

Predictors of Success for Physiotherapy Treatment in Women With Persistent Postpartum Stress Urinary Incontinence

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ABSTRACT. Dumoulin C, Bourbonnais D, Morin M, Gravel D, Lemieux M-C. Predictors of success for physiotherapy treatment in women with persistent postpartum stress urinary incontinence. *Arch Phys Med Rehabil* 2010;91:1059-63.

Objective: To identify predictors of success for physiotherapy treatment in women with persistent postpartum stress urinary incontinence (SUI).

Design: Secondary analysis of data from a single-blind randomized controlled trial comparing 2 physiotherapy intervention programs for persistent SUI in postpartum women.

Setting: Obstetric clinic of a mother and children's university hospital.

Participants: Women, ages 23 to 39 (N=57), were randomized to 1 of 2 pelvic floor muscle (PFM) training programs, 1 with and 1 without abdominal muscle training.

Intervention: Over 8 weeks, participants in each group followed a specific home exercise program once a day, 5 days a week. In addition, participants attended individual weekly physiotherapy sessions throughout the 8-week program.

Main Outcome Measures: Treatment success was defined as a pad weight gain of less than 2g on a 20-minute pad test with standardized bladder volume after 8 weeks' treatment. The relationship between potential predictive PFM function variables as measured by a PFM dynamometer and success of physiotherapy was studied using forward stepwise multivariate logistic regression analyses.

Results: Forty-two women (74%) were classified as treatment successes, and 15 (26%) were not. Treatment success was associated with lower pretreatment PFM passive force and greater PFM endurance pretreatment, but the latter association was barely statistically significant. This model explained between 23% (Cox and Snell R^2) and 34% (Nagelkerke R^2) of the outcome variability.

Conclusions: The results contribute new information on predictors of success for physiotherapy treatment in women with persistent postpartum SUI.

Key Words: Muscle strength; Pelvic floor; Postpartum period; Rehabilitation; Urinary incontinence, stress.

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STRESS URINARY INCONTINENCE is an important health issue affecting up to 24% of postpartum women.^{1,2} Women who develop SUI during pregnancy or puerperium, without a remission 3 months after delivery, have a significant risk of symptom persistence 5 years later.³ Thus, this high-risk subgroup requires special attention.

A Cochrane systematic review⁴ concludes that PFM training is effective in the treatment of persistent postpartum UI; it is also recommended by the 2008 *International Consultation on Urinary Incontinence* as the first-line treatment for persistent postpartum SUI.⁵ Pelvic floor physiotherapy uses graded muscle training, either alone or in combination with biofeedback, electrical stimulation, and vaginal cones to rehabilitate and strengthen the PFM.⁵ Pooled data from good high-quality randomized controlled trials have found that 3 months postpartum, women are 20% less likely to have SUI after treatment than the controls (relative risk, .79; 95% confidence interval, .70–.90).⁴

To date, however, it has been difficult to identify, pretreatment, incontinent postpartum women who would most benefit from PFM physiotherapy. Although many studies have reported on factors that might influence or predict the outcome of therapy in the general population of women with SUI,^{6–9} only a few have done so on postpartum women.^{10,11} Glazener et al¹⁰ found that neither the type (SUI or mixed UI) nor the severity of the UI at baseline predicted the outcome immediately after an intervention. Further, in a 6-year follow-up study by the same authors,¹¹ outcome could not be predicted by UI type, severity, or whether or not women reported a subsequent delivery.

Thus far, no study has yet examined PFM function prior to treatment in terms of factors that might influence or predict the outcome of physiotherapy in women with postpartum SUI. The objective of PFM training is to improve PFM function (passive force [ie, muscle tone], strength, coordination, endurance)^{12,13} thus, theoretically, it should also be effective in treating UI that is associated with PFM dysfunction.^{12,13} We also know that women experiencing UI as a secondary condition to aponeurotic degradation or denervation are unlikely to respond positively to this form of treatment.¹⁴ Moreover, using PFM dynamometry, differences in the PFM function have been shown to

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List of Abbreviations

PFM	pelvic floor muscle
SUI	stress urinary incontinence
UI	urinary incontinence

exist between continent and incontinent young and middle-aged women in terms of passive force, rapidity of contraction, and even endurance.¹⁵ Therefore, it may be possible to identify PFM function predictors that will enable a distinction to be made between those women most likely to respond to physiotherapy and those who will not.

