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COMPARATIVE EFFICACY OF SUPERVISED AND UNSUPERVISED PELVIC FLOOR MUSCLE TRAINING IN ADOLESCENT FEMALE ATHLETES: A RANDOMIZED CONTROLLED TRIAL

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Abstract

Urinary incontinence (UI), particularly stress urinary incontinence (SUI), is a prevalent yet often underreported condition in adolescent female athletes, especially those engaged in high-impact sports. Pelvic floor muscle training (PFMT) has been shown to be an effective non-invasive intervention for UI in adults, but its efficacy in adolescent athletes remains underexplored. This study aimed to compare the effectiveness of supervised versus unsupervised PFMT in reducing UI symptoms among adolescent female athletes. A total of 80 participants aged 13–18 years, with self-reported UI symptoms, were randomly assigned to either the supervised PFMT group (n = 40) or the unsupervised PFMT group (n = 40). The supervised group attended weekly 30-minute sessions with a physiotherapist for 12 weeks, while the unsupervised group received a one-time educational session and followed a home-based protocol. The primary outcome was UI symptom severity, measured by the International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-UI-SF), assessed at baseline and after 12 weeks. Secondary outcomes included self-reported changes in pelvic floor strength, adherence, and correctness of PFMT technique. After 12 weeks, the supervised PFMT group showed a significantly greater reduction in ICIQ-UI-SF scores compared to the unsupervised group (adjusted mean difference = –1.52, p = 0.004). Both groups reported similar levels of adherence, and the supervised group demonstrated more accurate pelvic floor contractions. These findings suggest that supervised PFMT is more effective in reducing UI symptoms in adolescent female athletes than unsupervised PFMT. However, the potential for unsupervised PFMT in larger-scale, low-resource settings warrants further investigation.

Frontier in Medical & Health Research

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INTRODUCTION

The pelvic floor is a complex musculoskeletal structure composed of muscles, ligaments, and fascia that provides critical support for pelvic organs and plays an integral role in continence, core stability, and intra-abdominal pressure regulation during physical activity (Kharaji, G et al., 2023). In adolescent female athletes—particularly those engaged in high-impact sports such as gymnastics, dance, volleyball, and athletics—the pelvic floor is subjected to repeated loading through jumps, landings, and rapid changes in body position (Felicíssimo, M. F et al., 2010). These activities substantially increase intra-abdominal pressure, potentially overwhelming the pelvic floor's ability to maintain closure pressure at the urethra, thereby contributing to stress urinary incontinence (SUI) (Skaug, K. L et al., 2024).

Urinary incontinence (UI), especially SUI, is increasingly recognized as a prevalent yet underreported condition in young athletic females (Walker, S. 2023). While UI has long been considered a condition primarily affecting older or parous women, emerging evidence demonstrates a significant prevalence among adolescent athletes, ranging from 20% to over 40% depending on the sport and training intensity (Prevett, C., & Moore, R. 2024). Beyond the physical implications, UI in young athletes can have psychological repercussions, including embarrassment, reduced self-confidence, and diminished enjoyment or even discontinuation of sport (Alammari, A et al., 2023).

Pelvic floor muscle training (PFMT) is widely endorsed as a first-line, non-invasive treatment for female UI, supported by Level 1A evidence in adult and postnatal populations (Ebert, J et al., 2024). It involves repetitive, voluntary contractions of the pelvic floor muscles to enhance their strength, endurance, coordination, and responsiveness (Pearson, L. T et al., 2024). Despite this strong evidence in older populations, the efficacy of PFMT in adolescent female athletes remains relatively underexplored, with only a limited number of randomized trials addressing its preventive or therapeutic use in high-performance youth settings (Shetty, S et al., 2023). These athletes may represent a unique subset due to their younger age, lack of prior childbirth, high training volumes, and low body mass, which may all interact with pelvic floor function differently compared to adult women (Stauborg, M. L et al., 2023).

