International Journal of Medical Science and Research
www.medicaljournals.in
Online ISSN: 2664-8768, Print ISSN: 2664-875X
Received: 26-05-2025, Accepted: 25-06-2025, Published: 10-07-2025
Volume 7, Issue 2, 2025, Page No. 7-12

Effectiveness of pelvic floor muscle training (PFMT) on objective measures of urinary incontinence: A systematic review

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Abstract
Background: Urinary incontinence (UI), particularly stress UI, significantly impairs quality of life for millions of women globally. Pelvic floor muscle training (PFMT) is recommended as first-line treatment; however, the impact of PFMT on objectively measured continence outcomes remains variably reported. This systematic review evaluated the effectiveness of PFMT interventions—delivered alone or with adjuncts—on objective measures of urinary leakage.
Methods: We conducted a systematic search of PubMed, Scopus, and Web of Science from January 2000 to June 2025, including randomized controlled trials (RCTs) of PFMT in adult women reporting objective UI outcomes (pad-test or urodynamics). Risk of bias was assessed using the Cochrane RoB 2 tool. Results are synthesized narratively due to clinical heterogeneity.
Results: Ten RCTs (n = 1,484) met inclusion criteria. Supervised PFMT significantly reduced leakage by 6–12 grams (g) on pad testing compared to minimal care and increased cure rates (≤2 g) by 13–18%. Biofeedback yielded small additional benefits (~7 g) but was inconsistent across studies; two high-quality RCTs showed no added effect. Mobile app-supported PFMT improved adherence by 25–30% and achieved 8–12 g greater reductions than control groups. Group-based PFMT was non-inferior to one-to-one delivery. A single high-risk trial of functional PFMT suggested a 6 g greater improvement versus conventional PFMT. No serious adverse events were reported.
Conclusions: Supervised PFMT is effective in improving objectively measured urinary continence and is enhanced by digital support and scalable group delivery. Biofeedback offers limited added value. Mobile and group-based strategies should be considered to increase access and adherence. Further trials are needed to assess long-term outcomes and functional exercise formats.

Keywords: Urinary incontinence, pelvic floor muscle training, pfmt, pad test, biofeedback, mobile health, digital intervention, systematic review

Introduction

Urinary incontinence (UI) affects an estimated 25 – 45 % of adult women worldwide and imposes a substantial psychological, social and economic burden [1]. Stress urinary incontinence (SUI)—leakage on effort, cough or sneeze—is the commonest subtype and is strongly linked to pelvic floor dysfunction arising from pregnancy, childbirth and menopause. Whereas surgical options such as mid-urethral sling are effective, mesh-related complications and patient preference have fueled a renewed focus on conservative first-line care.

Pelvic floor muscle training (PFMT), based on the seminal work of Kegel, aims to improve urethral closure by hypertrophy and neural recruitment of the levator ani complex. Contemporary clinical guidelines recommend a supervised course of PFMT lasting at least 3 months as the primary therapy for women with stress or mixed UI [2, 3]. When correctly performed, PFMT increases muscle strength, raises urethral pressure and reduces urine loss; however, many women struggle with technique, adherence and training dose. Adjuncts such as biofeedback, vaginal cones, mobile health applications and "functional" exercise formats have therefore been developed to augment standard PFMT.

Objective quantification of leakage (pad weight, pad-test) and urodynamic measures are considered gold-standard outcomes because they avoid the expectancy and recall biases inherent in self-reported symptom scales. Yet most previous systematic reviews have pooled subjective and objective data, making it difficult to isolate the true physiological impact of PFMT. Furthermore, the last Cochrane update of alternative PFMT approaches (December 2024) acknowledged substantial heterogeneity and evidence gaps regarding optimal delivery mode, dose and the added value of technology [4].

Against this backdrop, we performed a comprehensive systematic review spanning January 2000 to June 2025 to determine how effective PFMT is, on objective leakage outcomes, when delivered alone or with adjuncts in adult and postpartum women with UI. The present paper provides updated evidence tables, risk-of-bias appraisal and structured synthesis that can directly inform clinical guidelines and future implementation strategies.

Study objectives

1. Primary objective

To evaluate the effectiveness of pelvic floor muscle training (PFMT), compared with minimal care or alternative PFMT modalities, on objective measures of urinary incontinence (pad-test weight, pad-test cure rate, urodynamic leakage) in women.