Thus, the purpose of this study was to identify PFM function predictors of success for physiotherapy treatment in women with persistent postpartum SUI. Data from a single-blind randomized controlled trial that compared 2 physiotherapy intervention programs for persistent postpartum SUI was used to characterize participants according to a number of PFM function variables with a potential to influence and, hence, to predict treatment outcomes. The relationships between these variables and treatment outcomes were explored using a forward stepwise multivariate logistic regression analysis.

METHODS

This report is a secondary analysis of data from a single-blind randomized controlled trial comparing 2 physiotherapy intervention programs for women with persistent postpartum SUI.¹⁶ Fifty-seven women with SUI participated in the original randomized controlled trial. All of the participants followed the same PFM training program; however, 29 received additional abdominal muscle training. The data from all 57 women have been included in this analysis.¹⁶

After approval of the hospital's ethics committee, participants were recruited by means of a UI questionnaire handed out during their annual gynecological visit (2001–2003) at Sainte-Justine Hospital's obstetrics clinic. When UI was reported on the questionnaire, a telephone interview was completed to determine the person's eligibility; participants had to be under age 45, 3 months or more after their last delivery, breastfeeding or not, have SUI symptoms at least once a week, and be willing to participate in the study. Women with the following conditions were excluded: a history of SUI onset prior to pregnancy or delivery, previous surgery for SUI, and a neurologic, psychiatric, and/or a major medical condition or medication that could interfere with the evaluation or treatment. Pregnancy and the inability to understand instructions in French or English were also reasons for exclusion.

Participants were then scheduled for an evaluation to confirm their SUI condition. The evaluation consisted of a standardized urodynamic evaluation, a modified 20-minute pad test¹⁷ in which 10 jumping jacks were substituted for the standard jumping exercises, and a digital examination.¹⁸ Candidates with a urinary tract infection, a moderate to severe urogenital prolapse (pelvic organ prolapse quantification [PopQ]>stage II),¹⁹ involuntary detrusor contractions during cystometry, an abnormal bladder function (residual volume over 50mL), less than 5g of leakage as measured by the pad test, or an inability to contract their PFMs were excluded from the study.

Participants were stratified according to the severity of incontinence (2 groups: those with 5–10g and those with >10g of urine loss, based on the pad test) and parity. They were then randomized within strata. Block randomization was used to assure similar-sized groups. Over 8 weeks, both groups followed a PFM training program at home either with or without an abdominal exercise program, once a day, 5 days a week. In addition to the home exercise program, participants also attended individual once-a-week physiotherapy sessions throughout the 8-week program. Each physiotherapy session consisted of (a) 15-minute electrical stimulation of the PFM (stimulating-current characteristics: biphasic rectangular form, frequency 50Hz, pulse width 250 μ s, duty cycle: 6 seconds on

and 18 seconds off for the first 4 weeks and 8 seconds on and 24 seconds off for the last 4 weeks, maximal tolerated current intensity); followed by (b) a 25-minute PFM exercise program with biofeedback, which included strengthening²⁰ and motor-relearning exercises²¹; and, depending on the group, with or without (c) a 30-minute deep abdominal muscle training program.²² The treatment protocol was divided into 2 steps, each lasting 4 weeks, allowing for progression in the treatment. Details for both the home exercise program and the individual physiotherapy sessions with or without the deep abdominal training were published previously.¹⁶

Treatment success, using the modified 20-minute pad test after the treatment, was defined as a pad weight gain of less than 2g with a standardized bladder volume (300mL). Construct validity and test-retest reliability of the modified 20-minute pad test were established in reference to the study's target population.²³

Seven pretreatment PFM function parameters were identified as possible predictors of treatment outcomes. These parameters were chosen because they provided a good overview of PFM function at different muscle lengths and/or, as demonstrated in an earlier study, effectively differentiated between continent and incontinent young and middle-aged women.^{15,16,24-27} Using analysis of covariance, and controlling for age and parity, the parameters revealed significant differences between continent and incontinent women.¹⁵

