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# Pelvic Floor Muscle Exercise after Delivery with or without the Biofeedback Method: An Intervention Study

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## Abstract

**Objective:** The aim of this study was to explore the strength of the pelvic floor muscles after delivery by performing pelvic floor muscle exercises using the biofeedback method, with and without supporting visits and to compare with a conventional method. Further, to explore the objective measurement by EMG (electromyography) of the contracting ability of those with weakest pelvic floor muscle strength and compare the effect of the intervention.

**Methods:** An intervention study, where 150 recently delivered women were consecutively selected, at their first postpartum visit, into one of three groups.

**Results:** There was no significant difference between the three groups in pelvic floor muscle (PFM) contraction at 6-months. Analysis of a subgroup of women (n = 42), who had the poorest ability to contract their PFM with Periform®, controlled by EMG (<17.5 μV) at the first visit postpartum, showed that there was a statistical difference between group I (n = 15) and group III (n = 15) at the six month control (p = 0.010), where group III had significantly better objective results of the strength in their PFM. Significantly more women in groups II (n = 11 of 12) and III (n = 14 of 15) increased their PFM strength (p = 0.005 and 0.001), respectively.

**Conclusion:** Women with a poor ability to contract their PFM had better results regarding the strength of their PFM when they exercised using the biofeedback method with the Periform® instrument compared to those who exercised without it. Motivation and support from the midwife had a positive impact on the results.

**Keywords:** Biofeedback; Postnatal care; Pelvic floor muscle exercise; Support; Urinary stress incontinence; Women's health

## Introduction

Urinary incontinence (UI) is defined by the International Continence Society (ICS) as "the complaint of any involuntary leakage of urine" [1]. In the report from the Swedish Council on Technology Assessment in Health Care (2000), UI is highlighted as a serious public health problem, which affects about half a million people, two-thirds of whom were women [2]. A large cross-national study in Europe reported that 35% of women (>18 years) self-reported UI [3]. Pregnancy and childbirth strain the pelvic floor muscles (PFM) and can lead to permanent weakness and damage resulting in stress urinary incontinence (SUI) [4-7], defined as a complaint of involuntary leakage of urine on effort or exertion, or when sneezing or coughing [8].

The prevalence of SUI after pregnancy ranges from 7.9-44% depending on the definition, material and method used [3,4]. However, a Swedish study among 2390 women found a prevalence of 22% reporting SUI one year after childbirth, of whom 2% found the symptoms troublesome [9]. The main risk factors for SUI are vaginal delivery, multiparity and obesity [5-10]. Even caesarean section [4,11] and epidural anaesthesia during delivery are predisposing factors for SUI [6,10]. Existing literature diverges on whether SUI during pregnancy is a risk factor for constant incontinence after delivery or not [12,13]. The involuntary leakage of urine is not only a hygiene problem but also the cause of social and psychological suffering that negatively affects daily life, leisure time and sexual activity [14-16]. Many women suffer in silence and are reluctant to seek help as they are ashamed of the condition itself and find it difficult to seek professional help [17-19]. It is therefore very important to prevent SUI and to offer adequate treatment to reduce or cure the problem among women for both physical and psychological reasons.

More than 50 years ago, Kegel introduced pelvic floor muscle exercise (PFME) as a therapy for urinary incontinence [20]. There is evidence that PFME results in the increased strength of the pelvic floor muscles and that incontinence can be improved or cured [21-23]. In addition, intensive PFME during pregnancy prevents UI during and after delivery [22,23]. However, the degree to which a woman will succeed with PFME has shown to depend partly on the severity of their incontinence, the exercise instruction she receives, her level of motivation and the quality of the follow-up she is given [21,22]. Earlier research has shown that correct PFME is difficult to teach if only brief verbal and written instructions have been offered. This has resulted in less than 40–50% of the study participants being able to contract their PFM successfully [24]. Furthermore, health care professionals often have limited knowledge about what type of PFME, should be offered to women during pregnancy as well as postpartum [25]. With biofeedback treatment of PFM, women are trained to improve their pelvic floor muscles strength by observing the signals given by their own body [26].

The aim of the biofeedback method using Periform® by EMG

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(electromyography) is to provide a further sensory contribution for the women so that they can teach themselves, by reading off the instrument display, how appropriate effort can affect their pelvic floor activity. A pelvic floor contraction indicator is used in combination with the Periform® probe to enhance the therapy. The indicator demonstrates a correct contraction by pointing downwards when the pelvic floor contracts, which shows the user how to use the right muscles and teaches her how to do correct muscle contraction [26,27].

