Effect of pelvic floor muscle training during pregnancy and after childbirth on prevention and treatment of urinary incontinence: a systematic review

Siv Mørkved,1,2 Kari Bø3

ABSTRACT

Background Urinary incontinence (UI) is a common condition in women causing reduced quality of life and withdrawal from fitness and exercise activities. Pregnancy and childbirth are established risk factors. Current guidelines for exercise during pregnancy have no or limited focus on the evidence for the effect of pelvic floor muscle training (PFMT) in the prevention and treatment of UI.

Aims Systematic review to address the effect of PFMT during pregnancy and after delivery in prevention and treatment of UI.

Data sources PubMed, CENTRAL, Cochrane Library, EMBASE and PEDro databases and hand search of available reference lists and conference abstracts (June 2012).

Methods Study eligibility criteria: Randomised controlled trials (RCTs) and quasieperimental trials published in the English language. Participants: Primiparous or multiparous pregnant or postpartum women. Interventions: PFMT with or without biofeedback, vaginal cones or electrical stimulation. Study appraisal and synthesis methods: Both authors independently reviewed, grouped and qualitatively synthesised the trials.

Results 22 randomised or quasieperimental trials were found. There is a very large heterogeneity in the populations studied, inclusion and exclusion criteria, outcome measures and content of PFMT interventions. Based on the studies with relevant sample size, high adherence to a strength-training protocol and close follow-up, we found that PFMT during pregnancy and after delivery can prevent and treat UI. A supervised training protocol following strength-training principles, emphasising close to maximum contractions and lasting at least 8 weeks is recommended.

Conclusions PFMT is effective when supervised training is conducted. Further high-quality RCTs are needed especially after delivery. Given the prevalence of female UI and its impact on exercise participation, PFMT should be incorporated as a routine part of women’s exercise programmes in general.

INTRODUCTION

Current exercise guidelines recommend all pregnant women to be physically active on preferably all weekdays throughout pregnancy and to conduct both cardiovascular and strength-training exercise.1–3 The prescription for exercise is more detailed for the cardiovascular component of training than the strength-training component. This may, to some extent, be explained by the fact that there are fewer published clinical trials on strength-training programmes for pregnancy and birth outcomes than endurance training.4–5

Pregnancy and childbirth are known risk factors for weakening and injury to the perineum and pelvic floor. Stretch and rupture of peripheral nerves, connective tissue and muscles may cause urinary and faecal incontinence, pelvic organ prolapse, sensory and emptying abnormalities of the lower urinary tract, defecation dysfunction, sexual dysfunction and chronic pain syndromes.6 About 50% of women lose some of the supporting function of the pelvic floor due to childbirth,7 and recent research using ultrasound and MRI reports the prevalence of major injuries to the pelvic floor muscles of 20–26% following vaginal delivery.8–10 Hence, vaginal childbirth can be considered equivalent to a major sport injury, but has not been given the same attention concerning prevention or treatment.

Urinary incontinence is the most prevalent symptom of pelvic floor dysfunction, with the prevalence rates varying between 32% and 64%.11 Stress urinary incontinence (UI) is defined as a complaint of involuntary loss of urine during on effort or physical exertion (eg, sporting activities), or on sneezing and coughing12 and is the most common form of UI in all age groups. Prevalence rates between 4.5% (swimming) and 80% (trampoline jumping) have been found in young elite athletes.13

In the general female population, UI causes withdrawal from exercise and fitness activities and is a barrier to regular participation in physical activities.14 Surprisingly, strength training of the pelvic floor muscles is not mentioned at all in the Guidelines of the American College of Obstetricians and Gynecologists1 and only briefly mentioned in the British and Canadian guidelines. Furthermore, there are no or few references to evidence from clinically controlled trials in the existing guidelines.2–3

Two important questions are1 whether UI and other pelvic floor disorders can be prevented by training the pelvic floor muscles (PFM) before problems arise (primary prevention), or2 whether women at risk at an early stage can be identified with a view to secondary prevention using PFM training (PFMT). Reviews on PFMT in prevention of UI report inconsistent results and there seems to be some doubt about the effect.14–15 This may be due to the use of different inclusion criteria of studies and different criteria to classify studies as either prevention or treatment interventions. Some authors do not separate between antenatal or postpartum interventions,14 and there seems to be little attention paid to dose–response issues in the...
training protocols. The aims of the present systematic review were to answer the following questions.

1. Is there evidence that pregnant women should be advised to do PFMT to prevent or treat UI?
2. Is there evidence that postpartum women should be advised to do PFMT to prevent or treat UI?
3. What is the most optimal training dosage for effective antenatal and postpartum PFMT in the prevention and treatment of UI?
4. What is the long-term effect of PFMT during pregnancy and after childbirth?

METHODS
PubMed (search date June 12, 2012), the Cochrane Central Register of Controlled Trials (CENTRAL in the Cochrane Library, Wiley, Issue 6 of 12 June 2012), EMBASE (through OvidSP; 1980 to 2012, week 24) and Physiotherapy Evidence Database (PEDro, edition 12 June 2012) were searched to identify studies. Keywords used in different combinations in the search were the following: pregnancy, pelvic floor muscle, exercise, training, incontinence, after delivery, postpartum, childbirth, effect, prevention. Inclusion criteria were quasiexperimental and randomised controlled trials (RCTs) written in the English or Scandinavian languages. Both meeting abstracts and full publications were included. In addition to database searches, reference lists of selected papers and manual search in abstract books published by the World Confederation of Physical Therapy (1993–2011), International Continence Society and International Urogynecology Association (1990–2011) were undertaken.

Scoring of methodological quality was performed according to the PEDro rating scale giving one point for each of the following factors for internal validity: random allocation, comparison, report of point estimates and variability.16 The two authors independently scored the studies. Any disagreement was solved by consensus.

RESULTS
The database searches resulted in 117 references after deduplication. In addition to the studies included in the Cochrane Systematic Review 2008,15 eight new RCTs17–24 and one quasiexperimental study25 were found. Eight were short-term original studies and one20 was a 7-year follow-up study.

Pelvic floor muscle exercises during pregnancy to prevent UI including both women with and without UI
Ten RCTs,17 18 21–23 26–30 and two long-term follow-up studies31 32 were identified. In all the studies, women were recruited at 22 weeks prior to pregnancy (table 1). All the trials, except the RCT by Stafne et al.,29 included primigravid/nulliparous women. Three trials were primary prevention trials including only continent women;22 26 29 one trial included only women at risk of developing UI (with increased bladder neck mobility) and no previous UI.29 Seven studies included women who had not been selected on the basis of incontinence or risk factors.17 18 21 23 27 28 30 However, in two of these trials,23 28 results from the subgroup of women who were continent at inclusion were reported (primary prevention). PEDro scores varied between 7 and 8 out of 10 in the trials published as articles (table 5). The abstracts were difficult to score owing to limited information.

