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# Investigation of the Effectiveness of Diaphragmatic Breathing Exercise Added to Pelvic Floor Muscle Training in Individuals with Urinary Incontinence: A Randomized Controlled Trial

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**Abstract**

**Objectives:** This study aimed to investigate the impact of diaphragmatic breathing (DB) exercise, when incorporated into pelvic floor muscle training (PFMT), on the incontinence severity, the life quality, and the intensity of symptoms in individuals afflicted with stress urinary incontinence (UI).

**Materials and Methods:** The study included 66 women diagnosed with UI who met the inclusion criteria. Participants were randomly assigned to a control group (n=33) receiving PFMT alone and an intervention group (n=33) receiving PFMT plus DB exercises. The Incontinence Severity Index (ISI) was utilized to evaluate the severity of incontinence, whereas quality of life was assessed using both the Incontinence Quality of Life Questionnaire (I-QOL) and the King's Health Questionnaire (KHQ). All evaluations were performed face-to-face at the start of the study and again at the eight-week follow-up.

**Results:** Significant improvements were obtained in both groups after treatment in the ISI, the psychological impact and total scores of the I-QOL, and the Symptom Severity Scale. In the KHQ, no significant changes were found in most sub-dimensions, except for physical limitations and personal relationships in the intervention group, and incontinence severity in the control group. Following the intervention, no statistically significant differences were observed between the groups across any of the evaluated parameters.

**Conclusions:** This study demonstrated improvements in incontinence severity, incontinence-related life quality and symptom severity in both groups. However, the integration of DB exercises with PFMT did not produce significantly better outcomes compared to PFMT alone. This study demonstrated improvements in incontinence severity, symptom severity, and specific aspects of incontinence-related quality of life, particularly psychological impact and total scores, in both groups. However, the integration of DB exercises with PFMT did not produce significantly better outcomes compared to PFMT alone.

**Keywords:** Diaphragmatic breathing, Exercises, Pelvic floor muscles, Physiotherapy, Urinary incontinence

## Introduction

According to the International Continence Society (ICS), incontinence refers to the unintentional leakage of urine or feces due to loss of control over bladder or bowel function. Urinary incontinence (UI) is a persistent condition characterized by the involuntary release of urine (1). UI particularly the form categorized as stress UI, has been characterized as a prevalent and distressing condition affecting individuals across diverse age demographics. A substantial proportion of these cases are reported to occur among women, with global prevalence rates ranging from 4% to 35% being documented (2). This condition manifests as unintentional urination during activities that elevate intra-abdominal pressure, such as coughing, sneezing, lifting heavy items or running (3).

Although UI does not pose a threat to life, the ongoing discomfort from skin irritation, constant wetness, and concern about odor can significantly impair patients' social interactions and daily routines (4). Furthermore, UI has a detrimental effect on sexual function in women (5). It is therefore unsurprising that patients diagnosed with UI report a significant limitation of their physical and social lives, and an aversion to social interaction (4,6). Consequently, in addition to its physical symptoms, UI can have a significant impact on an individual's social life and personal well-being, thereby potentially compromising the overall quality of life (7).

Stress UI may be attributed to impairments in urethral closure and supportive urethral mechanisms. Decreased urethral closure ability has been associated with several conditions, including menopause, pelvic surgery, and urogenital atrophy. The occurrence of pelvic floor trauma as a consequence of vaginal delivery has the potential to result in a range of adverse outcomes, including but not limited to nerve damage, levator ani muscle injuries, and weakening of the endopelvic fascia. This, in turn, can lead to a reduction in urethral support. Such structural changes result in UI when intra-abdominal pressure is elevated.

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Continence is achieved by an integrated system including the intrinsic urethral closure mechanism, lumbopelvic stability and urethral support system. The efficacy of this system is contingent on the coordination of various muscle groups, thus necessitating a holistic approach in the treatment of stress UI (8).

Pelvic floor muscle training (PFMT) is a recommended non-invasive and non-pharmacological treatment for UI, and there is a global agreement that it should be the primary treatment (9,10). Supervised and regular use of PFMT has been demonstrated to increase pelvic floor muscle endurance and strength, elevate the rectal ampulla and bladder neck, constrict the levator hiatus, reduce the length of the pelvic floor muscle, and augment the cross-sectional area of the pelvic floor muscle. Consequently, these factors directly impact the elements that precipitate UI (11,12).

