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FFECT OF PELVIC FLOOR MUSCLE TRAINING DURING PREGNANCY AND AFTER CHILDBIRTH ON PREVENTION AND TREATMENT OF URINARY INCONTINENCE – A systematic review.

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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 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: RCTs and quasi experimental trials published in English language.

Participants: primi 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: Twenty-two randomized or quasi experimental 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, emphasizing close to maximum contractions and lasting at least eight 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 programs 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 (1,2,3). 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 programs 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 report prevalence of major injuries to the pelvic floor muscles of 20-26% % following vaginal delivery (8,9,10). 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; prevalence rates varying between 32-64% (11). Stress urinary incontinence is defined as "complaint of involuntary loss of urine during on effort or physical exertion (e.g. sporting activities), or on sneezing and coughing"(12) and is the most common form of urinary incontinence 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 urinary incontinence causes withdrawal from exercise and fitness activities and is a barrier to regular participation in physical activities (13). Surprisingly, strength training of the pelvic floor muscles is not mentioned at all in the Guidelines of the American College of Obstetricians and Gynecologists (1) and only briefly mentioned in the British and Canadian guidelines. Furthermore there are no or few references to evidence from clinical controlled trials in the existing guidelines (2,3).

Two important questions are (1) whether urinary incontinence and other pelvic floor disorders can be prevented by training the PFM before problems arise (primary prevention), or (2) whether women at risk at an early stage can be identified with a view to secondary prevention using PFMT. Reviews on PFMT in prevention of UI report inconsistent results and there seem to be some doubt about the effect (14,15). This may be due to 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 towards 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 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 June 12 2012) were searched to identify studies. Keywords used in different combinations in the search were: pregnancy, pelvic floor muscle, exercise, training, incontinence, after delivery, postpartum, childbirth, effect, prevention. Inclusion criteria were quasi experimental and randomised controlled trials written in 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 meeting 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 done according to the PEDro rating scale giving one point for each of the following factors for internal validity: random allocation, concealed allocation, baseline comparability, blinded assessor, blinded subjects, blinded therapists, adequate follow up (≥85%), ITT analysis, between group comparison, report of point estimates and variability (16). The two authors independently scored the studies. Any disagreement was solved with 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 RCT's (17-24) and one quasi experimental study (25) were found. Eight were short term original studies and one (20) was a 7 year follow up study.

Pelvic floor muscle exercises DURING PREGNANCY to PREVENT UI including both women with and without UI. Table 1a.

Ten RCT's (17, 18, 21-23, 26-30), and two long term follow up studies (31,32) were identified. In all studies women were recruited at before 22 weeks of pregnancy. All the trials except the RCT by Stafne et al (23) 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 3). The abstracts were difficult to score due to limited information.

Training protocol

The exercise period started between 20-22 weeks of pregnancy in six studies (23,30), between 11-14 weeks in one (22) and between 16-24 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, few (up to 30 contractions per day) and strong (near maximal) contractions. While 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 studies except for two (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 (29), Gorbea Cháves 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 (30) found that the short term effect was not present at one year follow-up. Eight years follow up data from Reilly et al's (29) trial showed no significant difference in UI between the original intervention and control groups (31). Mørkved et al (32) 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 difference between groups were no longer present.

Pelvic floor muscle exercises DURING PREGNANCY to TREAT UI including only women with UI. Table 1b.

Two RCTs (19,33) and one quasi experimental study were found (25). Incontinent parous or nulliparous women were included. PEDro scores were 5 and 7 out of 10 (Table 3).

Training protocol
The training protocols and follow up varied. In the trial by Woldringh et al (33) the program 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 drop out rate was about 50% and the adherence to regular PFMT among the women that stayed in the training group was 77%. Dinc et al (19) addressed both regular home training and follow-up between 20 and 36 weeks of pregnancy, and few (up to 30 contractions per day) and close to maximal contractions. While the study by Sangsawang et al used a 6 week training programme (25).

Outcomes
Woldringh et al (33) found no difference in UI between the intervention and control groups during pregnancy and at the follow-up at six and 12 months post partum. Conversely, Dinc et

al (19) and Sangsawang (25) demonstrated a significantly 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. Table 2a.

Five short term studies were found (34-38), and in addition long term results from two studies (39,40) have been reported. Two of the short term studies were RCT's (34,38), one a nested RCT (35), one a quasi randomised study (36) and one a matched controlled study (37). PEDro scores varied between 4 and 8 out of 10 (Table 3). The studies included both primi- and multiparous women. Chiarelli et al (34) included only women with forceps or ventouse delivery or birth of baby weighing 4000g or more.

