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The Effect of Postpartum Pelvic Floor Muscle Exercise in the Prevention and Treatment of Urinary Incontinence

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Abstract: The aim of this study was to evaluate the effect of postpartum pelvic floor muscle exercise in the prevention and treatment of urinary incontinence. A prospective comparison design of 99 matched pairs ($n = 198$) of mothers, a training group and a control group, was used. Eight weeks postpartum the training group attended an 8-week intensive pelvic floor muscle exercise course, training in groups led by a physical therapist for 45 minutes once a week. In addition they were asked to exercise at home at least three times per week. The control group followed the ordinary written postpartum instructions from the hospital. Pelvic floor muscle strength was measured pretreatment at the eighth, and post-treatment at the 16th week after delivery, using a vaginal balloon catheter connected to a pressure transducer. Vaginal palpation and observation of inward movement of the balloon catheter during contraction were used to test the ability to perform correct the pelvic floor muscle contraction. Urinary leakage was registered by interview, specially designed instruments to measure how women perceive SUI, and a standardized pad test. At baseline (8 weeks postpartum) there was no significant difference in the number of women with urinary incontinence in the training group compared to the control group. At 16 weeks postpartum, after the 8-week treatment period, there was a significant ($P < 0.01$) difference in favor of the training group. In addition, a significantly greater improvement in pelvic floor muscle strength between test 1 and test 2 was found in the training group compared to the control group. The results show that a specially designed postpartum pelvic floor muscle exercise course is effective in increasing pelvic floor muscle strength and reducing urinary incontinence in the immediate postpartum period.

Keywords: Pelvic floor muscles; Physical therapy; Postpartum exercise; Prevention; Strength training; Urinary incontinence

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Introduction

Pregnancy and vaginal delivery have been considered the main risk factors in the development of urinary incontinence (UI) [1,2,3]. Although UI has been demonstrated in nulliparous women [4], a higher prevalence has been shown in parous women [5–7].

As early as in 1948 Kegel [8] emphasized the value of pelvic floor muscle (PFM) exercise in restoring function after childbirth. As a consequence of his studies, women in most industrialized countries have been encouraged to engage in postpartum PFM exercise to prevent and treat UI [9]. However, in spite of the lapse of some 50 years, the effects of postpartum PFM exercise to strengthen the pelvic floor and prevent and treat UI have been sparsely documented. We have been able to find only two prospective studies evaluating the effect of postpartum PFM exercise in the prevention and treatment of UI [10,11]. Comparing two training groups, Sleep and Grant [10] found no significant difference in reported UI after 4 weeks PFM training. On the other hand, Dumolin et al. [11], in an uncontrolled study of 8 women, found a 92% increase in vaginal pressure and a significant reduction in UI after pelvic-floor neuromuscular electrostimulation combined with exercises.

Both PFM strength and UI are difficult to measure, and the reliability and validity of the methods used in previous studies can be questioned. Bø et al. [12] concluded that an inward movement of the perineum must be visually observable during PFM contraction for the vaginal pressure measurement to be considered valid. This criterion has not been applied in previous studies.

Another flaw in previous studies is the training protocols applied to improve PFM strength [13]. The general recommendation for strength training is three to four sets of 8–12 high-resistance, slow-velocity contractions three times per week [14]. In some rehabilitation situations, however, maximum contraction – or overload – is not possible, and more frequent training sessions are necessary and are often more desirable. Bø et al. [15] demonstrated that the strength training protocol significantly influenced the increase in PFM strength and reduction in stress urinary incontinence (SUI).

The function of the PFM is to keep the bladder and the urethra within the intra-abdominal cavity [16.17], and also to support them during increased abdominal pressure [18]. The theory behind PFM exercise in the treatment of SUI is that a strong and fast contraction of the PFM will prevent descent of the urethra and increase urethral pressure during abrupt rises in intra-abdominal pressure. DeLancey [19] has suggested that during PFM contraction the urethra is pressed against the pubic symphysis, producing a mechanical pressure rise.