Recent evidence suggests that, beyond pelvic floor muscles, core muscles—such as the transverse abdominis, multifidus and diaphragm—play a key role in stress UI rehabilitation. The bidirectional interaction between pelvic floor and core muscles indicates that targeting the entire core may enhance treatment effectiveness. Additionally, respiratory centers influence abdominal and pelvic muscle control via spinal and sacral nerves (13). These mechanisms highlight the need for a comprehensive approach to stress UI that includes pelvic floor, respiratory, and spinal muscle training (14).

PFMs are believed to work synergistically with the abdominal muscles and thoracic diaphragm, given their anatomical position at the base of the abdominal cavity (15,16). This functional connection suggests that suboptimal posture, movement, or breathing strategies may impair load transfer, contributing to UI (17). Conversely, PFMs are also thought to influence respiratory function (15), and sustained inspiration during exertion may strain these muscles, potentially leading to dysfunction (16). Despite this theoretical link, few studies have investigated the impact of adding diaphragmatic breathing (DB) exercises to PFMT for stress UI (18). This study aimed to investigate the effect of incorporating DB into PFMT on incontinence severity, symptom burden, and life quality. We hypothesize that the combined approach will yield greater improvements than PFMT alone.

**Key Messages**

- Adding diaphragmatic breathing (DB) to pelvic floor training did not enhance outcomes beyond pelvic floor muscle training (PFMT) alone.
- Both interventions improved incontinence severity, symptom intensity, and incontinence-related quality of life in women with stress urinary incontinence (UI).
- Findings support PFMT as an effective primary treatment for stress UI.

## Methods

### Study Design

This randomized, prospective, controlled study with a parallel-group design was carried out between September and December 2023. The research took place at the Urology Clinic of Private Sani Konukoğlu Hospital.

### Sample Size Calculation

A power analysis was performed using G*Power 3.1 software to calculate the required sample size. Based on an effect size of 0.32, a 5% margin of error, 95% confidence level, and 95% population representativeness, the total sample size was determined to be 66 participants, with a minimum of 33 individuals allocated to each group (19,20).

### Randomization and Blinding

In this single-blind study, 66 participants were assigned randomly to either the PFMT (control, n=33) or the PFMT+DB group (intervention, n=33). Randomization was conducted using pre-prepared cards, with participants drawing one card indicating assignment to group 1 (control) or group 2 (intervention). Allocation concealment was maintained until assignment, and the researcher administering the interventions was aware of the groups, whereas participants were blinded. Data analysts were only aware of groups labeled as "group 1" and "group 2" to ensure impartiality and balanced group distribution.

Informed consent was obtained from 66 participants, selected based on eligibility determined by a urology specialist. Figure 1 outlines the participant flow. The study included women over 18 diagnosed with stress incontinence who had not previously undergone physiotherapy and were medically and physically fit for assessment. Participants were considered "medically and physically fit" based on a review of their medical history and a brief physical examination conducted by a clinician, ensuring no contraindications to pelvic floor or DB exercises. Exclusion criteria included pregnancy or postpartum status (within six weeks), infections, menstruation during examination, tumors, fractures, acute inflammation, chronic pelvic pain, organ prolapse, prior pelvic surgery, estrogen therapy, neurological disorders, and sexual dysfunction.

### Intervention and Procedure

*Control group:* The control group underwent PFMT. The Kegel exercises were administered three days per week, with two sets performed on each day and 20 repetitions completed for each set. The program began with an overview of pelvic floor anatomy. Exercises were introduced in the supine position following the method outlined by Kegel (21). Participants lay on their backs with their head and shoulders relaxed, spine flat against the surface, and knees slightly bent and supported with a