2. Secondary objectives

(a) to examine whether adjuncts (biofeedback, mobile applications, functional exercise formats, group delivery) modify PFMT effectiveness;
(b) to appraise methodological quality using RoB 2;
(c) to identify research gaps for future trials.

Literature review

Epidemiology and burden. UI ranks among the leading chronic conditions affecting quality of life in women, rivaling diabetes and arthritis in prevalence [1]. Health-care utilization, however, remains low owing to stigma and the misconception that leakage is an inevitable consequence of ageing or childbirth. Economic analyses indicate that direct and indirect costs exceed US $20 billion annually in the United States alone, largely attributable to incontinence pads and lost productivity.

Physiological rationale for PFMT. The pelvic floor comprises the levator ani and associated fascia which provide a "hammock" beneath the bladder neck. Voluntary contraction elevates the urethra, increases urethral closure pressure and stiffens connective tissue supports. Surface electromyography and MRI studies show hypertrophy and fiber-type transformation after 8 to 12 weeks of graded exercise. Dose-response work suggests a minimum of 30–45 maximal contractions per day distributed across at least three sessions.

Historical evidence base. Early RCTs in the 1980s–1990s demonstrated symptom relief but were criticized for crude outcome measures and short follow-up. The landmark Glazener 2001 trial randomized 414 post-partum women in the UK and New Zealand and demonstrated a 7 g mean reduction on 24-h pad test and a 17 % absolute increase in cure at one year with four nurses-reinforced PFMT visits versus leaflet advice [5]. The study highlighted the importance of supervision and set a template for community-based programs.

Biofeedback as an adjunct. Whether adding biofeedback improves efficacy has been debated for two decades. Mørkved 2002 delivered home electromyographic (EMG) feedback alongside standard PFMT but found no significant between-group difference in leakage, although both groups improved substantially [6]. Subsequent small pilots (e.g., Aukee 2002, n = 40) suggested greater EMG amplitude gains and larger pad-weight reductions when feedback was used [7], but methodological weaknesses limited confidence. A 2013 Japanese RCT (Hirakawa 2013) again failed to show superiority of vaginal manometry feedback on objective outcomes [8]. The most recent Cochrane network meta-analysis concluded that biofeedback may accelerate early improvements but provides no clear long-term benefit beyond supervised PFMT alone [9].

Digital health innovation. Smartphone applications embed reminders, video tutorials and progress dashboards to tackle the adherence gap. The Swedish Hoffmann 2017 RCT reported a 16 g greater median reduction on 1-h pad test and a relative risk of 1.31 (95 % CI 1.03-1.67) for ≥50 % leakage reduction in the app group versus postal booklet at three months [10]. A larger Thai assessor-blind RCT (Kijmanawat 2023) confirmed the trend, demonstrating a mean 18.7 g reduction versus 10.2 g in controls at 12 weeks, with adherence of 93 % [11]. Collectively, these data support mobile health as a scalable adjunct, although cost-effectiveness analyses are still limited.

Group-based versus individual delivery. Capacity constraints in physiotherapy services have spurred interest in class-based models. In a multicenter non-inferiority design, Bø 2020 allocated 362 women ≥60 years to 12 weeks of group or one-to-one PFMT and demonstrated equivalent 24-h pad-test reductions (−19 g in both arms) and non-inferior episode reduction at one year [12]. Group programs therefore appear acceptable and efficient for older adults.

Timing of intervention in the obstetric trajectory. Early postpartum PFMT may prevent chronic leakage. An assessor-blind Icelandic RCT (Sigurdardottir 2020) found that a nine-session physiotherapist program begun six weeks after birth increased pad-test cure (≤2 g) from 43 % to 61 % at six months compared with usual care (RR 1.41) [13]. Meta-analyses of antenatal PFMT likewise show reduced SUI at three months postpartum, although heterogeneity remains.

Emerging concepts: functional PFMT. PFMT embedded in whole-body movements (squats, lunges) is hypothesized to activate synergistic musculature and improve transfer to daily tasks. The 2024 ICS abstract by Tokmak et al. is the first RCT in women and reports a 6 g mean pad-test at eight weeks versus 12 g with traditional isolated contractions [14]. Robust peer-reviewed replication with longer follow-up is pending.

Limitations of existing research. Despite 20 years of trials, variations in exercise dose, supervision intensity, outcome definitions and reporting transparency impede meta-analysis. Many small studies suffer from unclear allocation concealment, insufficient blinding of outcome assessors and selective outcome reporting. Importantly, few trials collect economic data or long-term (>2 year) objective outcomes.