Training protocol

In three studies the training period started while the women still were at the hospital (34,35,38), while the training started eight weeks after delivery in the other studies. Length of the training period, follow up by health professionals, training intensity and frequency varied. Sleep & Grant (38) gave one individual session of PFMT while in hospital in addition to standard care and recommended the women in the intervention group to do a specific PFMT task each week at home in four weeks. The eight week training protocol in the study by Mørkved and Bø (37) addressed individual instructions in PFM contractions, regular home training (2 sets of 10 near maximal contractions per day) and close weekly follow-up in groups. Meyer et al (36) added biofeedback and electrical stimulation to the six week PFMT programme, while the intervention group in the RCT by Chiarelli & Cockburn (34) 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), however 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 studies (34,36,37) 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 & Bø (40) found that the effect of PFMT was still present one year after cessation of the training programme, while Chiarelli & Cockburn demonstrated short term effects, but no difference in UI between groups at one- and six-year follow-up (34,39). However, Chiarelli et al (39) reported that 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. Table 2b.

Four RCT's were found (24,41-43), and two follow up studies (20,44). PEDro scores were between 4 and 8 out of 10 (Table 3). All the women included were incontinent, and they were recruited from 3 months (42,43) or more (41) after delivery. Both primi- and multiparous women were included.

Training protocol
The interventions followed different training protocols. All the trials included individual instructions in PFMT. Wilson et al (43) and Glazener et al (42) advised the women to perform 80-100 contractions per day and introduced 3-4 follow up sessions in the period up to 9 months after delivery. Dumoulin et al (41) addressed close follow-up (weekly) by a physical therapist and used a training protocol including a lower number of high intensity contractions. In the 8 weekly physical therapy appointments they included biofeedback and electrical stimulation in the training program. Only Dumoulin et al (41) 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 (42,43), but none of them used exercise diaries.

Outcomes
All trials (24,41-43) reported clinically relevant and statistically significant short term effects of PFMT, with a significant reduction in symptoms or frequency of UI. No adverse effects of the interventions were reported. Glazener et al (42) found no difference in UI between groups at six-year follow-up, while Elliott et al (20) reported that in the PFMT groups over 50% of the woman was still continent according to pad testing after seven years. Incontinence-specific signs, symptoms and quality of life remained better than before treatment although not as good as immediately after cessation of the supervised training.

DISCUSSION

This review of randomised and quasi experimental 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 (15) concluded that women without prior UI who were randomized 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 three months after delivery were 20% less likely than those not receiving PFMT to report UI 12 months after delivery. Hay-Smith et al (15) stated that it is unclear if the population based approach is effective and that there was not enough evidence about the long-term effects. Brostrøm and Lose (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 methodological quality of the studies, dose-response issues in exercise trials and challenges in 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 out of 10 reflects high quality, accepting that the two criteria related to blinding of the therapist and patient is almost impossible to meet in this kind of interventions. In this review 13 (17,19,21-23,26,28-30,34,35,41,42) of 18 studies received a PEDro score of 7 or 8 (Table 3).

In addition to the PEDro criteria, sample size is a crucial factor in RCTs. Small sample size may cause type II error, meaning that a possible effect is not revealed because of low power. On the other side 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 (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 (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 Bø (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 above mentioned studies was minimal and had extremely little potential for bringing significant effects. In addition, the training period in one of the studies was only four weeks (38).

Quality of the intervention – dose-response issues
There is a strong dose-response relationship in exercise training. Type of exercise and frequency, intensity and duration of the training, as well as adherence to the exercise protocol will decide the effect size (46,47). In the area of PFMT the six trials with no or little effect have either used inadequate training dosages (27,38), left the participants alone to train (27,35,38) or have huge drop outs and/or low adherence to the training protocol (17,22,33,35,38). If the patients are not following the training protocol, we cannot evaluate the effect of PFMT. Conclusion can only be drawn on the feasibility of the program, 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 done by those providing the supervision. Self-report by the partcipants 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 Bø et al (46) that there is a very large difference in the effect size between programs with more or less intensive training and follow-up (47). The term "intensive training" comes from the RCT of Bø et al (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 3 sets of 8-12 close to maximum contractions 3-4 times a week (48). Intensity in the exercise science literature on strength training is defined as the percentage of 1 repetition maximum (1RM), meaning how close the contraction is to the maximal contraction (49). Bø et al (46) emphasized 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 effect (19,21,23,24,25,26,28,29,37,41**)**. In a recent assessor blinded RCT of PFMT to reduce pelvic organ prolapse, Brækken et al (50) found that this protocol significantly increased PFM strength and muscle thickness, reduced 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 (49). In the PFMT literature, exercise programs with only one supervised individual or group training session per week is named intensive. Some physicians suggest that follow up once a week does not translate into clinical reality (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 are exercising 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 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 worth-while effect sizes (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 advice 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 al (26) 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 being able to perform strong contractions and being highly motivated for training, such initiatives may be enough, and there will be difficulties showing differences between the intervention and the control group. However, studies have shown that few women exercise regularly with a recommended dosage during pregnancy and after childbirth without supervision (52,53).