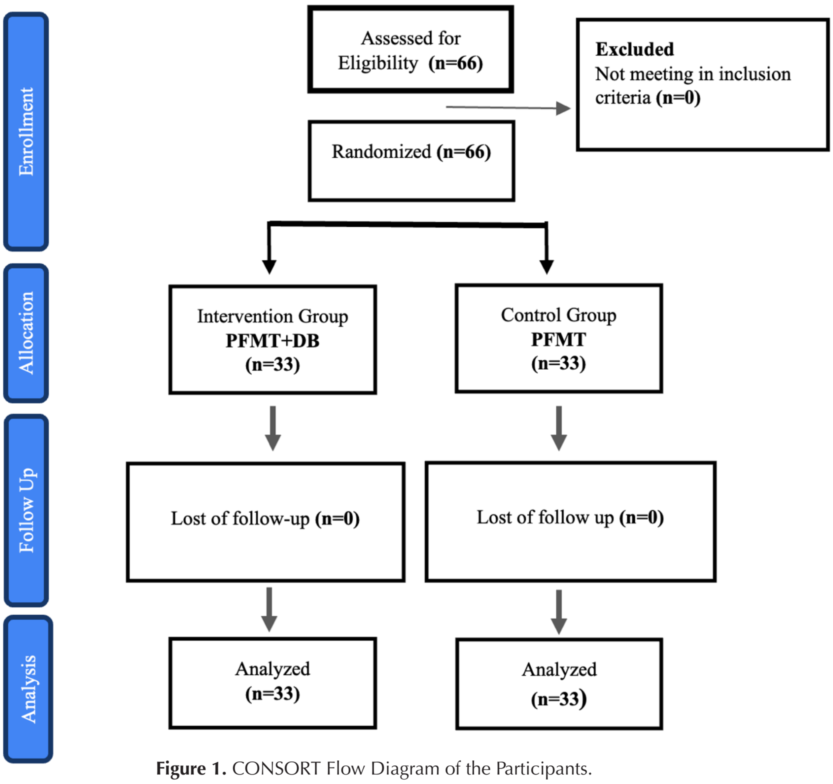


**Figure 1.** CONSORT Flow Diagram of the Participants.

rolled-up pillow. They were instructed to avoid engaging their abdominal, gluteal, or leg muscles, as well as to keep the pelvis stable throughout the exercise. The focus was placed solely on activating the pelvic floor muscles, as if attempting to stop the flow of urine, and maintaining this contraction for 10 seconds. Participants were informed to maintain each contraction at maximal voluntary intensity for 5-10 seconds, followed by a relaxation period of the same duration. This protocol was applied to both groups. A one-minute rest period was allocated between each set. Participants were instructed to maintain their breath while contracting the pelvic floor for 5–10 seconds, then exhale during relaxation (20).

*Intervention group:* In addition to PFMT (Kegel exercises), DB exercises were administered to the intervention group for 8 weeks, with sessions conducted three days per week and each set comprising two repetitions, with a duration of 10 minutes. A one-minute rest period was allocated between each set. Participants were first given an explanation of the diaphragm and abdominal wall anatomy, along with the objective of the exercise. They were then positioned lying on their backs, with their head and shoulders at ease and their spine in contact with the floor. Their knees were slightly bent and supported by a rolled pillow placed under the knee. Participants were instructed to position one hand at the navel level and the other hand on the symphysis pubis. Participants were informed to breathe through the nose and to feel the breath moving craniocaudally into the abdominopelvic cavity. During the breathing exercises, participants were instructed to imagine the abdominopelvic cavity as an inflating balloon, to feel the rise of the abdomen with their hands, and to realize that the pelvis was tilted slightly forward at the same time. Participants were instructed to maintain this posture for approximately 10 seconds, coinciding with the point at which they perceived maximal abdominal and pelvic mobility, and then to exhale. As they exhaled, participants were guided to resume the starting position without engaging their pelvic floor or abdominal muscles and were encouraged to imagine a balloon slowly deflating (20).

The exercises were initially (first week) performed under the supervision of a physiotherapist. Subsequent exercises were administered as an individual home program. Reminder messages were disseminated to participants weekly, while the study was renounced both verbally and in writing to ensure maximum participant access. Pre- and post-treatment assessments were conducted in person at the clinic.

## Outcome Measures

The body mass index, age, educational attainment, and marital status of the participants were recorded. As for inter-rater reliability, all assessments were conducted by a single trained evaluator to minimize variability.

## Incontinence Severity Index

The Incontinence Severity Index (ISI) developed was utilized to assess UI severity (22,23). The index comprises two items evaluating the frequency and amount of leakage, with the total score calculated by multiplying the two responses. Severity was categorized as mild (1–2; intermittent leakage), moderate (3–6; daily leakage), and severe (8–12; leakage at least once per week) (22,23). The Turkish version of the ISI was validated and tested for reliability by Hazar and Şirin (24).