The purpose of the present study was to evaluate the effect of an intensive postpartum PFM exercise course [15] on the prevention and treatment of UI in the immediate postpartum period.

Materials and Methods

A prospective comparison design comprising 99 matched pairs (n = 198) of mothers was used. All women in a particular Norwegian community, delivering at the local hospital during a 1-year period, were assigned to the study's training group. A matched control group was formed of women from a neighboring community, delivering at the same hospital within the same period. The criteria for matching were age (±2 years), parity (1, 2, 3, 4 ⩾ deliveries) and type of delivery (normal vaginal, forceps, vacuum, elective cesarean section).

Eight weeks postnatally, 212 women (66%) gave their written consent to participation in the study. Five women assigned to the training group dropped out immediately after the first test, 2 were unable to attend the second test, 2 lacked control persons and 3 were excluded because of chronic illness. Hence, the final study group consisted of 99 matched pairs (n = 198), mean age 28 years (range 19–40) and mean number of deliveries 1.8 (range 1–5). Ninety pairs had had normal vaginal deliveries, one forceps, three vacuum and five elective cesarean sections.

The study was approved by the Regional Medical Ethics Committee.

PFM Exercise Protocol

All women were individually instructed in pelvic floor anatomy and how to contract the PFM correctly. Feedback – knowledge of results and performance – was provided by the physical therapist. The training group followed a specially designed PFM exercise course, training with a physical therapist in groups of 5–10 participants for 45 minutres once a week for a period of 8 weeks. In addition, they were asked to perform 8–12 maximum PFM contractions twice a day at home. The physical therapist encouraged the participants to contract the PFM as hard as possible and to hold the contraction for 6–8 s. At the end of each contraction three to four fast contractions were added [15]. The frequency of exercise was recorded in a training diary. Participant motivation was strongly emphasized by the therapist.

The control group received the customary written postpartum instructions from the hospital. These included encouragement to perform daily contractions of the PFM. Participants were not discouraged from performing PFM exercise on their own between test 1 (8 weeks after delivery) and test 2 (16 weeks after delivery).

Evaluation

Structured Interview. All subjects were asked about the prevalence of UI before pregnancy, during pregnancy and postpartum. UI was registered both in accordance with the ICS definition and in more general terms. The question was, 'Do you leak urine at any time: never, seldom, weekly or daily?' In addition they were asked about breastfeeding, menstruation, participation in physical activities, and PFM exercise during pregnancy, between birth and test 1, and between test 1 and test 2.

Pad Test. All participants performed a standardized test, designed for this study. After voiding the women drank 1 l of water within 30 minutes. They wore a preweighed pad and jumped up and down for 30 s, jumped with the legs in alternate abduction and adduction for 30 s, and coughed three times. After the test the participants voided, the volume was measured and the pad was weighed.

Test–retest reliability was tested in 7 women before starting. The correlation coefficient was 0.97 (P = 0.0003). The cut-off for a positive pad test was 2 g.

Social Activity Index and Leakage Index. Two instruments designed to measure how women perceive SUI, tested for reproducibility [20], were used before and after treatment. The leakage index is a 5-point scale (1 = never, 5 = always) containing 13 types of physical exertion known to trigger urinary leakage. The social activity index contains nine social settings in which women may have problems with participation. For each characteristic, a 10 cm visual analogue scale (0 = impossible to participate, 10 = no problem to participate) was used. Test–retest reliability was 0.92 ($P<0.01$) and 0.94 ($P<0.01$) for the leakage index and the social activity index, respectively [20].

Urodynamic Assessment. To exclude those with detrusor instability, all women with UI were asked to participate in urodynamic testing at test 1: 42 out of 94 women agreed. After bladder emptying and the measurement of residual urine, a double-sensor microtip catheter with filling lumen (Camtech AS, Sandvika, Norway) was introduced into the bladder and urethra. Cystometry was performed with saline, using a filling rate of 50 ml/min. The bladder was filled to subjective capacity or a maximum of 300 ml. Two urethral pressure profiles were registered as the catheter was retracted at a speed of 2.5 mm/sd when the the women coughed repeatedly. Urethral closure pressure was recorded simultaneously. Any visible leakage during coughing was recorded.

