Evaluation of the pelvic floor muscles training in older women with urinary incontinence: a systematic review

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Abstract
Background: Urinary incontinence (UI) is defined as any involuntary urine loss that predominantly affects older women. There is evidence that pelvic floor muscles training (PFMT) program is effective on the treatment of pelvic floor (PF) dysfunctions and is considered to be first-line treatment. The evaluation of pelvic floor muscles (PFM) function and strength is central to validate the effectiveness of the training protocol in UI decrease. The Oxford Grading Scale and manometry are fundamental to evaluate the PFM function and strength.

Objective: The aim of the study was to systematize the scientific evidence about the effects of PFMT in older women, assessing the PF function and strength through Oxford Grading Scale and manometry.

Methods: The research of randomized controlled clinical trials was performed through B-on, EBSCO, PEDro, Pubmed, and SciELO data carried out from 2003 to 2016.

Results: A total of 35 studies were identified, 26 of these were selected and fully analyzed. From the analyzed studies (n=26), 20 were excluded for not meeting the criteria for inclusion, and only 6 studies were classified as high methodological quality, scoring an overall 4 points according the PEDro scale.

Conclusion: The PFMT seems to be effective in treating UI in older women; the Oxford Grading Scale and manometry are considered the most reliable in the random and controlled clinical trials results. However, future investigations with high methodological quality with older women are necessary to support these results.

Keywords: urinary incontinence; pelvic floor muscles training; Oxford Grading Scale; manometry

Introduction
Urinary incontinence (UI), according to the International Continence Society (ICS), is defined as a condition of any involuntary loss of urine.1–2 Although not considered a cause of morbidity or mortality, UI has a serious negative impact on aspects of the social, emotional, and well-being life of the population, and may even result in depression, isolation, and physical inactivity, affecting the health-related quality of life.3,6–12

The prevalence of UI increases with age; it is estimated that 20% to 40% of the older women present involuntary loss of urine.11,14 Stress urinary incontinence (SUI) is the most common type of UI in women; this type of voluntary urine loss occurs during coughing, sneezing, and exertion.12,15,16

In the pathophysiology of UI, several risk factors such as increased age, obesity, pregnancy, menopause, pelvic surgeries, postmenopausal estrogen deficiency, and collagen fibers decrease. These are the causes of the weakening of the pelvic floor muscles (PFM).9,15

The atrophic changes that occur with aging of PFM through endocrine, enzymatic, neural, and energetic alterations are possibly genetically driven, resulting in the reduction of muscle mass by degradation and its replacement by adipocytes, contributing to the weakening of the pelvic floor (PF).15,16

Studies have shown with advancing age the functional and anatomical deterioration of PFM striated muscles could be at the origin of UI.16,18 Exercise practice seems to contribute to a better PF function, as reported in Ree et al study, arguing that physical exercise potentiates the volume of PFM making them more capable of contraction during abdominal pressure.19

Sherburn et al15 reported that with advancing age the maximum urethral closure pressure and the number of per urethral fibers decreased, being a risk factor for UI development, due to changes in PF structures and their response to increase in intra-abdominal pressure.

Some studies have shown that the pelvic floor muscles training (PFMT) is highly effective in the treatment of PF dysfunctions, and it is considered a first-line therapy, covering 56% to 75%...
success rates in the treatment of SUI and mixed urinary incontinence (MUI).9–11,20,21

The PFMT is based on 3 primary objectives: strengthen PFM, improves the mechanism that allows urethral closure, and inhibits the reflex contraction of the detrusor muscle in the MUI.5 According to some authors, as reported in Bernards et al,9 Bø,22 and Hay-Smith et al,23 the PFMT is based particularly on the increase of force (maximum force generated by a muscle in a single contraction); endurance (ability of continuous contractions or maintain muscle contraction over a longer period of time); and coordination of muscle activity (precontraction of PFM anticipating an increase in intra-abdominal pressure), adherence, and motivation to the treatment program.