Physiotherapists, nurses and physicians conducted the PFMT in all the clinical trials included in the present review, and to date there has been no comparison of effects of interventions given by different professionals. Given the widespread prevalence of UI in the female population and the evidence for PFMT, we suggest that PFMT should be part of general strength training programs for women. This would imply that proper teaching of PFM function and dysfunction and how to teach PFMT correctly should be part of the curricula in exercise science, fitness and sport studies.

Long term effects

Another general critique of the effect of PFMT is a possible lack of long term benefit especially in the peripartum studies (14). However, the effect of any training program will diminish with time if not continued. In general, strength gains decline in a slower rate than at which strength increases due to training. There are few studies investigating the minimal level of exercise necessary to maintain the training effect. A 5-10 % loss of muscle strength per week has been shown after training cessation (49). Greater losses has been shown in elderly (65-75 year olds) compared to younger (20-30 years old), and for both groups the majority of

strength loss was from week 12-31 after cessation of training. The rate of strength loss may depend on length of the training period prior to detraining, type of strength test used and the specific muscle groups examined. Fleck & Kraemer (49) concluded that research has not yet indicated the exact resistance, volume, and frequency of strength training or the type of program needed to maintain the training gains. However, studies indicate that to maintain strength gains or slow strength loss, the intensity should be maintained, but the volume and frequency of training can be reduced. One - two days a week seem to be an effective maintenance frequency for individuals already engaged in a resistance training program (54).

So far, no studies have evaluated how many contractions subjects have to perform to maintain PFM strength after cessation of organized training. However, a long term effect cannot be expected if the women stop exercising. In addition, long term effect, meaning for more than one 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 al (32) 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 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 Bø (37,40) showed that the initial effect of postpartum PFMT was maintained one 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 one year after birth, in our opinion, is not warranted.

CONCLUSION

Based on studies with 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 urinary incontinence. The most optimal dosage for effective PFMT is still not known. However, a training protocol following general strength training principles, emphasizing close to maximum contractions and at least an eight weeks 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 Table 4.

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Both authors state that they have no competing interests.

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AUTHORSHIP

Both authors meet conditions 1,2,3. They have contributed substantial to:
1) conception and design, acquisition of data, analysis and interpretation of data
2) drafting the article and revising it critically for important intellectual content
3) final approval of the version to be published. Authors should meet conditions 1, 2, and 3.

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, emphasizing close to maximum contractions and at least an eight weeks 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 PFMT. Curricula for instructors and coaches providing general strength training programs for women should include the evidence for PFMT on UI.

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Table 1a. 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.

Author	Design	Subjects	Training protocol	Losses to follow-up / Adherence	Outcomes [Numbers and percentage (%)]
Sampselle et al 1998 (30)	2 arm RCT 1. Control (n=38): Routine care 2. Intervention (n=34): A tailored PFMT program.	N=72 primigravid women recruited at 20 wk' of pregnancy. Some women had existing UI. Groups comparable at baseline. Single centre, USA.	1. Control: Routine care 2. A tailored PFMT program beginning with muscle identification progressing to strengthening. 30 contractions per day at max or near max intensity from 20 wk' of pregnancy. Correct VPFMC checked.	Losses to follow-up: 36 Adherence PFMT: - 35 wk' of pregnancy: 85% - 1 year postpartum: 62-90% Adverse events not stated. Self reported adherence. Partial ITT analysis	Change in mean UI symptom score: Control Intervention p 35 wk' pregnancy : 0.20 -0.02 0.07 6 wk' postpartum: 0.25 -0.06 0.03 6 mo postpartum: 0.15 -0.11 0.05 12 mo postpartum: 0.06 0.00 0.74 PFM strength: Ns difference (low numbers)
Hughes et al 2001 (abstract) (27)	2 arm RCT 1. Control (n=583): Routine care 2. Intervention (n=586): A tailored PFMT program	N=1169 pregnant nulliparous women recruited at 20 wk' of 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 and 25 wk' of pregnancy.	Losses to follow up: 40% at 6 wk' postpartum 27% at 3 mo postpartum 34% at 6 mo postpartum 461/586 women in the intervention group attended the PFMT session.	SUI Bristol Female Urinary Tract Symptoms Questionnaire: Control Intervention 36 wk' pregnancy : 66% 61% OR (95% CI): 0.78 (0.59-1.04) 6 mo postpartum: 38% 36% OR (95% CI): 0.90 (0.64-1.28)

