Remote Pelvic Floor Muscle Training as a Sustainable Healthcare Innovation for Women with Stress Urinary Incontinence: A Systematic Literature Review

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Abstract. Stress urinary incontinence (SUI) is a common women's health issue causing significant distress, and pelvic floor muscle training (PFMT) is its primary treatment. Yet, the effectiveness of remotely delivered PFMT has not been fully explored. This systematic review based on the PRISMA and PICO guidelines evaluated the controlled trials on remote PFMT for SUI by means of the ICIQ-SF and ICIQ-LUTSqol indicators. PUBMED, SCOPUS, Springer and ScienceDirect were searched for studies published 2017–2023. All four studies included in the review showed significant improvements in ICIQ-SF scores and two studies showed reductions in ICIQ-LUTSqol scores supporting the effectiveness of remote PFMT, and compliance was found to be a key influencing factor of the outcomes. These findings support the feasibility and efficacy of PFMT delivered via telerehabilitation to women with SUI. However, further research on service delivery and cost effectiveness is needed.

Keywords: Women; Stress Urinary Incontinence; Remote Pelvic Floor Muscle Exercise.

1 Introduction

Women's health is greatly influenced by physiological and anatomical differences resulting from their gender. According to the World Health Organization (2024), sociocultural factors also lead to discrimination against and disadvantage women, so the health of women and girls is of particular concern in society [23,17]. One-third of women's health problems, with a prevalence of 15–44 years of age, revolve around sexual and reproductive health problems (WHO, 2015) [23,5]. Following the Sustainable Development Goals (SDGs), the global targets for 2030, point number three "Healthy and Prosperous Life," specifically points 3.7 and 3.8, address universal access to sexual and reproductive care, including universal health coverage [9,6]. This indicates that today's world leaders focus on reproductive health, especially for women. Urinary incontinence (UI), or involuntary urine leakage, causes distressing health problems and discomfort in women. This condition affects not only the health but also the quality of life of the sufferer. Patients often feel afraid to perform normal daily activities, such as interpersonal and sexual relationships and social, economic, and psychological interactions [4,5]. The three most common UI types are stress, urgency, and mixed incontinence. Accurate prevalence data are difficult to obtain because of under-reporting and the use of different definitions for UI [3]. About 432 million people worldwide aged 20 and older have some form of urinary incontinence.

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P. N. G. Akbar and K. A. Safitri (eds.), *Proceedings of the 8th International Conference of Vocational Education, Applied Science and Technology (ICVEAST 2026)*, Advances in Social Science, Education and Humanities Research 1034,
https://doi.org/10.2991/978-2-38476-620-8_34

Prevalence of stress incontinence is estimated to be 24-45% in women over 30 years of age. In Spain the prevalence is 23%, in France 44%, in Germany 41%, in the UK 42% and in Europe 35%. In Asian women there is a higher prevalence of 56%. Urinary incontinence can greatly interfere with patient productivity at productive age, and these signs and symptoms are often missed due to low knowledge and awareness [9].

SUI is an involuntary leakage that occurs with additional intra-abdominal muscle pressure, such as during sneezing, coughing, or exertion [6,7]. SUI usually results from the weakness of the pelvic floor muscles, particularly the urethral sphincter muscles, connective tissue, and neuromuscular damage. Pelvic floor muscle weakness commonly results from obesity, pelvic floor trauma, vaginal delivery, pregnancy, menopause, constipation, heavy lifting, and smoking [8].

The most common treatments are conservative, pharmacological, and surgical, depending on the incontinence type and severity. Conservative treatments include behavioral therapy, electrical stimulation, mechanical devices, pelvic floor muscle strengthening, and weight loss [14]. Riemsma et al. (2017) reported cure rates by modality of 84.4% at 12 months for women receiving surgical intervention, 58.8% at 12 months for women using supervised pelvic floor muscle training (PFMT), and 78% at 6 months for men using PFMT [15].

Pelvic floor muscle training (PFMT) is a frequently used conservative intervention for SUI PFMT involves activating the pelvic floor musculature, with the main aim of reducing symptoms of incontinence by strengthening the voluntary pelvic floor muscle bundles. Dietary recommendations for fluid intake may be included. The effectiveness depends on patient compliance and the mechanics of exercise. Supervised PFMT can reduce involuntary movements of the sphincter muscle and thereby reduce involuntary urine output [14]. PFMT is recommended as a first line treatment for SUI [4].