Evaluation of PFM’s function and strength is fundamental to instruct and obtain feedback regarding the participant’s ability to contract PFM, as well as to evaluate changes in the parameters in question. The intervention program aims to verify the effectiveness of the protocol. There are several methods of evaluating PFM function such as digital palpation, manometry, ultrasound, electromyography, and magnetic resonance imaging.10 However, according to the International Association of Urogynecology (IUGA) and ICS, it recommends the evaluation of voluntary contraction and relaxation of PFM through digital palpation and manometry.4,10 Digital palpation is considered a simple, inexpensive method, golden-standard, and mostly used in the evaluation of PFM contraction capacity. Laycock and Jerwood24 developed through the digital palpation, the Oxford Grading Scale, that aims to evaluate and grade the PFM contraction capacity. The Perineometer is considered a high reproducibility method, and mostly used in the study of pelvic floor activity.10 Likewise, manometry (also known as perineometry) evaluates the contraction of PFM, but more objectively through an intravaginal balloon device. The Perineometer is considered a high reproducibility method, and widely used in conjunction with other methods to analyze PFM activity.9,10,24

The aim of this study is to systematize the scientific evidence regarding the effects of PFMT in older women through the evaluation of the function and strength of the PFM, and determination of the maximum voluntary contraction through Oxford Grading Scale and manometry.

Methods

This study consisted of systematizing the scientific evidence on the effects of PFMT in older women, analyzing the function and strength of PFM through the Oxford Grading Scale and manometry. A systematic review of publications was carried out from 2003 to 2016.

Inclusion and exclusion criteria

From the screening of all titles and abstracts, the articles were read completely, assessing the eligibility according to the following inclusion criteria: randomized controlled trials; PFMT as a dependent variable including participants with UI; older women; articles in English language; methodological quality assessed by PEDro Scale with a class 2; 11,20,21 3 studies used manometry as an evaluation method. Of the selected studies, 1 study reported to assess maximal vaginal squeeze pressure and holding time through a manometer1; 1 study evaluated the contractility of PFM using a vaginal probe of surface electromyography;1 and 1 study assessed the average maximum intravaginal pressure by a perineometer.54 The articles selected for the elaboration of the systematic review are represented in Table 2.

Discussion

This systematic review demonstrates that independently of the type of UI, PFMT is recommended by ICS as a first-line conservative therapy in older women, and is fundamental to
increase strength and correct contraction of PFM.\textsuperscript{8–10} However, it is essential to evaluate the function and strength of PFM, before and after, the PFMT to determine the effects of the established training protocol. The physical evaluation is considered fundamental in the determination of UI and should include visual analysis of the urogenital region, vaginal palpation, and verification of the function of the PFM.\textsuperscript{9,10,23}

There are several methods to evaluate the function and strength of PFM, but digital palpation and manometry are considered the standardized and highly reproducible methods in the clinical evaluation.\textsuperscript{4}

Digital palpation is fundamental in the PF evaluation process. The determination of muscle strength and endurance provides indispensable information about the condition of the muscular

**Table 1**

| References          | Ea  | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | Total |
|---------------------|-----|----|----|----|----|----|----|----|----|----|----|-------|
| Hung et al, 2010    | +   | +  | +  | +  | -  | +  | +  | +  | +  | +  | +  | 8     |
| Tibaek et al, 2005  | +   | +  | +  | +  | -  | -  | +  | +  | -  | +  | +  | 7     |
| Alves et al, 2015   | +   | +  | +  | +  | -  | -  | +  | -  | -  | +  | +  | 6     |
| Camargo et al, 2009 | +   | +  | +  | +  | -  | -  | -  | -  | +  | -  | +  | 6     |
| Spruijt et al, 2003 | +   | +  | +  | +  | -  | -  | -  | -  | +  | +  | +  | 5     |
| Ailam et al, 2008   | +   | +  | -  | +  | -  | -  | -  | -  | +  | -  | +  | 4     |

