers to activity in UI and guide the development of targeted interventions to improve QoL.

MATERIALS AND METHODS

Study Design

This prospective, comparative study was conducted in accordance with the ethical guidelines of the Declaration of Helsinki. Data collection occurred between August 2024 and November 2024 at the urology outpatient clinic of Başakşehir Çam and Sakura City Hospital. Ethical approval was obtained from the Başakşehir Çam and Sakura City Hospital Ethics Committee (Approval number: 251412110, Date: 2024-08-14).

Participants

A total of 55 female patients, aged 18 to 65, who were clinically diagnosed with SUI and MUI at the institution, were prospectively enrolled. Inclusion criteria were: (1) age 18–65, (2) urologist-confirmed SUI and MUI, (3) ability to complete questionnaires, and (4) informed consent. Exclusion criteria included: (1) UI treatment within the past three months, (2) ongoing vaginal or urinary tract infections, (3) being pregnant, (4) neurological, pulmonary, or musculoskeletal conditions affecting spinal alignment, or (5) communication barriers.

Outcome Measures

Demographic and clinical information, such as age, body mass index (BMI), and type of incontinence, was documented. The following instruments were utilized:

1. **ICIQ-SF**: A validated measure of UI severity and impact.
2. **I-QOL**: A validated scale assessing UI's effect on QoL.
3. **UI-Specific Kinesiophobia Scale**: A three-item scale developed by the study team, comprising: (1) "I fear movement due to potential urine leakage," (2) "I limit my actions to avoid urinary leakage," and (3) "I avoid social activities due to leakage concerns." Each item was scored on a 10-point Likert scale (1 = not at all, 10 = extremely), with total scores ranging from 3 to 30. Higher scores indicated greater kinesiophobia.

Data Collection

Participants completed the ICIQ-SF, I-QOL, and UI-specific kinesiophobia scale during a single visit to the urology outpatient clinic. Questionnaires were administered in a private setting to ensure confidentiality and encourage honest responses. Clinical information was gathered from patient records, and all evaluations were performed by qualified research personnel.

Statistical Analysis

Data were analyzed using SPSS version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics (means, standard deviations, frequencies) were used to summarize demographic and clinical characteristics. Pearson correlation analysis was performed to examine the relationships between kinesiophobia (UI-specific kinesiophobia scale scores), UI severity (ICIQ-SF scores), and quality of life (I-QOL scores). In addition, a multivariate linear regression analysis (enter method) was conducted to identify independent predictors of kinesiophobia, including age, BMI, comorbidities, education level, UI severity, and quality of life as independent variables. Statistical significance was set at $p < 0.05$.

RESULTS

Out of 74 individuals with urinary incontinence evaluated for eligibility, 19 were excluded because they did not fulfill the inclusion criteria or chose not to participate. Ultimately, 55 women diagnosed with stress urinary incontinence and mixed urinary incontinence were enrolled in the study, with no participants withdrawing during the study duration. The demographic characteristics of the participants are presented in Table 1. Participants had a mean age of 45.64 years (SD = 11.70) and BMI of 28.39 kg/m² (SD = 4.72), consistent with similar UI patient populations. The majority of participants were married (87.0%), unemployed (58.2%), and had at least a high school education. Additionally, 58.2% reported comorbid conditions, 83.6% had no regular exercise habits, and 65.5% had a history of vaginal delivery.

Table 1. Demographic characteristics of the participants (N:55)

Variables	(Mean ± SD / n (%)
Age (years)	45.64 ± 11.70
Body mass index (kg/m²)	28.39 ± 4.72
Comorbidity	
Yes	32 (58.2%)
No	23 (41.8%)
Marital status	
Married	47 (87.0%)
Single	7 (13.0%)
Education	
Primary	13 (23.6%)
Secondary	5 (9.1%)
High school	25 (45.5%)
University	9 (16.4%)
Postgraduate	3 (5.5%)
Employment	
Working	23 (41.8%)
Not working	32 (58.2%)
Smoking	
Yes	15 (27.3%)
No	40 (72.7%)
Alcohol use	
Yes	7 (12.7%)
No	48 (87.3%)
Exercise habit	
Yes	9 (16.4%)
No	46 (83.6%)
Type of delivery	
Vaginal	36 (65.5%)
Cesarean	12 (21.8%)
None	7 (12.7%)
Difficult delivery	
Yes	36 (65.5%)
No	19 (34.5%)
Episiotomy	
Yes	37 (67.3%)
No	18 (32.7%)
Pad usage	
Yes	28 (50.9%)
No	27 (49.1%)

Values are reported as mean ± standard deviation (SD) for continuous variables and as counts (percentages) for categorical variables.