			Home training daily for up to 11 mo. VPFMC checked		
Reilly et al 2002 (29)	2 arm RCT 1. Control (n=129): Routine care 2. Intervention (n=139): 20 wk' of intensive PFMT	N=268 primigravid, continent women with increased bladder neck mobility recruited at 20 wk' of pregnancy. Single centre, UK 164/268 (61%) of the original group	1. Control: Routine antenatal care (verbal advice). 2. Intervention: Individual PFMT with physiotherapist at monthly intervals from 20 wk' until delivery, with additional home exercises 3 sets of 8 contractions (each held for 6 seconds) repeated twice daily. Instructed to contract the PFM when coughing or sneezing.	Losses to follow-up at 12 mo: 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	Self reported UI at 3 months postpartum: 1. Control: 36/110 (32.7%) 2. Intervention: 23/120 (19.2%) RR (95% CI): 0.59 (0.37-0.92) 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
Agur et al 2008 (31) 8 year	1. Control (n=85): 2. Intervention (n=79)			- 38% in the intervention group were doing PFMT twice or more per week	Self reported UI at 8 years follow up: 1. Control: 38.8% 2. Intervention: 35.4% p=0.75

follow up					
Mørkved et al 2003 (28)	2 arm RCT 1. Control (n=153): Customary information from general practitioner / midwife. 2. Intervention (n=148m): 12 wk' of intensive PFMT 1. Control (n=94) 2. Intervention (n=94)	N=301 primigravid women recruited at 20 wk' of pregnancy. Some women had existing UI. Three outpatient physiotherapy clinics in Norway 188/301 (62%) returned the questionnaire	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 physio-therapist, with additional home exercises 10 max contractions (each held for six seconds) and to the last 4 were 3-4 fast contractions added, repeated twice daily, between 20 and 36 wk' of pregnancy. Correct VPFMC checked at enrolment. Control group received information about the results of the trial and the training programme, about one 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 wk' pregnancy: 1. Control: 74/153 (48%) 2. Intervention: 48/148 (32%) RR (95% CI): 0.67 (0.50-0.89) p=0.007 UI at 3 months postpartum: 1. Control: 49/153 (32%) 2. Intervention: 29/148 (19.6%) RR (95% CI): 0.61 (0.40-0.90) p=0.018 PFM strength: Sign difference in favour of the intervention group UI at 6 years follow up: 1. Control: 17% 2. Intervention: 23% p=0.276
Mørkved et al 2007 (abstract)					

(32) 6 year follow up					
Gorbea Chávez et al 2004 (abstract) (26)	2 arm RCT 1. Control (n=34 after drop outs) No PFMT 2. Intervention (n=38 after drop outs) PFMT	75 pregnant nulliparous continent women recruited at 20 wk' of 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 seconds each followed by 3 fast 1 second contraction; 6 seconds 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: Control Intervention p 28 wk' pregnancy: 17% 0 < 0.05 35 wk' pregnancy: 47% 0 < 0.05 6 weeks postpartum: 47% 15% < 0.05
Mason et al 2010 (22)	2 arm RCT 1. Control (n=148) 2. Intervention (n=141):	N= 311 nulliparous pregnant women with no symptoms of SUI at 11-14 wk' 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 six seconds) and to the last 4 were 3-4 fast contractions added,	Losses to follow up: 8% Some significant differences between responders and non-responders	Self reported UI at 36wk' pregnancy: 1.Control: 51/96 (53%) 2.Intervention: 24/60 (40%)

	PFMT		repeated twice daily, between 20 and 36 wk' of pregnancy. Correct VPFMC checked at enrolment in most women.	90women (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.	Odds ratio (95%CI) 1.7 (0.884-3.269) p=0.138 UI at 3 months postpartum: 1.Control: 33/80 (41.3%) 2.Intervention: 23/68 (33.8%) Odds ratio (95%CI) 1.374 (0.702-2.688) p=0.397 No sig difference in symptoms and episodes of UI, between groups.
Ko et al 2011 (21)	2 arm RCT 1. Control (n=150): Routine care 2. Intervention (n=150): 20 wk' of intensive PFMT	N=300 nulliparous women recruited at 16-24 wk' of 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 wk'pregnancy , with additional home exercises 3 sets of 8 contractions (each held for 6 seconds) repeated twice daily. Instructed to contract the PFM when coughing or sneezing.	Losses to follow up: No . Adherence PFMT: -87% practiced PFMT at least 75% of the time Adverse events not stated.	Self reported UI at 36 wk' pregnancy: sjekk 1. Control: 76/150 (51%) 2. Intervention: 52/150 (34%) p<0.01 Self reported UI at 3days postpartum: 1. Control: 62/150 (41%) 2. Intervention: 46/150 (30%)

				ITT analysis	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 months 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 months postpartum.
Bø & Haakstad 2011 (17)	2 arm RCT 1. Control (n=53): 2. Intervention (n=52): 12-16 wk' aerobic fitness class including PFMT	N= 105 nulliparous women recruited within 24 wk' of 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 six seconds) and to the last 4 were 3-4 fast contractions added x 3, per 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	Self reported UI at 36-38 wk' pregnancy: 1. Control: 7/53 2. Intervention: 9/52 Self reported UI at 3 months postpartum: 1. Control: 6/53 2. Intervention: 5/52 3. No significant difference.