After the COVID-19 pandemic, health professionals increasingly used telehealth to provide health-related services remotely using electronic information technology. Telehealth uses telecommunication technology to monitor remote rehabilitation and is called telerehabilitation [5,16]. This technology is considered to improve access to health services and continuity of care for remote populations, while making the use of time and resources of both providers and service users more efficient by strengthening engagement and enabling assessment of service users within the home environment. Fortune et al. (2016) noted that telehealth enables service delivery to remote patients, increases access to health services for individuals with low-middle socioeconomic status, and provides a wider range of health services [5,16].

Although SUI can reduce quality of life, only about 20% of patients seek treatment; in some cases, SUI is not perceived as a considerable problem, while in others, patients feel embarrassed to seek treatment [14,16]. Women who work at home often have less pension and benefits and less access to health and social services than men (WHO, 2015). Therefore, telehealth can be an important service option for women, decreasing the need for expensive procedural or specialist follow-up by providing competent services more efficiently [17,23].

As pelvic floor muscle training delivered via telehealth may be a promising option, research on its use is limited, and whether telehealth can provide appropriate and effective training remains unclear. Patient adherence, engagement, and delivery medium also pose challenges in achieving the goal of improved quality of life. Therefore, this systematic review aims to identify the effectiveness of telerehabilitation interventions or online pelvic floor muscle training services for women with urinary incontinence to provide evidence that can guide clinical practice.

2 Methods

This study used a systematic literature review (SLR) approach, following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses and Problem, Intervention, Control, Outcome protocols to identify, analyze, and evaluate relevant information [2]. The eligibility criteria, information sources, data selection, data collection, and data retrieval were determined based on a series of Preferred Reporting Items for Systematic Reviews and Meta-Analyses stages. The Publish or Perish application and the PUBMED, SCOPUS, Springer, and ScienceDirect databases were used to collect data. Keywords used included: (1) "online or telerehabilitation or telehealth or app," "urinary incontinence," and "women"; (2) "online or telerehabilitation or telehealth or app," "stress urinary incontinence," and "women"; (3) "online or telerehabilitation or telehealth or app," "stress urinary incontinence," and "pelvic floor muscle training."" Titles and abstracts that did not fit the research topic were then screened and eliminated. Figure 1 shows the overall review process.

This systematic review aimed to answer the following guiding question based on the PICO strategy: "Do women with SUI (P) doing a telehealth program for PFMT (I) have better outcomes (O) when compared to usual care?" Studies were included if the following criteria were met: (1) female (age > 18 years); (2) published in 2017–2024; (3) in the intervention group, patients received any form of telehealth intervention (e.g., web-based system, teleconsultation, telemonitoring, mobile app, text messaging, and email); (4) in the control group, patients received only usual care (face-to-face in clinic/hospital); (5) outcomes assessed were urinary severity, quality of life, adherence, and socioeconomics; and the study design was a randomized controlled trial.

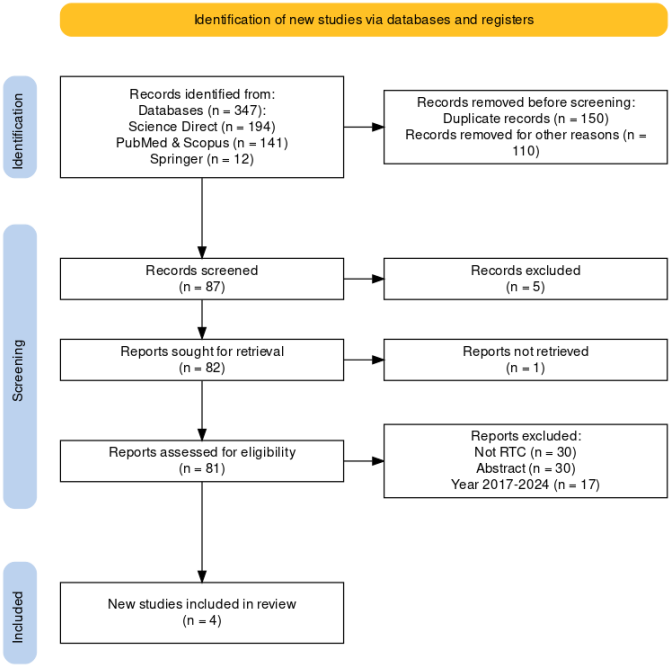


Fig. 1. PRISMA flow diagram of the study selection process.

3 Results

This review included four randomized controlled trials that met the inclusion criteria. Table 1 summarizes the study characteristics, interventions, comparators, follow-up periods, and main results.