Clinical characteristics are shown in Table 2. The mean duration of UI symptoms was 6.95 years (SD = 5.58). The mean score on the International Consultation on Incontinence Questionnaire–Short Form (ICIQ-SF) was 13.82 (SD = 4.57), and the mean score on the Incontinence Quality of Life Questionnaire (I-QOL) was 59.55 (SD = 20.60). The mean score on the UI-specific kinesiophobia scale was 14.09 (SD = 8.27).Stress-predominant mixed incontinence was the most common type (38.2%). Furthermore, 63.6% of participants reported dribbling, and 56.4% experienced constipation.

Table 2. Clinical characteristics of the participants

Variables	Mean ± SD / n (%)
Duration of symptoms (years)	6.95 ± 5.58
ICIQ-SF score	13.82 ± 4.57
I-QOL score	59.55 ± 20.60
24-hour pad test (gr)	80.33 ± 99.09
Kinesiophobia score	14.09 ± 8.27
Type of incontinence	
Stress	20 (36.4%)
Stress-predominant mixed	21 (38.2%)
Urge-predominant mixed	14 (25.5%)
Dribbling	
Yes	35 (63.6%)
No	20 (36.4%)
Intermittency	
Yes	20 (36.4%)
No	35 (63.6%)
Constipation	
Yes	31 (56.4%)
No	24 (43.6%)

Continuous variables are presented as mean ± standard deviation (SD), and categorical variables are shown as number (percentage).

Correlation analyses identified a statistically significant moderate positive relationship between kinesiophobia (scores on the UI-specific kinesiophobia scale) and UI severity (ICIQ-SF scores; $r = 0.548$, $p < 0.001$), and a moderate negative relationship between kinesiophobia and quality of life (I-QOL scores; $r = -0.447$, $p = 0.001$), as presented in Table 3 and visually depicted in Figure 1.

A multivariate regression analysis was conducted to identify independent predictors of kinesiophobia with results presented in Table 4. The results revealed that UI severity (ICIQ-SF score; $\beta = 0.496$, $p < 0.001$) was significantly associated with higher kinesiophobia scores, indicating that greater UI severity predicts increased kinesiophobia. Comorbidities ($\beta = 0.364$, $p = 0.001$) were also significant predictor, with the presence of comorbidities linked to increased kinesiophobia. Conversely, age ($\beta = -0.237$, $p = 0.031$) was negatively associated with kinesiophobia, suggesting that older age predicts lower kinesiophobia scores. No significant independent associations were found between kinesiophobia and quality of life (I-QOL score; $p = 0.144$), BMI ($p = 0.589$), or educational level ($p = 0.985$).