PFM Function. Vaginal palpation was used to assess ability to perform PFM contraction. The women were in the supine position with legs straight. One finger was used for palpation. No observable synergistic contraction of other muscles was accepted.

Measurement of PFM Strength. A vaginal balloon catheter (balloon size 6.7 × 1.7 cm) connected to a pressure transducer (Camtech Ltd, 1300 Sandvika, Norway) was used to measure vaginal pressure during PFM contractions. The middle of the balloon was positioned 3.5 cm inside the introitus. Only contractions with observed inward movement of the balloon catheter were accepted. The method has been found to be reliable and valid [12].

Statistical Analysis. Except for frequencies all results were expressed as median values with 95% confidence intervals (CI). Wilcoxon's signed ranks test for matched pairs was used for comparison within and between groups. Categorical data were analyzed by the χ^2 test. A significance level of 5% was accepted.

Results

There were no significant differences in background variables before the training period (Table 1). During pregnancy, and in the period from delivery to test 1, the control group exercised more frequently than the training group. In the period between test 1 and test 2 the training group exercised more frequently than the control group (Table 1). All participants in the training group had performed PFM exercises three times per week or more between the two tests. Fifty percent of the participants in the training group performed daily PFM exercise, and the others had exercised no less than 3 days each week. Sixty-five out of 99 participants in the control group had performed PFM exercise 3 days per week or more.

PFM strength at test 1, was significantly higher ($P<0.01$) in the control group (median: 9.3 cmH_2O,

Table 1. Background variables in the training group (TG) and the control group (CG)

Background variables: frequencies	TG n=99	CG n=99	P value
Breastfeeding at test 1	97	91	0.3338
Breastfeeding at test 2	86	86	1.0000
Menstruation at test 1	11	12	0.8447
Menstruation at test 2	31	25	0.3438
Leisure physical activity at test 1	25	25	1.0000
Leisure physical activity at test 2	43	45	0.7748
PFM exercise during pregnancy	35	57	0.0017*
PFM exercise between delivery and test 1	65	83	0.0032*
PFM exercise between test 1 and test 2	99	65	0.0000*

*$P<0.05$

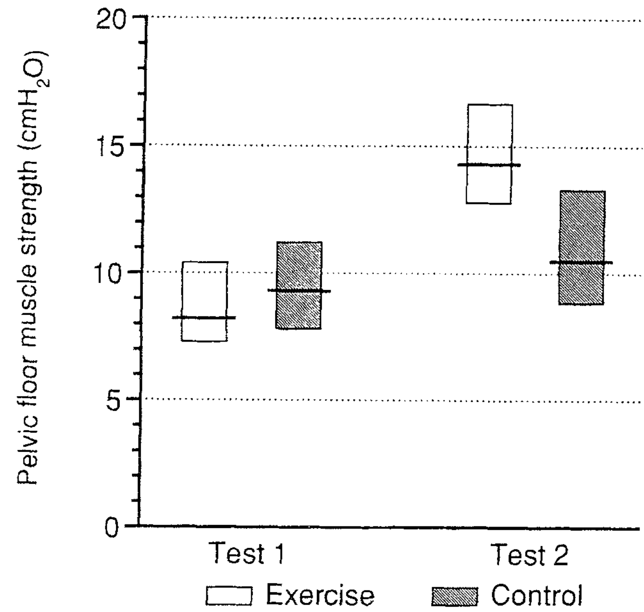

Fig. 1. Pelvic floor muscle strength measured by vaginal squeeze pressure in the training and control groups before and after the intervention period. Median and 95% confidence interval.