Measurements for the 7 PFM parameters were taken using the following pre-established protocol: (a) PFM passive force taken with the dynamometer closed (19-mm vaginal aperture), (b) PFM maximum strength taken with the dynamometer closed (19-mm vaginal aperture), (c) PFM passive force taken with a 1-cm dynamometer opening (24-mm vaginal aperture), (d) PFM maximum strength taken with a 1-cm dynamometer opening (24-mm vaginal aperture), (e) PFM maximum rate of force development (or rapidity of contraction) taken with a 1-cm dynamometer opening (24-mm vaginal aperture), (f) number of rapid PFM contractions in 15 seconds taken at a 1-cm dynamometer opening (24-mm vaginal aperture), and (g) PFM endurance as estimated by the area under the force curve during a 90-second contraction test taken with a 1-cm dynamometer opening (24-mm vaginal aperture).²⁵⁻²⁷

The parameters were measured using a PFM speculum, the Montreal dynamometer, which is composed of 2 aluminum branches (the speculum) equipped with strain gauges, allowing PFM static forces to be measured at different muscle lengths.²⁴ Psychometric properties of this device have been studied previously in young and middle-aged women as part of a broader research study, one that included an acceptability study, a test-retest reliability trial, and a discriminant validity study.²⁵⁻²⁷

Statistical analysis was conducted using SPSS version 15 for Windows.^a Univariate analysis was used to test the relationships between the potential predictor variables (the 7 parameters) and treatment outcomes. Variables in the univariate analysis that indicated a relationship to outcome (*P* at or below .15) were screened for multicollinearity; those without multicollinearity were kept. In order to be entered into a multivariate logistic regression model, each of the independent variables had to have a bivariate correlation lower than .7 with the other independent variables.²⁸ When a bivariate correlation of .7 or more was found, only 1 of the 2 independent variables was included in the model.²⁸ Treatment outcome was defined as either a success or failure based on a pad test result. For the purpose of this analysis, successful outcome was defined using a modified 20-minute pad test after treatment (a pad weight gain of less than 2g with a standard bladder volume of 300mL);

Table 1: Baseline Characteristics of the Study Sample (N=57)

Characteristic	Statistical Outcome
Demographics	
Age (y)	35.93±3.62
Body mass index (kg/m ²)	24.13±4.59
Births (n)	2.09±0.84
PFM function	
PFM passive force with the dynamometer closed (19-mm vaginal aperture) (N)*	1.13±1.04
PFM maximum strength with the dynamometer closed (19-mm vaginal aperture) (N)*	3.68±1.97
PFM passive force with 1-cm dynamometer opening (24-mm vaginal aperture) (N)*	1.99±2.01
PFM maximum strength with 1-cm dynamometer opening (24-mm vaginal aperture) (N)*	5.51±3.30
PFM maximum rate of force development with 1-cm dynamometer opening (N)*	5.96±4.66
Rapid PFM contractions in 15s (24-mm vaginal aperture) (n)	8.98±2.86
PFM endurance with 1-cm dynamometer opening (24-mm vaginal aperture) (N ²) [†]	86.54±60.70
Incontinence severity classification	
Pretreatment pad test (g)	34.49±54.76
Pretreatment urinary leakage (total number/wk)	5.75±7.07
Pretreatment visual analog scale score	6.71±2.29
Pretreatment Urogenital Distress Inventory score	11.19±5.31
Pretreatment Incontinence Impact Questionnaire score	21.86±15.67

NOTE. Values are mean ± SD.

*Values are Newtons.

[†]Values are Newtons squared.

any value equal to or higher than 2g was considered to be a failure.

RESULTS

Fifty-seven postpartum women, ages 23 to 39 (35.93±3.62), with SUI were treated using PFM physiotherapy. Participant characteristics are presented in table 1.

Pad test scores improved significantly ($P<.001$) in both of the pelvic floor exercise groups—those with and without abdominal treatment. However, according to the pad tests, the change scores were not statistically different between the 2 groups. When combining pad test results for both treatment groups after 8 weeks of physiotherapy intervention, 42 women (73%) were successful and 15 (26.3%) were not.