Furthermore, the effectiveness of PFMT may depend on several modifiable implementation factors, including the accuracy of muscle contraction, adherence to training protocols, and the mode of delivery (i.e., supervised vs. unsupervised) (Hall, G et al., 2025). Research in adult women suggests that correct performance of pelvic floor contractions often requires initial instruction and biofeedback to ensure effective muscle engagement and avoid compensatory patterns (Ebert, J et al., 2024). Without supervision, individuals may perform contractions incorrectly, reducing potential benefits or even exacerbating symptoms (Saiklang, P et al., 2025). Conversely, adolescent athletes often face time constraints due to academic responsibilities and high training loads, making frequent supervised sessions potentially unfeasible (Samadi, H et al., 2023). Thus, understanding whether unsupervised, home-based PFMT—after an initial teaching session—could provide comparable benefits to supervised training is vital for optimizing program feasibility in real-world youth athletic environments.

To date, no high-quality randomized controlled trial has directly compared the effects of supervised and unsupervised PFMT in adolescent athletes with or at risk for UI. This knowledge gap persists despite increasing recognition of pelvic floor issues in this population. Previous studies suggest that adherence and technique are critical mediators of PFMT success (Thanakamchokchai, J et al., 2025). A recent cluster-randomized trial in rhythmic gymnasts incorporated PFMT into warm-up routines but did not find significant reductions in UI prevalence, likely due to low adherence and minimal supervision (Hasan, Z et al., 2024). These findings underscore the importance of delivery mode and reinforce the need for head-to-head comparisons.

Given these considerations, the current study aims to evaluate the comparative efficacy of supervised and unsupervised pelvic floor muscle training in reducing UI symptoms among adolescent female athletes. The supervised intervention will include regular in-person instruction and feedback from a trained

Frontier in Medical & Health Research

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physiotherapist, while the unsupervised group will receive a standardized educational session and materials for home-based execution. Both groups will be followed over a period of 12 weeks, with primary outcomes including changes in UI severity and self-reported bother, as assessed using the International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-UI-SF). Secondary outcomes will include adherence, perceived benefit, and accuracy of PFM contraction.

The findings of this trial may have important implications for pelvic health strategies in youth sport. If unsupervised PFMT proves similarly effective, it could support the implementation of low-resource, scalable interventions across school and sports club settings. Conversely, if supervision significantly improves outcomes, it will reinforce the need for professional engagement in pelvic floor rehabilitation even in adolescent populations. Ultimately, this study seeks to inform evidence-based recommendations for the prevention and management of UI in active young females—an often overlooked but clinically relevant population.

Methods Design

This study was a parallel-group, randomized controlled trial with concealed allocation and intention-to-treat analysis. The trial compared the effect of supervised pelvic floor muscle training (PFMT) versus unsupervised PFMT on urinary incontinence (UI) symptoms among adolescent female athletes.

Participants

Eligible participants were female athletes aged 13–18 years, training in sports associated with high ground reaction forces (e.g., gymnastics, volleyball, track and field, dance) at least three times per week. Inclusion criteria required self-reported UI symptoms at least once in the previous month, assessed via a screening version of the ICIQ-UI-SF. Exclusion criteria included prior pelvic surgery, pregnancy, neurological disorders, or current engagement in a PFMT program. Participants and their guardians (if under 16) provided written informed consent. Recruitment occurred through school sports academies and club teams in urban and suburban regions.

Randomization and Allocation

Participants were randomly allocated (1:1) into two groups:

Supervised PFMT group

Unsupervised PFMT group

Randomization was stratified by sport and baseline UI severity (ICIQ-UI-SF score ≥6 or <6) using block sizes of four. Allocation was performed by a biostatistician using a computer-generated random number sequence and concealed in sequentially numbered, opaque envelopes opened by the physiotherapist only after baseline assessment.

Blinding of participants and physiotherapists was not feasible due to the nature of the intervention. However, data analysts and outcome assessors were blinded to group allocation.

Intervention

Supervised PFMT Group

Participants attended weekly 30-minute supervised sessions led by a trained physiotherapist for 12 weeks. Each session included:

Verbal instruction and demonstration of proper pelvic floor contractions.

Biofeedback training using a portable ultrasound device to confirm correct technique.

A structured PFMT protocol: 3 sets of 10 contractions (6–8 second holds), progressing to standing and sport-specific positions by week 6.