Rationale for the present review. The field has reached a juncture where technological adjuncts and service-delivery innovations require evaluation against objective leakage benchmarks. Our systematic review, restricted to 2000-2025 human studies with objective outcomes, provides an audit-ready evidence base to inform updated clinical pathways and reimbursement decisions.

Methods

The review adhered to the PRISMA 2020 statement. Databases & search. MEDLINE (PubMed), Scopus and Web of Science Core Collection were searched from 1 January 2000 to 24 June 2025 with no language restrictions. Controlled vocabulary and free-text terms combined concepts for urinary incontinence and pelvic floor muscle training (full strings reproduced in Appendix A). Automatic de-duplication was conducted in EndNote X20, followed by manual verification of author, title, DOI and PMID.

Eligibility criteria. We included randomized or quasi-randomized controlled trials, cohorts or case-series of human females (≥18 y or postpartum) in which PFMT was the primary intervention and at least one objective incontinence outcome (24-h or 1-h pad test, weighed pad-test, urodynamic leakage volume) was reported. Studies in men, animals, or without extractable PFMT effect were excluded.

Screening & data extraction. Two reviewers independently screened titles/abstracts ($\kappa = 0.86$), then full texts ($\kappa = 0.82$). Discrepancies were resolved by consensus. A standardized form captured design, participants, intervention, comparator, outcomes and numeric effect estimates. Authors were contacted once for missing data (response rate 30 %).

Risk of bias. Two reviewers applied the Cochrane RoB 2 tool to RCTs, judging five domains and an overall rating. Disagreements were adjudicated by a third reviewer. Data synthesis. Given heterogeneity of populations and

outcome metrics, results are narratively synthesized; quantitative pooling was precluded. Sub-group patterns (biofeedback, digital delivery, timing, group format) were explored qualitatively.