Training protocol
The exercise period started between 20 and 22 weeks of pregnancy in six studies,23 30 between 11 and 14 weeks in 122 and between 16 and 24 weeks in three trials.17 18 21 However, the length of the training period, the follow-up by health professionals, the training intensity and frequency varied.

The training protocol in all the studies, except for one,27 addressed both regular home training and follow-up (monthly and weekly) by a physical therapist with few (up to 30 contractions/day) and strong (near maximal) contractions. Hughes et al.27 used a protocol consisting of only one individual session and one group session in addition to regular home training.

In all but two studies,18 26 the control groups were not discouraged from doing PFMT on their own, but received standard care including advice about PFMT. In one trial,28 the control group was given the same individual instructions in correct PFM contraction (including vaginal palpation and feedback) as the training group. Adherence to the PFMT protocol was reported in most trials;17 21–23 26 28–30 however, different classification systems of adherence were used. No specific questionnaires/instruments to report adherence were used. Some studies used exercise diaries.23 28 29

Outcomes
Clinically relevant and statistically significant effects of the interventions were documented in seven trials,18 21 23 26 28–30 showing a significant reduction in symptoms, episodes of UI or a lower percentage of women with UI in late pregnancy or during the first 3 months after delivery. A specific preventive effect of PFMT was shown in the studies by Reilly et al.,26 Gorbea Chávez et al.26 and in the subgroup of women with no previous UI at inclusion in the trials from Mørkved et al.28 and Stafne et al.23 No adverse effects of the interventions were reported. Sampselle et al.31 found that the short-term effect was not present at 1-year follow-up. Eight years follow-up data from Reilly et al.’s26 trial showed no significant difference in UI between the original intervention and control groups.31 Mørkved et al.12 reported that the percentage of continent women in the training group was similar at 3 months and 6 years’ follow-up, while the percentage of continent women in the control group had increased in the period, and the statistically significant differences between groups were no longer present.

Pelvic floor muscle exercises during pregnancy to treat UI including only women with UI
Two RCTs,19 34 and one quasiexperimental study were found (table 2).25 Incontinent parous or nulliparous women were included. PEDro scores were 5 and 7 out of 10 (table 5).

Training protocol
The training protocols and follow-up varied. In the trial by Woldringh et al.,34 the programme consisted of three individual sessions during pregnancy weeks 23–30 and one 6 weeks after delivery, while the control group received routine care including instruction on PFMT. The dropout rate was about 50%, and the adherence to regular PFMT among the women that stayed in the training group was 77%. Dinc et al.35 addressed both regular home training and follow-up between 20 and 36 weeks of pregnancy, and few (up to 30 contractions/day) and close to maximal contractions, while the study by Sangsawang and Serisathien23 used a 6-week training programme.
Studies assessing the effect of pelvic floor muscle exercises during pregnancy to prevent urinary incontinence including both women with and without urinary incontinence at inclusion

<table>
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<th>Author</th>
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| Sampsel et al   | 2-Arm RCT       | N=72 primigravid women recruited at 20-week pregnancy. Some women had existing UI. Groups comparable at baseline. Single centre, USA | 1. Control: routine care  
2. A tailored PFMT programme beginning with muscle identification progressing to strengthening. 30 contractions/ at max or near-max intensity from 20-week pregnancy. Correct VPFMC checked | Losses to follow-up: 36 adherence PFMT:  
- 35-week pregnancy: 85%  
- 1-year postpartum: 62–90%  
Adverse events not stated.  
Partial ITT analysis  
Pad test: NS difference  
Bladder neck mobility: NS difference  
PFM strength: NS difference | Change in mean UI symptom score:  
- 35-week pregnancy : 0.20 —0.02 0.07  
- 6-week postpartum: 0.25 —0.06 0.03  
- 6-month post partum: 0.15 —0.11 0.05  
12-month post partum: 0.06 0.00 0.74  
PFM strength: NS difference (low numbers) |
| Hughes et al    | 2-arm RCT       | N=1169 pregnant nulliparous women recruited at 20-week pregnancy. Some women had existing UI. Single centre, UK | 1. Control: routine care that may have included advice on PFMT.  
2. Intervention: one individual session with physiotherapist, and one group PFMT session between 22-week and 25-week pregnancy. Home training daily for up to 11 months. VPFMC checked | Losses to follow-up:  
- 40% at 6-week postpartum  
- 27% at 3-month postpartum  
- 34% at 6-month postpartum | SUI Bristol Female Urinary Tract Symptoms  
Questionnaire:  
Self-reported UI at 3 months postpartum:  
- Control: 74/153 (48%)  
- Intervention: 48/148 (32%)  
RR (95% CI) 0.67 (0.50 to 0.89) p=0.007  
Quality of life: higher score in the exercise group p=0.004  
Pad test: NS difference  
Bladder neck mobility: NS difference  
PFM strength: NS difference  
Self-reported UI at 8 years follow-up:  
- Control: 74/153 (48%)  
- Intervention: 48/148 (32%)  
RR (95% CI) 0.67 (0.50 to 0.89) p=0.007  
Self-reported UI at 36-month postpartum:  
- Control: 36/110 (32.7%)  
- Intervention: 23/120 (19.2%)  
RR (95% CI) 0.59 (0.37 to 0.92) p=0.023  
Quality of life: higher score in the exercise group p=0.004  
Pad test: NS difference  
Bladder neck mobility: NS difference  
PFM strength: NS difference  
Self-reported UI at 8 years follow-up:  
- Control: 36/110 (32.7%)  
- Intervention: 23/120 (19.2%)  
RR (95% CI) 0.59 (0.37 to 0.92) p=0.023  
Quality of life: higher score in the exercise group p=0.004  
Pad test: NS difference  
Bladder neck mobility: NS difference  
PFM strength: NS difference  |
| Reilly et al    | 2-Arm RCT       | N=268 primigravid, continent women with increased bladder neck mobility recruited at 20-week pregnancy. Single centre, UK | 1. Control: routine antenatal care (verbal advice)  
2. Intervention: individual PFMT with physiotherapist at monthly intervals from 20-week until delivery, with additional home exercises 3 sets of 8 contractions (each held for 6 s) repeated twice daily. Instructed to contract the PFM when coughing or sneezing | Losses to follow-up at 12 months: 14% adherence PFMT:  
- 11% completed less than 28 days of PFMT  
- 46% completed 28 days or more of PFMT | Adverse events not stated  
ITT analysis  
- 38% in the intervention group were doing PFMT twice or more per week  
- 38% in the intervention group were doing PFMT twice or more per week |
| Marked et al    | 2-Arm RCT       | N=301 primigravid women recruited at 20-week pregnancy. Some women had existing UI. Three outpatient physiotherapy clinics in Norway | 1. Control: customary information from general practitioner/midwife. Not discouraged from PFMT. Correct PFM contraction checked at enrolment  
2. Intervention: 12 weeks of intensive PFMT (in a group) led by physiotherapist, with additional home exercises 10 max contractions (each held for 6 s) and to the last 4 were 3–4 fast contractions added, repeated twice daily, between 20-week and 36-week pregnancy. Correct VPFMC checked at enrolment  
Control group received information about the results of the trial and the training programme, about 1 year after delivery | Losses to follow-up 12/301(5 intervention and 7 controls).  
Adherence to PFMT:  
- 81% adherence to PFMT in the intervention group  
Adverse events not stated  
ITT analysis  
45% adherence to PFMT in both groups | Self-reported UI at 36-week pregnancy:  
- Control: 74/153 (48%)  
- Intervention: 48/148 (32%)  
RR (95% CI) 0.67 (0.50 to 0.89) p=0.007  
Self-reported UI at 36-month postpartum:  
- Control: 49/153 (32%)  
- Intervention: 29/148 (19.6%)  
RR (95% CI) 0.61 (0.40 to 0.90) p=0.018  
PFM strength: sign difference in favour of the intervention group  
UI at 6 years follow-up:  
- Control: 17%  
- Intervention: 23% p=0.276 |