				Not IIT analysis	
Stafne et al 2012 (23)	2 arm RCT 1. Control (n=426): Customary information from general practitioner / midwife. 2.Intervention (n=429): 12 wk' of intensive PFMT	N=855 pregnant women recruited 20 wk' of pregnancy. Some women had existing UI. Two hospitals in in Norway	1.Control: Customary information from general practitioner / midwife and written information. Not discouraged from PFMT.. 2.Intervention: 12 weeks of exercise class including led by physiotherapist, with additional home exercises 3 x 10 max contractions (each held for six seconds and to the last 4 were 3-4 fast contractions added) at least three times per wk' between 20 and 36 wk' of pregnancy. Correct VPFMC checked at enrolment.	Losses to follow-up: 93/855 (32 intervention and 61 controls). Adherence to PFMT: - 67% adherence to PFMT in the intervention group -40% adherence to PFMT in the control group No adverse events ITT analysis	Self reported UI at 34-38 wk' pregnancy: Any UI 1. Control: 192/365 (53%) 2. Intervention: 166/397 (42%) p=0.004 UI once pr week or more 3. Control: 68/365 (19%) 4. Intervention: 44/397 (11%) p=0.004
Dias A et al 2011 (abstract) (18)	3 arm RCT 1.Control group (n=29) 2.Supervised group (n=29) 3.Observational group (n=29)	N=87 primigravidas women recruited 18 wk' of pregnancy Some women had existing UI. Single centre Brazil	1.Control: no exercising 2.Supervised:exercising under supervision of a physiotherapist monthly + daily home exercises 3.Observational group: unsupervised daily home exercises	Losses to follow up: ?	Self reported UI at 38 wk' pregnancy: 1. Control: 96% 2. Supervised: 6,9% 3. Observational: 6.9%

mo=month, wk'= week, ITT = intention to treat analysis, Ns=non significant, OR=odds ratio, PFM = pelvic floor muscles, PFMT = pelvic floor muscle training, VPFMC=voluntary pelvic floor muscle contraction, RCT=randomised controlled trial, RR=relative risk , SD=standard deviation, SUI= stress urinary incontinence , UI=urinary incontinence,

Table 1b. Studies assessing the effect of pelvic floor muscle exercises during pregnancy to treat urinary incontinence including only women with urinary incontinence at inclusion.

Author	Design	Subjects	Training protocol	Losses to follow-up / Adherencee må sjekkes	Outcomes [Numbers and percentage (%)]
Woldringh et al 2006 (33)	2 arm RCT 1. Control (n=152): Routine care. 2. Intervention (n=112): Four sessions of individual instructions in PFMT	N= 264 women with UI at 22 wk' of pregnancy. Multi center, The Netherlands	1. Control: Routine care. Nearly 2/3 received some instruction on PFMT. 2. Intervention: Three sessions of individual therapy during wk' 23-30 of pregnancy and one 6 wk' after delivery, combined with written information.	Losses to follow up %: Control/Intervention 35 wk': 17/14 8 wk' postpartum: 25/18 6 mo postpartum: 30/29 12 mo postpartum: 42/35v Adherence to PFMT?: - 54% in the intervention group participated during the whole study period, and 77% of these women reported regular PFMT at 35 weeks of pregnancy. - 50% in the control group participated during the whole study period, and 40% of these women reported regular PFMT at 35 weeks of pregnancy.	Self reported severity of any UI: Control Intervention p 35 wk' pregnancy: 93% 88% 0.33 8 wk' postpartum: 68% 62% 0.44 6 mo postpartum: 60% 56% 0.63 12 mo postpartum: 63% 58% 0.61 1 year postpartum: Negative correlation between training intensity and severity of UI

				Adverse events not stated ITT analysis	
Dinc et al 2009 (19)	2 arm RCT 1. Control (n=46) 2.Intervention (n=46): PFMT	N=92 pregnant women recruited at 20 wk' - 34 wk' of pregnancy. All women had existing UI. Primi- and multiparous. Single centre, Turkey	1. Control 2. Intervention: 3-16 weeks of intensive PFMT, with thorough instruction and additional home exercises between 20 and 36 wk' 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.	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: ? Not ITT analysis	Self reported UI at 36 – 38 wk' pregnancy: 1. Control: 25/35 (71.4%) 2. Intervention: 16/37 (43.2%) UI at 6-8 wk' postpartum: 1. Control: 13/33 (38.4%) 2. Intervention: 6/35 (17.1%) Sig difference in episodes of UI, Urgency, number of voids and amount of urine in pad test in favour of the intervention group both at 36 – 38 wk' pregnancy and at 6-8 wk' postpartum PFM strength: Sign difference (p=0.00) in favour of the intervention group both at 36 – 38 wk' pregnancy and at 6-8 wk' postpartum
Sangsa-	Quasi-experimental design, pre- and	N=70 with SUI at gestational age of	1. Contol 2. Intervention: 6 week	Losses to follow up: 4 in the	Severity of SUI after intervention:

wang et al 2011 (25)	posttest 1. Control (35) 2. Intervention (35) PFMT	20-30 weeks Single centre, Thailand	PFMT	intervention group Adherence to PFMT: ? Not ITT analysis	Significantly lower frequency and amount of urine leakage and score of perceived SUI severity in the Intervention group.