Table 1. Result of the Article Review

Study	Method	Intervention Group	Control Group	Follow-up	Result
Santiago, M., et al. (2022) [16] Portugal	RCT (2020–2021). Age, 18–65 years; predominance of SUI, n = 35.	Hybrid telerehabilitation (n = 18): 12-week program–4-week video telerehabilitation + 8 weeks face-to-face therapy.	n = 17: 2 individual sessions + group classes 2×/week + face-to-face consultations for 12 weeks.	Weeks 0, 6, 12, and 16 (ICIQ-SF)	Both groups showed significant ↓ in ICIQ-SF (−4.9 control, −5.6 intervention) and pad test; increase in KHQ mean score for QoL. No significant difference was observed between hybrid and offline rehabilitation.
Loohuis, A M.M., et al. (2021) [12] The Netherlands	RCT (2015–2018). Ages 23–86 years (mean 54), n = 262 (66% moderate SUI).	URinControl app (n = 131), prepopulated with content per Dutch/int'l GP guidelines.	Referral to GP for usual care per Dutch guidelines (n = 131), no restriction on treatment type.	4 and 12 months (ICIQ-UI-SF, ICIQ-LUTSqol)	At 12 months: 89 (68%) app users and 83 (63%) controls were analyzed. Symptom severity −2.17 (SD 2.8) vs −3.43 (SD 3.6); QoL −4.66 (SD 5.1) vs −4.34(SD5.7); mean difference 0.903 (−0.66 to 1.871) – not significant.
Hoffman, V., et al. (2017) [8] Sweden	RCT. Women aged 27–72 years	Tät® mobile app from the initial 3 months (app	Waitlist, received the app after 3 months	3 months and 2 years (ICIQ-UI	At 2 years, 46 participants had significant ↓ in

Study	Method	Intervention Group	Control Group	Follow-up	Result
	with SUI; n = 123 randomized, n = 121 followed at 3 months, n = 46 followed at 2 years.	group, n = 62/61 followed).	(control group, n = 61/60 followed).	SF, ICIQ-LUTSqol, and PGI-I)	symptom severity (mean 95% CI 2.0–4.2) and QoL (mean reduction 4.0, 95% CI 2.1–5.9); two-thirds reported improvement (PGI-I). No control group after 3 months–key limitation.
Kijmanawat, Athasit, et al. (2023) [11] Thailand	Prospective, randomized, single-blind RCT (Sep 2020-Apr 2021), n = 60 randomized, n = 51 completed.	Basic mobile application for PFMT (n = 30/26 completed) for 12 weeks.	Printed PFMT instructions at home with adherence diary (n = 30/25 completed).	Weeks 4, 8, and 12 (one-hour pad test, ICIQ-UI SF, and PGI-I)	No significant difference in the pad-test scores was observed between the groups (p = 0.727). The ICIQ-UI SF showed a significantly greater decrease in the app group than in the control group (p = 0.045). The application group exhibited higher adherence.

Table 2. Statistical Results

Study	Outcome Measure	Timepoint	Control	App / Intervention
Santiago, M. et al.	ICIQ-UI SF, mean (SD)	Initial	12.6 ± 3.4	11.9 ± 3.3
		12 Weeks	9.9 ± 3.4	8.3 ± 3.1
		1 Year	7.7 ± 3.5	6.3 ± 2.6
		Difference	**−4.9**	**−5.6**
	KHQ, Incontinence impact, median (IQR)	Initial	66.7 (0)	66.7 (8.3)
		1 Year	66.7 (0)	66.7 (33.3)
		Difference	**0.0**	**0.0**