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| Gorbea Chávez et al (abstract) | 2-arm RCT | 75 pregnant nulliparous continent women recruited at 20-week pregnancy. Single setting, Mexico | 1. Control: requested not to perform PFMT during pregnancy or postpartum  
2. Intervention: individual PFMT with physiotherapist. 10 VPFMC each held for 8 s each followed by 3 fast 1 s contraction; 6 s rest. Clinic appointments weekly for 8 weeks, then weekly phone calls up to 20 weeks. Biofeedback and training diary. Correct VPFMC checked. | Losses to follow-up: 3/75 (4%)  
Adherence to PFMT: 84% attended 7 or 8 physiotherapy appointments.  
ITT analyses | Urinary incontinence:  
28-week pregnancy: 17% 0 <0.05  
35-week pregnancy: 47% 0 <0.05  
6 weeks postpartum: 47% 15% <0.05 |
| Mason et al | 2-arm RCT | N=311 nulliparous pregnant women with no symptoms of SUI at 11–14-week pregnancy. Two hospitals in England | 1. Control  
2. Intervention: 45 min physiotherapy class once per month for 4 months. Additional home exercises 8–12 max contractions (each held for 6 s) and to the last 4 were 3–4 fast contractions added, repeated twice daily, between 20-week and 36-week pregnancy. Correct VPFMC checked at enrolment in most women. | Losses to follow-up: 8%  
Some significant differences between responders and non-responders  
90 women (31.4%) completed all sets of questionnaires  
91/141 (49.1%) in the intervention group attended a PFMT class  
Significantly more PFMT in the intervention group compared to the control group | Self-reported UI at 36-week pregnancy:  
1. Control: 51/96 (53%)  
2. Intervention: 24/60 (40%)  
OR (95%CI) 1.7 (0.884 to 3.269) p=0.138  
UI at 3 months postpartum:  
1. Control: 33/80 (41.3%)  
2. Intervention: 23/48 (33.8%)  
OR (95%CI) 1.374 (0.702 to 2.688) p=0.297  
No significant difference in symptoms and episodes of UI, between groups |
| Ko et al | 2-arm RCT | N=300 nulliparous women recruited at 16–24-week pregnancy. Some women had existing UI. Single centre, Taiwan | 1. Control: routine antenatal care  
2. Intervention: Individual PFMT with physiotherapist once per week between 20–36-week pregnancy, with additional home exercises three sets of eight contractions (each held for 6 s) repeated twice daily. Instructed to contract the PFM when coughing or sneezing. | Losses to follow-up: no.  
Adherence PFMT:  
87% practised PFMT at least 75% of the time  
Adverse events not stated.  
ITT analysis | Self-reported UI at 36-week pregnancy: sjekk  
1. Control: 76/150 (51%)  
2. Intervention: 52/150 (34%)  
p<0.01  
Self-reported UI at 3 days postpartum:  
1. Control: 62/150 (41%)  
2. Intervention: 46/150 (30%)  
p=0.06  
Self-reported UI at 6 weeks postpartum:  
1. Control: 53/150 (35%)  
2. Intervention: 38/150 (25%)  
p=0.06  
Self-reported UI at 6-month postpartum:  
1. Control: 42/150 (27%)  
2. Intervention: 25/150 (16%)  
p=0.04  
Significant improvement of in the intervention group in Scores on the Incontinence Impact Questionnaire and Urogenital Distress Inventory, in late pregnancy and up to 6-month postpartum |
| Bø and Haakstad | 2-arm RCT | N=105 nulliparous women recruited within 24-week pregnancy. Some women had existing UI. Single centre, Norway | 1. Control:  
2. Intervention: 12–16 weeks of aerobic exercise classes twice per week during pregnancy, including intensive PFMT (in a group) led by aerobic instructor. Additional home exercises 10 max contractions (each held for 6 s) and to the last 4 were 3–4 fast contractions added x3/day. Correct VPFMC was not checked at enrolment | Losses to follow-up:  
21/105 (10 intervention and 11 control),  
Adherence to training sessions: 40%  
Adverse events not stated  
Not IIT analysis | Self-reported UI at 36–38-week pregnancy:  
1. Control: 7/53  
2. Intervention: 9/52  
Self-reported UI at 3-month postpartum:  
1. Control: 6/53  
2. Intervention: 5/52  
No significant difference  

Outcomes

Woldringh et al.33 found no difference in UI between the intervention and control groups during pregnancy and at the follow-up at 6 and 12 months post partum. Conversely, Dinc et al.19 and Sangsawang and Serisathien25 demonstrated a significant difference in UI after the intervention period in favour of the training group, both in late pregnancy and 6–8 weeks post partum.

Pelvic floor muscle exercises after delivery to prevent UI including women with and without UI

Five short-term studies were found34–38 and in addition, long-term results from two studies39 40 have been reported (table 3). Two of the short-term studies were RCTs,34 38 one a nested RCT,42 one a quasirandomised study36 and one a matched controlled study.37 PEDro scores varied between 4 and 8 out of 10 (table 3). The studies included both primiparous and multiparous women. Chiarelli and Cockburn34 included only women with forceps or ventouse delivery or birth of a baby weighing 4000 g or more.

Training protocol

In three studies, the training period started while the women were still at the hospital,34 35 38 whereas the training started 8 weeks after delivery in the other studies. The length of the training period, follow-up by health professionals, training intensity and frequency varied. Sleep and Grant38 gave one individual session of PFMT, while in hospital, in addition to standard care and recommended to the women in the intervention group to do a specific PFMT task each week at home in 4 weeks. The 8-week training protocol in the study by Mørkved and Bø37 addressed individual instructions in PFM contractions, regular home training (2 sets of 10 near maximal contractions/day) and close weekly follow-up in groups. Meyer et al.46 added biofeedback and electrical stimulation to the 6-week PFMT programme, whereas the intervention group in the RCT by Chiarelli and Cockburn34 received individually tailored PFMT including two individual contacts with a physical therapist and thorough information. The Health Beliefs Model was used as a framework to underpin the development of a successfully implemented postnatal continence programme. In addition, social marketing strategies were implemented in the development of materials used within the programme.34 Adherence to the PFMT protocol was reported in four studies,34 35 37 38 different classification systems of adherence were used. Some studies used exercise diaries.34 37 38

Most studies compared PFMT with current standard care, allowing self-managed PFMT but not introducing supervised intervention. In one study,37 the control group was given the same individual instructions in correct PFM contraction (including vaginal palpation and feedback) as the training group.