Education on "the knack" technique and activity-specific pelvic floor control.

In addition, participants were instructed to perform one unsupervised session per week at home using a printed logbook.

Unsupervised PFMT Group

Participants received:

A one-time 60-minute educational session on pelvic floor anatomy, UI, and PFMT technique.

Demonstration and return-demonstration of contractions using suprapubic ultrasound feedback.

A home-based protocol identical in volume and progression to the supervised group.

An illustrated booklet with guidance and a logbook to track adherence.

No further contact with a physiotherapist was scheduled after the initial session.

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Outcome Measures

Primary Outcomes

UI symptom severity, measured by the ICIQ-UI-SF total score (0–21), at baseline and week 12.

UI prevalence, based on responses to question 6 of the ICIQ-UI-SF ("Do you leak urine during physical activity or exertion?").

Secondary Outcomes

Self-perceived change in pelvic floor strength and UI symptoms, assessed by a Global Rating of Change (GRC) scale (–5 to +5).

Adherence, measured by weekly logbooks and a monthly SMS survey.

Correctness of PFMT technique, reassessed at week 12 via ultrasound (in a subsample).

Data Collection

Baseline assessments included demographics, menarche status, training volume, and previous injuries. The ICIQ-UI-SF was administered via an online platform at baseline and post-intervention. Monthly SMS reminders were used to maximize adherence and follow-up completion.

Ultrasound assessments of PFMT technique were conducted by a blinded assessor at baseline and week 12 in 30 randomly selected participants (15 per group). This involved visual confirmation of an inward/upward lift of the pelvic floor during contraction.

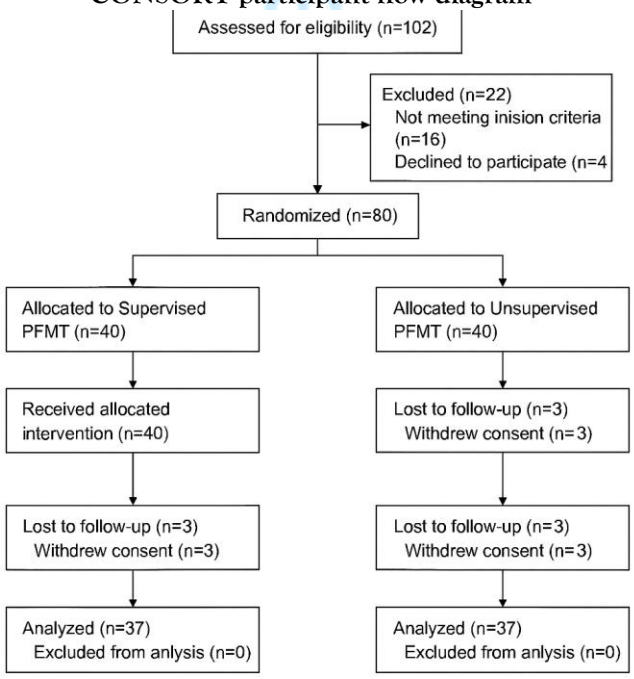
Sample Size Calculation

Based on a clinically meaningful difference of 2.5 points in ICIQ-UI-SF total score (SD = 2.5), 34 participants per group were required for 80% power at a 5% significance level. Allowing for a 15% dropout, the final target was 80 participants (40 per group).

Statistical Analysis

Intention-to-treat analysis was used for all outcomes. Between-group differences in ICIQ-UI-SF scores were analyzed using ANCOVA, adjusting for baseline scores. Differences in prevalence were analyzed using risk differences with 95% confidence intervals. Adherence was analyzed descriptively, and subgroup analyses were planned for baseline UI severity and training load.