Table 2. Number of women with urinary incontinence (UI) registered in the structured interview in the training group (TG) and the control group (CG) at test 1 and test 2

Urinary incontinence: frequencies	TG n=99	CG n=99	P value
Test 1 8 weeks postpartum	**41**	**42**	**0.8855**
< Once per week	28	32	
< Daily ≥ once per week	6	7	
≥ Daily	7	3	
Test 2 16 weeks postpartum	**14**	**28**	**0.0149***
< Once per week	13	21	
< Daily ≥ once per week	0	7	
≥ Daily	1	0	

*$P<0.05$

Table 3. Number of women with stress urinary incontinence (SUI), registered by pad test, in the training group (TG) and the control grtoup (CG) at test 1 and test 2

Urinary incontinence: frequencies	TG n=99	CG n=99	P value
Test 1 8 weeks postpartum	20	17	0.5844
Test 2 16 weeks postpartum	3	13	0.0091*

*$P<0.05$

95% CI: 7.8–11.2) than in the training group (median: 8.2 cmH_2O, 95% CI: 7.3–10.2) (Fig. 1). At test 2, PFM strength had increased significantly in both groups. However, the improvement was significantly greater ($P<0.01$) in the training group (median: 5.3 cmH_2O, 95% CI: 4.5–6.6) than in the control group (median: 0.8 cmH_2O, 95% CI: 0.3–1.7) (Fig.1).

Eight weeks after delivery (before the treatment period) there was no significant difference in the number of women with UI registered by structured interview, between the training group and the control group. After the 8-week treatment period more women in the control group than in the training group reported UI ($P<0.01$) (Table 2).

Two women in the training group and 7 in the control group developed UI in the period between the tests.

Also, assessed by pad test, there was no statistically significant difference between the groups concerning the number of participants with UI measured by pad test before treatment. Nevertheless, the difference between groups was statistically significant ($P<0.01$) post-treatment (Table 3). The cut-off for a positive pad test was 2 g.

At test 1 there was no significant difference in the degree of leakage registered by pad test in the training group (mean 2.4 g, SD 9.6) and the control group (mean 2.2 g, SD 6.6). At test 2 the difference between training group (mean 0.09 g, SD 0.6) and control group (mean 1.3 g, SD 4.5) was statistically significant ($P<0.01$).

Measured by the leakage index and the social activity index, no statistical significant difference between the groups was demonstrated, neither at test 1 nor at test 2.

Forty-five percent of the women with UI at test 1 agreed to participate in urodynamic assessment. There was no detrusor instability in any of the participants in any of the urodynamic tests.

Discussion

In the present study an intensive exercise group improved PFM strength and reduced the prevalence of UI significantly more than a control group, after 8 weeks of postpartum exercise. In addition, the results indicated a lower incidence of UI in the training group than in the control group, in the period between the 8th and 16th weeks after delivery.

All the participants in the training group had performed PFM exercise 3 days per week or more between the two tests. The results indicate that postpartum UI may be successfully treated with PFM exercises in most women. However, 15% of the women in the training group still were incontinent at test 2, in spite of exercising, raising the question as to why the exercises did not prevent UI or cure it in all women in this group. Severe damage to the pelvic floor during delivery, e.g. peripheral nerve damage or rupture of muscle fibers and/or connective tissues, may be one explanation [3,21,22]. Another may be the overstretching of the supporting ligaments [23].

The theoretical basis for PFM exercise to treat and prevent UI is based on the muscular changes that may occur after specific strength training. These changes are assumed to be neural adaptation during the first 6–8 weeks and muscle hypertrophy after a further period of strength training [14]. The training period in the present study was only 8 weeks, and therefore neural adaptation – i.e. more effective motor units and increased frequency of excitation – most probably caused the increase in strength. PFM strength training may have caused more effective action of the remaining motor units, and thereby a reduction in UI in 33 of the 48 participants in the training group. In the 15 participants with persistent UI, development of muscle hypertrophy might be necessary to reduce UI. The training period in the present study may have been too short to achieve muscle hypertrophy: a prolonged exercise period might therefore have improved the results.

The training protocol and the measurement methods used in the present study were the same as used by Bø et al. [15] in another study population. In Bø et al.'s study an intensive exercise group demonstrated higher improvement in PFM strength after 8 weeks of exercise than was demonstrated in the present study. However, this group was exercising every day, and muscle hypertrophy also depends on the frequency and intensity of the training [14]. In addition, the difference may indicate that there is another progression in PFM strength increase following training in the postpartum period.