Study	Outcome Measure	Timepoint	Control	App / Intervention
	Social and Emotional Limitations, Median (IQR)	Initial	20.8 (41.7)	22.9 (35.4)
		1 Year	16.7 (8.3)	12.5 (16.7)
		Difference	**−8.3**	**−4.2**
	ICS pad test (g), median (IQR)	Initial	13.0 (9.0)	10.5 (16.0)
		1 Year	0.0 (5)	0.0 (0)
		Difference	**−11.0**	**−11.9**
Loohuis, A. M. M., et al.	ICIQ-UI SF, mean (SD)	Initial	10.3 ± 3.4	9.54 ± 3.2
		1 Year	7.1 ± 4.3	7.00 ± 3.3
		Difference	**−3.43 ± 3.6**	**−2.71 ± 2.81**
	ICIQ-LUTSqol, mean (SD)	Initial	33.4 ± 7.8	33.9 ± 8.4
		1 Year	29.1 ± 8.0	28.4 ± 6.9
		Difference	**−4.31 ± 5.7**	**−4.66 ± 5.1**
Hoffman, V.	ICIQ-UI SF, mean (SD)	Initial	14.0	14.9
		2 Year	10.6 (2.6)	11.3 (3.2)
		Difference	**−3.4**	**−3.6**
	ICIQ-LUTSqol, mean (SD)	Initial	34.0	39.0
		2 Year	33.6	34.2
		Difference	**−6.4**	**−4.8**
Kijmanawat, A., et al.	ICIQ-UI SF, mean (SD)	Initial	8.0 (2.3)	8.5 (2.6)
		12 Weeks	5.0 (2.0, 7.5)	4.5 (1.0, 6.0)
		Difference	**−2.0 (−5.5, −1.0)**	**−4.0 (−4.0, −2.0)**
	One-hour pad test (g), median (IQR)	Initial	4.3 (2.7, 10.0)	4.6 (3.0, 8.1)
		12 Weeks	3.5 (0.6, 8.3)	3.2 (0.1, 6.5)
		Difference	**−1.6 (−3.0, 0)**	**−1.8 (−2.9, −0.4)**

Study	Outcome Measure	Timepoint	Control	App / Intervention
	SUI episodes, median (IQR)	Initial	1.5 (0.7, 3.7)	1.9 (1.0, 3.3)
		12 Weeks	1.0 (0, 3.0)	0.9 (0, 1.7)
		Difference	**−0.4 (−0.9, 0.2)**	**−0.9 (−1.6, −0.7)**
	Brink's scale, mean (SD)	Initial	6.9 (1.4)	6.5 (1.5)
		12 Weeks	7.2 (1.5)	8.5 (1.8)
		Difference	**0.3 (1.4)**	**2.1 (1.6)**

4 Discussion

The International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF) and the International Consultation on Incontinence Questionnaire Lower Urinary Tract Symptoms Quality of Life Module (ICIQ-LUTSqol) were used to assess the severity of urinary incontinence [16]. The validity level according to the ICI recommendation level is level A. The Portuguese version of the King's Health Questionnaire (KHQ) is used as a valid measure of quality of life for UI sufferers in Portugal and is relevant to clinical practice and research [16].

In the study by Santiago, et al. (2022), a hybrid telerehabilitation program was carried out in the intervention group for 12 weeks, with two individual face-to-face sessions, 2 weeks of video telerehabilitation sessions and face-to-face sessions for 8 weeks [12,16]. Reassessment medical teleconsultations were conducted at weeks 6 (T6) and 12 (T12) and evaluation teleconsultation were conducted at week 16 (T16). The first face-to-face meeting was the initial consultation, where patients were instructed on the program and the PFMT protocol, which was performed three times daily [12,16].

The therapist was contactable at all times and the intervention group was contacted every 15 days to check for compliance with the video sessions. In the initial 2-week telerehabilitation sessions, the program duration was 30 minutes, divided into three phases with gradual addition of exercises in duration, repetitions, and position (standing, sitting, lying) [12,16]. The control group also received their first medical consultation and was instructed on the 12-week PFMT program in a face-to-face group setting, consisting of two one-on-one sessions followed by group classes twice a week with the same therapist, with similarly graded increments in duration, repetition, and position [12,16].

In that study, 23 patients were excluded due to negative ICS pad testing (< 1 g), comorbidities, pregnancy, level 1 muscle strength on MOS, refusal to participate, or loss of contact. Adherence to PFMT at week 6 was less than 80% and at week 12 was greater than 50%. At week 16, 11.8% of the control group and 41.2% of the intervention group reported no urinary incontinence in the past 4 weeks. Both groups showed a significant reduction in severity of UI as evidenced by the reduction in the mean ICIQ−SF total score at week 12 (−4.9 and −5.6 points) and the median ICS pad testing score (−11.0 and −11.9). Although the hybrid telerehabilitation and offline rehabilitation did not show any significant difference, the hybrid protocol showed

comparable effectiveness to offline rehabilitation in improving UI symptoms and quality of life [12,16].