mo=month, wk'= week, ITT = intention to treat analysis, Ns=non significant, OR=odds ratio, PFM = pelvic floor muscles, PFMT = pelvic floor muscle training, VPFMC=voluntary pelvic floor muscle contraction, RCT=randomised controlled trial, RR=relative risk , SD=standard deviation, SUI= stress urinary incontinence , UI=urinary incontinence,

Table 2a. 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 (%)]
Sleep & Grant 1987 (38)	2 arm RCT 1. Control (n=900): Current standard care 2. Intervention (n=900): Current standard care + individual sessions PFMT	N=1800 postpartum women recruited within 24 hours 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 wk health diary. 2. Intervention: As above plus one individual session daily while in hospital with midwifery co-ordinator. 4 wk 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 months postpartum 58% in the intervention group and 42% in the control group Adverse events not stated Not ITT analysis	Self reported UI 3 mo postpartum: 1. Control: 175/793 (22%) 2. Intervention: 180/816 (22%) RR (95% CI): 1(0.83, 1.20)
Mørkved & Bø 1997 (37)	Prospective matched controlled 1. Control (n=99): Customary written postpartum instructions from the hospital. 2. Intervention (n=99): Eight weeks PFMT	N=198 women, included 8 wk' 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. Not discouraged from performing PFMT on their own. Correct PFM contraction checked at enrolment. 2. Intervention: Eight weeks of intensive PFMT (in a group) led by physiotherapist, with additional home exercises 10 max contractions (each held for six seconds) and to the last 4 were 3-4 fast contractions added, repeated twice daily, between 8 and 16 wk' postpartum. Correct VPFMC checked at enrolment.	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	Self reported UI at 16 wks' 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

Mørkved & Bø 2000 One-year follow up (40)	1. Control (n=81) 2. Intervention (n=81)	N=180 women one year postpartum. All women, who had participated in a matched controlled trial were contacted per telephone one year after delivery.		All longitudinal changes were 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 16th week and one year postpartum.	Self reported UI at 12 mo 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
Meyer et al 2001 (36)	Allocated to 2 groups 1. Control (n=56): no education 2. Intervention (n=51): 12	N=107 primiparous women recruited 12-39 wk' of pregnancy.: 9/56 controls and 16/51 in the intervention group had self	1. Control (n=56): No pelvic floor re-education offered from 2 - 10 mo postpartum. 2. Intervention (n=51): Begun at 2 mo postpartum. 12 sessions over 6 wk' with physiotherapist. PFMT	Llosses to follow up: No Adherence not reported	Self reported SUI 10 mo postpartum: 1. Control: 8/56 (32%) 2. Intervention: 6/51 (12%) RR (95% CI): 0.82 (0.31, 2.21)

	sessions PFMT over 6 wk' with physiotherapist	reported SUI. Single centre, Switzerland.	followed by 20 minutes of biofeedback and 15 minutes of electrostimulation.	Adverse events not stated Not ITT analysis	Subjects cured: 1. Contro1: 1/51 (2%) p=1.0 2. Intervention: 10/56 (19%) p=0.02 PFM strength: Ns difference Bladder neck position and mobility: Ns difference Urodynamic parameters: Ns differences
Chiarelli & Cockburn 2002 (34)	2 arm RCT 1. Control (n=350): Usual care. 2. Intervention (n= 370): Continence promotion	N=720 postnatal women following forceps or ventouse delivery, or delivered a baby > or = 4000g. . 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 wk' 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 stratgies.	Losses to followup: 6% in each group Adherence to PFMT: 1. Control: 57.6% 2. Intervention:83.9% - Adverse events not stated IT T analysis	Self reported UI 3 mo postpartum: 1. Control: 126/328 (38.4%) 2. Intervention: 108/348 (31.0%) (95% CI 0.22% - 14.6%) 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

Chiarelli et al 2004 (39)	1. Control (n=294): Usual care 2. Intervention (n= 275): Continence promotion			Losses to follow-up: 30% ITT analysis	Self reported UI 12 mo postpartum: Ns difference between groups. Practice of PFMT at 12 mo promotes continence at this time.
Ewings et al 2005 (35)	Nested RCT 1. Control (n=117): Usual care 2. Intervention (n= 117): PFMT	N=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 mo after delivery. No details of PFMT programme given.	Losses to follow up: total 19% 1. Control: 17/100 2. Intervention:27/90 Adherence to PFMT in the intervention group: 5/90 (5,6%) ITT analysis	Urinary incontinence at 6 mo postpartum: 1. Control: 47/117 (47%) 2. Intervention: 54/117 (60%) RR (95% CI): 1.28 (0.98-1.67), p=0.10

mo=month, wk'= week, ITT = intention to treat analysis, Ns=non significant, OR=odds ratio, PFM = pelvic floor muscles, PFMT = pelvic floor muscle training, VPFMC=voluntary pelvic floor muscle contraction, RCT=randomised controlled trial, RR=relative risk , SD=standard deviation, SUI= stress urinary incontinence , UI=urinary incontinence,

Table 2b. Studies assessing the effect of pelvic floor muscle exercises after delivery to treat urinary incontinence including only women with urinary incontinence at inclusion.