The National Board of Health and Welfare in Sweden provides national regulations and recommendations for antenatal care (ANC) throughout the country. The national guidelines are interpreted at the regional level and adapted locally in each health care district. Midwives working at an ANC in Sweden are responsible for the routine care of the pregnant women which includes giving parental educational classes and offering at least one visit to the ANC after delivery. The postpartum visit takes place about eight to twelve weeks postpartum and includes a gynaecological inspection and an examination [28].

The aim of this study was to explore the strength of the pelvic floor muscles after delivery by performing pelvic floor muscle exercises using the biofeedback method, with and without supporting visits and to compare with a conventional method. Further, to explore the objective measurement by EMG of the contracting ability of those with weakest pelvic floor muscle strength and compare the effect of the intervention.

## Methods

The study was designed, as an intervention study at a university hospital in the south of Sweden. Three study groups were created: Group I acted as a control group where the women received only written and verbal instructions on how to exercise their PFM at home, i.e. using the conventional method as practised in Swedish clinics today. In group II, the women received the same written and verbal instructions as group I complemented with instructions for exercising their PFM, at home, using the biofeedback instrument Periform®. Group III received the same information and instructions as group II but were also offered three additional visits (at 12, 14 and 18 weeks postpartum) to the midwife for support and, if necessary, instructions for the adjustment of their exercise programme. At these additional visits EMG assessed measurements of the PFM's strength and endurance were performed.

The participants were both primi- and multipara women who were recently delivered and were able to communicate in Swedish. Inclusion criteria was also that they had received antenatal care from one of three midwives who were trained to teach how to use and exercise with the biofeedback Periform® instrument. Women with uterine manifest prolapse or UI who needed to be referred for medical assessment by a physician were excluded, as well as women with contraindications towards the use of the Periform® instrument. Recruitment to the study was performed during the 33rd–34th week of gestation. The participants received both written and verbal information about the study and their informed consent was obtained. At the first postpartum visit, e.g. eight to twelve weeks after delivery, the women who had given their written and verbal consent to participate were consecutively selected into one of three groups. According to advice related to gathering statistics, each group required at least 30 women. For the selection process, opaque envelopes with slips of paper marked I, II or III were thoroughly shuffled. All three of the midwives received an equal number of envelopes and the recruitment was performed consecutively. At her to the first postpartum visit each woman was given the envelope next in turn. A random inclusion was added before the examination of the woman, which was that the existing PFM strength of the participant was to be unknown to the instructing midwives (Figure 1).

Firstly a pilot study was carried out using ten women in order for the instructing midwives to test and learn how to use the Periform® instrument in order to ensure its reliability. In this study, the Periform® probe was used as an 'educator' to assist the participating women with their home exercises, and further to measure the strength and endurance of their pelvic muscles.

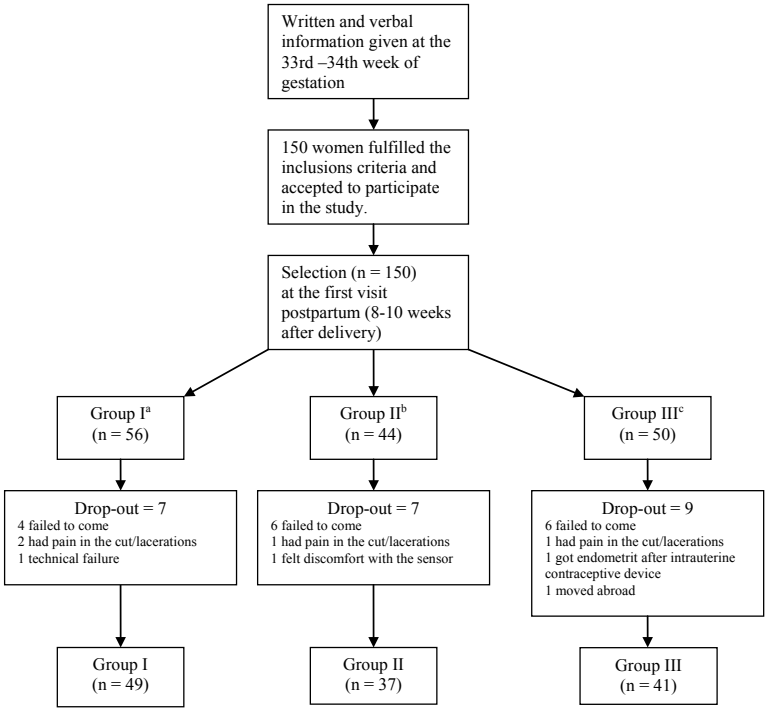


**Figure 1:** Flowchart of participants through each stage of the selection. [a]Control; [b]Biofeedback instrument; [c]Biofeedback instrument and supporting visits.