Table 3. Correlation between kinesiophobia and ICIQ-SF and I-QOL scores

Correlation	r	p
ICIQ-SF	0.548**	< 0.001
I-QOL	-0.447**	0.001

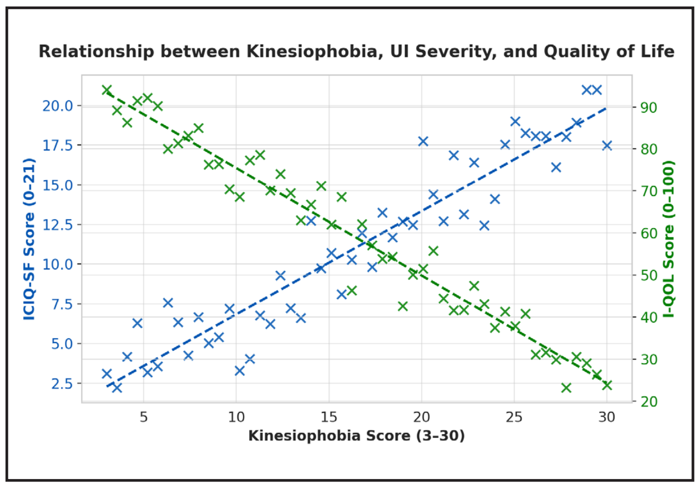

Figure 1. Relationship Between Kinesiophobia, UI Severity and Quality of Life

DISCUSSION

In this prospective study, we found a moderate positive correlation between urinary incontinence severity and kinesiophobia in women diagnosed with stress or mixed UI ($r = 0.548$, $p < 0.001$). This suggests that as UI symptoms become more severe or frequent, fear of movement increases—potentially due to

Table 4. Results of multivariate linear regression analysis predicting kinesiophobia scores

Independent variable	B (Unstandardized)	SE	β (Standardized)	t	p
Constant	12.492	7.554	-	1.654	0.105
ICIQ-SF	0.880	0.231	0.496	3.815	**<0.001**
I-QOL	-0.081	0.054	-0.193	-1.488	0.144
Age	-0.195	0.088	-0.237	-2.222	**0.031**
BMI	-0.098	0.181	-0.056	-0.545	0.589
Comorbidity	6.003	1.626	0.364	3.693	**0.001**
Education level	0.018	0.995	0.003	0.019	**0.985**

Model summary: $R = 0.755$, $R^2 = 0.571$, Adjusted $R^2 = 0.504$, $F(7,45) = 8.548$, $p < 0.001$
Dependent variable: Kinesiophobia score

concerns about leakage or social embarrassment during physical activity. Additionally, kinesiophobia was moderately negatively correlated with quality of life (QoL) ($r = -0.447$, $p = 0.001$), indicating that increased fear of movement is associated with decreased overall well-being. These findings align with prior research noting activity avoidance in women with UI due to concerns about leakage, confirming the relevance of addressing psychological barriers in UI management [8].

To further explore the multifactorial nature of kinesiophobia, a multivariate regression analysis was conducted to identify independent predictors of kinesiophobia, the analysis confirmed that UI severity (ICIQ-SF score; $\beta = 0.496$, $p < 0.001$) is a strong positive predictor of kinesiophobia, consistent with the correlation analysis and indicating that greater UI severity significantly increases fear of movement. This reinforces the notion that symptom severity is a primary driver of kinesiophobia. Comorbidities ($\beta = 0.364$, $p = 0.001$) was also a significant predictor, with the presence of chronic conditions (e.g., cardiac or respiratory diseases). These findings align with existing literature highlighting that chronic health conditions, often associated with fear-related avoidance in the original definition of kinesiophobia, exacerbate movement-related fears [9].

Conversely, age ($\beta = -0.237$, $p = 0.031$) was negatively associated with kinesiophobia, suggesting that older age predicts lower kinesiophobia scores. Although this may seem counterintuitive given the lower prevalence of comorbidities in younger patients, it likely reflects psychosocial factors, such as younger women experiencing greater concern about leakage in social settings, leading to heightened social isolation and embarrassment. In contrast, older women may perceive UI as a natural consequence of aging, thus exhibiting less fear of movement. Notably, while the bivariate correlation analysis identified a moderate negative relationship between kinesiophobia and quality of life (I-QOL scores), the multivariate regression analysis found no independent association ($p = 0.144$). This suggests that the relationship between kinesiophobia and quality of life is likely mediated by other factors, particularly UI severity, highlighting the complex interplay of these variables.