Ea: eligibility criteria; 01: randomization; 02: allocation of subjects; 03: similar groups in concern important prognosis indicators; 04: blind subjects; 05: blind therapists; 06: blind evaluators; 07: adequate follow up; 08: intention of treatment; 09: comparison between groups; 10: estimated points and variability; +: the criteria is clearly satisfactory; -: the criteria is not satisfactory; ?: it is nuclear if the criteria is satisfactory; a: eligibility criteria did not contribute to the overall score.
Table 2: Characteristics and main results of the included studies

| References               | Aim                                                                 | Study design                  | Population                      | Intervention                                                                                       | Parameters assessed                                      | Results                                                                 |
|--------------------------|----------------------------------------------------------------------|--------------------------------|---------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------------|
| Hung et al, 2010         | Investigate the effect of breathing in coordination with the transverse abdominal muscle and PFMT | RCT; 4 mo of intervention; pre-post test | n=70                            | EG: PFMT supervised (n=35); CG: (n=35); 18-65 y                                                | Urine Journal (3 d); Pad Test (20 min); Vis Analog Scale | EG presented better results in decreasing UI higher than 90% when compared to CG. EG improvement in quality of life compared to CG. However, the PFMT maximum contraction force presented a slight decrease in both groups. |
| Tibak et al, 2009        | Evaluate the effect of PFMT in women with UI                           | RCT; 3 mo of intervention; pre-post test | n=24                            | EG: PFMT supervised (n=12); CG: (n=12); 40-65 y                                                  | Urine Journal (3 d); Pad Test (24 h); Digital palpation; Oxford Grading Scale. | EG presented improvements in the results of Urine Journal, Pad Test, and digital palpation when compared to CG. PFMT demonstrated improvements in UI in EG |
| Alves et al, 2015        | Investigate the effectiveness of PFMT in increasing PFM contractility and decreased POP as well as UI when compared to EMG in postmenopausal women | RCT; 6 wk of intervention; pre-post test | n=30                            | EG: Group of 12 sessions of PFMT, 2x/wk, each session with 30 min duration; CG: physical activity with 1-h sessions without PFMT | EMG; Oxford Grading Scale; ICIQ-UI-SF; ICIQ-OB; ICIQ-VS; POP-Q; Visual Analog Scale | Effectiveness of PFMT contractility, decrease in UI and POP after PFMT program when compared to CG |
| Camargo et al, 2009      | Compare the effectiveness of PFMT with group treatment and individual treatment | RCT; 12 wk of intervention; pre-post test | n=60                            | EG: PFMT performed in a group 2x/wk, each session lasting 45 min. CG: PFMT performed individually based on the PERFECT assessment scheme | Oxford Grading Scale; Pad Test; Urine Journal (7 d); KOH | Both groups had a significant decrease in UI, as well as improvements in the PFM strength, and in the participants’ quality of life. There were no differences between the 2 groups. |
| Spruijt et al, 2003-16   | Evaluate the effectiveness of intravaginal EMG, and to verify if it is the preferential treatment of the older women with UI Determine the effectiveness of bladder training exercises and PFMT in older women living in nursing homes | RCT; 8 wk of intervention; pre-post test | n=35                            | EG: EMG intravaginal supervised (n=24); CG: PFMT at home without any type of supervision (n=1); 72 y (EG) and 74 y (CG) | Pad Test (48 h); Urodynamics study; PRAFAB Scale; manometry | Both groups presented a decrease in UI, but the CG presented better results (36.4%) compared to the EG (29.2%). EMG presented several limitations, such as: physical and emotional cost, duration of treatment, is invasive, and not preferred by the participants. The EG presented better results in decreasing UI compared to CG. EG presented significant results both in the Pad Test and in the frequency and urgency of mucination after 8wk of intervention. Nocturia showed improvements after 6 wk of intervention. The study verified the effectiveness of PFMT in reducing UI in women living in nursing homes |