### Incontinence Quality of Life Questionnaire

The Incontinence Quality of Life Questionnaire (I-QOL) was employed to evaluate how incontinence affects the quality of life of participants (25). Its Turkish adaptation, including validation and reliability testing, was carried out by Wagner et al in 1996 (26). This scale comprises 22 items, each rated on a 5-point Likert scale ranging from 1 (very much) to 5 (not at all). The overall score is determined by averaging the item responses and converting the result to a 0–100 scale, where higher scores reflect a better life quality (26).

### King Health Questionnaire

The King Health Questionnaire (KHQ), originally created by Kelleher et al in 1997 (27), was used to evaluate quality of life related to urinary health. Its Turkish version, validated by Kaya et al in 2015, was employed in this study (28). The KHQ consists of 32 items divided into two sections. The first section (21 items) evaluates the, limitations in daily roles, physical and social activities, impact of incontinence, personal relationships, emotional well-being, sleep/energy disturbances, incontinence severity, and general health. The second section (11 items) includes the Symptom Severity Scale, which measures the severity and presence of urinary symptoms with scores ranging from 0 to 30. All items are rated on a 4-point scale (0 = none to 3 = very). The total score ranges from 0 (best health state) to 100 (worst health state), with lower scores indicating improved quality of life (27).

### Statistical Analysis

The data obtained in this study were analyzed using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics, including percentage distributions of demographic characteristics, were calculated, and group differences in these variables were assessed using the chi-square test. To evaluate whether the scale data followed a normal distribution, a one-sample Kolmogorov-Smirnov test was conducted. The results indicated a deviation from normality ($P < 0.05$), prompting the use of non-parametric statistical methods. Within-group comparisons were performed using the Wilcoxon signed-rank test, while between-group comparisons were assessed with the Mann-Whitney U test. A $P$ value of less than 0.05 was accepted as the threshold for statistical significance throughout the analysis.

## Results

The socioeconomic and demographic characteristics of the study participants are demonstrated in Table 1, categorized based on designated groups. No significant difference was observed between the body mass index, marital status, age and educational status variables of the 66 participants ($P > 0.05$).

The intragroup and intergroup comparisons of the ISI and the IQLQ before and following treatment in both the intervention and control groups are shown in Table 2. The intragroup and intergroup comparisons of the ISI and the I-QOL scores before and after treatment are presented in Table 2. In the intervention group, ISI scores significantly decreased from baseline (X= 5.45, SD = 2.91) to after intervention (X = 5.06, SD = 2.29; $P$ = 0.034). Similarly, a significant within-group improvement was observed in the control group (baseline: X = 6.30, SD = 3.20; post-treatment: X = 5.76, SD = 3.03; $P$ = 0.015). For the I-QOL questionnaire, significant intragroup improvements were found in the psychological impact sub-dimension in both the intervention group (baseline: X = 71.80, SD = 21.21; post-treatment: X = 72.56, SD = 20.12; $P$ = 0.039) and the control group (baseline: X = 70.54, SD = 20.99; post-treatment: X = 71.38, SD = 20.23; $P$ = 0.026). Additionally, total I-QOL scores increased significantly after treatment in both groups (intervention group: from X = 68.56, SD =

**Table 1.** Socio-Demographic Information of the Participants

| Variables | Intervention Group (n=33) | Control Group (n=33) | *P* value |
|---|---|---|---|
| Age (years), X ± SD | 50.66±8.35 | 49.12±8.67 | 0.875[a] |
| BMI (kg/m$^2$), X ± SD | 30.17±3.35 | 28.63±4.26 | 0.762[a] |
| Marital status, N (%) | | | 0.923[b] |
| Married | 28 (84.85) | 29 (87.88) | |
| Single | 4 (12.12) | 3 (9.09) | |
| Divorced | 1 (3.03) | 1 (3.03) | |
| Education status, N (%) | | | 0.644[b] |
| Primary school | 8 (24.24) | 7 (21.21) | |
| High school | 7 (21.21) | 11 (33.33) | |
| Associate degree | 6 (18.18) | 7 (21.21) | |
| Bachelor's degree | 11 (33.33) | 8 (24.24) | |
| Master's degree | 1 (3.03) | 0 (0.00) | |

X, mean, SD, standard deviation.
*$P$<0.05, [a] Mann Whitney U test, [b] Pearson chi-square test.