Common UI assessment tools, such as the ICIQ-SF and I-QOL, primarily focus on symptom severity and the psychological and social effects of urinary incontinence, including embarrassment, anxiety, and social isolation [5]. However, these tools do not specifically evaluate movement avoidance caused by fear of leakage. The new three-item UI-specific kinesiophobia scale developed for this study addresses this gap by measuring fears related to physical activity, providing a targeted way to assess this often-overlooked aspect of UI [7]. While this scale offers a novel and clinically relevant contribution, its psychometric properties, such as reliability and construct validity, have not yet been comprehensively validated, as noted in the limitations section. Consequently, the scale should be considered a preliminary screening tool rather than a validated diagnostic instrument at this stage. Future research is needed to conduct rigorous psychometric evaluations, including test-retest reliability and convergent validity assessments, to establish the scale's robustness and enhance its applicability in clinical and research settings. Nevertheless, due to its evaluation of fear-based avoidance, this study highlights the role of kinesiophobia in contributing to emotional distress, such as anxiety, lowered self-esteem, and depressive symptoms, which add to the wellestablished psychological burden of UI [4,10].

Kinesiophobia has a complex impact on urinary incontinence. Our study showed that patients tend to avoid movement due to fear of leakage, and this avoidance is closely linked to the severity of symptoms, as further supported by the regression analysis. Reduced activity weakens the pelvic floor muscles, which in turn worsens urinary incontinence, creating a vicious cycle where symptoms and avoidance reinforce each other [11]. In addition, limiting physical activity because of kinesiophobia raises the risk of systemic health issues like hypertension, cardiovascular disease, and osteoporosis [11]. These conditions negatively affect overall health, further restricting movement and contributing to pelvic floor muscle weakness. Breaking this vicious cycle is essential not only for managing urinary symptoms but also for improving overall health status.

The development of the UI-specific kinesiophobia scale represents an important step forward, providing a brief and focused alternative to musculoskeletal tools like the Tampa Scale for Kinesiophobia [7]. With just three items addressing fears related to movement, activity limitation, and avoidance of social situations due to leakage concerns, the scale is well-suited for use in clinical settings. It helps healthcare providers quickly identify kinesiophobia and tailor interventions accordingly. For example, kinesiophobia can interfere with patients' adherence to pelvic floor muscle training, a key component of UI treatment [12]. Combining this with cognitive-behavioral therapy (CBT) or gradual exposure to movement may help reduce these fears, promoting physical activity and improving both UI symptoms and quality of life [13].

Clinically, these results support the inclusion of routine kinesiophobia screening during UI evaluations to guide personalized treatment plans that integrate both urological care and psychological support. Such an approach may enhance patient adherence to therapies like pelvic floor exercises and help reduce the risk of health issues related to a sedentary lifestyle [11,12].

Limitations

This study has some limitations. The relatively small sample size (N = 55) and single-center setting may affect the generalizability of the findings, especially to broader populations or community-based contexts. While innovative, the UI-specific kinesiophobia scale still requires formal validation to confirm its reliability and reproducibility. Another limitation of this study is the potential for self-report bias in the questionnaires. Patients may underreport or overreport their symptoms due to embarrassment, social desirability, or recall errors. This limitation must be considered when interpreting the study's findings, as it may affect the reliability and validity of the reported results. Additionally, the cross-sectional design limits the ability to draw causal conclusions between kinesiophobia, UI severity, and quality of life. Future studies should focus on validating the scale with larger, multi-center cohorts, investigating longitudinal interventions combining pelvic floor physiotherapy and cognitive-behavioral therapy, and exploring kinesiophobia's role in other UI subtypes, such as urge incontinence, or different patient groups, including men and older adults.

CONCLUSION

This study highlights the important relationship between urinary incontinence severity and kinesiophobia in women with stress and mixed urinary incontinence, with multivariate regression analysis identified UI severity, comorbidities, and younger age as key predictors of increased fear of movement. Our findings demonstrate that fear of movement due to leakage concerns significantly impacts physical activity levels and quality of life. The newly developed UI-specific kinesiophobia scale offers a practical tool for identifying patients who may benefit from tailored interventions. Addressing kinesiophobia through combined urological and psychological approaches, including pelvic floor muscle training and cognitive-behavioral therapy, may help break the vicious cycle of symptom exacerbation and inactivity. Future research should validate this scale in larger and more diverse populations and explore longitudinal treatment effects to optimize care and improve overall health outcomes.