CG = control group; EG = experimental group; EMG = electromyography; ICIQ-OAB = International Consultation on Incontinence Questionnaire Overactive Bladder; ICIQ-UI-SF = International Consultation on Incontinence Questionnaire Short Form; ICIQ-UI-VS = International Consultation on Incontinence Questionnaire Vaginal Symptoms; PFAD-SF = International Physical Activity Questionnaire Short Form; NHQ = King’s Health Questionnaire; PF = pelvic floor; PFMT = pelvic floor muscle training; POP = pelvic organ prolapse; POP-Q = pelvic organ prolapse quantification system; RCT = randomized controlled trial; UI = urinary incontinence.
strength of the patient, which allows the physiotherapist to establish a specific training program appropriate to the patient.\(^{5,10}\)

All studies selected showed improvements in UI symptoms; however, the results of PFM evaluation are divergent. In the study performed by Hung et al.,\(^{53}\) 70 women were randomly allocated in a training group (TG) and control group (CG). The TG was subjected to individual clinical visits twice a month during 4 months and a training program that consists of exercises: diaphragmatic breathing; tonic activation of transversus abdominis and PFM; strengthening of transversus abdominis, PFM and internal oblique; functional expiratory exercises; and impact activities. The subjects in CG followed the oral instruction and the normal information that was composed of UI, bladder hygiene, and PFMT program. The participants performed self-monitored PFMT program at home. PF assessment was performed by a physiotherapist through digital palpation to assess maximal voluntary contraction, and teach women to contract PFM correctly. Together, it was performed through manometry in which participants were instructed to contract PP 3 times, taking into account the last 2 contractions (mean of the 2 measurements). Although there was improvement in PFM strengthening in the treatment group when compared with the CG, a slight decrease in the maximum contraction pressure (effect size 0.36) was observed through manometry. This can be explained by the fact that the patient cannot maintain the PFM’s maximum contraction for a long time, keeping only enough to hold the device. Studies indicate that increased abdominal pressure resulting from abdominal transverse contraction may cause PFM to weaken in women with UI.\(^{57}\) Hung et al\(^{53}\) advocate that physiotherapists supervise the co-contraction of the abdominal transverse with PFM, to prevent PFM weakening resulting from increased intra-abdominal pressure.

Camargo et al\(^{56}\) evaluated the PFM maximum strength through Oxford Grading Scale. The endurance has been defined as a time interval of up to 10 seconds, where a maximum vaginal contraction may be maintained before a force decreases to approximately 35% or more occurs. Another hypothesis indicator of muscular fatigue is the simultaneous contraction of the adductor muscle of the hip, buttocks, and a strong co-contraction of the transverse abdominal. According to the principle of the biomechanics of the pelvic structure, Alves et al\(^{51}\) believe that PFMT should not only be based on PFM but should also highlight the interaction and harmony of all the structures that are involved in the function of PF.

Some authors suggest that there is not a correlation between strength weakening during a maximal voluntary contraction of PFM and UI symptoms. However, in the study Da Roza et al\(^{44}\) reported a significant moderate correlation between the Oxford Grading Scale score and peak pressure on manometry (\(r=0.646, P=.002\)).

Despite improvements in the decrease in UI, some authors point out limitations to the study of Hung et al.,\(^{53}\) one of which was the fact that most participants did not present involuntary loss of urine at the baseline. In addition, both groups did not receive a structured PFMT program. Another limitation of the investigation was that participants in the CG were instructed how to perform the PFM exercises protocol on one occasion, without continuous supervision or feedback, for that reason the control intervention was not considered the best practice.\(^{5}\)

In the study of Tibbäck,\(^{55}\) Oxford Grading Scale was used in the evaluation of the maximum voluntary contraction and 3 measurements were made, being considered only the best result. Mattiasson and Tibbäck,\(^{55,58}\) refer to digital palpation as a simple and important method that provides the necessary information about the structure and function of PF, compared with electromyography and manometry. The Oxford Grading Scale is considered a simple, low-cost, and widely used method in clinical practice, which presents as its main disadvantage subjectivity by including only 1 examiner.\(^{55}\) Alves et al\(^{51}\) observed an increased strength and contractility of PFM after the PPMT program in the TG, evaluated both by digital palpation (\(P=.001\)) and electromyography (\(P=.003\)).

