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Pelvic floor morphometrical and functional changes immediately after pelvic floor muscle training and at 1-year follow-up, in older incontinent women

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Abstract

Aims: To compare the effects of group-based and individual physiotherapy for stress or mixed urinary incontinence (UI) on pelvic floor morphometry, pelvic floor muscle (PFM) function, and related self-efficacy, immediately after treatment and at 1 year.

Methods: This is a planned secondary analysis of the group rehabilitation or individual physiotherapy study, an assessor-blinded, randomized, non-inferiority trial. Eligible participants included 362 community-dwelling older women with symptoms of stress/mixed UI. After learning how to contract PFMs, participants completed 12 weeks of PFM training, either individually (one-on-one) or as part of a group (eight women). Pelvic floor transperineal ultrasound volumes (morphometry), PFM intravaginal dynamometric data (function), and self-efficacy in performing PFM exercises were acquired at baseline, posttreatment, and at 1 year.

Results: Groups were comparable at all time points. Immediately posttreatment, both groups demonstrated significant changes in pelvic floor morphometry during coughs, and in PFM function during contractions and coughs. Participants also reported improved self-efficacy in performing PFM exercises. Results were sustained at 1 year. When participants coughed, pelvic floor structures were better supported (reflected by less caudal movement of the puborectalis sling and a smaller opening of the levator hiatus) in a pattern consistent with the "knack" strategy. Furthermore, both interventions resulted in stronger, faster, more coordinated, and more endurant PFMs.

Conclusion: In older women with stress or mixed UI, both individual and group-based PFM training resulted in comparable improvements in overall PFM function, pelvic floor morphometry during coughs, and related self-efficacy in performing PFM exercises, which were sustained at 1 year.

KEYWORDS

conservative management, dynamometry, elderly women, physiotherapy, rehabilitation, ultrasound, urinary incontinence

1 | INTRODUCTION

Pelvic floor muscle (PFM) training is the recommended first-line treatment for stress and mixed urinary incontinence (UI) in women (Evidence Level 1, Recommendation Grade A).[1] As per standard care, PFM training is provided in individual one-on-one physiotherapy sessions.

Evidence from recent clinical trials, including the group rehabilitation or individual physiotherapy trial (GROUP trial),[2] suggests that group-based physiotherapy is not inferior to individual physiotherapy for reducing UI episodes in older women with stress and mixed UI.

However, it is unclear whether changes in pelvic floor morphometry and PFM function previously reported for the current standard of care (individual physiotherapy)[3–7] are comparable to a group-based physiotherapy approach. Furthermore, it is not known if both interventions result in similar self-perceived efficacy in performing PFM exercises.

This secondary analysis of the GROUP trial aims to investigate if group-based PFM training is comparable to individual PFM training on pelvic floor morphometry, PFM function, and related self-efficacy in performing PFM exercises in women age 60 and over with stress or mixed UI.

2 | MATERIALS AND METHODS

2.1 | Study design

This is a planned secondary analysis of the GROUP trial,[8] an assessor-blinded, randomized, multicenter, noninferiority trial comparing individual versus group-based physiotherapy with respect to the average percentage reduction in UI episodes, 1-year postrandomization.

Details of this study have been previously published.[9] The study protocol was approved by the research ethics board at both recruitment sites and each volunteer provided written consent before participation (trial registration—ClinicalTrials.gov Identifier: NCT02039830).

2.2 | Population

Eligible participants were women age 60 and over with symptoms of stress or mixed UI, who reported at least three episodes of involuntary urine loss per week during the preceding 3 months. Stress/mixed UI was confirmed using the validated questionnaire for incontinence diagnosis.[10] Details on the participants' inclusion/exclusion criteria are provided in the trial protocol.[8]

2.3 | Outcome measurements, blinding

Pelvic floor morphometry, PFM function, and self-efficacy data were acquired at baseline, immediately posttreatment and at the 1-year follow-up by an outcome assessor, who was blinded to the participants' intervention allocation.[8]

2.3.1 | Pelvic floor morphometry

Pelvic floor morphometric data acquisition

Pelvic floor morphometry was obtained from transperineal ultrasound (US) volumes using either a Siemens Acuson Antares system with a 3–5 MHz curvilinear three-dimensional (3D)/4D probe or a GE Voluson Expert system with a 2–6 MHz curvilinear 3D/4D probe, depending on equipment available at each study center.