Loohuis et al. (2021) argued that app-based medicine can serve as a viable and effective alternative to traditional physician-assisted care in general practice, usable either as a standalone option or as a support tool for usual care in overcoming barriers to seeking health services [12,14]. A total of 262 eligible women (mean age 54 years) were included, most (66%, n = 114) of whom had moderate SUI; despite randomization, more severe incontinence appeared more common in the control group. Women in the intervention group (n = 131) had access to the URinControl app, pre-populated with content based on Dutch and international GP guidelines. In contrast, the control group (n = 131) was referred to their GP for usual care per Dutch guidelines, with no restriction on treatment type [12].

The intervention and control groups were reduced by 42 and 48 women, respectively, after the 4-month follow-up. At the 12-month follow-up, 89 (68%) women in the intervention group and 83 (63%) in the control group were assessed for effectiveness based on change in incontinence severity, measured with ICIQ-UI-SF and ICIQ-LUTSqol [8]. Severity reduced by −2.17 (SD 2.8) versus −3.43 (SD 3.6), and quality-of-life changes improved by −4.66 (SD 5.1) versus −4.34 (SD 5.7), with a non-significant mean difference of 0.903 (−0.66 to 1.871) [11]. This indicates that there was no significant difference between the app-based care program and usual care, i.e., neither intervention was superior; however, the change was slightly larger at 12 months than at 4 months. This study did not collect micro-level adherence data, so the true picture of adherence in either arm cannot be established [11].

Hoffman et al. argued that app-based PFMT as a first-line treatment has promising sustained effects and can influence the quality of life [8], consistent with their results showing a significant reduction in SUI symptoms and improved quality of life; 66.7% of the participants reported that their leakage had improved. The study included 123 women with SUI (from Sweden, 2013–2014), aged 27–72, randomized to receive the Tät® mobile app either immediately (app group, n = 62) or after a 3-month wait (control group, n = 61); two participants defaulted, leaving 121 followed at 3 months. The app provided information on SUI, lifestyle, and pelvic floor, allowed users to set reminders and save statistics, and presented six basic and six advanced PFMT exercises of increasing difficulty [8].

All participants received a web-survey link by email at the 3-month follow-up; at the 2-year follow-up, only the intervention group was included, since the control group was offered the app after 3 months, so post-treatment outcomes for that period are unavailable. Outcome severity (ICIQ-UI SF), quality of life (ICIQ-LUTSqol), and Patient Global Impression of Improvement (PGI-I) were used [8,11,16]. Of the 61 three-month follow-up participants, 46 responded at 2 years; they showed significant reduction in symptom severity (mean 95% CI 2.0–4.2) and quality of life (mean reduction 4.0, 95% CI 2.1–5.9), with two-thirds reporting improvement on the PGI-I

[11,12]. Limitations included the lack of a true control group beyond 3 months and a small sample size.

Pad-test scores or the severity reduction of SUI did not significantly differ between groups, as found by Kijmanawat et al. (2023). However, the intervention group showed a significantly higher decrease of ICIQ-UI SF than the control group [11]. Participants were recruited through the Female Pelvic Medicine and Reconstructive Surgery Clinic. The clinic's cure rate was determined via a negative one-hour pad test (< 1 g leakage) comparing a basic PFMT mobile application (intervention) with printed home instructions (control). The one-hour pad test involved drinking 500 mL of water within 15 minutes, then walking up and down stairs for 30 minutes, performing 10 sit-to-stand repetitions, 10 jumps, 10 bouts of continuous coughing, and handwashing with running water, with a pad weight gain ≥ 1 g considered positive [8,11,12,16].

Both groups received daily exercise, 3 rounds/day, 5–10 minutes/round (sitting, lying, or standing) for 12 weeks; 60 women were randomized (30 per arm), with 51 completing the study (26 app, 25 control). The median (IQR) one-hour pad test change was −1.8 (−2.9, −0.4) for the intervention and −1.6 (−3.0, 0) for the control ($p = 0.727$, not significant). The median (IQR) change in ICIQ-UI SF was −4.0 (−4.0, −2.0) vs −2.0 (−5.5, −1.0), which was significantly different ($p = 0.045$) [11]. Participants reported subjective improvement, decreased frequency of leakage and improved quality of life, although the reduction in SUI symptoms was not statistically or objectively significant. The app also resulted in higher exercise adherence than the control condition.

The findings of this literature review suggest that remote physiotherapy of pelvic floor muscle training (PFMT) or telerehabilitation is effective in reducing urinary incontinence symptoms. Telerehabilitation of the pelvic floor muscle allows therapists to provide a program just as effective and convenient, supervising patients through video conferencing. The four studies reviewed (2017–2023) demonstrate that telerehabilitation-based pelvic floor muscle training is an emerging and effective clinical practice [8,11,12,16]. It offers valuable support for the implementation of advanced digital health technologies in the management of pelvic floor dysfunction.