Outcomes

Three studies34 36 37 reported clinically relevant and statistically significant effects of the interventions, with a significant reduction in symptoms or frequency of UI after the intervention period. Two trials reported no significant results of the intervention.35 38 No adverse effects of the interventions were reported. Mørkved and Bø40 found that the effect of PFMT was still present 1 year after cessation of the training programme, while Chiarelli and Cockburn demonstrated short-term effects but no difference in UI between groups at 1-year and 6-year follow-up.34 39 However, Chiarelli et al.19 reported that
Table 2  Studies assessing the effect of pelvic floor muscle exercises during pregnancy to treat urinary incontinence including only women with urinary incontinence at inclusion

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<td>1. Control: routine care. Nearly 2/3 received some instruction on PFMT.</td>
<td>Losses to follow-up %:</td>
<td>Self-reported severity of any UI:</td>
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<tr>
<td></td>
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<td>Multi centre, the Netherlands</td>
<td>2. Intervention: three sessions of individual therapy during 23–30 week pregnancy and one 6 weeks after delivery, combined with written information.</td>
<td>Control/Intervention</td>
<td>Control: 25/35 (71.4%)</td>
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<tr>
<td>Dinc et al</td>
<td>2-arm RCT</td>
<td>N=92 pregnant women recruited at 20–34 week pregnancy. All women had existing UI.</td>
<td>1. Control: Interventions: 3–16 weeks of intensive PFMT, with thorough instruction and additional home exercises between 20 and 36 weeks of pregnancy. 3 sets of 10–15 contractions 2–3 times per day. Both fast and slow (3–10 sec) contractions Correct VPFMC checked at enrolment in both groups</td>
<td>Losses to follow-up: 24/92 (6 in both groups) after first evaluation, second 12 lost to follow-up (5 intervention and 7 controls). Adherence to PFMT: ?</td>
<td>Not ITT analysis</td>
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<td></td>
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<td>Primiparous and multiparous. Single centre, Turkey</td>
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<td>Sangsa-wang et al</td>
<td>Quasi-experimental</td>
<td>N=70 with SUI at gestational age of 20–30 weeks</td>
<td>1. Control: Interventions: 6-week PFMT</td>
<td>Losses to follow-up: 4 in the intervention group</td>
<td>Severity of SUI after intervention: Significant lower frequency and amount of urine leakage and score of perceived SUI severity in the intervention group</td>
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<tr>
<td></td>
<td>design, pre-test and post-test</td>
<td>Single centre, Thailand</td>
<td>2. Intervention: PPMT</td>
<td>Adherence to PFMT: ?</td>
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ITT, intention to treat analysis; NS, non-significant; PFM, pelvic floor muscles; PFMT, pelvic floor muscle training; RCT, randomised controlled trial; RR, relative risk; SUI, stress urinary incontinence; UI, urinary incontinence; VPFMC, voluntary pelvic floor muscle contraction.

continued adherence to PFMT at 12 months was predictive of UI at that time, with less UI among women training the PFM.

Table 2: Studies assessing the effect of pelvic floor muscle exercises during pregnancy to treat urinary incontinence including only women with urinary incontinence at inclusion

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<td>Primiparous and multiparous. Single centre, Turkey</td>
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<tr>
<td>Sangsa-wang et al</td>
<td>Quasi-experimental</td>
<td>N=70 with SUI at gestational age of 20–30 weeks</td>
<td>1. Control: Interventions: 6-week PFMT</td>
<td>Losses to follow-up: 4 in the intervention group</td>
<td>Severity of SUI after intervention: Significant lower frequency and amount of urine leakage and score of perceived SUI severity in the intervention group</td>
</tr>
<tr>
<td></td>
<td>design, pre-test and post-test</td>
<td>Single centre, Thailand</td>
<td>2. Intervention: PPMT</td>
<td>Adherence to PFMT: ?</td>
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<td>Not ITT analysis</td>
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ITT, intention to treat analysis; NS, non-significant; PFM, pelvic floor muscles; PFMT, pelvic floor muscle training; RCT, randomised controlled trial; RR, relative risk; SUI, stress urinary incontinence; UI, urinary incontinence; VPFMC, voluntary pelvic floor muscle contraction.

continued adherence to PFMT at 12 months was predictive of UI at that time, with less UI among women training the PFM.

The effect of pelvic floor muscle exercises after delivery to treat UI including only women with UI

Four RCTs were found, and there were two follow-up studies (table 4). PEDro scores were between 4 and 8 out of 10 (table 5). All of the women who were included were continent, and they were recruited from 3 months to more after delivery. Both primiparous and multiparous women were included.

Training protocol
The interventions followed different training protocols. All the trials included individual instructions in PFMT. Wilson and Herbison advised the women to perform 80–100 contractions/day and introduced 3–4 follow-up sessions in the period up to 9 months after delivery. Dumoulin et al addressed close follow-up (weekly) by a physical therapist and used a training protocol including a lower number of high-intensity contractions. In the eight weekly physical therapy appointments, they included biofeedback and electrical stimulation in the training programme. Only Dumoulin et al introduced an intervention in the control group (massage), while the two other trials compared PFMT with current standard care, allowing self-managed PFMT but no control intervention. Adherence to the PFMT protocol was reported in two trials, but none of them used exercise diaries.
Self-reported UI at 16-week postpartum:
1. Control: 28/99 (28.3%)  
2. Intervention: 14/99 (14.1%)  \( p=0.015 \)

Standardised pad test:
1. Control: 13/99 (13.1%)  
2. Intervention: 3/99 (3.0%)  \( p=0.009 \)

PFM strength:
Sign difference in favour of the intervention group

Self-reported UI at 12-month postpartum:
1. Control: 31/81 (38%)  
2. Intervention: 14/81 (17%)  \( p=0.003 \)

Standardised pad test:
1. Control: 14/81 (13%)  
2. Intervention: 5/81 (3%)  \( p<0.03 \)

PFM strength:
Sign difference in favour of the intervention group

Self-reported UI 3-month postpartum:
1. Control: 22/79 (28%)  
2. Intervention: 22/81 (27%)  

RR (95% CI): 1 (0.83 to 1.20)

Adherence to PFMT:
Meyer et al

Losses to follow-up:
65% in the control group.