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Informed Consent: Written informed consent was obtained from all participants prior to their inclusion in the study.

Ethical Approval: Ethical approval was obtained from the Basaksehir Cam and Sakura City Hospital Ethics Committee (Approval number: 251412110, Date: 2024-08-14).

Author Contributions: Conception: YÇ, ZG - Design: YÇ - Supervision: -İY Fundings: ZG -Materials: ZG,İT -

Data Collection and/or Processing: ZG, İT- Analysis and/or Interpretation: ZG- Literature: YÇ- Review: YÇ,ZG- Writing: YÇ- Critical Review: YÇ,ZG,İY

REFERENCES

[1] Abrams P, Cardozo L, Fall M, Griffiths D, Rosier P, et al. Standardisation Sub-Committee of the International Continence Society (2003). The standardisation of terminology in lower urinary tract function: report from the standardisation sub-committee of the International Continence Society. Urology. 61(1):37-49. https://doi.org/10.1016/s0090-4295(02)02243-4

[2] Hunskaar S, Burgio K, Diokno A, Herzog AR, Hjälmås K, Lapitan MC. (2003). Epidemiology and natural history of urinary incontinence in women. Urology. 62(4 Suppl 1):16-23. https://doi.org/10.1016/s0090-4295(03)00755-6

[3] Weissbart SJ, Smith AL. (2021). Mixed Urinary Incontinence: Strategic Approach. In Springer eBooks. https://doi.org/10.1007/978-3-030-54839-1_8

[4] Coyne KS, Kvasz M, Ireland AM, Milsom I, Kopp ZS, Chapple CR. (2012). Urinary incontinence and its relationship to mental health and health-related quality of life in men and women in Sweden, the United Kingdom, and the United States. European urology. 61(1):88-95. https://doi.org/10.1016/j.eururo.2011.07.049

[5] Wagner TH, Patrick DL, Bavendam TG, Martin ML, Buesching DP. (1996) Quality of life of persons with urinary incontinence: development of a new measure. Urology. 47(1):67-72. https://doi.org/10.1016/s0090-4295(99)80384-7

[6] Kori SH, Miller RP, Todd DD. (1990) Kinesiophobia: A new view of chronic pain behavior. Pain Management. 3:35-43.

[7] Knapik A, Saulicz E, Gnat R. (2011) Kinesiophobia - Introducing a new diagnostic tool. Journal of Human Kinetics. 28:25-31. https://doi.org/10.2478/v10078-011-0019-8

[8] Peinado-Molina RA, Martínez-Vázquez S, Hernández-Martínez A, Martínez-Galiano JM. (2023) Impact and influence of urinary incontinence on physical activity levels. European Urology Open Science. 55:50-58. https://doi.org/10.1016/j.euros.2023.07.004

[9] Enzin F, Dikici İC, Tülüce D. (2023) The relationship between kinesiophobia and adaptation to illness in different chronic illnesses. Chronic Illness. https://doi.org/10.1177/17423953231221837

[10] Sinclair AJ, Ramsay IN. (2011) The psychosocial impact of urinary incontinence in women. The Obstetrician & Gynaecologist. 13(3):143-148. https://doi.org/10.1576/toag.13.3.143.27665

[11] Warburton DE, Nicol CW, Bredin SS. (2006) Health benefits of physical activity: The evidence. CMAJ. 174(6):801-809. https://doi.org/10.1503/cmaj.051351

[12] Bo K, Frawley HC, Haylen BT, Abramov Y, Almeida FG, et al. (2017). An International Urogynecological Association (IUGA)/International Continence Society (ICS) joint report on the terminology for the conservative and nonpharmacological management of female pelvic floor dysfunction. Neurourology and urodynamics. 36(2):221-244. https://doi.org/10.1002/nau.23107

[13] Diokno AC, Newman DK, Low LK, Griebling TL, Maddens ME, et al. (2018). Effect of Group-Administered Behavioral Treatment on Urinary Incontinence in Older Women: A Randomized Clinical Trial. JAMA. 178(10):1333-1341. https://doi.org/10.1001/jamainternmed.2018.3766

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