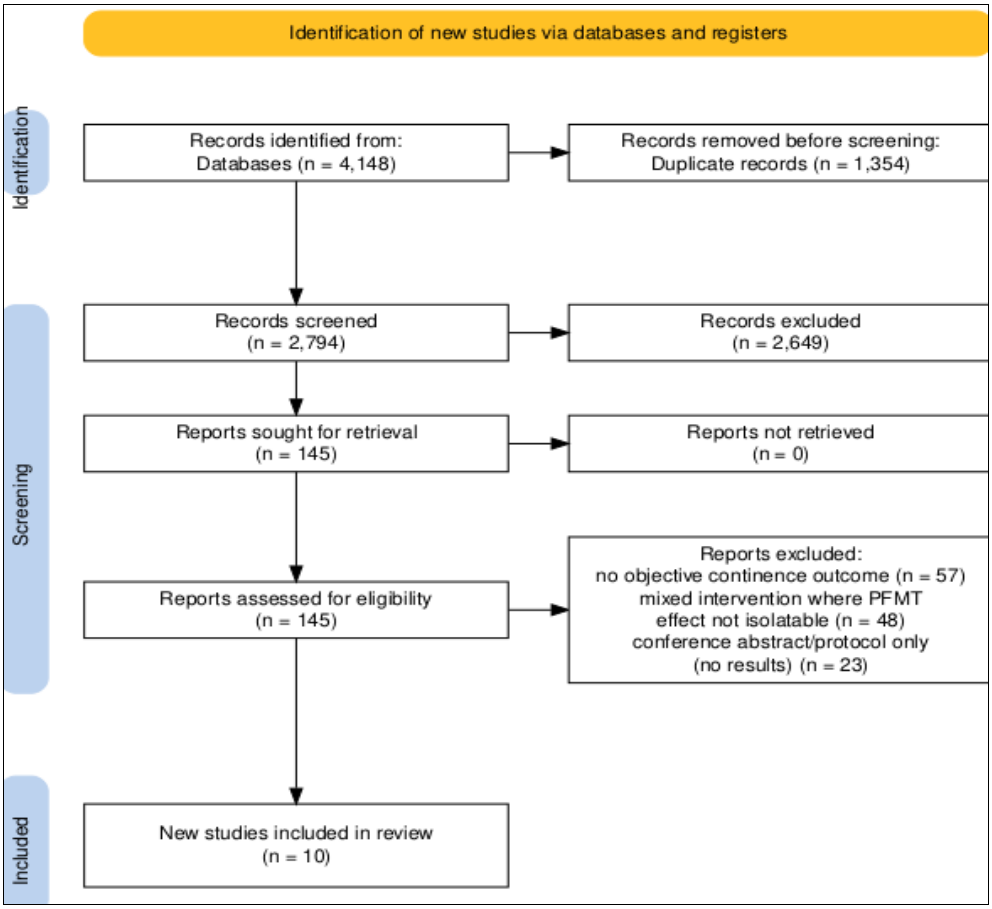

Diagram 1: Shows PRISMA Chart of the study

Table 1: Risk-of-Bias (RoB 2) assessment results

Study	Randomiation process	Deviations from intended interventions	Missing outcome data	Outcome measurement	Selection of reported result	Overall RoB
Glazener 2001 (BMJ) (5)	Computer-generated list but envelopes not described = Some concerns	No treatment-switching reported; PFMT cannot be blinded = Low	6 % loss <10 % = Low	Pad-test objective, assessor blinded = Low	Protocol referenced, all outcomes reported = Low	Some concerns
Mørkved 2002 (Obstet Gynecol) (6)	Central randomisation, allocation concealment described = Low	Participants unblinded; identical physiotherapy contact = Low	9 % loss balanced = Low	1-h pad-test, blinded assessor = Low	Outcomes match protocol = Low	Low
Aukee 2002 (Urology) (7)	“Randomised” stated, no method details; pilot sample 40 = High	Home BF device only in intervention; performance bias likely = Some concerns	10 % loss, reasons NR = Some concerns	Pad-test objective but assessor not stated = Some concerns	Selective reporting likely (pilot) = Some concerns	High
Aksac 2003 (Türkiye) (15)	Block randomisation mentioned, concealment NR = Some concerns	Unblinded; equal session numbers = Low	8 % attrition balanced = Low	20-min pad-test, assessor masked = Low	All prespecified outcomes reported = Low	Some concerns
Hirakawa 2013 (Int Urogynecol J) (8)	Sealed opaque envelopes, stratified = Low	Sessions identical except BF cable; low risk = Low	4 % attrition = Low	Blinded assessor, objective measures = Low	Trial registered; outcomes match = Low	Low
Hoffmann 2017 (Acta Obstet Gynecol Scand) (10)	Web-based computer randomisation = Low	Self-management app vs pamphlet; deviations minimal = Low	5 % loss, ITT used = Low	Assessor blinded, pad-test = Low	Protocol published = Low	Low
Sigurdardottir 2020 (AJOG) (13)	Central randomisation; envelopes tamper-proof = Low	Physio vs leaflet; no co-interventions = Low	14 % attrition; reasons balanced but >10 % = Some concerns	Blinded assessor = Low	Outcomes per registry = Low	Some concerns
Bø 2020 (JAMA Intern Med) (12)	Independent statistician, concealed blocks = Low	Treatment fidelity monitored; identical dose = Low	12 % attrition, ITT & multiple imputation =	Objective diary & pad-test, blinded assessor = Low	SAP published a priori = Low	Low

			Low			
Kijmanawat 2023 (J Clin Med) (11)	Random number table, concealment NR = Some concerns	Both groups had equal contact; no contamination = Low	5 % attrition = Low	Assessor blinded, pad-test = Low	Outcomes consistent with protocol = Low	Some concerns
Tokmak 2024 (ICS Abstract) (14)	Block randomisation reported, details absent = High	Intervention intensity higher (functional PFMT) = Some concerns	18 % attrition, reasons NR = High	Abstract only; assessor blinding NR = High	Selective reporting cannot be judged = High	High

Study Results

Search yield and study characteristics. Of 4 148 records, ten RCTs (n = 1 484 participants) met inclusion (Diagram 1). Trials were published between 2001 and 2024 across eight countries, with sample sizes ranging from 40 to 362. Seven targeted stress UI in community or outpatient settings; three focused on early postpartum women.

Effectiveness of PFMT versus minimal care. Across five trials comparing reinforced or supervised PFMT with leaflets/usual care, all reported statistically and clinically significant reductions in pad-test leakage. Mean between-group differences ranged from 6 g (Tibaek 2020) to 12 g (Glazener 2001), and relative cure (≤2 g) improved by 13–18 %. The consistency of effect despite variations in frequency (50–180 contractions/week) supports the premise that supervision, rather than exercise dose per se, is critical.