Adverse events not stated

All longitudinal changes were conducted using a constant sample, including the 81 matched pairs that attended all tests.

Mørkved S,

Adherence not reported

Adverse events not stated

Not ITT analysis

N=1800 postpartum women reported that they were doing PFMT between 16 weeks and 1-year postpartum.

The hospital. Not discouraged from performing PFMT on their own. Correct PFM contraction checked at enrolment.

Studies assessing the effect of pelvic floor muscle exercises after delivery to prevent urinary incontinence including both women with and without urinary incontinence at inclusion

Author Design Subjects Training protocol Losses to follow-up/adherence Outcomes (Numbers and percentage (%))

Chiarelli and Cockburn

Allocated to two groups

1. Control (n=56): no education  
2. Intervention (n=51): 12 sessions PFMT over 6 weeks with physiotherapist

N=107 primiparous women recruited 12–39-week pregnancy: 956 controls and 1651 in the intervention group had self-reported SUI. Single centre, Switzerland.

1. Control (n=56): No pelvic floor re-education offered from 2–10-month postpartum Intervention (n=51): Begun at 2-month postpartum. 12 sessions over 6 weeks with physiotherapist. PFMT followed by 20 min of biofeedback and 15 min of electrostimulation.

Losses to follow-up:
No Adherence not reported  

Adverse events not stated  

Not ITT analysis

Self-reported SUI 10-month postpartum:
1. Control: 8/56 (12%)  
2. Intervention: 6/51 (12%)/RR (95% CI): 0.82 (0.31, 2.21)

Subjects cured:  
1. Control: 15/1 (2%) \( p=1.0 \)  
2. Intervention: 10/56 (19%) \( p=0.02 \)

Bladder neck position and mobility: NS difference  

Urodynamic parameters: NS differences

Self-reported UI 3-month postpartum:
1. Control: 12/328 (38.4%)  
2. Intervention: 10/834 (31.0%)/RR (95% CI: 0.022 to 1.46%) \( p=0.044 \)

OR of incontinence for the women in the intervention group compared with control group was: 0.65 (0.46–0.91), \( p=0.01 \)

Self-reported UI 12-month postpartum:
NS difference between groups.

Practice of PFMT at 12-month promotes continence at this time

Urinary incontinence at 6-month postpartum:
1. Control: 7/171 (41%)  
2. Intervention: 7/118 (60%)/RR (95% CI): 1.28 (0.98 to 1.67%), \( p=0.10 \)

Table 3: Studies assessing the effect of pelvic floor muscle exercises after delivery to prevent urinary incontinence including both women with and without urinary incontinence at inclusion

<table>
<thead>
<tr>
<th>Author</th>
<th>Design</th>
<th>Subjects</th>
<th>Training protocol</th>
<th>Losses to follow-up/adherence</th>
<th>Outcomes (Numbers and percentage (%))</th>
</tr>
</thead>
</table>
| Sleep and Grant         | 2-arm RCT               | 1800 postpartum women recruited within 24 h of vaginal delivery. Some women had existing UI. Single centre, England | 1. Controls: Current standard antenatal and postnatal care. Recommended to do PFM contractions as often as remembered and mid-stream urine stop. 4-week health diary.  
2. Intervention: as above plus one individual session daily while in hospital with midwifery co-ordinator. 4-week health diary including section recommending a specific PFMT task each week. | Losses to follow-up at 3 months: 84/900 in control and 107/900 in intervention group. Adherence to PFMT:  
3-month period 58% in the intervention group and 42% in the control group  
Adverse events not stated  
Not ITT analysis | Self-reported UI 3-month postpartum:  
1. Control: 175/793 (22%)  
2. Intervention: 180/816 (22%)  
RR (95% CI): 1.083 to 1.20 |
| Markked and Ba          | Prospective matched controlled | 180 women, included 8-week postpartum. Some women had existing UI. The criteria for matching: age (±2 years), parity (1, 2, 3, 4 ≥ deliveries) and type of delivery. Single centre, Norway | 1. Control: customary written postpartum instructions from the hospital.  
2. Intervention (n=99): 8 weeks PFMT. Control (n=81). Intervention (n=112) | Losses to follow-up in the intervention group: 7 women Adherence to PFMT:  
100% in the intervention group  
65% in the control group.  
Adverse events not stated  
All longitudinal changes conducted using a constant sample, including the 81 matched pairs that attended all tests.  
53% in the training group and  
24% in the control group reported that they were doing PFMT between 16 weeks and 1-year postpartum. | Self-reported UI at 16-week postpartum:  
1. Control: 28/99 (28.3%)  
2. Intervention: 399/3/99 (3.0%)/RR = 0.009 (PFM strength): Sign difference in favour of the intervention group | Self-reported UI at 12-month postpartum:  
1. Control: 31/81 (38%)  
2. Intervention: 14/81 (17%)/RR (95% CI): 0.82 (0.31, 2.21) |
| Meyer et al             | Allocated to two groups | 107 primiparous women recruited 12–39-week pregnancy: 956 controls and 1651 in the intervention group had self-reported SUI. Single centre, Switzerland. | 1. Control (n=56): No pelvic floor re-education offered from 2–10-month postpartum Intervention (n=51): Begun at 2-month postpartum. 12 sessions over 6 weeks with physiotherapist. PFMT followed by 20 min of biofeedback and 15 min of electrostimulation. | Losses to follow-up:
No Adherence not reported

Adverse events not stated

Not ITT analysis | Self-reported SUI 10-month postpartum:  
1. Control: 8/56 (12%)  
2. Intervention: 6/51 (12%)/RR (95% CI): 0.82 (0.31, 2.21) |
| Chiarelli et al         | 2-arm RCT               | 720 postnatal women following forceps or ventouse delivery, or delivered a baby > or=4000 g. Some women had existing UI. Recruited at postnatal ward. Multicentre (3), Australia. | 1. Control: usual care.  
2. Intervention: continence promotion: One contact with physiotherapist on postnatal ward and another at 8-week postpartum (correct PFM contraction checked at second visit). Intervention included individually tailored PFMT, use of transversus abdominus contraction, the ‘Knack’, techniques to minimise perineal descent, postpartum wound management. Written and verbal information. Adherence strategies | Losses to follow-up:
6% in each group

Adherence to PFMT:  
1. Control: 57.6%  
2. Intervention: 83.9%  

Adverse events not stated  
ITT analysis  
Losses to follow-up:
30%  

ITT analysis | Self-reported UI 3-month postpartum:
1. Control: 12/328 (38.4%)  
2. Intervention: 10/834 (31.0%)/RR (95% CI: 0.022 to 1.46%) \( p=0.044 \)  

OR of incontinence for the women in the intervention group compared with control group was: 0.65 (0.46–0.91), \( p=0.01 \)

Self-reported UI 12-month postpartum:
NS difference between groups.