20.77 to X = 69.18, SD = 19.95; $P = 0.017$; control group: from X = 65.12, SD = 21.62 to X = 65.63, SD = 21.12; $P = 0.010$). In the post-treatment comparison between the groups, no significant difference was found in the ISI and I-QOL sub-dimensions and total scores ($P > 0.05$).

The intragroup and intergroup comparisons of the KHQ in the intervention and control groups after and before treatment are presented in Table 3. The intragroup and intergroup comparisons of the KHQ scores before and after treatment in the intervention and control groups are presented in Table 3. In the intervention group, significant within-group improvements were observed in the physical limitations sub-scale, with mean scores decreasing from baseline (X = 36.87, SD = 27.25) to post-treatment (X = 34.34, SD = 25.66; $P = 0.025$), and in the limitations in personal relationships sub-scale (baseline: X = 26.26, SD = 16.55; post-treatment: X = 24.49, SD = 17.05; $P = 0.020$). In contrast, no statistically significant changes were detected in the remaining KHQ sub-scales in the intervention group (all $P > 0.05$). In the control group, a significant within-group difference was found only in the seriousness for incontinence sub-scale, which decreased from baseline (X = 38.79, SD = 26.32) to post-treatment (X = 37.98, SD = 26.06; $P = 0.046$). No significant differences were observed in the other KHQ sub-scales in the control group (all $P > 0.05$). Regarding symptom severity, both groups demonstrated significant improvements following treatment. In the intervention group, Symptom Severity Scale scores decreased from X = 2.62 (SD = 2.56) at baseline to X = 2.15 (SD = 2.06) after treatment ($P = 0.004$), while a similar reduction was observed in the control group (baseline: X = 2.81, SD = 2.90; post-treatment: X = 2.62, SD = 2.81; $P = 0.034$). Post-treatment intergroup comparisons revealed no statistically significant differences between the intervention and control groups across any of the KHQ sub-scales or the Symptom Severity Scale (all $P > 0.05$).

## Discussion

This study aimed to evaluate the impact of incorporating DB exercises into a PFMT regimen on stress UI severity and quality of life. Both the PFMT-only and PFMT+DB groups demonstrated significant improvements in incontinence severity, symptom severity, psychological effects, and quality of life after eight weeks of intervention. However, no statistically significant differences were found between the two groups, indicating that adding DB exercises did not confer additional short-term benefits beyond PFMT alone.

PFMT is a well-established conservative treatment for UI, supported by Level A evidence (9). The rationale for integrating breathing exercises with PFMT is based on the anatomical and functional relationship between the diaphragm and pelvic floor muscles (PFM), which are linked via fascial connections and act synergistically to regulate intra-abdominal pressure (IAP) (29). Electromyographic studies have shown coordinated activity between the diaphragm and transversus abdominis during postural control and respiratory tasks, supporting the notion that these muscles work together to maintain continence (30). Furthermore, DB exercises have been demonstrated to enhance abdominal muscle contribution to thoracoabdominal movement and may facilitate reflexive PFM activation (31).

Previous research indicates that both home-based and supervised PFMT programs produce comparable

Table 2. Incontinence Severity Index and Incontinence Quality of Life Questionnaire Results

| Variables | | Intervention Group (n=33) | Control Group (n=33) | *P* value[a] |
|---|---|---|---|---|
| | | X±SD | X±SD | |
| Incontinence Severity Index | BI | 5.45±2.91 | 6.30±3.20 | 0.319 |
| | AI | 5.06±2.29 | 5.76±3.03 | 0.524 |
| | *P*[b] | **0.034** | **0.015** | |
| Incontinence Quality of Life Questionnaire | | | | |
| Limiting behaviors | BI | 65.81±19.93 | 62.50±22.74 | 0.625 |
| | AI | 66.29±19.57 | 62.78±22.31 | 0.563 |
| | *P*[b] | 0.096 | 0.180 | |
| Psychological impact | BI | 71.80±21.21 | 70.54±20.99 | 0.837 |
| | AI | 72.56±20.12 | 71.38±20.23 | 0.807 |
| | p[b] | **0.039** | **0.026** | |
| Limiting social life | BI | 67.12±24.50 | 59.55±25.87 | 0.214 |
| | AI | 67.73±23.25 | 59.85±25.63 | 0.207 |
| | *P*[b] | 0.102 | 0.157 | |
| Total | BI | 68.56±20.77 | 65.12±21.62 | 0.472 |
| | AI | 69.18±19.95 | 65.63±21.12 | 0.465 |
| | *P*[b] | **0.017** | **0.010** | |