Before data acquisition, the participant was asked to empty their bladder. Measurements were taken with the participant in a supine position, with hips and knees flexed and supported, and feet flat on a conventional examination table. The US probe was covered with a glove, with conducting gel applied directly on the US probe as well as onto the glove covering the probe. It was then placed on the perineum in a midsagittal plane and oriented cranially. The volumes scanned included the posteroinferior margin of the symphysis pubis up to the back sling of the puborectalis muscle. A trained physiotherapist obtained the US volumes under three conditions: (1) at rest, (2) during a 3-s maximal PFM contraction, and (3) during a single cough. Each condition was repeated twice, and a 10-s relaxation period was provided between each contraction and cough trial.

Pelvic floor morphometric data analysis

Pelvic floor morphometry data were analyzed offline (4D View, Version 10.2; GE Healthcare or Syngo FourSight ViewTool, Siemens Canada Ltd.) by an independent assessor, who was blinded to the participant's intervention allocation and evaluation time point. The best trial of each condition was considered for analysis, based on image quality at the resting condition, or anorectal and/or bladder neck (BN) displacement at the contraction and cough conditions.

Four morphometric parameters were measured for each test condition, according to the previously published methodology.[11–13] Measurements taken in the sagittal plane included the vertical positioning (*y*-axis) of the BN and the back sling of the puborectalis muscle (i.e., the junction between the posterior wall of the rectal ampulla and the anal canal) in reference to a horizontal projection of the posteroinferior border of the pubic symphysis (BN_{HEIGHT} and PFM_{HEIGHT}). In the axial plane, the levator hiatus (LH)

anteroposterior dimension and area were both measured in the plane of minimal hiatal dimension (LH_{AP} and LH_{AREA}).[11,12] Intrarater repeatability of all measured parameters were previously tested in a similar population and found to be "good" to "very good" (intraclass correlation coefficients = 0.625–0.98).[13] The percentage displacement between rest and contraction or cough were used for the within- and between-group comparisons ([contraction − rest]/rest × 100; [cough − rest]/rest × 100). Measurements are detailed in Figure 1 and Table 1.

2.3.2 | PFM function

PFM function data acquisition

PFM function was assessed using the Montreal dynamometer.[14] This instrument consists of two parallel aluminum branches fixed to a base. The upper branch is fixed, while the lower branch is adjustable to allow measurements under variable vaginal apertures (from 11 to 50 mm, including the speculum width). The lower branch has two strain gauges mounted in a differential arrangement, where the resultant force is captured independently of the exact depth applied to the lower branch, causing a voltage potential change expressed in force (N).

Before data acquisition, each dynamometer speculum branch was covered with a condom lubricated with hypoallergenic gel. Measurements were taken with the participant in a supine position, with hips and knees flexed and supported, and feet flat on a conventional examination table. The two branches of the dynamometer were closed and inserted anteroposteriorly into the vaginal cavity to a depth of 5 cm, as per protocol. Subsequently, the participant was asked to perform three unrecorded PFM contractions to ensure comfort and familiarization with the procedure.

Data was acquired under six conditions following a previously tested standardized protocol[15,16]: (1) 5-s rest at a minimal dynamometer opening (11 mm); (2) 5-s rest at a