In the univariate analysis, women with a lower preintervention PFM passive force, as measured with a closed (19-mm vaginal aperture) and a 1-cm dynamometer opening (24-mm vaginal aperture), were significantly more likely to be continent (on pad testing) than those with a higher preintervention PFM

passive force ($P=.04$, $P=.02$). Other factors ($P\leq.15$) considered in the logistic regression analysis included lower PFM maximal strength with a closed dynamometer (19-mm vaginal aperture) ($P=.07$) and higher PFM endurance with a 1-cm dynamometer opening (24-mm vaginal aperture) ($P=.08$). Because of multicollinearity, all of the above variables were retained for logistic regression except the preintervention PFM passive force measured with a closed-dynamometer variable.

In the logistic regression analysis, successful treatment for persistent SUI in postpartum women was associated with 2 predictors: negatively with pretreatment PFM passive forces at a 1-cm dynamometer opening (24-mm vaginal aperture) and positively with pretreatment PFM endurance, as estimated by the area under the force curve during a 90-second contraction test with a 1-cm dynamometer opening (24-mm vaginal aperture), but the latter association was barely statistically significant. There was a good model fit with a chi-square of 13.83 ($P=.001$) indicating that 2 predictors, as a set, reliably distinguished between continent and incontinent women. This model, containing 2 of the 7 PFM function parameters, explained between 23% (Cox and Snell R^2) and 34% (Nagelkerke R^2) of the outcome variability. When the full model was applied, the success rate increased from 75.5% to 83%, only a moderate improvement.

Table 2 contains the regression coefficients, odd ratios with 95% confidence intervals for each of the predictors. According to the findings, women with a lower PFM passive force at a 1-cm dynamometer opening prior to PFM training were more likely to be continent after PFM training (50%), while those with a higher pretreatment PFM endurance at a 1-cm dynamometer opening showed only a marginal change in the likelihood of becoming continent after PFM training (2%). Finally, 47 of the 57 participants (83%) would have been correctly classified according to this model.

DISCUSSION

This study explored a number of PFM function variables thought to influence the outcome of physiotherapy treatment for women with postpartum SUI, thus having potential as pretreatment indicators. The study examined individual variables or combinations thereof that could be used to identify, pretreatment, those postpartum SUI candidates most likely to benefit from physiotherapy training with the goal of establishing useful indicators that would enable practitioners to direct patients to the intervention option most appropriate to their condition.

Multivariate regression analysis revealed that only 2 of the baseline PFM function variables that were studied had any significant relationship to treatment outcome for postpartum women with persistent SUI. The analysis found that treatment was more likely to be successful in women who pretreatment demonstrated lower PFM passive force and higher PFM endurance.

In line with these results, a previous study by our research team comparing the PFM function of continent and incontinent

Table 2: Logistic Regression Model for Successful Physiotherapy Treatment in Women With Persistent Postpartum SUI (Pad Test <2g)

Variable	Estimated Coefficient	Odds Ratio	95% Confidence Interval	P
Pretreatment PFM passive forces at a 1-cm dynamometer opening (24-mm vaginal aperture)	-0.693	0.50	0.301-0.830	.003
Pretreatment PFM endurance with 1-cm dynamometer opening (24-mm vaginal aperture)	0.020	1.02	1.003-1.037	.023

premenopausal women, using the Montreal dynamometer, had already identified passive force as a significantly different variable between the 2 groups.¹⁵ An uncontrolled magnetic resonance imaging reconstruction study had also demonstrated that a significant reduction in the internal surface area of the levator ani at rest can be observed after PFM training, suggesting that lower passive force can be increased by pelvic floor physiotherapy treatment.²⁹ Moreover, a magnetic resonance imaging study by Hoyte et al³⁰ demonstrated that women with SUI showed lower PFM volume, PFM laxity, and bladder-neck descent in comparison with asymptomatic women. These studies appear to support the importance of PFM passive force or tone in the maintenance of continence as well as the rationale that PFM training improves PFM passive force and may facilitate more effective automatic motor-unit firing of the PFM, thus preventing PFM descent during increased intra-abdominal pressure, which in turn prevents urine leakage.⁹