X, mean, SD, standard deviation; BI, before intervention; AI, after intervention.
*$P<0.05$, [a] Mann Whitney U test, [b] Wilcoxon test.

**Table 3.** Findings Related to King Health Questionnaire

| Variables | | Intervention Group (n=33) | Control Group (n=33) | *P* value[a] |
|---|---|---|---|---|
| | | X ± SD | X ± SD | |
| **KHQ** | | | | |
| General health status | BI | 37.58±16.40 | 36.36±15.37 | 0.955 |
| | AI | 36.36±16.92 | 35.76±13.93 | 0.761 |
| | *P*[b] | 0.157 | 0.317 | |
| Impact on quality of life | BI | 48.48±23.70 | 52.53±25.04 | 0.354 |
| | AI | 46.46±23.48 | 51.52±23.70 | 0.223 |
| | *P*[b] | 0.157 | 0.317 | |
| Role limitations | BI | 39.39±29.99 | 40.91±29.19 | 0.886 |
| | AI | 38.89±29.36 | 40.40±27.96 | 0.881 |
| | *P*[b] | 0.317 | 0.564 | |
| Physical limitations | BI | 36.87±27.25 | 40.40±25.36 | 0.601 |
| | AI | 34.34±25.66 | 39.90±26.00 | 0.416 |
| | *P*[b] | **0.025** | 0.317 | |
| Social limitations | BI | 23.74±26.03 | 25.25±27.04 | 0.851 |
| | AI | 22.22±23.81 | 24.24±26.38 | 0.846 |
| | *P*[b] | 0.083 | 0.157 | |
| Limitations in personal relationships | BI | 26.26±16.55 | 28.79±15.46 | 0.486 |
| | AI | 24.49±17.05 | 28.28±15.58 | 0.239 |
| | *P*[b] | **0.020** | 0.317 | |
| Emotional problems | BI | 25.25±28.37 | 29.63±25.41 | 0.252 |
| | AI | 24.58±27.60 | 28.62±24.54 | 0.281 |
| | *P*[b] | 0.157 | 0.083 | |
| Sleep and energy disorders associated with incontinence | BI | 26.26±24.31 | 25.25±27.99 | 0.638 |
| | AI | 25.76±23.97 | 24.24±27.03 | 0.591 |
| | *P*[b] | 0.317 | 0.157 | |
| Seriousness for incontinence | BI | 36.36±22.49 | 38.79±26.32 | 0.862 |
| | AI | 35.15±22.62 | 37.98±26.06 | 0.786 |
| | *P*[b] | 0.132 | **0.046** | |
| **Symptom Severity Scale** | BI | 2.62±2.56 | 2.81±2.90 | 0.964 |
| | AI | 2.15±2.06 | 2.62±2.81 | 0.701 |
| | *P*[b] | **0.004** | **0.034** | |

X, mean, SD, standard deviation; BI, before intervention; AI, after intervention.
*$P$<0.05, [a] Mann Whitney U test, [b] Wilcoxon test.

improvements in UI symptoms (32). Consistent with this, our study found significant symptom reduction and quality of life improvements in both groups. Voluntary PFM contractions likely aid continence by preventing abnormal detrusor overactivity (33). Supporting this, Kaya et al reported increased pelvic floor electromyography (EMG) activity and improved quality of life following an eight-week PFMT protocol (34), and Nygaard et al observed reduced incontinence episodes across all types of UI with PFMT (35).