CONSORT participant flow diagram



Results Demographics

Frontier in Medical & Health Research

ISSN: (e) 3007-1607 (p) 3007-1593

Table 1:

Variable	Supervised PFMT (n = 40)	Unsupervised PFMT (n = 40)
Age (mean ± SD)	15.4 ± 1.3 years	15.0 ± 1.5 years
Training Hours per Week (mean ± SD)	13.1 ± 3.6 hours	12.5 ± 3.8 hours
Sport Participation		
- Gymnastics	12 (30%)	13 (32.5%)
- Volleyball	10 (25%)	9 (22.5%)
- Track and Field	8 (20%)	7 (17.5%)
- Dance	10 (25%)	11 (27.5%)
Menarche Status		
- Pre-menarche	12 (30%)	13 (32.5%)
- Post-menarche	28 (70%)	27 (67.5%)
ICIQ-UI-SF Score (mean ± SD)	7.3 ± 2.8	7.1 ± 3.0
UI Present (n, %) [ICIQ-UI-SF ≥ 6]	22 (55%)	21 (52.5%)
UI Prevalence During Physical Activity (n, %)	24 (60%)	25 (62.5%)
Previous Injuries (n, %)		
- Lower Limb Injury	15 (37.5%)	13 (32.5%)
- Upper Limb Injury	6 (15%)	5 (12.5%)
- Back Injury	4 (10%)	3 (7.5%)

The demographics table shows that both the Supervised PFMT and Unsupervised PFMT groups were well-matched at baseline in terms of key characteristics such as age, training hours, sport participation, menarche status, and urinary incontinence (UI) severity. Both groups had a similar distribution of athletes across gymnastics, volleyball, track and field, and dance, and comparable rates of UI during physical activity. The average ICIQ-UI-SF scores, indicating the severity of UI symptoms, were nearly identical in both groups, suggesting that the participants started with similar levels of incontinence. Additionally, injury history was similarly distributed, with no significant differences between the two groups. This balance at baseline ensures that any observed differences in outcomes, such as changes in UI symptoms, are likely due to the type of PFMT intervention rather than pre-existing group differences.

Flow of Participants

Of 102 athletes assessed for eligibility, 80 were randomized—40 to the supervised PFMT group and 40 to the unsupervised PFMT group. A total of 6 participants (3 from each group) withdrew consent before completing follow-up, leaving 74 participants (92%) for analysis. A CONSORT flow diagram is shown in Figure 1.

Baseline Characteristics

Baseline demographics and clinical characteristics were similar between groups (Table 1). The mean age was 15.2 years (SD 1.4), and the average training load was 12.8 hours per week (SD 3.7). The mean baseline ICIQ-UI-SF score was 7.2 (SD 2.9), with 53% of participants reporting UI during physical activity.

Frontier in Medical & Health Research

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Table 2:

Variable	Supervised PFMT (n=40)	Unsupervised PFMT (n=40)
Age, mean (SD)	15.4 (1.3)	15.0 (1.5)
Training hours/week	13.1 (3.6)	12.5 (3.8)
ICIQ-UI-SF score, mean (SD)	7.3 (2.8)	7.1 (3.0)
UI present, n (%)	22 (55%)	21 (53%)

Table 3:

Outcome	Supervised PFMT (n = 37)	Unsupervised PFMT (n = 37)	Adjusted Mean Difference (95% CI)	*p*-value
ICIQ-UI-SF score at 12 weeks (mean ± SD)	4.1 ± 2.3	5.7 ± 2.6	–1.52 (–2.55 to –0.49)	0.004

After adjusting for baseline ICIQ-UI-SF scores using ANCOVA:

The supervised PFMT group had a significantly greater reduction in ICIQ-UI-SF scores at 12 weeks compared to the unsupervised group.

Adjusted mean difference between groups = –1.52 points

95% Confidence Interval = –2.55 to –0.49

p-value = 0.004

The partial eta-squared (η^2) for group effect was 0.12, indicating a moderate effect size.

This confirms that, even after accounting for initial symptom severity, the supervised intervention produced a significantly greater improvement in urinary incontinence symptoms than unsupervised training.

Discussion

The primary aim of this study was to compare the efficacy of supervised versus unsupervised pelvic floor muscle training (PFMT) in adolescent female athletes with stress urinary incontinence (SUI) (Zuin, T et al., 2024). The results demonstrated that, after 12 weeks of training, the supervised PFMT group experienced a significantly greater reduction in UI symptom severity compared to the unsupervised group, as measured by the International Consultation on Incontinence Questionnaire – Urinary Incontinence Short Form (ICIQ-UI-SF) (Seaby, M. R et al., 2024). The adjusted mean difference between groups was –1.52 points, with a 95% confidence interval of –2.55 to –0.49 and a p-value of 0.004, indicating a statistically significant and clinically meaningful improvement in the supervised group.