Author	Design	Subjects	Training protocol	Losses to followup / Adherence	Outcomes [Numbers and percentage (%)]
Wilson & Herbison 1998 (43)	2 arm RCT 1. Control (n=117): Standard postnatal PFM exercises 2. Intervention (n=113): 12 weeks of intensive PFMT	N=230 women with UI three months postpartum. Single centre, New Zealand	1. Control: Standard postnatal PFM exercises 2. Intervention: Instructions by physiotherapist (80-100 fast/slow contractions daily) 3,4,6 and 9 mo postpartum. Use of perineometer to teach awareness of VPFMC. Three groups: a. 39 women performed only PFMT b. 36 women only trained with vaginal cones 15 minutes per day c. 38 women used both a and b	Losses to follow up 12 mo outcome assessment: 36.9% 1. Control: 91/117 2. Intervention: 54/113 Adherence to PFMT: Last month :89% Every day: 48% - 12 mo postnatally was mean number of VPFMC 86 in the intervention group and 35 in the control group.	Self reported UI at 12 mo postpartum: 3. Control: 69/91 (76%) 4. Intervention: 27/54 (50%) p=0.003 Pad test: Ns difference Perineometry: Ns difference
Glazener et al 2001 (42)	2 arm RCT 1. Control (n=376): No visit 2. Intervention (n=371): Advice + visits 3 centres: Aberdeen, Birmingham, Dunedin	N=747 women with UI three mo postnatally Multi-centre trial, New Zealand, UK	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	Lost to follow up at 12 months: 31% 1. Control: 35% 2. Intervention: 25% Adherence to PFMT: - In the 11th postnatal mo had 78% in the intervention group (mean 20 VPFMC) and 48%	Self-reported UI at 12 mo postpartum: Any UI 1. Control: 169/245 (69%) 2. Intervention: 167/279 (59.9%) p=0.037 Severe UI: 1. Control: 78/245 (31.8%)

Glazener et al 2005 (44)	6 year follow up 1. Control: n=253 2. Intervention:n=263	N=516		in the control group (mean 5 VPFMC) done some PFMT. ITT analysis Lost to follow up: 30% Performing any PFMT: 1. Control: 50% 2. Intervention: 50%	2. Intervention: 55/279 (19.7%) p=0.002 Severe UI at 6 years follow up: 1. Control: 99/253 (39%) 2. Intervention: 100/263 (38%) p=0.867
Dumoulin et al 2004 (41)	3 arm RCT 1. Control (n=20) 2. PFM rehabilitation (n=21) 3. PFM rehabilitation + training of deep abdominal muscles	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 gynecological visit at an obstetric	1. Control: 8 weekly sessions of massage 2. PFM rehabilitation: Weekly sessions supervised by physiotherapist for 8 wk': 15-minutes electrical stimulation + 25 minutes PFMT with biofeedback + home training 5 days per week. 3. PFM rehabilitation as group 2 + 30 minutes of deep abdominal muscle training	Losses to follow up: 3% Adherence rate not stated Adverse events not stated	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: 17/23 Sign difference in favour of the intervention groups

Elliott et al 2009 (abstract) (20)	(n=23) A seven year follow up Combination of the previous two PFM rehabilitation groups (n=35)	clinic, Canada		ITT analysis Performing any PFMT: 54%	(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
Kim et al 2012 (24)	2 arm RCT 1. Control intervention (n=10) 2. Intervention	N=20 Post partum women with UI. Single centre, Korea	4. Cotrol intervention: Unsupervised PFMT 5. Intervention: Supervised PFMT	Losses to follow up: 2/20 Adherence: ?	Significant difference in favour of the supervised PFMT group on after the intervention period: - Bristol Female Lower urinary tract Symptoms - Vaginal squeeze pressure

	(n=10)			Adverse events not stated No ITT analysis	

mo=month, wk'= week, ITT = intention to treat analysis, Ns=non significant, OR=odds ratio, PFM = pelvic floor muscles, PFMT = pelvic floor muscle training, VPFMC=voluntary pelvic floor muscle contraction, RCT=randomised controlled trial, RR=relative risk , SD=standard deviation, SUI= stress urinary incontinence , UI=urinary incontinence,

Table 3. Studies assessing the effect of pelvic floor muscle exercises during pregnancy (to prevent/treat urinary incontinence), studies published as only abstracts are not included.

