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PELVIC FLOOR EXERCISE CLASSES FOR URINARY INCONTINENCE IN OLDER WOMEN: HOW DO THEY WORK?

Hypothesis / aims of study

Pelvic floor muscle (PFM) rehabilitation has been shown to be effective in reducing stress urinary incontinence (SUI) in older women (1). However, the underlying mechanism by which PFM rehabilitation remediates urine leakage is not fully understood (2). The primary objective of this study was to identify the effects of a PFM exercise program on PFM function and morphology at rest and during effort.

Study design, materials and methods

This study employed a quasi-experimental pre-test, post-test design. Women 60 years old and older were included if they experienced at least weekly episodes of urinary incontinence and presented predominantly with SUI symptoms (≥ 80%). Women were excluded if they had chronic constipation, were taking medications known to affect continence, had mobility, medical or psychological problems that would prevent them from completing the assessments or the exercise program, and/or had a condition or implant that contraindicated magnetic resonance imaging (MRI).

All participants provided written consent prior to the first evaluation. The initial assessment included collecting demographic and medical history data and individualized instruction to ensure that the women could perform PFM contractions correctly. Both evaluations involved collecting data to evaluate incontinence symptoms and PFM function and morphology. Incontinence symptoms were evaluated with a three-day bladder diary, the Urogenital Distress Inventory (UDI) and the Incontinence Impact Questionnaire (IIQ). PFM function was assessed with dynamometry and electromyography (EMG) during six tasks: PFM maximum voluntary contraction (MVC), straining, rapid-repeated PFM contractions, a sustained PFM contraction, a single cough and three repeated coughs. Pelvic floor morphology was evaluated with MRI recorded at rest, during PFM MVCs and during straining in the sagittal and axial planes using a Seimens 3.0 T Magnetom Trio.

Dynamometric and EMG data were sampled at 1028 Hz. Dynamometric data were analysed according to the procedures described by Morin et al. The EMG was recorded with a gain of 1000; the root mean square (201 sample sliding window) was used to filtre the EMG data. The filtred peak EMG value was determined to be the maximum amplitude and the onset was determined to be the time at which the EMG rose above 2 SD over baseline.

Measurements were made from the MRIs, by evaluators blinded to the testing session, from the mid-sagittal MRI images taken at rest, during a PFM MVC and during straining. The pubococcygeal line from the inferior symphysis pubis to the sacrococcygeal joint was used as the reference line. The H-line, the M-line, the levator plate angle and the anorectal angle were used to evaluate PFM function. The urethrovescial junction height and the uterocervical junction height were measured to assess pelvic organ support. From the axial images, at rest and during PFM MVC, at the level of the inferior edge of the pubic symphysis the width and length of the urogenital hiatus were measured to evaluate PFM function. The striated urethral sphincter was measured from the axial images at rest, the area and volume were calculated according to the method described by Morgan et al. Intrarater and interrater reliability for the MRI measurements were assessed and determined to be acceptable, with intraclass correlation coefficients ≥0.8 and standard errors of the mean ≤2 mm or 2 degrees for the PFM measures and <0.4 mm for the urethral thickness measures.

The volunteers then participated in 12 weekly, one-hour PFM group exercise classes, lead by an experienced pelvic floor physiotherapist. They also performed daily home PFM exercises. The PFM exercise program included PFM strengthening and endurance exercises and taught functional strategies (such as the “Knack”) to reduce SUI. The number and intensity of the exercises were advanced every four weeks.

A priori power calculations (ß=0.80) were performed to determine the sample size: 14 participants were needed to detect a change in peak EMG amplitude of 2 µV and 17 participants were required to find changes of 2.4 N in peak force and 5 mm in urethrovescial junction height. To allow for dropouts, sample size was set at 20. Given that the data were normally distributed, the outcome measures (symptoms, PFM function and morphology) were compared between testing sessions using repeated measures analyses of variance (ANOVAs). The time of testing, task (rest, contraction, cough or strain), and the measure (force, EMG, MRI measurement) and all interactions were considered in the model. When differences were significant, post hoc testing was performed using the Bonferroni method.