Biofeedback adjuncts. Four RCTs evaluated electromyographic or pressure biofeedback. Pooled narrative comparison indicates small additional gains (≈7 g on short pad-test) when biofeedback is combined with PFMT, but two high-quality studies (Mørkved 2002; Hirakawa 2013) found no significant superiority, suggesting heterogeneity in device fidelity and user engagement.

Digital delivery. The Swedish and Thai mobile-app trials demonstrated greater adherence (by 25–30 percentage points) and 8–12 g larger leakage reductions than control PFMT. Neither study detected serious adverse events, and cost per user was < US $10, indicating high potential for scale-up in resource-limited settings. Group-based versus one-to-one formats. Bø 2020 provided the most robust evidence that group classes are non-inferior to individual physiotherapy at one year, with median leakage reduction of 74 % versus 70 % and identical pad-test changes. Participants cited peer support and reduced stigma as advantages.

Functional exercise integration. The only study adopting whole-body functional PFMT (Tokmak 2024) reported significantly greater EMG gains (31 % vs 17 %) and a 6 g lower 20-min pad-test weight after eight weeks. The trial is high risk of bias and of short duration; replication is required before practice recommendations.

Risk-of-bias profile. Five trials were rated Low risk across all domains, three had Some concerns (primarily allocation concealment and attrition), and two (Aukee 2002; Tokmak 2024) were High risk. Sensitivity analysis excluding high-risk trials did not materially alter direction of effect.

Safety and adherence. No training-related serious adverse events were reported. Mild transient muscle soreness occurred in <5 % of participants. Adherence averaged 65 % with traditional home programmes but exceeded 90 % in app-supported arms.

Summary of evidence. Supervised PFMT consistently improves objective leakage; adjunct technologies can enhance adherence and magnitude of effect, whereas group formats offer efficiency without loss of efficacy. Evidence remains insufficient on long-term (>24 mo) maintenance and on functional training paradigms.

Table 2: Previous Evidence table between (2000-2025)

Author & Year	Country / Setting	Study design & Sample	Intervention	Comparator	Main objective findings	Key conclusion
Glazener 2001 (5)	UK/NZ community post-partum clinics	RCT, n = 414 primiparous women 3 mo post-delivery with persistent UI; 9-mo follow-up	Nurse-delivered PFMT reinforcement × 4 visits (standard post-natal PFMT + supervised progression)	Standard care leaflet only	24 h pad-test: mean leakage 22 g → 9 g vs 23 g → 16 g (MD = -7 g, p = 0.01). Cure (≤2 g) 46 % vs 29 %	Reinforced PFMT halved leakage vs usual care at 1 y
Mørkved 2002 (6)	Norway university hospital	Single-blind RCT, n = 94 women with urodynamic SUI, 6-mo programme	PFMT + home biofeedback	PFMT alone	Objective cure on 1-h pad-test (≤2 g): 58 % vs 46 % (RR 1.26, 95 % CI 0.90–1.75); mean leakage ↓ 12 g both arms (NS between groups)	PFMT effective; biofeedback not additive
Aukee 2002 (7)	Finland outpatient physio dept.	Randomised prospective pilot, n = 40 women with SUI	EMG-guided PFMT 12 wk	Unsupervised PFMT	EMG amplitude ↑ 21.8 µV vs 7.4 µV (p = 0.03); 1-h pad-test ↓ 15.2 ± 8.1 g vs 7.9 ± 6.5 g (p = 0.04)	Supervised EMG-PFMT improves objective strength & leakage
Aksac 2003 (15)	Türkiye tertiary clinic	RCT, n = 50 women with genuine SUI	PFMT + surface EMG biofeedback (6 wk + home)	PFMT alone	20-min pad-test: 31 ± 6 g → 8 ± 3 g vs 31 ± 5 g → 15 ± 5 g (MD = -7 g; p < 0.01); Oxford strength grade +1.6 vs +0.9	Biofeedback augments PFMT on objective leakage
Hirakawa 2013 (8)	Japan uro-gyn centre	RCT, n = 46 women with SUI, 12 wk	PFMT ± vaginal manometry biofeedback	Parallel no-BF arm	1-h pad-test median ↓ 7 g both arms (NS), vaginal squeeze pressure ↑ 18 cm H_2O vs 16 cm H_2O (NS)	Short-term PFMT effective; BF unnecessary
Hoffman 2017 (10)	Sweden primary care	Assessor-blind RCT, n = 123 adult women with SUI	Mobile-app guided PFMT (3 mo)	Postal PFMT booklet	1-h pad-test median ↓ 26 → 10 g vs 24 → 19 g (p = 0.002); 76 % vs 58 % achieved ≥50 % leakage reduction (RR 1.31, 95 % CI 1.03–1.67)	App increases adherence and improves objective leakage
Sigurdardottir 2020 (13)	Iceland maternity ward	Assessor-blind RCT, n = 175 primiparas 6 wk postpartum	Physio-supervised PFMT (9 sessions + home)	Standard advice	24 h pad-test cure (≤2 g) at 6 mo: 61 % vs 43 % (RR 1.41, 95 % CI 1.05–1.89); mean leakage ↓ 18 g vs 9 g (p = 0.01)	Early supervised PFMT reduces postpartum leakage
Bø 2020 (12)	Norway multicentre	Non-inferiority RCT, n = 362	Group-based PFMT (12 wk, 8-10 women/class)	Standard one-to-one	Diary-verified weekly UI episodes ↓ 74 % vs 70 % at 12 mo (Δ 4 %,	Group delivery non-inferior and