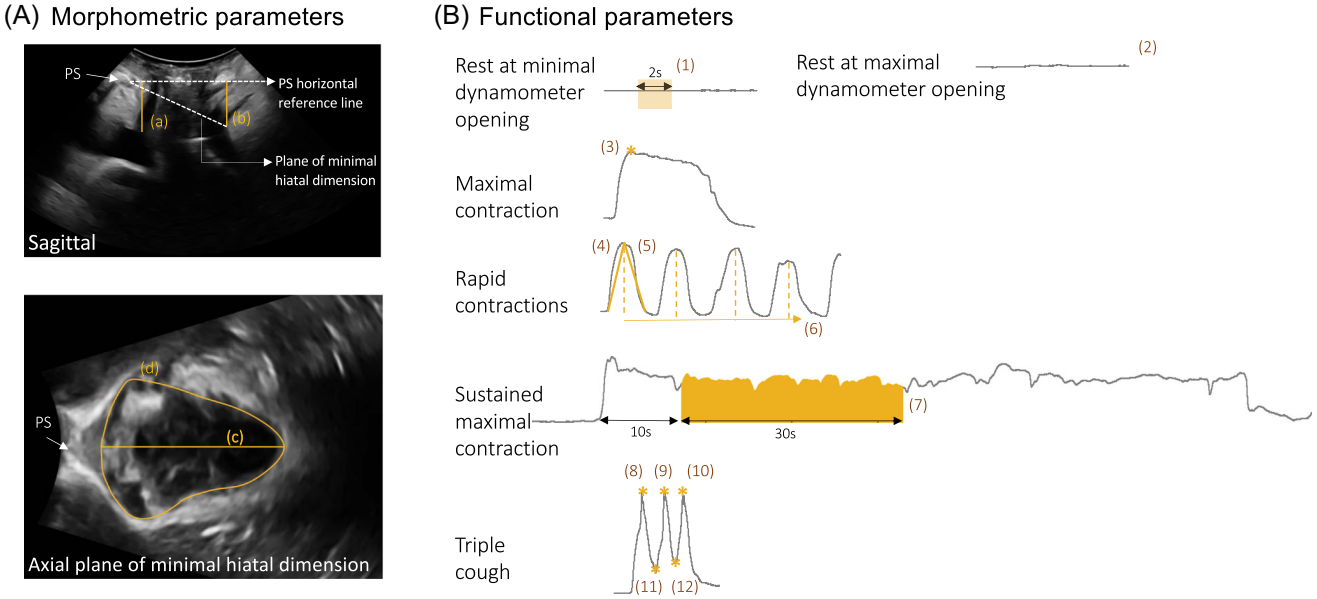

FIGURE 1 Pelvic floor morphometric and functional parameters. (A) Morphometric parameters: sagittal plane (a) BN_{HEIGHT}, distance from BN to the horizontal reference line passing by the posteroinferior border of PS and (b) PFM_{HEIGHT}, distance from the back sling of the puborectalis muscle to the PS horizontal reference line. The axial plane, at the plane of minimal hiatal dimension,[11] (c) LH_{AP}, the distance between the posteroinferior border of PS anteriorly and the pubovisceral muscle posteriorly, (d) LH_{AREA}, bordered laterally and posteriorly by the pubovisceral muscle, and anteriorly by PS and the pubic rami. (B) Functional parameters: *rest at minimal dynamometer speculum opening*, (1) mean force (N) in a steady-state window; *rest at maximal dynamometer speculum opening*, (2) maximal vaginal aperture (mm); *maximal contraction*, (3) maximal force (N); *rapid contractions*, (4) speed of contraction (N/s) based on the time taken from the baseline to the first peak, (5) speed of relaxation (N/s) based on the time taken from the first peak to the next valley (lowest part between two contractions), (6) the number of valid rapid contractions (complete contractions starting from the baseline and returning to the baseline); *sustained maximal contraction* (7), area under the force curve (N*s), taken between 10 and 40 s after the beginning of the effort; *triple cough*, (8–10) three peaks (N) and (11–12) two valleys (N) (the lowest point between each cough burst). BN, bladder neck; LH, levator hiatal; LH_{AP} levator hiatus anteroposterior dimension; PFM, pelvic floor muscle; PS, pubic symphysis

TABLE 1 Description of all calculated pelvic floor morphometrical and pelvic floor muscle (PFM) functional parameters at baseline, posttreatment, and at the 1-year follow-up

Pelvic floor morphometry—calculated from 4D transperineal ultrasound volumes at rest, during a PFM maximal contraction and during a single cough condition		
Parameters measured in the midsagittal plane		
BN_{HEIGHT}	a	Distance from the BN to a horizontal reference line passing by the posteroinferior border of the PS
PFM_{HEIGHT}	b	Distance from the back sling of the puborectalis muscle (i.e. the junction between the posterior wall of the rectal ampulla and the anal canal) to a horizontal reference line passing by the posteroinferior border of the PS
Parameters measured in the axial plane at the level of the minimal hiatal dimension		
LH_{AP}	c	LH AP distance between the posteroinferior border of the PS anteriorly and the pubovisceral muscle posteriorly
LH_{AREA}	d	LH area, bordered laterally and posteriorly by the pubovisceral muscle, and anteriorly by the PS and the pubic rami
PFM function—calculated from the Montreal dynamometry data. Parameters are specific to each assessment condition (rest, maximal contraction, fast contractions, sustained contraction, and triple cough)		
Force magnitude was subtracted from a baseline mean value obtained before each test for the maximal, rapid, and sustained contraction tests and the triple cough test		
Rest at minimal dynamometer speculum opening	1	Mean force (N) recorded at rest
Rest at maximal dynamometer speculum opening	2	Maximal vaginal aperture (mm) determined by the participant's tolerance
Maximal contraction	3	Maximal force (N)
Rapid contractions	4	Speed of contraction, considered as the rate of force development of the first contraction, from the baseline to the first peak (N/s)
	5	Speed of relaxation, based on the time taken from the first peak to the next valley, lowest part between two contractions (N/s)
	6	Number of valid rapid contractions in 15 s, considered as complete contractions starting from the baseline and returning to the baseline
Sustained maximal contraction	7	The area under the force curve (N*s) taken between 10 and 40 s after the beginning of the effort
Triple cough	8–10	Maximal force (N) observed in each of the three cough bursts
	11–12	Minimal force observed in the two valleys (N), lowest point between each cough burst