The pelvic muscle contraction was estimated both objectively and subjectively. The objective measuring was performed using the Periform® instrument to measure the EMG for both the strength and endurance of the PFM. The subjective measuring was performed by the midwife checking the vaginal palpation. The woman was instructed to make a contraction with her PFM during the palpation. Muscle contraction was described either as "no perceptible contraction", "weakly perceptible contraction", or "moderate contraction" i.e., pressure could be felt around the midwives fingers and lastly, the description "strong contraction" meant that there was firm resistance against the midwives fingers when lifted upwards and inwards.

The strength and endurance of the PFM were measured in all three participant groups at their first visit and at their follow-up visit six-months postpartum. All of the women in the groups were recommended to exercise at home by making 15 contractions, twice a day [29]. At their first visit postpartum, the participants were asked to answer a structured questionnaire with background information including their self-reported UI and PFME, the questionnaire was also used again at the six month control. The UI was measured by asking the following question: Do you have difficulties to control your urine? The response alternatives were: Yes or no. In addition, the same question was used to inquire if the urine leakage had existed before or began during pregnancy. The Research Ethics Committee of Lund University approved the study (LU 780-02) and permission was given by the Swedish Data Inspection Board.

## Data Analysis

Body Mass Index (BMI) was calculated from the woman's height and normal weight before pregnancy. In accordance with the WHO definition, a BMI of less than 18.5 is viewed as being underweight, 18.5-24.9 as normal weight, 25-30 as pre-obesity and more than 30 is defined as obese [30]. For data analysis, the variables were dichotomised into BMI ≤ 25 and BMI > 25. The three groups were compared at baseline in order to assess any potential imbalance. The Kolmogorov-Smirnoff test was used to determine that the PFM contraction was not normally distributed; therefore, nonparametric methods were used. Pearson's chi-squared test ($\chi^2$) was used to estimate statistical differences in the nominal data. To examine for eventual differences in the women between the measurements of the strength of their PFM at their two main visits to their ANC, the Wilcoxon signed ranks test (WSR Z) was performed as a paired test. The Kruskal-Wallis test (K-W) was used to examine possible statistical differences between the three study groups concerning the EMG results for numerical data. Further, the Mann-Whitney U-test (M-W Z) was used to examine differences between pairs of groups. The Bonferroni method was used to adjust the significance level in multiple testing [31]. Analyses were performed on the one-third of the total sample who had the poorest ability to contract their PFM at baseline and controlled by EMG, where the cut off was at <17.5 μV. The result was statistically significant when $p \leq 0.05$.

## Results

150 participants were recruited for the study, of these 23 (15%) dropped out before the six month post-partum follow-up (Figure 1). The total number of women in the final analysis was 127 (85%). Out of 31 (24.5%) women, 16 who were primipara and 15 who were multipara, reported that they had UI. There were no significant differences between the groups except for that of self-reported UI at the first postpartum visit ($p = 0.013$) (Table 1).

PFM strength measured by EMG increased in each group ($p < 0.001$), but there was no statistically objective difference between the groups. There was a trend between the groups regarding the frequency of PFME six months after the delivery in favour of group II and III ($p = 0.05$). Seven of the 14 women who experienced UI at the six month control did not report any problem at baseline (i.e., the first postpartum visit, eight to twelve weeks after delivery) (Table 2).

Of the women who noted that they had experienced UI at the first visit postpartum (n = 31), twenty- four were continent at the six months postpartum and there was no significant differences between the groups. There was a significantly increased strength of the PFM measured by EMG ($p = 0.046$, 0.008 and 0.009, respectively) in all three groups.

The 42 women (1/3 of the 127 women) who had the poorest ability to contract their PFM controlled by EMG (<17.5 μV) at the first visit postpartum were analysed separately. Six months after delivery, there was a difference between group I (n = 15) and group III (n = 15) regarding the results of the strength of their PFM measured by EMG ($p = 0.010$), (Bonferroni adjusted). Significantly more women in groups II (n = 11 of 12) and III (n = 14 of 15) increased their PFM strength ($p = 0.005$ and 0.001, respectively) (Table 3).

## Discussion

In the current study, PFM exercise, with or without the biofeedback method, improved the strength of the PFM. This is in accordance with other results [22,23]. The biofeedback groups of women who had the poorest results in their ability to contract their PFM at the first visit postpartum (n = 42), had significantly increased their contracting ability at six months postpartum when compared to the control group. Another earlier study found, to the contrary, no difference between the groups whether or not they used the biofeedback method [32]. However, the participants in that study differed regarding age (they were 30–70 years) and the duration of symptoms of UI when compared to ours (ibid). It is possible that the Periform® probe helped the women to make better contact with the right PFM.