Overall, there were no significant differences between studies in telehealth and conventional care. However, barriers such as patient compliance, internet connectivity and technology utilization should be considered in implementing a telerehabilitation program as telerehabilitation can be an effective option for women with SUI. Given the limited amount and quality of the available literature, the evidence for the effectiveness of telehealth in women with SUI is still insufficient to draw firm

conclusions.

Our findings are in line with Hao's (2024) findings, which showed that pelvic floor muscle exercises provided through telerehabilitation are feasible and effective [7], supporting our findings. The domains affected by telehealth delivery of PFMT are:

4.1 Quality of Life (QoL)

All included studies in the present systematic review assessed the quality of life in SUI patients using ICIQ-LUTSqol. In telehealth participants, 2 of 4 studies reported a significant reduction in ICIQ-LUTSqol scores versus controls. Quality of life measurement evaluates well-being by improvement over expectations of individual treatment outcomes. In Asklund et al. (2017), condition-specific QOL was considered [3]: most of the intervention group (98.4%) performed PFMT daily, compared with % in the control group; the intervention group had a significantly higher reported QOL ($P < 0.001$) [3].

4.2 Adherence

Adherence to PFMT is a key factor in its effectiveness, given the many barriers to exercise, including forgetting, deprioritizing, and not feeling the benefits of training [3]. Asklund et al. (2017) reported a higher rate of adherence in the mobile app group (41% of patients performed PFME daily). Compared with the control group (3.3% adherence to basic daily resistance exercise). Similarly, a higher adherence rate in the mobile app group was found by Araujo et al. (2020) at 1–2 months from the start of the intervention ($P < 0.001$) [1].

4.3 Symptom Improvement

All included studies in the present systematic review used ICIQ−UI SF to evaluate the severity of SUI symptoms. Three of the four studies showed a significant decrease in ICIQ−UI SF score in telehealth patients compared to controls. At week 12, large reductions in the mean ICIQ−SF total score were found in control and intervention groups (−4.9 and −5.6 points, respectively) [16]. Hoffman et al. (2017) demonstrated a significant reduction in symptom severity score (mean 95% CI 2.0–4.2) in 46 participants [8]. In a study by Kijmanawat et al. (2023), median (IQR) changes in ICIQ−UI SF score were −4.0 (−4.0, −2.0) in the intervention group and −2.0 (−5.5, −1.0) in controls (p = 0.045) [11].

Remote PFMT has a number of advantages over face-to-face PFMT including increased accessibility, convenience and cost benefits and can be used as an alternative approach to rehabilitation in agreement with the view of Trutnovsky et al. (2015) [24] however, it may be less effective for women with severe SUI or with internet or technology barriers. Our findings are also consistent with the findings of Willburger et al (2024) who examined the quality of online information for pelvic floor exercises for SUI reduction and interest in pelvic floor exercises [22]. The median score for understanding video information was 95.5% and for actionability 100%. Thus, the internet is not merely a source of information and education about pelvic floor exercises but also has the potential to improve patient compliance with PFE [22]; further research and video-based education and treatment programs for women are warranted [22].

This literature review focuses only on randomized controlled trials of remote PFMT. Other study types, such as observational studies, may provide additional evidence on the effectiveness of remote PFMT, and the intrinsic limitations of RCTs, such as possible bias and generalizability, should also be considered.

5 Conclusion

Telehealth has appeared as a promising approach for improving the efficiency and equity of health service delivery, particularly in geographically diverse and low-resource settings such as Indonesia. Telehealth can help address long-standing discrepancies in access to care by reducing barriers related to distance, cost and wait times, enabling remote access to medical and rehabilitative services. Physiotherapy Telehealth is an opportunity to create a connection between the physical therapist and the patient with different service delivery methods that could enhance the responsiveness and personalization of care. Given these potential benefits, further examination of telehealth adoption in Indonesia's health system is justified.

The results of this literature review support the effectiveness and feasibility of remote pelvic floor muscle training (PFMT) in women with SUI. However, further research is needed to establish its comparative effectiveness, therapy outcomes, and cost-benefit relative to conventional in-person treatment. The current evidence implies that remote PFMT represents an effective alternative for SUI management in this population.

Disclosure of Interests. The authors declare no competing interests that are relevant to the content of this article.

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