Abbreviations: AP anteroposterior; BN, bladder neck; LH levator hiatal; PS, pubic symphysis.

maximal dynamometer opening (determined by the participant's tolerance), both repeated twice; (3) 10-s maximal PFM contraction, repeated three times; (4) rapid PFM contractions (as many maximal rapid contractions and relaxations as possible in 15 s), repeated twice; (5) 90-s sustained maximal PFM contraction, performed once to avoid fatigue, and finally, (6) three strong coughs in succession, repeated twice. A 2-min relaxation period was respected between trials. As per protocol, the dynamometer opening was set to a vaginal aperture of 25 mm for all except the two rest conditions.

PFM function data analysis

PFM function data were analyzed offline (LabView program; National Instruments) by an independent assessor, who was blinded to the participant's intervention allocation. The best trial for each condition was considered for analysis, (i.e., the stronger response on contraction or cough tasks). PFM functional parameters were specific to each assessment condition (detailed in Figure 1 and Table 1).

2.3.3 | Self-efficacy

The Broome Pelvic Muscle Self-Efficacy Scale (Part A)[17] was administered to measure participants' perceptions of self-efficacy in performing PFM exercises. This 14-item questionnaire was tested for predicted validity and reliability in older women with UI following PFM training.[17] Scores range from 0 to 100, with higher scores

indicating higher perceived self-efficacy. Self-efficacy was considered high for scores above 66, moderate for scores between 33 and 66, and low for scores below 33.[17]

2.4 | Intervention

After an initial individual session to learn how to effectively contract the PFM through vaginal palpation, participants from both groups received a 12-week training program under the direction of an experienced pelvic floor physiotherapist, either in individual or group sessions. For both groups, each weekly session lasted 1 h and included a 15-min educational period and a 45-min exercise component.

In addition, participants from both groups were expected to practice PFM exercises at home, 5 days per week during the 12-week physiotherapy program, and, subsequently, 3 days per week for 9 months. Further details on the physiotherapy program are provided in the trial protocol and previous publication.[2,8]

2.5 | Statistical analysis

There was no a priori power calculation for this secondary analysis. However, the main trial sample size (362 participants) allowed at least 90% power to detect small effect-size (0.2) changes over time (for morphometrical or functional parameters) at a significance level of $\alpha = .05$, considering either the smallest possible sample size available for each specific parameter or the highest correlation found between repeated measures.

Pelvic floor morphometrical and functional parameters, in addition to the perceived self-efficacy in performing PFM exercises score, were compared using mixed-effects models for repeated measures to minimize the effect of missing data.[18] Comparisons were made between intervention arms and over time (two interventions and three time points), followed by paired *t* tests with Bonferroni correction for multiple comparisons. The outcome was a function of the intervention arm, time points, and their interaction.

Two-sided *p* values of less than .05 were considered statistically significant. Cohen's *dz* effect sizes were based on paired *t* tests between the baseline and the 1-year follow-up.[19] G*Power software[20] (version 3.1) was used for the a posteriori power calculation. SPSS software (version 24.0) was used for all other statistical analyses.