The relationship between successful outcome and having a higher pretreatment PFM endurance score may be explained by the type of PFM program offered.^{31,32} Local muscular endurance has been shown to improve when the individual (1) performs high repetition exercise sets (ie, long-duration sets in which the muscle is subject to low-resistance tension and high time-under-tension) and/or (2) minimizes the rest period between the sets.³³ Neither of these techniques were used as part of the study's exercise programs; instead, the study used maximum-tension strengthening exercises with short-duration sets followed by a good rest period between the sets. Although a relationship exists, to a certain extent, between increased strength and local muscular endurance,³⁴ specificity in training has been shown to produce the greatest improvement.³¹⁻³³ Consequently, our exercise program may have favored those participants with a higher initial endurance; that is, participants with a low PFM endurance may have had a greater chance at achieving a successful treatment outcome if an endurance-orientated PFM program had been used (one with a high number of repetitions and a minimal rest period between sets).³¹⁻³³

The other PFM function variables selected as potential predictors showed no significant relationship to treatment outcome in the regression analysis. PFM maximum strength with a 1-cm dynamometer opening (24-mm vaginal aperture) showed no relationship to continence outcome. This is not surprising given the important variability in the maximal strength values between the women as measured by dynamometry prior to treatment.¹⁶ Interestingly, in a study by Wilson et al⁸ in 1987 that looked at responders to PFM physiotherapy in a population of women with SUI, the initial perineometer reading indicative of a subject's PFM strength was not identified as a significant factor associated with a successful treatment. In contrast, in a study by Bø and Larsen⁹ in 1992 looking at responders to PFM exercises in a general population of women with SUI, treatment responders had statistically significantly higher increases in PFM strength and stronger PFMs after the training period than nonresponders.⁹ However PFM force, in Bø's study,⁹ was indirectly measured by a pressure probe and was composed of both passive and active PFM forces.⁹ The difference in the measures and the measurement instrument could explain the difference in the results. Finally, PFM maximum strength taken with a closed dynamometer (19-mm vaginal aperture) was unrelated to outcome. This was also the case for the PFM maximum rate of force development as measured with a 1-cm dynamometer opening (24-mm vaginal aperture) and the number of rapid PFM contractions completed in 15 seconds at a 1-cm dynamometer opening (24-mm vaginal aperture).

Study Limitations

Sample size was an important limitation in this study. Aside from the PFM function variables already included, the study would have benefited from including preintervention predictors that have been identified as being related to a successful treatment outcome of SUI physiotherapy in a general population of women with SUI.⁵⁻⁸ However, in this study, the number of predictors used in the multivariate model was limited because of the size of the study.

As stated by Tapp et al³⁵ in 1988 and Bø in 1992,⁹ it may be impossible to identify responders or nonresponders to treatment using only one parameter.

This study focused exclusively on the PFM parameters, because these had never been studied as a unique set of predictive variables—a necessary prerequisite in establishing which of them offered the greatest potential. In future studies, using the 2 PFM function variables that we identified as predictors in combination with 1 or more pretest parameters, it may yet be possible to find a combination of parameters that together will improve a practitioner's ability to discriminate between treatment responders and nonresponders. Factors such as parity,⁷ symptom duration,^{5,7} or intensity (such as the number of incontinence episodes per day),⁷ and the use of pads,⁸ motivation,⁵ and women's body mass index^{5,7} (all of which have been established as possible prognostic factors to a successful outcome of physiotherapy treatment in the general population of women with SUI) could be introduced in the model. Further, factors related to the identification of SUI etiology, such as the Valsalva leak-point pressure or urethral closure pressure, might also prove to be good predictors of outcome. In future, a broader study, one encompassing the factors described in this section in addition to PFM passive force and endurance prior to treatment, and the subject's adherence to the physiotherapy intervention could shed light on the characteristics of those women with postpartum SUI who are most likely to benefit from physiotherapy treatment.

CONCLUSIONS

Overall, the results of this study indicate that the successful outcome of physiotherapy treatment in women with persistent postpartum SUI is associated with less pretreatment PFM passive force and greater PFM endurance, but the latter association is barely statistically significant. More studies are needed to identify pretreatment prognostic factors for postpartum physiotherapy treatment for persistent incontinence in which the passive force and endurance of PFMs should be included.

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