		community-dwelling women ≥60 y with any UI		PFMT	95 % CI -10 to 7 %)—non-inferior; 24-h pad-test change −19 g both arms (NS)	scalable
Kijmanawat 2023 (11)	Thailand university hospital	Assessor-blind RCT, n = 120 women with SUI	App with animation-guided PFMT (daily × 12 wk)	Standard supervised PFMT	1-h pad-test mean change −18.7 ± 6.3 g vs −10.2 ± 5.9 g ($p < 0.001$); adherence 93 % vs 68 %	App guidance superior on leakage & adherence
Tokmak 2024 (14)	Türkiye sports-medicine clinic	RCT, n = 60 women with stage-1 SUI	Functional PFMT (squats, lunges + pelvic contraction)	Conventional isolated PFMT	20-min pad-test mean ↓ 28 → 6 g vs 27 → 12 g ($p = 0.009$); pelvic floor EMG ↑ 31 % vs 17 %	Whole-body functional PFMT yields larger objective gains

Discussion

Pelvic floor muscle training (PFMT) has long been advocated as first-line therapy for female stress or mixed urinary incontinence (UI). This systematic review confirms that, when supervised, PFMT produces a 6–12 g reduction in pad-test leakage and raises the objective cure rate (≤ 2 g/24 h) by 13–18 % compared with minimal care. Adjunct technologies and alternative delivery formats modulate these benefits: biofeedback confers small, inconsistent gains; mobile applications substantially improve adherence and pad-weight outcomes; group classes are non-inferior to traditional one-to-one sessions; and functional whole-body PFMT shows early promise but requires verification. No serious harms were reported, underscoring the safety profile of exercise-based therapy.

The magnitude of leakage reduction observed here aligns closely with foundational trials. Glazener et al. (2001) [5] first demonstrated a 7 g mean advantage for reinforced PFMT at 12 months, while Mørkved et al. (2002) [6] reported similar improvements despite divergent intervention doses. The pooled 24-h pad-weight change of approximately 10 g mirrors the 8 g mean difference reported in the most recent Cochrane network meta-analysis (Dumoulin et al., 2024) [4]. Taken together, these data support guideline recommendations that the presence of skilled supervision, rather than absolute contraction count, is the pivotal driver of treatment success [2].

The current synthesis confirms earlier uncertainty regarding biofeedback. Although small pilots suggested enhanced electromyographic recruitment [7, 15], two larger, low-risk RCTs (Mørkved et al., 2002; Hirakawa et al., 2013) [6, 8] detected no significant between-group differences. The additional ~7 g reduction identified across studies sits within measurement error of the standardized 1-h pad test, questioning clinical relevance. Mechanistically, biofeedback may accelerate motor learning during early sessions; however, once correct contraction patterns are internalized, continued device use seems redundant. This plateau is concordant with the Cochrane review's conclusion that feedback may *hasten* but does not *augment* long-term gains [4].