3 | RESULTS

3.1 | Description of participants and data availability

A total of 362 participants were randomized to either individual (184) or group-based physiotherapy (178). The mean age of the participants was 67.9 years old (*SD*, 5.8). The median number of births per participant was 2 (range, 0–8). Participants were on average overweight with a mean body mass index of 27.1 (*SD*, 4.5). Three hundred participants (83%) had symptoms of mixed UI, and 62 (17%) had symptoms of stress UI. The mean duration of UI symptoms was 9.7 (*SD*, 9.8) years. Mean leakage episodes per week was 14.7 (*SD*, 14.7). Overall, 337 of 362 (93%) completed the intervention and 319 of 362 (88%) completed the 1-year follow-up assessment. Morphometric datasets were available from 153 of 184 (83%) and 136 of 184 (74%) participants from the individual physiotherapy and 148 of 178 (83%) and 128 of 178 (72%) participants from the group physiotherapy at the posttreatment and follow-up assessments, respectively. PFM function datasets were available from 164 of 184 (89%) and 144 of 184 (78%) participants from the individual physiotherapy and 154 of 178 (87%) and 127 of 178 (71%) participants from the group physiotherapy at the posttreatment and follow-up assessments, respectively.

Missing US datasets were mostly due to technical difficulties (poor imaging conditions, equipment limitations, or incomplete imaging of the hiatus). Dynamometry data were missing mostly due to the unwillingness of the participants to complete the procedure and occasionally due to inadequately recorded data. When possible, partial data analysis was performed. The precise sample size available for each group's morphometric or functional parameter is specified in Tables 1 and 2 (flowchart available in Material S1). Of note, no baseline clinical or demographic imbalances were observed between intervention arms,[9] nor between those with and without available data at the follow-up (Material S2).

3.2 | Pelvic floor morphometry

Table 2 summarizes pelvic floor morphometry results. There was no interaction effect between intervention arms and assessment time points. Also, groups were comparable, with no intervention arm effect. Furthermore, for the parameters measured at rest and during the maximal PFM contraction, there was no time-point effect.

However, for the single cough condition, there was a time-point effect for PFM_{HEIGHT}, LH_{AREA}, and LH_{AP}.

TABLE 2 Pelvic floor morphometric parameters

	Intervention arm	*n*	Baseline	*n*	Posttreatment	*n*	One-year follow-up	Interaction effect	Group effect	Time effect	Effect size
Rest											
BN_{HEIGHT} (mm)	Individual	146	23.9 (4.4)	149	24.4 (5)	125	23.7 (4.5)	0.366	0.208	0.942	−0.02
	Group	146	24.4 (4.4)	142	24.2 (4.6)	116	24.6 (5.4)				
PFM_{HEIGHT} (mm)	Individual	143	18.3 (6.6)	150	19.3 (6.5)	127	18 (6.7)	0.957	0.307	0.097	−0.06
	Group	150	17.8 (6.4)	144	18.7 (6.7)	120	17.7 (6.1)				
LH_{AREA} (mm^2)	Individual	141	1519 (335)	143	1492 (312)	117	1494 (314)	0.998	0.566	0.626	0.01
	Group	143	1503 (364)	133	1479 (332)	119	1481 (375)				
LH_{AP} (mm)	Individual	147	54 (6.7)	151	53 (6.8)	130	53.8 (7.4)	0.682	0.223	0.564	0.09
	Group	153	53.2 (7.8)	144	53 (7.2)	127	52.7 (8)				
Contraction percentage change											
BN_{HEIGHT} (%)	Individual	128	9 (20)	130	8 (19)	109	9 (15)	0.356	0.483	0.601	0.02
	Group	127	7 (16)	121	10 (15)	108	6 (28)				
PFM_{HEIGHT} (%)	Individual	141	23 (40)	149	17 (48)	125	15 (141)	0.670	0.243	0.695	−0.03
	Group	148	24 (38)	142	21 (37)	118	26 (39)				
LH_{AREA} (%)	Individual	140	−16 (12)	143	−18 (12)	116	−17 (13)	0.865	0.587	0.655	0.09
	Group	139	−16 (13)	129	−17 (13)	115	−17 (12)				
LH_{AP} (%)	Individual	147	−15 (9)	151	−16 (9)	130	−16 (10)	0.941	0.677	0.793	0.05
	Group	152	−15 (10)	142	−16 (9)	126	−15 (9)				
Cough percentage change											
BN_{HEIGHT} (%)	Individual	141	−16 (23)	145	−15 (25)	120	−16 (21)	0.260	0.945	0.070	−0.08
	Group	145	−19 (22)	136	−12 (22)	114	−15 (27)				
PFM_{HEIGHT} (%)[a]	Individual	139	−17 (33)	150	−7 (37)	121	−3 (74)	0.604	0.187	0.008	−0.19
	Group	147	−17 (27)	138	−12 (32)	117	−10 (28)				
LH_{AREA} (%)[b]	Individual	133	13 (14)	141	7 (16)	111	7 (18)	0.868	0.806	<0.001	0.33
	Group	139	13 (15)	128	6 (16)	116	7 (16)				
LH_{AP} (%)[b]	Individual	142	1 (8)	150	−2 (10)	126	−2 (10)	0.668	0.839	<0.001	0.27
	Group	150	1 (8)	140	−2 (8)	125	−1 (10)				