In the present study the control group had exercised more frequently than the training group both during pregnancy and in the period between delivery and test 1 (8 weeks postpartum), and had stronger PFM at baseline. Sixty-five out of 99 participants in the control group reported performing PFM exercises 3 days per week or more between tests 1 and 2. In spite of this, the training group demonstrated significantly greater improvements in PFM strength than the control group at test 2 (16 weeks postnatally). This indicates that strength training of the PFM has to be intensive to be effective. This is supported by the results of studies in genuine stress incontinent women [15,24].

In the present study there was a difference in the number of women with UI registered by self-report, and SUI objectively assessed by the pad test. The validity and reproducibility of the registration and evaluation methods used can be questioned. Concerning the self-report, the women's daily life experiences with UI were registered. During daily life women may experience a variety of situations that trigger urinary leakage even more than performing the stress test (pad test). Also, some might have reported incontinence caused by urge. The pad test was not performed with a standardized bladder volume. According to Krajl [25] and Lose et al. [26], tests without a standardized bladder volume are less reproducible.

The ICS standardization committee has recommended that both subjective and objective outcome measures should be used to evaluate the degree of UI [27]. However, for the moment there is no consensus about what outcome measures to choose. In the present study the result of the pad test was not the only indicator of UI. Prevalence and degree of UI was registered in a structured interview, with the women themselves describing the prevalence. In a review article Bø [13] emphasized the importance of the women's own evaluation. In addition to the structured interview, two instruments that give detailed information about how women perceive UI before and after treatment were used. The results of the leakage index showed no statistically significant change between the groups. Also, the results of the social activity index indicated that the perceived urinary leakage had very little influence on these women's participation in the social activities mentioned. The instruments used have been tested and been found to be reproducible [20]. Nevertheless, some of the questions being used may be less useful for women in the postpartum period: for example, questions about high-impact aerobics and high intensity running are not helpful because women seldom perform such activities in this period. The social activity index registers problems with participating in different social situations, e.g. at work, while dancing, attending educational courses, or during sexual activity. In Norway women receive a full salary to stay at home with their babies for the first 10 months after childbirth. None of the participants therefore had gone back to work, and many women had not attended all of the aforementioned social situations in the questionnaire, at the time of this investigation.

As far as can be ascertained, only one other research group has measured PFM strength and registered the prevalence of UI before and after a postpartum PFM exercise course [11]. Dumolin [11] assessed PFM strength and UI both before and after a physical therapy program of pelvic-floor neuromuscular electrostimulation combined with exercises. A 92% increase in vaginal pressure and a significant reduction in UI were measured in a group consisting of 8 women with postpartum UI. A major limitation of the study was the small sample size and the lack of a control group.

It is difficult to make comparisons between the results of the present study and previous studies because the methods of measuring PFM strength and UI, and the training protocol, differ. The results of the present study cast some doubts on the efficacy of postpartum PFM exercise in the way it is taught in hospitals today. Women in the postpartum period seem to need strong motivation and close follow-up if exercise is to be maximally effective. It is essential that future services for women after childbirth should be organized according to results from controlled clinical trials.

Conclusion

The results demonstrate that a specially designed postpartum PFM exercise course is effective in increasing PFM strength and reducing urinary incontinence in the immediate postpartum period. They also show that the success of postpartum PFM exercise depends on their frequency and intensity. This requires a more intensive follow-up of the participants than the written information given at many hospitals today.

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EDITORIAL COMMENT: This paper is one of only a few looking at the efficacy of a rigorous pelvic floor muscle exercise training regime to help women with incontinence in the postpartum period. Whether or not these results will translate long-term into a lower incidence of urinary incontinence as these women age, is unknown, and may never be known. However, this paper points out that there is a definite benefit from pelvic floor muscle exercise for the treatment of postpartum incontinence, and we can use this information to more strongly counsel our patients in the use of these exercises.