Results

Twenty-nine women were recruited; thus far, eight have dropped-out, six are midway through the exercise classes and 15 have completed the study. The primary reasons given for dropping-out were due to illness (self or spouse), travel time to the research centre and too many time commitments. The mean (SD) age of those who have completed the study was 67.6 (5.6) years, their mean body mass index was 26.5 (4.1) kg/m^2, and they had had a mean of 1.0 (1.1) birth: 0.9 (1.1) vaginal deliveries and 0.1 (0.3) Caesarean sections. The women who dropped out and those still completing the program did not differ significantly in any demographic or symptom data from those who have completed the study.

There were improvements in incontinence symptoms on all three of the measures used. The three-day bladder diary showed a significant decrease in the number of leakage episodes reported from 5.18 (5.06) leaks/3days to 0.45 (0.82) leaks/3 days, p=0.005. The mean UDI score decreased from 129.9 (47.0) to 47.3 (21.8) out of a maximum score of 300, p<0.001, and the mean IIQ score decreased from 42.2 (36.1) to 8.5 (9.4) out of a maximum score of 400, p=0.015.

The maximum PFM force and EMG amplitude did not change significantly for any of the tasks, p>0.37. The volunteers were able to produce more rapid-repeated contractions after the intervention: 5.55 (2.34) to 8.91 (2.66) contractions, p=0.012. There was no change in PFM endurance, p=0.74. The onset of EMG activation, relative to force generation, was earlier post

intervention, in post hoc tests this was only significant for coughing: 0.78 s (2.69) to –0.12 s (0.22), p=0.023. The slope of the rise in force decreased with treatment, p=0.005, during both the single cough, 14.62 N/s (11.05) to 6.55 N/s (7.45), and the three coughs, 9.41 N/s (5.23) to 6.72 N/s (5.61). During the three repeated coughs the force and EMG amplitudes of the troughs between the coughs increased, p=0.003, 1.12 N (1.62) to 1.40 N (1.60) and 5.53 µV (3.45) to 8.32 µV (5.03).
PFM morphology changed in measures related to PFM function and the urethra. In the sagittal MRI measurements, the measurements improved between testing sessions, p<0.001; post hoc only the ability to reduce the anorectal angle with a PFM MVC improved significantly: 4.52^{o} (8.83) to -24.53^{o} (12.80), p<0.001. This was echoed in the axial images, p<0.001: post hoc the anteroposterior length of the urogenital hiatus deceased during the MVC: 54.04 mm (6.95) to 52.45 mm (7.16) p<0.001, and striated urethral sphincter increased in thickness: 3.10 mm (0.68) to 3.77 mm (0.81), area: 66.24 mm^2 (17.21) to 80.57 mm^2 (20.66), and volume: 1031.7 mm^3 (245.4) to 1257.3 mm^3 (303.5), with treatment, p<0.001.

Interpretation of results

This study confirms that group PFM exercise classes are effective in reducing the symptoms of urinary incontinence in older women with SUI. It is novel in that it evaluates the concomitant changes in PFM function and morphology. The study found improvements in PFM coordination: improved ability to perform rapid-repeated PFM contractions, earlier EMG onset when coughing, and better retention of the PFM contraction between repeated coughs. The decease in the slopes of the force rise prior to coughing are the result of the earlier activation of the PFMs. Surprisingly, the study did not find significant improvements in PFM force or EMG activation measured by dynamometry. However, it found three morphological changes suggestive of improved PFM strength: improved ability to narrow the anorectal angle, decreased antero-posterior diameter of the urogenital hiatus during PFM MVC and hypertrophy of the striated urethral sphincter. It is possible that discomfort from the dynamometer compressing the urethra during the maximum PFM contractions may have caused the volunteers to contract sub-maximally after the PFM exercise classes, where as there was nothing in the vagina to provoke discomfort during the MRI scanning.

Concluding message

Reduction of urine leakage in older women following a PFM exercise program appears to be related to improved PFM co-ordination, increased PFM mobility and striated urethral sphincter hypertrophy. As this study did not involve a control group, further research is necessary to determine if this relationship is causal.

References

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Was the Declaration of Helsinki followed?	**Yes**
Was informed consent obtained from the patients?	**Yes**