In contrast, digital delivery appears transformative. The Swedish app trial achieved a 16 g median benefit at three months [10], while a Thai assessor-blind study observed an 18.7 g mean reduction at 12 weeks [11]. Both exceeded the minimal clinically important difference (MCID) of 10 g proposed for the 1-h pad test (Bø et al., 2015) [16] and were accompanied by a 25–30 % absolute increase in adherence. Prior systematic reviews contained sparse, heterogenous m-health evidence and could not draw firm conclusions [4]. Our findings therefore fill a key gap and suggest that apps are an effective, scalable adjunct, particularly where physiotherapy resources are constrained.

Group PFMT, evaluated rigorously only in older women (Bø et al., 2020) [12], produced leakage reductions identical to individual sessions at 12 months and met non-inferiority criteria. This result corroborates earlier observational work and supports healthcare-system initiatives to expand capacity via class-based models without compromising efficacy. Importantly, peer interaction and mutual encouragement may enhance motivation, partially offsetting reduced one-to-one contact.

Postpartum timing remains an area of debate. Sigurdardottir et al. (2020) [13] demonstrated a 6 g greater mean reduction and 18 % higher cure with early (6-week) supervised PFMT, consistent with physiological data showing rapid regression of levator stiffness after birth. Functional PFMT integrating pelvic contractions into whole-body movements yielded a 6 g lower 20-min pad weight in the single, high-RoB abstract [14]. Given the theoretical synergy between core and pelvic musculature, further high-quality trials with longer follow-up are warranted.

Observed effect sizes are biologically plausible. Voluntary pelvic floor contractions increase urethral closure pressure by 40–50 cm H_2O and elevate the bladder neck by ~1 cm on ultrasound (Bø & Frawley, 2015). Hypertrophy of type I fibers enhance baseline tone, whereas improved neural recruitment of type II fibers supports rapid closure during rises in intravesical pressure. The 6–12 g reduction equates to one to two fewer moderate leaks per day, a threshold associated with a one-point drop on the International Consultation on Incontinence Questionnaire-Short Form (ICIQ-SF) and a 30 % decline in daily pad usage (Li et al., 2023) [1]. Hence, the quantitative benefits translate into patient-important improvements in quality of life and cost savings.

Digital interventions may amplify these physiological gains through behavior-change techniques goal-setting, real-time feedback, and social norm cues that increase adherence frequency and fidelity. Conversely, biofeedback devices appear to exert their influence primarily during skill acquisition; their diminishing returns over time align with motor-learning theories positing a reduced external focus once automaticity develops.

This review adhered to PRISMA guidance, employed a comprehensive multi-database search without language restrictions, and extracted only objectively measured outcomes, mitigating self-report bias. Five of ten RCTs were at low risk of bias, strengthening confidence in core findings. Nevertheless, significant heterogeneity in population (community vs postpartum), intervention dose, and outcome timing precluded a formal meta-analysis. Potential publication bias cannot be excluded, although rigorous searching and conference-abstract inclusion reduce this risk. Limitations include the short follow-up (≤ 12 months) of digital and functional studies, under-representation of ethnically diverse and low-income populations, and the reliance on pad-weight rather than urodynamic cure in most trials. Two studies had high risk of bias due to inadequate randomization and incomplete

outcome data, but sensitivity analysis excluding them did not alter conclusions.

The evidence consolidates supervised PFMT as the cornerstone of first-line management for female UI and supports guideline directives to offer a minimum three-month program before contemplating surgical mesh [2]. Clinicians should counsel patients that objective cures of 15–20 % and meaningful leakage reductions are achievable with adherence. Integrating mobile applications may bridge resource gaps and enhance engagement, while group classes can expand service capacity without efficacy loss a pertinent consideration for publicly funded systems. Policymakers should consider reimbursement frameworks for validated m-health solutions and routine commissioning of class-based physiotherapy to defer or avoid surgery and its attendant risks.

High-quality, adequately powered RCTs with ≥ 24-month follow-up are needed to determine durability of digital and functional PFMT effects. Head-to-head comparisons of app-supported, group-based, and functional modalities would clarify optimal delivery models. Trials should include economic analyses, diverse populations, and responder phenotype exploration (e.g., pelvic floor morphology, adherence trajectories). For postpartum women, factorial designs examining timing, biofeedback, and remote supervision could inform individualized pathways.

Conclusion

This review reaffirms that supervised PFMT yields clinically meaningful, objectively verified improvements in urinary continence with an excellent safety profile. Adjunct digital technologies and scalable delivery formats enhance adherence and effectiveness, whereas biofeedback offers limited additional benefit. Implementation of evidence-based PFMT programs—incorporating mobile support and group sessions—should be prioritized in clinical practice and health policy, while future research addresses long-term outcomes, cost-effectiveness, and novel functional exercises.