A home-based exercise period of four months, from the 8th week to six months postpartum, was used in our study. An earlier study [33] used a postpartum PFME course led by a physiotherapist where the participants had an exercise period of eight weeks beginning at the 8th week postpartum. This proved to be an effective method for increasing the strength of the PFM and reducing UI in the immediate postpartum period [33]. However, a longer exercise period for women to practise at home, as in our study, is both less time-consuming and less resource-demanding for the health care services. Furthermore, it offers privacy and protects the integrity of the women; moreover, it resulted in stronger PFM contractibility and reduced symptoms of UI. Though, the support from the midwife seemed to empower the women to

**Table 1:** Description of participants at first postpartum visit.

| Characteristics | Group I[a] (n = 49) | Group II[b] (n = 37) | Group III[c] (n = 41) | df | p-value |
|---|---|---|---|---|---|
| Age: Mean (min–max) | 29 (19–38) | 28 (21–37) | 29 (21–39) | | |
| BMI > 25 | 12 (25%) | 11 (30%) | 13 (32%) | 2 | 0.733 |
| Multiparity | 28 (57%) | 16 (43%) | 14 (34%) | 2 | 0.087 |
| Normal vaginal delivery | 39 (80%) | 34 (94%) | 35 (85%) | 4 | 0.424 |
| Episiotomy | 7 (15%) | 10 (27%) | 7 (17%) | 2 | 0.324 |
| Self-reported Uid during pregnancy | 17 (35%) | 8 (23%) | 18 (44%) | 2 | 0.157 |
| Self-reported UI[d] at the first postpartum visit | 6 (12%) | 9 (25%) | 16 (39%) | 2 | 0.013 |
| No exercise of PFM[e] | 17 (35%) | 18 (49%) | 21 (51%) | 2 | 0.233 |

[a]Control; [b]Biofeedback instrument; [c]Biofeedback instrument and supporting visits; [d]Urine incontinence; [e]Pelvic floor muscles.

**Table 2:** Outcomes at the 6-month visit for all women (n = 127).

| Outcomes | Group I[a] (n = 49) | Group II[b] (n = 37) | Group III[c] (n = 41) | Test statistic | df | P value |
|---|---|---|---|---|---|---|
| | | | | K-W[d] | | |
| Pelvic floor muscles contraction (mV): | 42.2 | 36.6 | 35.5 | 0.178 | 2 | 0.915 |
| median (min–max) | (6.5–113.7) | (8.3–96.6) | (10.2–126) | | | |
| | | | | WSR Z[e] | | |
| Increased Pelvic floor muscles contraction | 38 (78%) | | | -4.715 | | <0.001[e] |
| compared with first postpartum visit | | 32 (86%) | | -4.509 | | <0.001[e] |
| (subjectively measured) | | | 36 (88%) | -4.574 | | <0.001[e] |
| | | | | $c^2$ | | |
| Experienced difficulty contracting | | | | | | |
| pelvic floor muscles contraction | | | | | | |
| Yes | 5 (10%) | 4 (11%) | 1 (3%) | | | |
| No | 35 (73%) | 27 (73%) | 38 (94%) | 8.31 | 4 | 0.081 |
| Don't know | 8 (17%) | 6 (16%) | 1 (3%) | | | |
| Pelvic-floor training | | | | | | |
| Daily | 21 (44%) | 14 (38%) | 16 (40%) | | | |
| Often | 15 (31%) | 20 (54%) | 21 (53%) | 9.477 | 4 | 0.05 |
| Sometimes | 12 (25%) | 3 (8%) | 3 (7%) | | | |
| Experienced problems with urine incontinence* | | | | | | |
| Yes | 5 (10%) | 6 (16%) | 3 (8%) | 1.516 | 2 | 0.469 |
| No | 43 (90%) | 31 (84%) | 37 (92%) | | | |

[a]Control; [b]Biofeedback instrument; [c]Biofeedback instrument and supporting visits; [d]Kruskal Wallis; [e]Wilcoxon signed ranks test (comparison is within groups); *Seven of the 14 women who experienced UI at the six month control did not report any problem at baseline.