Note: Data are means and standard deviations. Mixed models for repeated measures (two intervention arms and three time points) and paired *t* tests with Bonferroni correction. Cohen's *dz* effect sizes were based on paired *t* test between the baseline and the 1-year follow-up.[2]

Abbreviations: AP, anteroposterior; BN, bladder neck; LH, levator hiatus; PFM, pelvic floor muscles.

[a]Pairwise differences: baseline versus follow-up ($p = .009$).

[b]Pairwise differences: baseline versus posttreatment ($p < .001$) and baseline versus follow-up ($p < .001$).

During coughs, participants in both intervention arms presented a smaller LH_{AREA} opening, with a noticeable reduction of $LH_{AP,}$ both at posttreatment and at the 1-year follow-up, compared to the baseline. Furthermore, participants presented less caudal descent of PFM_{HEIGHT} during coughs at the follow-up than at baseline. For all parameters measured, no differences were observed between the posttreatment and the 1-year follow-up. Overall, the effect sizes of morphometry changes between baseline and the one-year follow-up were small (ranging from 0.2 to 0.3).

3.3 | PFM function

Table 3 summarizes PFM functional results. There was no interaction effect between intervention arms and assessment time points for any of the functional parameters. There was an intervention-arm effect only for the number of valid contractions achieved during the rapid contraction condition, which slightly favored the individual arm at the follow-up (9.1 [3.1] vs. 8.3 [2.5]; $p = .02$).

No time-point effect was observed for both rest conditions (mean force at minimal dynamometer opening or vaginal aperture at maximal dynamometer opening). There was, however, a time-point effect for all other functional parameters assessed. Both at posttreatment and at the 1-year follow-up, participants in each intervention arm presented higher forces on the maximal contraction; a higher number of valid contractions with faster contraction and relaxation speeds on the rapid contractions; a higher area under the curve on the sustained contraction; and finally, higher peak (maximal force in each cough burst) and valley forces (minimal force between cough bursts) on the triple cough compared to the baseline. No differences were observed between the posttreatment and the 1-year follow-up. The effect sizes of PFM functional changes between baseline and the 1-year follow-up were also small (ranging from 0.1 to 0.5).

3.4 | Self-efficacy in performing PFM exercises

Table 4 summarizes self-efficacy results. Overall, high self-efficacy in performing PFM exercises was perceived by 48 (14%) of the 334 participants at baseline, 307 (92%) of the 334 participants postintervention, and 284 (90%) of the 315 participants at the 1-year follow-up.

There was no interaction effect between intervention arms and assessment time points ($p = .307$). However, a group effect was observed ($p = .018$) slightly favoring the group arm, although not confirmed by pairwise comparisons (Table 4). Finally, there was a time-point effect, where participants in each intervention arm presented higher self-efficacy scores in performing PFM exercises at posttreatment and at the follow-up than at baseline. Large effect size was observed for the scores obtained at the follow-up compared to the baseline (Cohen's $dz = 1.83$). No differences were observed between the posttreatment and the follow-up scores.

4 | DISCUSSION

In this secondary analysis of the GROUP trial, individual and group-based physiotherapy treatments were comparable immediately posttreatment and at the 1-year follow-up. Furthermore, both interventions resulted in significant changes over time in pelvic floor morphometry, PFM function, and self-efficacy in performing PFM exercises.

For pelvic floor morphometry, no significant differences were found between groups. Changes over time were observed mainly during the cough condition. These changes were consistent with training known as the "knack" strategy.[21] During increased intra-abdominal pressure (e.g., a strong cough), PFMs are thought to support the pelvic floor structures and prevent urine leakage by closing the LH to "clamp" the urethra.[22] In this population of incontinent older women, pelvic floor structures were better supported during a cough after the 12-week intervention (reflected by the less caudal movement of the PFM_{HEIGHT} and a smaller opening of the LH, with a noticeable reduction of its anteroposterior dimension). It has been suggested that practicing the "knack," or a PFM contraction before a cough, is one way to build automatic function.[23] The fact that both intervention approaches resulted in more effective PFM contractions when coughing in the long term suggests that this continence strategy was well integrated by our study population.