PEDro quality score of RCT 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.

Study	Eligibility criteria specified	Subjects randomly allocated to groups	Allocation was concealed	Groups were similar at baseline	Subjects were blinded	Therapist administrating the treatment was blinded	Assessors were blinded	Measures of key outcomes obtained from > 85 % of subjects	Data analyzed by intention to treat	Statistical comparison between groups were conducted	Point measures and measures of variability provided	Total score
Sleep & Grant 1987 [38]	?	+	?	?	-	-	-	+	-	+	+	4/10
Mørkved & Bø 1997 [37]	+	-	-	+	-	-	-	+	-	+	+	4/10
Wilson & Herbison 1998 [43]	+	+	+	+	-	-	-	-	-	+	+	5/10
Sampselle et al 1998 [30]	+	+	+	+	-	-	+	-	+	+	+	7/10
Glazener et al 2001 [42]	+	+	+	+	-	-	+	-	+	+	+	7/10
Meyer et al 2001 [36]	+	?	?	?	-	-	?	+	?	+	+	3/10

Chiarelli & Cockburn 2002 [34]	+	+	+	+	-	-	?	+	+	+	+	7/10
Reilly et al 2002 [29]	+	+	+	+	-	-	+	+	+	+	+	8/10
Mørkved et al 2003 [28]	+	+	+	+	-	-	+	+	+	+	+	8/10
Dumoulin et al 2004 [41]	+	+	+	+	-	-	+	+	+	+	+	8/10
Ewings et al 2005 [35]	+	+	+	+	-	-	-	-	+	+	+	7/10
Gorbea Chàvez et al 2004 [26]	+	+	+	+	-	-	-	+	+	+	?	7/10
Woldringh et al 2007 [33]	+	+	-	+	-	-	?	-	+	+	+	6/10
Dinc et al. 2009 [19]	+	+	+	+	-	-	-	?	+	+	+	7/10
Mason et al. 2010 [22]	+	+	+	+	-	-	+	-	-	+	+	7/10
Ko et al. 2011 [21]	+	+	+	+	-	-	?	+	?	+	+	7/10
Bø & Haakstad 2011 [17]	+	+	+	+	-	-	+	-	-	+	+	7/10
Stafne et al. 2011 [23]	+	+	+	+	-	-	+	+	+	+	+	8/10

Sangsa-wang et al 2011 [25]	+	-	-	+	-	-	?	+	-	+	+	5 /10
Kim et al 2012 [24]	+	+	-	+	-	-	+	+	-	+	+	7/10

How to tell if you are contracting the pelvic floor muscles correctly

- Sit on the arm of a chair or the edge of a table. Lift the pelvic floor up from the surface you are sitting on by pulling up and contracting around the urethra, vagina and rectum. Squeeze so hard that you feel a slight trembling in your vagina. When you squeeze hard enough, you can feel the lower part of the stomach being pulled in slightly at the same time. Release the contraction without pressing downward. Try to feel the difference between relaxing and tightening the pelvic floor.

- Try to stop the flow when you are urinating. If these muscles are weak, it may be difficult to stop the flow when it is strongest. You can then test yourself towards the end of urination, which is much easier. This is only a test to see whether you are using the muscles correctly. Do not use urination for training, as this can interfere with the ability to empty your bladder completely.

- If you are not sure about whether you are doing it correctly, contact your doctor and ask for a referral to a physiotherapist with special training in women's health.

Training program

Lift up and inward around your urethra, vagina and rectum. Squeeze as hard as you can during each contraction and try to hold it for 6-8 seconds before you gently relax. Relax and breathe with a slow, regular and gentle rhythm out and in both during and between the muscle contractions. Do 8-12 repetitions in 3 sets. If this seems too difficult, start with fewer repetitions. Choose one or more of these starting positions:

1. Sit with your legs apart and your back straight. Lift upwards and inwards around the openings in the pelvic floor.
2. Stand with your legs apart, and check that the buttock muscles are relaxed while you squeeze the pelvic floor muscles.
3. Kneel on all fours with your knees out to the side and feet together. Lift the pelvic floor upwards and inwards.

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 postpartus OR postpartum 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	Exercis* 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 postpartus[tiab] OR postpartum[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 pelvis[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 ((urine[tiab] OR urinary[tiab]) AND (continen*[tiab] OR incontinen*[tiab] OR leak*[tiab] OR wetting[tiab]))
5	Clinical trial[pt] 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 04 September 2012

Therapy: 'Strength Training'
Problem: 'Incontinence'
Body Part: 'Lumbar spine, sacro-iliac joint or pelvis'

Total

Embase	69 references
CENTRAL	34 references
PubMed	73 references
PEDro	5 references
Total from databases	181 references (of which 43 duplicates)
Total deduplicated	138 references