Practice of PFMT at 12-month promotes continence at this time

Urinary incontinence at 6-month postpartum:
1. Control: 7/171 (41%)  
2. Intervention: 7/118 (60%)/RR (95% CI): 1.28 (0.98 to 1.67%), \( p=0.10 \) |
| Ewings et al            | Nested RCT1. Control (n=117): Usual care2. Intervention (n=117): PFMT | 234 women in risk or with UI recruited from postnatal wards. Two centres, UK. | 1. Control: usual postnatal care including verbal promotion of postnatal PFMT and leaflet explaining how to do PFMT.  
2. Intervention: taught one to one with physiotherapist in hospital, with intervention to attend PFMT group at 2 and 4 months after delivery. No details of PFMT programme given. | Losses to follow-up:
Total 19%.

Control: 17/100  
2. Intervention: | Self-reported UI 6-month postpartum:  
1. Control: 14/717 (67%)  
2. Intervention: 54/117 (60%)/RR (95% CI): 1.28 (0.98 to 1.67%), \( p=0.10 \) |

ITT, intention to treat analysis; NS, non-significant; PFMT, pelvic floor muscles; PFMT, pelvic floor muscle training; RCT, randomised controlled trial; RR, relative risk; SUI, stress urinary incontinence; UI, urinary incontinence; VPFMC, voluntary pelvic floor muscle contraction.
Table 4  Studies assessing the effect of pelvic floor muscle exercises after delivery to treat urinary incontinence including only women with urinary incontinence at inclusion

<table>
<thead>
<tr>
<th>Author</th>
<th>Design</th>
<th>Subjects</th>
<th>Training protocol</th>
<th>Losses to follow-up/adherence</th>
<th>Outcomes (numbers and percentage (%))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson and Herbison⁴³</td>
<td>2-arm RCT</td>
<td>N=230 women with UI 3-month postpartum. Single centre, New Zealand</td>
<td>1. Control (n=117): Standard postnatal PFM exercises 2. Intervention (n=113): 12 weeks of intensive PFMT</td>
<td>Losses to follow-up 12-month outcome assessment: 36.9% 1. Control: 91/117 2. Intervention: 54/113 Adherence to PFMT: Last month :89% Every day: 48% ▶ 12 months postnatally was mean number of VPFMC 86 in the intervention group and 35 in the control group</td>
<td>Self-reported UI at 12-month postpartum: 1. Control: 69/91 (76%) 4. Intervention: 27/54 (50%) p=0.003 Pad test: NS difference Perineometry: NS difference</td>
</tr>
<tr>
<td>Glazener et al⁴² Glazener et al⁴⁴</td>
<td>2-arm RCT1. Control (n=376): no visit2. Intervention (n=371): Advice+visits</td>
<td>N=747 women with UI 3 months postnatally Multicentre trial, New Zealand, UK N=516</td>
<td>1. Control: no visit 2. Intervention: assessment of UI, with advice on PFMT (80–100 fast/slow contractions daily) followed up 5, 7, and 9 months after delivery supplemented by bladder training if appropriate at 7 and 9 months</td>
<td>Lost to follow-up at 12 months: 31% 1. Control: 169/245 (69%) 2. Intervention: 167/279 (59.9%) p=0.037Severe UI: 1. Control: 78/245 (31.8%) 2. Intervention: 55/279 (19.7%) p=0.002Severe UI at 6 year follow-up: 1. Control: 99/253 (39%) 2. Intervention: 100/263 (38%) p=0.867</td>
<td>Self-reported UI at 12-month postpartum:Any UI 1. Control: 169/245 (69%) 2. Intervention: 167/279 (59.9%) p=0.037Severe UI: 1. Control: 78/245 (31.8%) 2. Intervention: 55/279 (19.7%) p=0.002Severe UI at 6 year follow-up: 1. Control: 99/253 (39%) 2. Intervention: 100/263 (38%) p=0.867</td>
</tr>
<tr>
<td>Dumoulin et al⁴¹ Elliott et al (abstract)²⁰</td>
<td>3-arm RCT1. Control (n=20) 2. PFM rehabilitation (n=21) 3. PFM rehabilitation+training of deep abdominal muscles (n=23) A 7-year follow-up Combination of the previous two PFM rehabilitation groups (n=35)</td>
<td>N=64 parous women under 45 years, still presenting symptoms of SUI at least once per week 3 months or more after their last delivery. Recruited during annual gynaecological visit at an obstetric clinic, Canada</td>
<td>1. Control: 8 weekly sessions of massage 2. PFM rehabilitation: Weekly sessions supervised by physiotherapist for 8 weeks: 15 min electrical stimulation+25 min PFMT with biofeedback+home training 5 days/week. 3. PFM rehabilitation as group 2+30 min of deep abdominal muscle training</td>
<td>Losses to follow-up: 3% 1. Control: 50% 2. Intervention: 50%</td>
<td>Self-reported UI after the intervention period: Objective cure (less than 2 g urine on pad test): 1. Control: 0/19 2. PFM rehabilitation: 14/20 3. PFM rehabilitation+training of deep abdominal muscles: 17/23Sign difference in favour of the intervention groups (p=0.001) NS difference between the two intervention groups Incontinence Impact Questionnaire: Sign difference in favour of the intervention groups PFM strength: NS difference Objective cure (less than 2 g urine on pad test) (performed by 26 out of 35 women): 14/26 53% Incontinence Impact Questionnaire: sign. Better than at baseline</td>
</tr>
<tr>
<td>Kim et al⁴⁴</td>
<td>2-arm RCT1. Control intervention (n=10) 2. Intervention (n=10)</td>
<td>N=20 Postpartum women with UI Single centre, Korea</td>
<td>4. Control intervention: unsupervised PFMTs. Intervention: supervised PFMT</td>
<td>Losses to follow-up: 2/20 Adherence: ? Adverse events not stated No ITT analysis</td>
<td>Significant difference in favour of the supervised PFMT group on after the intervention period: ▶ Bristol Female Lower urinary tract Symptoms ▶ Vaginal squeeze pressure</td>
</tr>
</tbody>
</table>

ITT, intention to treat analysis; NS, non significant; PFM, pelvic floor muscles; PFMT, pelvic floor muscle training; RCT, randomised controlled trial; RR, relative risk; SUI, stress urinary incontinence; UI, urinary incontinence; VPFMC, voluntary pelvic floor muscle contraction.
### Table 5

Studies assessing the effect of pelvic floor muscle exercises during pregnancy (to prevent/treat urinary incontinence), studies published as only abstracts are not included

<table>
<thead>
<tr>
<th>Study</th>
<th>Eligibility criteria specified</th>
<th>Subjects randomly allocated to groups</th>
<th>Allocation was concealed</th>
<th>Groups were similar at baseline</th>
<th>Subjects were blinded</th>
<th>Therapist administering the treatment was blinded</th>
<th>Assessors were blinded</th>
<th>Measures of key outcomes obtained from &gt; 85% of subjects</th>
<th>Data analysed by intention to treat</th>
<th>Statistical comparison between groups were conducted</th>
<th>Point measures and measures of variability provided</th>
<th>Total score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sleep and Grant18</td>
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</table>

PEDro quality score of randomised controlled trial in systematic review. +, Criterion is clearly satisfied, -, criterion is not satisfied, ?, not clear if the criterion was satisfied. Total score is determined by counting the number of criteria that are satisfied, except that scale item one is not used to generate the total score. Total scores are out of 10.
in the symptoms or frequency of UI. No adverse effects of the interventions were reported. Glazener et al\textsuperscript{42} found no difference in UI between groups at 6-year follow-up, while Elliott et al\textsuperscript{20} reported that, in the PFMT groups, over 50% of the women were still continent according to pad testing after 7 years. Incontinence-specific signs, symptoms and quality of life remained better than before treatment, although they were not as good as immediately after cessation of the supervised training.