For the PFM function, the intervention groups differed on the number of valid rapid contractions: The individual arm had 10% higher valid rapid contractions at the follow-up. This between-group difference may be explained by the use of biofeedback in the individual arm, which has been linked to increased proprioception of the PFMs and facilitated contraction and relaxation.[24] However, over time, both interventions resulted in a significantly higher number of fast contractions, as well as stronger, faster, more coordinated, and endurant PFM contractions. Of interest, PFM contractions were stronger and better sustained between each cough burst on the triple-cough test. Our study confirms findings from a

TABLE 3 PFM functional parameters

	Intervention arm	*n*	Baseline	*n*	Posttreatment	*n*	One-year follow-up	Interaction effect	Group effect	Time effect	Effect size
Rest											
Mean force at minimal dynamometer opening (N)	Individual	165	1.2 (0.9)	164	1.3 (0.8)	142	1.2 (0.7)	0.440	0.941	0.539	−0.02
	Group	158	1.1 (0.9)	153	1.2 (0.8)	126	1.3 (0.9)				
Maximal vaginal aperture (mm)	Individual	165	36.3 (8.3)	164	37 (8.3)	143	35.8 (8)	0.332	0.405	0.463	0.08
	Group	157	37.5 (8.1)	150	36.4 (7.6)	126	36.5 (7.6)				
Maximal contraction											
Maximal force (N)[a]	Individual	167	5.4 (3.1)	158	6.6 (3.6)	141	6.4 (3.4)	0.868	0.892	<0.001	0.08
	Group	155	5.5 (3.2)	152	6.4 (3.2)	127	6.4 (3.3)				
Rapid contractions											
Number of valid contractions (*n*)[a,b]	Individual	167	7.8 (2.9)	161	9 (2.9)	141	9.1 (3.1)	0.156	0.038	<0.001	−0.35
	Group	156	7.8 (2.7)	153	8.6 (2.7)	125	8.3 (2.5)				
Speed of contraction (N/s)[c]	Individual	167	9.9 (7.7)	160	11.1 (7.3)	141	12.1 (8.3)	0.965	0.096	<0.001	−0.28
	Group	156	9 (6.3)	153	10.5 (6.3)	125	11.3 (8.3)				
Speed of relaxation (N/s)[a]	Individual	167	−6.2 (5)	160	−7.9 (5.9)	141	−7.9 (5.3)	0.552	0.522	0.002	0.30
	Group	156	−7 (5)	153	−7.9 (4.8)	125	−7.8 (5.2)				
Sustained maximal contraction											
Area under the force curve (N·s)[a]	Individual	163	94.5 (65.2)	161	119.7 (80.3)	138	114.3 (73.4)	0.853	0.980	<0.001	−0.28
	Group	154	97.6 (67.9)	151	116.3 (74.7)	125	114.2 (68.2)				
Triple cough											
Peak force 1[a]	Individual	165	2.4 (1.9)	159	4.1 (2.8)	138	3.7 (2.7)	0.942	0.253	<0.001	−0.46
	Group	151	2.3 (1.5)	154	3.9 (2.6)	124	3.4 (2.2)				
Peak force 2[a]	Individual	165	2.9 (2.2)	159	3.9 (2.9)	138	3.5 (2.7)	0.958	0.28	<0.001	−0.18
	Group	151	2.8 (2)	154	3.7 (2.5)	124	3.3 (2.2)				
Peak force 3[a]	Individual	165	3.2 (2.2)	159	4.5 (2.9)	138	4.1 (2.6)	1.00	0.773	<0.001	−0.31
	Group	151	3.1 (2.2)	154	4.4 (2.7)	124	4 (2.6)				
Valley force 1[a]	Individual	165	0.9 (0.9)	159	1.7 (2)	138	1.7 (1.8)	0.971	0.717	<0.001	−0.41
	Group	151	0.9 (0.9)	154	1.7 (1.7)	124	1.6 (1.4)				
Valley force 2[a]	Individual	165	0.9 (0.9)	159	1.8 (1.9)	138	1.6 (1.7)	0.978	0.752	<0.001	−0.38
	Group	151	0.9 (0.9)	154	1.7 (1.7)	124	1.5 (1.5)				

Note: Data are means and standard deviations. Mixed models for repeated measures (two intervention arms and three time points). Cohen's *dz* effect sizes were based on paired *t* test between the baseline and the 1-year follow-up[2]

Abbreviation: PFM, pelvic floor muscle.