**Table 3:** Outcomes at the 6-month visit for women with pelvic floor muscle contraction <17.5 µV at the first visit (n = 42).

| Outcomes | Group I[a] (n = 15) | Group II[b] (n = 12) | Group III[c] (n = 15) | Test statistic | df | p value |
|---|---|---|---|---|---|---|
| | | | | K-W[d] | | |
| Pelvic floor muscles contraction (µV) (Median, Min-Max) | 12.4 | 23.1 | 24.1 | 7.43 | 2 | 0.024 |
| | | | | M-W Z[e] | | |
| Mean Rank of pelvic floor muscles contraction measured by EMG | (6.5–113.7) | (8.3–38.1) | (10.2–53.7) | 59 | | 0.130* |
| | 11.9 | 16.6 | 15.8 | 63 | | 0.188* |
| | 11.3 | 11.7 | 19.7 | 50 | | 0.010* |
| | | | | WSR Z[f] | | |
| Increased strength in pelvic floor muscles measured by Electromyography | 8 (53%) | 11 (92%) | 14 (93%) | -1.392 | | 0.164[f] |
| | | | | -2.824 | | 0.005[f] |
| | | | | -3.351 | | 0.001[f] |

[a]Control; [b]Biofeedback instrument; [c]Biofeedback instrument and supporting visits; [d]Kruskal Wallis; [e]Mann-Whitney U-test; [f]Wilcoxon signed ranks test (comparison is within groups); *Bonferroni adjusted.

continue with their health promotion. This was also demonstrated by Ciccone et al. that the strong "partnership" between the care manager and the patient had an impact on the patient health and the health-management [34]. But, that study addressed another patient group i.e. patients with heart failure and diabetes.

Over time self-reported UI improved in the groups in spite of exercise with or without biofeedback. However, significantly more women reported UI at baseline in groups II and III compared to group I (control group), which could have influenced our results negatively. Twenty-four of the women (n = 31) who were troubled by UI at their first postpartum visit reported that they were symptom free six months after delivery. However, there were 14 women who, at their six month control postpartum, stated that they were still troubled by UI in spite of exercising with or without biofeedback. Half of them (n = 7) did not report any problems with UI until their six month postpartum control. It is possible that these women felt embarrassed about their incontinence and avoided reporting this sensitive subject at baseline [14,18,19]. Shame and the fear of not being able to control urine leakage at all times can cause women a loss of confidence and lower self-esteem and even promote the feeling that they are unique in their discomfort [15,35,36].

## Limitations of the Study

The study has some limitations as no power calculations were made. However, there were more participants included in the sample than was recommended as the minimum by statistician. Further, when the participants were selected, it was not considered whether the woman was primi- or multiparae. However, there was no significant difference between the distribution of primi- and multiparae in the study at baseline. However, only a few participants had more than two children (Group I: 3; Group II: 6, Group III: 3). Significantly, more women in groups II and III than in group I (control group) reported UI at baseline. This could also have negatively influenced our results. Another limitation was that the three midwives who made the intervention also evaluated the results from the intervention. However, it also gives strength to the reliability of the study results.

A midwife working at an ANC in Sweden is in a unique position to identify women who develop UI in fertile age. The midwife has contact with the pregnant woman during the pregnancy as well as the first postpartum visit, if it has been a normal delivery, and even over a long period afterwards up until the woman reaches her menopause. Hypothetically, if shame and embarrassment are the main obstacles for women to talk about their UI, continuous contact with their midwife could be a way to overcome this. There is a good opportunity to initiate purposeful and effective PFME at the first postpartum visit. The midwife could continue to be a key person for women who have recently delivered and give them the support they need. In future, the proposed routine changes for ANC's could help fertile women, who suffer from UI, to increase their quality of life. A considerable number of studies in this area have been published, but more are needed. There is, for instance, a need to investigate the extent to which women in childbearing age possess the knowledge about how they can improve their PFM function in relation to involuntary leakage of urine.

## Conclusions

Pelvic floor muscle exercise with the biofeedback method by Periform® and especially together with supporting visits improved PFM strength. Women with a poor ability to exercise or contract their PFM achieved better results from using the method, regarding the strength of their PFM, compared to those who exercised in another

way. Therefore, it is important to identify women with a poor ability to contract their PFM at their first visit postpartum. In the study it was shown that motivation and support from the midwife had a positive impact on the results of the exercise and could therefore be implemented in the postpartum routines.

## Conflict of Interests

The authors declare that they have no competing interests as well as no economic support from Periform® Neen http://www.neenpelvichealth.com/ Patterson Medical UK except for the supply of the probes. The representatives for the company have not seen the study or its results.

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### Author Contribution

H Finnbogadóttir: Protocol/project development, Data collection and management, Data analysis, Manuscript writing/editing; MN Moghaddassi: Data analysis; K Stenzelius: Manuscript writing/editing.

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