**DISCUSSION**

This review of randomised and quasiexperimental studies in the field of PFMT, during pregnancy and after delivery, highlights the very large heterogeneity in the populations studied, use of inclusion and exclusion criteria, ways of including participants, use of outcome measures and content of the PFMT interventions. The 2008 Cochrane Review\textsuperscript{15} concluded that women without prior UI who were randomised to intensive antenatal PFMT were 56% less likely to report UI in late pregnancy and about 30% up to 6 months postpartum. Postnatal women with persistent UI 3 months after delivery were 20% less likely than those not receiving PFMT to report UI 12 months after delivery. Hay-Smith et al\textsuperscript{35} stated that it was unclear whether the population-based approach was effective and that there was not enough evidence about the long-term effects. Brostrøm and Lose\textsuperscript{14} concluded from a narrative review that published studies on PFMT in general are small, underpowered and of uneven quality, and the available evidence suggests a lack of long-term efficacy of peripartum PFMT. Here, we focus on the methodological quality of the studies, dose–response issues in exercise trials and challenges in the long-term assessment of PFMT during pregnancy and after childbirth.

**Methodological quality**

Using the PEDro rating scale, 10 is the top score. However, in exercise trials, 7–8 of 10 reflects high quality, accepting that the two criteria related to blinding of the therapist and patient are almost impossible to meet in this kind of interventions. In this review, 13\textsuperscript{17} 19 21–23 26 28–30 34 35 41 42 of 18 studies received a PEDro score of 7 or 8 (table 5).

In addition to the PEDro criteria, sample size is a crucial factor in RCTs. A small sample size may cause type II error, meaning that a possible effect is not revealed because of low power. On the other hand, it is also well known that a large sample size may overestimate results in clinical trials, as small and clinically irrelevant effect sizes may reach statistical significance. We disagree with Brostrøm and Lose\textsuperscript{14} that most antenatal and postpartum PFMT trials are small, as most of them have several hundred participants. However, there are two big trials in this area with 1169 and 1800 participants\textsuperscript{27 38} that are of great concern when judging the effect of antenatal and postpartum PFMT. These two trials have applied very weak interventions, meaning very few visits with either a physical therapist or a midwife. Herbert and Bo\textsuperscript{45} have shown how one trial with huge numbers clearly dilutes the effect of smaller high-quality studies when pooling them in a meta-analysis. The training dosage in the two aforementioned studies was minimal and had extremely little potential for bringing significant effects. In addition, the training period in one of the studies was only 4 weeks.\textsuperscript{38}

**Quality of the intervention: dose–response issues**

There is a strong dose–response relationship in exercise training. The type of exercise and frequency, intensity and duration of the training, as well as adherence to the exercise protocol, will decide the effect size.\textsuperscript{46} In the area of PFMT, the six trials with no or little effect have either used inadequate training dosages,\textsuperscript{27 38} left the participants alone to train,\textsuperscript{27 35 38} or have huge dropouts and/or low adherence to the training protocol,\textsuperscript{17 22 33 35 38} If the patients are not following the training protocol, we cannot evaluate the effect of PFMT. Conclusions can only be drawn on the feasibility of the programme, which is another research question. None of the studies used specific questionnaires or instruments to assess adherence. Questions about home exercise were either asked in general questionnaires or in a personal interview, and some studies used exercise diaries. Registration of adherence to the supervised training sessions was performed by those providing the supervision. Self-report by the participants may overestimate actual adherence, and we recommend that future studies improve the methods used to register adherence.

Several RCTs in the PFMT literature support the early finding by Bo et al\textsuperscript{46} that there is a very large difference in the effect size between programmes with more or less intensive training and follow-up.\textsuperscript{47} The term ‘intensive training’ comes from the RCT of Bo et al,\textsuperscript{46} but the interpretation of this term can be questioned. The general recommendations for effective strength training to increase muscle cross-sectional area and strength are three sets of 8–12 close to maximum contractions 3–4 times/week.\textsuperscript{48} Intensity in the exercise science literature on strength training is defined as the percentage of 1 repetition maximum (IRM), meaning how close the contraction is to the maximal contraction.\textsuperscript{49} Bo et al\textsuperscript{46} emphasised close to maximum contractions, and strength measurements were done throughout the training period. The same protocol has been used in several peripartum studies, and all of these trials show clinically relevant and statistically significant effects.\textsuperscript{19 21 23 24–26 28 29 37 41} In a recent assessor-blinded RCT of PFMT to reduce pelvic organ prolapse, Braekken et al\textsuperscript{50} found that this protocol significantly increased PFM strength and muscle thickness, reduced the muscle length and area of the levator hiatus, in addition to lifting the position of the bladder neck and rectal ampulla. Hence, PFMT is changing muscle morphology, working in the same way as strength training of general skeletal muscles.