[a]Pairwise differences: baseline versus posttreatment ($p < .01$) and baseline versus follow-up ($p < .05$).

[b]Pairwise differences: individual versus group treatment at the follow-up ($p = .009$).

[c]Pairwise differences: baseline versus follow-up ($p < .001$).

TABLE 4 Broome pelvic muscle self-efficacy scale

Intervention arm	*n*	Baseline	*n*	Posttreatment	*n*	One-year follow-up	Interaction effect	Group effect	Time effect	Effect size
Individual	170	31.9 (25.6)	170	84 (14.7)	162	82.5 (14.8)	0.307	0.018	<0.001[a]	−1.83
Group	164	37.2 (26.6)	164	84.8 (13.8)	153	85 (14)				
Between group comparison		0.062		0.588		0.129				

Note: Data are means and standard deviation. Scores ranged from 0 to 100, with higher scores indicating higher perceived self-efficacy in performing pelvic floor muscle exercises and their use as continence strategies. Mixed models for repeated measures (two intervention arms and three time points). Cohen's *dz* effect sizes were based on paired *t* test between the baseline and the 1-year follow-up.[2]

[a]Post hoc differences baseline versus posttreatment and baseline versus follow-up ($p < .001$). No difference between posttreatment and follow-up ($p = .659$). Between group comparison are based on independent *t* tests.

smaller trial[3] indicating that PFM physiotherapy results in pelvic floor morphometrical and functional changes and reduces UI symptoms in older women.

For perceived self-efficacy in performing PFM exercises, no significant differences were found between groups nor between scores at posttreatment and at the 1-year follow-up. Compared to the baseline, both interventions resulted in significantly higher scores at both time points. In fact, over 90% of the participants reported high self-efficacy immediately after the intervention and at the 1-year follow-up.

Earlier studies investigating the effects of individual PFM training for the treatment of UI in younger women (vs. no treatment,[4,5] or in pre- vs. posttreatment conditions[6,7]) observed other positive changes in pelvic floor morphometry immediately after treatment. These changes included a smaller LH_{AREA} at rest,[6] increased displacement of the bladder base[4] or BN[7] during a PFM contraction, and reduced displacement of BN during coughs.[5]

Aging and menopause have been linked to continuous loss of PFM mass and reduced contraction strength and velocity, as with other skeletal muscles. More specifically, menopause is associated with increased LH diameters and impaired PFM contractions in response to sudden rises in intra-abdominal pressure.[25,26] Therefore, one would expect that older women would present minor if any long-term effects of PFM training. Nevertheless, our study demonstrates that both group or individual PFM training result in pelvic floor morphometrical and functional improvements in older women with UI that are sustained at 1 year.

4.1 | Limitations of this study

A potential weakness of this study includes missing datasets for pelvic floor morphometry and PFM functional assessments, either due to participants withdrawing, incomplete assessments, or technical difficulties. Nonetheless, complete datasets were available from ¾ of the participants at the 1-year follow-up ($n = 263$). Furthermore, no baseline differences were found between participants with and without complete datasets, and no missing data imbalances were found between groups. Finally, it is important to acknowledge that our study population included older women with UI, who had few comorbidities. Therefore, it is possible that improvements in morphometry and function may not be observed in frail elderly women.

5 | CONCLUSION

In women aged 60 and over with stress or mixed UI, individual and group-based physiotherapy resulted in comparable improvements in pelvic floor morphometry and PFM function that were sustained at the 1-year follow-up. These results suggest improved support and control of PFMs, which was reinforced by the participants' reported self-efficacy in performing PFM exercises.

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CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ETHICS STATEMENT

Ethics approval for this study was obtained from the Research Ethics Committee of the Institut universitaire de gériatrie de Montréal (CER IUGM 12-13-002), the Centre hospitalier de l'Université de Montréal (CE 12.347), CLSC Lucille Teasdale & the CSSS Jeanne-Mance (CSSSJM-2014-07-04), and the Centre hospitalier de l'Université de Sherbrooke (#12-170-M5).

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