Vaginal electrical stimulation does not seem to be the most effective treatment for UI reduction. Spriujt et al\(^{44}\) verified through manometry, there is no significant improvement in urinary loss in women treated with vaginal electrostimulation, when compared with the group submitted to PFMT. Vaginal electrostimulation presents several limitations, such as physical and emotional cost, duration of treatment, and invasive.

One of the criticisms attributed to the Oxford Grading Scale is the difficulty in obtaining valid and reproducible measures because it is not able to correctly classify women who present diminished muscle strength when compared with pressure measurement (manometry). To limit this difficulty, it is suggested to associate with other methods of evaluation, such as manometry and ultrasound.\(^{56}\) Camargo et al\(^{56}\) reported that one of the limitations of their study was the assessment of PFM function and strength. The validity and reproducibility of the evaluation is very difficult to reach only by digital palpation, requiring a more objective evaluation such as manometry, to better understand the relationship between PFM strength and involuntary loss of urine in the research area, but in clinical practice digital palpation is considered a standard method.

In the study performed by Aslan,\(^{52}\) it was verified that there was an improvement in UI comparing the PFMT group to the CG, but it was limited in its sample because 30% of the older women did not accept to be evaluated by digital palpation as well as by manometry. The selected test was the digital palpation and performed with repetitions of 4 to 5 times, not being mentioned how the measurements were calculated.

Several studies have demonstrated good intrarater reproducibility using manometry with intragroup correlation; the mean coefficient ranges from 0.88 to 0.97 in the maximal voluntary contraction, but few studies have reported inter-rater reproducibility.\(^{45,59}\) Although the limited sample size, in the study by Da Roza et al\(^{44}\) with a group of young nulliparous athletes with UI, compared the maximum pressure values of manometry with the scores of the Oxford Grading Scale, determined a moderate inter-rater reproducibility of 0.65, considering differences between the measures of maximum voluntary contraction between continent and incontinent women. Another limitation of the study was that the data obtained should only be validated for young athletes and the results should be different in older women with PF dysfunctions. In the study by Hung et al.,\(^{53}\) the test–retest reproducibility of manometry was established as being good with a correlation coefficient of 0.95.

Currently, the assessment of PFM strength and function seems to be better when determined through a combination of observation, palpation, and vaginal tightening pressure. There are several factors that make it difficult to evaluate the function of PF among which stand out, location of the PF within the pelvic cavity, volume and anatomy. To overcome this problem, we may have the association of other methods such as ultrasonography and magnetic resonance.\(^{10}\)
Digital palpation is a very common procedure in the evaluation of PFM contraction in pelvic dysfunctions. Although it is a subjective assessment, the Oxford Grading Scale is a qualitative method (if there was contraction or not), useful, low cost and simple to perform. Digital palpation is adequate for clinical evaluations. Proper testing of the patient, standardization of instruction, motivation, and the patient’s position are key issues in order for the test to occur properly.

Manometry is the method chosen when evaluating the strength of PFM because it is considered less invasive, without risk of infection and more reliable to use in research assessment when compared to urodynamic evaluation. However, both methods require a lot of experience and training of the examiner due to the variation of sensitivity by the test taker.10

The evaluation of PFM is essential in clinical practice as in scientific research, but there are limitations to studies, such as the number of evaluations of maximum voluntary contraction. Some of these studies do not mention the calculation of these measurements. The rest time between evaluations is divergent. The existence of having an examiner or more may be a factor of subjectivity. The different types of instruments may be a confounding variable in the results of the evaluation of the maximal voluntary contraction of PFM. Although it is considered a first-line treatment in the prevention of urogynecological dysfunctions, and the literature has shown that PFM have high success rates in the treatment of PF dysfunction, studies conducted in PFM are still scarce and present some methodological problems (eg, insufficient sample, nonappropriate study designs). These limitations prevent the establishment recommendations regarding the type, frequency, and duration of training, thus standardized PFM protocols are required.

Conclusion

In conclusion, the Oxford Grading Scale and manometry are methodological quality that compare the results of the Oxford Grading Scale with manometry evaluation in older women. The authors report no conflicts of interest.

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