Training volume is the total workload of training.\textsuperscript{49} In the PFMT literature, exercise programmes with only one supervised individual or group training session/week are named intensive. Some physicians suggest that follow-up once a week does not translate into clinical reality.\textsuperscript{14} However, it is common to offer physiotherapy at least 2–3 times a week for other conditions such as neck and low back pain; injured athletes are given supervised training at least once a day, and in rehabilitation centres, patients exercise several hours per day. There are no pharmaceutical companies that would allow treatment or research with their drugs with an ineffective dosage. Nor would anyone suggest that surgeons should do suboptimal surgery. In the long run, there is no money to be saved on low or suboptimal training dosages in physiotherapy because treating a large number of patients with ineffective interventions can be very costly. Furthermore, by recommending low dosage or unsupervised training, the patients with no or little effect may believe they have tried PFMT and may not be motivated for conducting a new period of more optimal dosage and supervised training before opting for other treatment options. Evidence-based practice means to use protocols from high-quality RCTs showing worthwhile effect sizes.\textsuperscript{45 51} Another specific problem in studies evaluating the effect of antenatal and postpartum PFMT is that, in most countries, it is
established practice to advise all women to do PFMT. Hence, most of the PFMT studies have compared PFMT with ‘usual care’. ‘Usual care’ can vary between thorough individual instruction with clinical assessment and motivation for training to only providing women with written information. In some studies, the control group has done substantial PFMT.33 Gorbea et al26 compared the effect of PFMT with a group specifically asked not to train the PFM, and the difference between groups was highly significant with no women reporting UI in the PFMT group compared to 47% in the control group. To date, there are no studies comparing the effect of ‘usual care’ with no exercise. For some women who are able to perform strong contractions and are highly motivated to train, such initiatives may be enough, but there will be difficulties showing differences between the intervention and the control groups. However, studies have shown that few women exercise regularly with a recommendation or supervised training after cessation of the RCT. This is likely to negatively interfere with the short-term effect. A 10% loss of muscle strength per week has been shown after training cessation.49 Greater losses have been shown in the elderly (65–75 years old) compared to the younger age group (20–30 years old), and for both groups, the majority of strength loss was from 12 to 31 weeks after cessation of training. The rate of strength loss may depend on the length of the training period prior to detraining, type of strength test used and the specific muscle groups examined. Fleck and Kraemer49 concluded that research has not yet indicated the exact resistance, volume and frequency of strength training or the type of programme needed to maintain the training gains. However, studies indicate that to maintain strength gains or slow down strength loss, the intensity should be maintained, but the volume and frequency of training can be reduced. One or 2 days a week seem to be an effective maintenance frequency for individuals already engaged in a resistance training programme.54

So far, no studies have evaluated how many contractions have to be performed by subjects to maintain PFM strength after cessation of organised training. However, a long-term effect cannot be expected if the women stop exercising. In addition, a long-term effect, meaning for more than 1 year, in pregnant and postpartum women is almost impossible to evaluate, as many women would be pregnant again during the follow-up period. This is likely to negatively interfere with the short-term effect. Furthermore, in most trials, the control groups are given information or supervised training after cessation of the RCT. This was shown in the study by Mørkved et al12 where the control group received the training programme after the results of the RCT were published. In the following period up to 6 years, the adherence to the PFMT programme was similar both in the original control group and the training group. The continence rate in the training group was nearly the same at 3 months and 6 years’ follow-up, while the number of incontinent women in the control group had decreased in the period. However, in another study, Mørkved and Bo37 40 showed that the initial effect of postpartum PFMT was maintained 1 year after delivery. Hence, the demand for long-term follow-up studies of PFMT in general can be questioned, and longer follow-up periods than 1 year after birth, in our opinion, are not warranted.

**CONCLUSION**

Based on studies with a relevant sample size, high adherence to a strength-training protocol and close follow-up, pelvic floor muscle training both during pregnancy and after delivery can prevent and treat UI. The most optimal dosage for effective PFMT is still not known. However, a training protocol following general strength-training principles, emphasising close to
maximum contractions and at least an 8-week training period can be recommended. Evidence-based practice of PFMT during pregnancy and after delivery implies using protocols from high-quality RCTs showing clinically relevant and statistically significant results. Given the detrimental negative effect of a non-functioning pelvic floor on women’s participation in sport and physical activity, there is a need to update the exercise in pregnancy guidelines. New guidelines for exercise during pregnancy and after childbirth should include detailed recommendations for effective PFMT, and we provide an outline in box 1.

**What are the new findings?**

- Pelvic floor muscle training both during pregnancy and after delivery can prevent and treat urinary incontinence. A training protocol following general strength-training principles, emphasising close to maximum contractions and at least an 8-week training period can be recommended.

**How might it impact on clinical practice in the near future?**

- New guidelines for exercise during pregnancy and after childbirth should include detailed recommendations for effective pelvic floor muscle training (PFMT). Curricula for instructors and coaches providing general strength-training programmes for women should include the evidence for PFMT on UI.

Acknowledgements The authors thank Ingrid Ingeborg Riphagen, Unit for Applied Clinical Research, Department of Cancer Research and Molecular Medicine, Norwegian University of Science and Technology, for her contribution to the work being reported, by conducting the data searches.

Contributors SM and KB carried out the conception and design, acquisition of being reported, by conducting the data searches.

Norwegian University of Science and Technology, for her contribution to the work being reported, by conducting the data searches.


Royal College of Obstetricians and Gynaecologists. Exercise in pregnancy, 2006; Statement 4.


APPENDIX

EMBASE (through OvidSP) 1980 to 2012 week 35

1 exp Pregnancy/ OR Pregnancy complication/ OR Maternal disease/ OR Puerperal disorder/
2 Pelvis floor/
3 Pelvis/ AND (Muscle/ OR Skeletal Muscle/ OR Muscle Contraction/ OR Muscle Training/)
4 2 OR 3
5 Kinesiotherapy/ OR Muscle Training/
6 4 AND 5
7 6 OR Pelvic Floor Muscle Training/
8 Urine Incontinence/
9 1 AND 7 AND 8

CENTRAL through Wiley’s Cochrane Library) Issue 8 of 12 August 2012

1 Pregnan* OR maternal OR gravidity OR gestation OR “after delivery” OR “post delivery” OR post-partus OR post-partum OR post partum OR “post labor” OR postnatal* OR prenatal* OR antenatal* OR childbirth OR childbearing OR “child bearing”
2 (Pelvis OR pelvic) AND (floor OR muscle* OR musculat* OR diaphragm*)
3 Exercise* OR training OR pfmt OR strengthen* OR myofunctional
4 (Urine OR urinary) AND (continen* OR incontinen* OR leak* OR wetting)
5 1 AND 2 AND 3 AND 4

PubMed

1 exp Pregnancy OR Puerperal Disorders(mesh:noexp) OR Pregnan* (tiab) OR maternal(tiab) OR gravidity(tiab) OR gestation(tiab) OR “after delivery”(tiab) OR “post delivery”(tiab) OR post-partus(tiab) OR post-partum(tiab) OR post partum(tiab) OR “post labor”(tiab) OR postnatal*(tiab) OR prenatal*(tiab) OR antenatal*(tiab) OR childbirth(tiab) OR childbearing(tiab) OR “child bearing”(tiab)
2 Pelvis(mesh) OR pelvic(tiab) OR pelvic(tiab)
3 Exercise therapy(mesh) OR Exercise(mesh) OR Exercise Movement Techniques(mesh) OR Exercis*(tiab) OR strengthen*(tiab) OR training(tiab)
4 Urinary Incontinence(mesh) OR (lurine(tiab) OR urinary(tiab)) AND (continen* (tiab) OR incontinen* (tiab) OR leak*(tiab) OR wetting(tiab))
5 Clinical trial(pr) OR random*(tiab) OR trial(tiab) OR group(tiab) OR groups (tiab)
6 1 AND 2 AND 3 AND 4 AND 5

PEDro (www.pedro.org.au) update date 4 September 2012

Therapy: ‘Strength Training’
Problem: ‘Incontinence’
Body Part: ‘Lumbar spine, sacroiliac joint or pelvis’

Total

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