Despite these positive findings, the PFMT-only group did not exhibit significant improvements in certain quality of life subdomains, which may be related with the small sample size and relatively short intervention period reducing statistical power. The absence of additional benefit from DB exercises may reflect challenges in mastering and consistently performing DB correctly, given that motor learning and coordination of respiratory and pelvic floor muscles can be complex and time-consuming (18). Moreover, individual factors such as body mass index, age, parity, and respiratory patterns could have influenced participants' responsiveness to DB exercises. Clinically, DB exercises may still be beneficial for subgroups of patients who have respiratory issues, poor postural control, or require enhanced diaphragmatic activation, even if they do not show large improvements in the general population.

The extant literature on the efficacy of DB exercises for UI is limited (12), and this study contributes to the extant research in this field. Hung et al. reported improved recovery rates when PFMT was combined with abdominal co-contraction and breathing exercises (36), while Sapsford hypothesized that activation of the transversus abdominis indirectly supports the pelvic floor (37). Toprak et al conducted a six-week pilot study comparing PFMT and DB exercises in women with UI. Both groups improved in symptom severity and quality of life, with the DB group showing greater reductions in urgency-related symptoms (20). Our study supports the potential for combined training but suggests that any added benefits of DB exercises might require longer durations. One limitation of the current study is the relatively short duration of the intervention. The 8-week period may not have been sufficient to fully capture the potential benefits of DB exercises, as motor learning for coordinated breathing often requires longer practice. Future studies are recommended to investigate longer intervention periods to better assess the efficacy of DB training. Additionally, longer-term practice or targeting specific subgroups, such as postpartum women, might yield more noticeable effects. Future research could explore these aspects. A further limitation of this study is that adherence to the exercise program was monitored only via weekly reminders and initial supervision, without structured logs or objective measures such as EMG to assess muscle activation patterns more precisely and determine whether DB exercises lead to measurable improvements in pelvic floor muscle function. Future studies should incorporate systematic adherence tracking to more accurately assess compliance. The data were based on self-reported questionnaires, which are subject to the participants' recollection and may not be entirely accurate. The exercises were only demonstrated once with no supervision, which may have led to variations in technique and adherence. Regarding generalizability, the sample was limited to women from a single clinic in Turkey, which may restrict the applicability of the findings to broader populations. Future research should aim to include more diverse groups to assess the wider relevance of DB exercises for UI treatment. Ultimately, the relatively small sample size, short intervention duration, limited adherence monitoring, reliance on self-reported questionnaires, and inclusion of only a Turkish population may collectively affect the generalizability and reliability of the study's findings.

## Conclusions

In conclusion, while both PFMT and PFMT+DB interventions improved symptoms and life quality of women with stress UI, the addition of DB exercises did not show superior short-term benefits. The functional interplay among the diaphragm, pelvic floor and abdominal muscles remains a promising area for rehabilitation, but optimizing training protocols and adherence is essential for maximizing clinical outcomes.

### Authors' Contribution

**Conceptualization:** Elif Balki, Ömer Şevgin.
**Data curation:** Elif Balki.
**Formal analysis:** Elif Balki, Beyzanur Dikmen Hoşbaş.
**Investigation:** Elif Balki.
**Methodology:** Elif Balki, Ömer Şevgin.
**Project administration:** Ömer Şevgin.
**Resources:** Elif Balki, Ömer Şevgin, Beyzanur Dikmen Hoşbaş;
**Software:** Elif Balki, Beyzanur Dikmen Hoşbaş.
**Supervision:** Ömer Şevgin.
**Validation:** Ömer Şevgin, Beyzanur Dikmen Hoşbaş.
**Visualization:** Elif Balki, Beyzanur Dikmen Hoşbaş.
**Writing–original draft:** Elif Balki, Ömer Şevgin, Beyzanur Dikmen Hoşbaş.
**Writing–review & editing:** Ömer Şevgin, Beyzanur Dikmen Hoşbaş.

### Conflict of Interests

Authors declare that they have no conflict of interests.

### Data Availability Statement

Data sets generated during the current study are available from the corresponding author upon reasonable request.

### Ethical Issues

Ethical clearance for the study was granted by the Non-Interventional Research Ethics Committee of Üsküdar University (approval number: 61351342/DEC 2022-78). The research was carried out in accordance with the principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their inclusion in the study. Furthermore, the study protocol has been registered on ClinicalTrials.gov (Registration date: August 15, 2023; Trial ID: NCT06003894).

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Not applicable.

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