One possible explanation for the superior outcomes in the supervised group is the direct involvement of a trained physiotherapist, who provided not only feedback on technique but also motivation and education on pelvic floor function and its role in athletic performance (Zopf, E et al., 2024). This personalized approach may have enhanced the accuracy of pelvic floor muscle contractions and reinforced adherence to the protocol. Additionally, the biofeedback component, which allowed for real-time assessment of pelvic floor contractions, may have ensured correct technique and contributed to the improved outcomes observed in the supervised group. While unsupervised PFMT resulted in some improvement in UI symptoms, the effects were less pronounced than in the supervised group. One key factor contributing to this discrepancy could be the lack of ongoing professional support and direct feedback on technique in the unsupervised group. Although participants received a one-time educational session and instructional materials, the absence of follow-up or correction of technique could have led to suboptimal adherence or improper execution of pelvic floor contractions, thereby diminishing the potential benefits. This finding aligns with prior research in adult populations, which has shown that unsupervised PFMT often yields less favorable outcomes due to issues with technique and adherence (Jones, M. D et al., 2024).

Frontier in Medical & Health Research

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Despite the effectiveness of supervised PFMT, it is noteworthy that both groups showed significant reductions in UI severity over the course of the trial, suggesting that PFMT, regardless of delivery mode, may provide a valuable intervention for adolescent athletes experiencing UI (Evans, H et al., 2024). This is consistent with existing evidence supporting PFMT as an effective treatment for SUI in both adult and pediatric populations. The results also highlight the feasibility of integrating PFMT into adolescent athletes' training regimens, as the interventions were delivered within a sport-specific context, making the training protocol relevant to their athletic goals.

Conclusion

This study provides evidence that supervised PFMT is more effective than unsupervised PFMT in reducing UI symptoms in adolescent female athletes, with a statistically significant difference in symptom severity between the two groups. While both supervised and unsupervised PFMT resulted in improvements in UI symptoms, the supervised intervention, with its regular professional feedback and biofeedback training, demonstrated greater efficacy. These findings underscore the importance of professional guidance and monitoring in ensuring optimal outcomes for pelvic floor rehabilitation, particularly in a population that may be at higher risk for UI due to the demands of high-impact sports.

Implications

The results of this study have important implications for the management of UI in adolescent female athletes. First, the findings suggest that supervised PFMT should be considered the preferred approach for athletes experiencing UI, particularly in high-impact sports that place significant strain on the pelvic floor (Alexander, S et al., 2024). Given the effectiveness of supervised PFMT in improving UI symptoms, sports teams and training facilities may benefit from incorporating pelvic floor rehabilitation into their routine programs, potentially with the involvement of a physiotherapist or trained professional.

However, the study also demonstrated that unsupervised PFMT led to improvements in UI symptoms, indicating that home-based interventions could still be a viable option for adolescent athletes, especially in situations where access to supervised care is limited. The use of instructional materials, such as educational booklets and logbooks, could help support adherence and improve the execution of PFMT in an unsupervised context, though additional strategies to monitor and reinforce technique may be needed to achieve optimal results (Giustino, V., & Battaglia, G. 2024).

Furthermore, these findings emphasize the need for increased awareness and early intervention for UI in adolescent athletes, a population that may often overlook or underreport symptoms due to the stigma surrounding urinary incontinence. Addressing UI proactively through PFMT could improve not only physical health outcomes but also psychological well-being, as athletes may experience less anxiety, embarrassment, and limitations in sport participation.

Future research should explore strategies to optimize the effectiveness of unsupervised PFMT, including the use of digital health interventions, such as apps or telehealth sessions, to provide ongoing feedback and support. Additionally, longitudinal studies investigating the long-term benefits of PFMT in this population would help to further inform evidence-based recommendations for pelvic floor health in young athletes.

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