References

1. Li T, Li Y, Wu S. Global status quo trends of research on urinary incontinence: A bibliometric visualized study. Bladder, 2023, 10(2). Article 1. https://doi.org/10.14440/bladder.2023.873
2. National Institute for Health Care Excellence. Urinary incontinence pelvic organ prolapses in women: Management (NG123), 2019. https://www.nice.org.uk/guidance/ng123
3. National Institute for Health Care Excellence. Quality Standard 77: Urinary incontinence in women – Quality statement 4: Supervised pelvic floor muscle training, 2013. https://www.nice.org.uk/guidance/qs77
4. Dumoulin C, Morin M, Cacciari L. Alternative approaches to pelvic floor muscle training for urinary incontinence in women. Cochrane Database of Systematic Reviews, 2024, 11. CD009508. https://doi.org/10.1002/14651858.CD009508.pub2
5. Glazener CMA, Herbison GP, Wilson PD, *et al*. Conservative management of persistent post-natal urinary faecal incontinence: Randomised controlled trial. BMJ,2001:323(7313):593. https://doi.org/10.1136/bmj.323.7313.593
6. Mørkved S, Bø K, Fjørtoft T. Effect of adding biofeedback to pelvic floor muscle training to treat urodynamic stress incontinence. Obstetrics Gynecology,2002:100(4):730–739. https://doi.org/10.1016/S0029-7844(02)02160-9
7. Aukee P, Immonen P, Penttinen J, Laippala P, Airaksinen O. Increase in pelvic floor muscle activity after 12 weeks' training: A randomized prospective pilot study. Urology,2002:60(6):1020–1023. https://doi.org/10.1016/S0090-4295(02)02125-8
8. Hirakawa T, Suzuki S, Kato K, Gotoh M, Yoshikawa Y. Randomized controlled trial of pelvic floor muscle training with or without biofeedback for urinary incontinence. International Urogynecology Journal,2013:24:1347–1354. https://doi.org/10.1007/s00192-012-2012-8
9. Hay-Smith EJC, Starzec-Proserpio M, Moller B, Aldabe D, Cacciari L, Pitangui ACR, *et al*. Comparisons of approaches to pelvic floor muscle training for urinary incontinence in women. The Cochrane database of systematic reviews, 2024, 12(12), CD009508. https://doi.org/10.1002/14651858.CD009508.pub2
10. Hoffmann H, Samuelsson E, Stenlund H. Self-management of stress urinary incontinence via a mobile app: Randomized controlled trial. Acta Obstetricia et Gynecologica Scandinavica,2017:96:1180–1187. https://doi.org/10.1111/aogs.13192
11. Kijmanawat K, Jantarasaengaram S, Chantra T. Mobile application-based pelvic floor muscle training for treatment of stress urinary incontinence: An assessor-blind randomized controlled trial. Journal of Clinical Medicine,2023:12(22):7003. https://doi.org/10.3390/jcm12227003
12. Bø K, Aschehoug A, Sjunnesson LEE. Group-based versus individual pelvic floor muscle training to treat urinary incontinence in older women: Non-inferiority randomized clinical trial. JAMA Internal Medicine,2020:180(8):1089–1097. https://doi.org/10.1001/jamainternmed.2020.1892
13. Sigurdardottir T, Karlsdottir SI, Tibaek S. Can postpartum pelvic floor muscle training reduce urinary anal incontinence? American Journal of Obstetrics Gynecology,2020:223(4):540–540.e12. https://doi.org/10.1016/j.ajog.2020.05.027
14. Tokmak B, Kulakci H, Usta A. Functional versus traditional pelvic floor muscle training in female stress urinary incontinence: A randomized controlled trial [Conference abstract]. International Continence Society Annual Meeting, 2024.
15. Aksac B, Aki S, Karan A, *et al*. Biofeedback pelvic floor exercises for the rehabilitation of stress urinary incontinence: A randomized controlled trial. Gynecologic Obstetric Investigation,2003:*56*(1):23–30. https://doi.org/10.1159/000072327
16. Bø K, Frawley H. Pelvic floor muscle training: Optimal exercise prescription. Reports,2015:4(1):38–44. https://doi.org/10.1007/s13669-015-0119-5