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ORIGINAL REPORT

SPECIFIC MUSCLE STABILIZING AS HOME EXERCISES FOR PERSISTENT PELVIC GIRDLE PAIN AFTER PREGNANCY: A RANDOMIZED, CONTROLLED CLINICAL TRIAL

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Objective: **To investigate the efficacy of home-based specific stabilizing exercises focusing on the local stabilizing muscles as the only intervention in the treatment of persistent postpartum pelvic girdle pain.**

Design: **A prospective, randomized, single-blinded, clinically controlled study.**

Subjects: **Eighty-eight women with pelvic girdle pain were recruited 3 months after delivery.**

Methods: **The treatment consisted of specific stabilizing exercises targeting the local trunk muscles. The reference group had a single telephone contact with a physiotherapist. Primary outcome was disability measured with Oswestry Disability Index. Secondary outcomes were pain, health-related quality of life (EQ-5D), symptom satisfaction, and muscle function.**

Results: **No significant differences between groups could be found at 3- or 6-month follow-up regarding primary outcome in disability. Within-group comparisons showed some improvement in both groups in terms of disability, pain, symptom satisfaction and muscle function compared with baseline, although the majority still experienced pelvic girdle pain.**

Conclusion: **Treatment with this home-training concept of specific stabilizing exercises targeting the local muscles was no more effective in improving consequences of persistent postpartum pelvic girdle pain than the clinically natural course. Regardless of whether treatment with specific stabilizing exercises was carried out, the majority of women still experienced some back pain almost one year after pregnancy.**

Key words: low back pain; postpartum; physical therapy; exercise therapy; pelvic floor; specific stabilizing exercises; trunk muscles.

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INTRODUCTION

Approximately 50% of all pregnant women experience lumbopelvic pain to some degree during pregnancy (1). For the majority of women, this pain disappears within 3 months after delivery (2). However, the pain is persistent postpartum for a substantial number of women (3, 4), and in 7% the pain is severe (1). Of women with recurrent lumbopelvic pain, 10–20% relate their first episode of pain to pregnancy (5, 6). Research aiming to identify effective and early treatment strategies for persistent pregnancy-related lumbopelvic pain is important. Studies have demonstrated the importance of subgrouping lumbopelvic pain (7–9). In this study we have chosen to focus on the subgroup with pelvic girdle pain (PGP) (10) or PGP in combination with lumbar pain (combined pain), since these groups were shown to have the highest impact on daily life (9).

Dysfunction of load transfer in the lumbopelvic region has been raised as one possible explanation of lumbopelvic pain (11). A theoretical model of lumbopelvic pain presents a self-locking mechanism of the pelvic joints based on the principles of form closure and force closure (12). The local stabilizing muscles, i.e. the transversely oriented abdominal, the lumbar multifidus, and the pelvic floor muscles, are reported to play an important role in load transfer in the lumbopelvic region (13–15). Likewise muscle dysfunction has been associated with PGP (16).

It has been suggested that improving the activation pattern of the local stabilizing muscles results in functional improvement in lumbopelvic pain patients (17, 18). Treatment that includes specific stabilizing exercises for the local muscles is effective for women with PGP during pregnancy using a home training approach (19). After pregnancy, Stuge et al. (20) successfully used a treatment concept including training of the global and local muscles, ergonomic advices, body awareness, and, when indicated, massage, mobilization, and stretching. Home training, following introduction of the exercises by a physiotherapist, is a common approach in the clinic settings for specific stabilizing exercises. The aim of the present study was to investigate if home-based specific stabilizing exercises focusing on the local stabilizing muscles are sufficient as treatment for women with persistent postpartum PGP or combined pain.

METHODS

Study design

This was a prospective, randomized, clinically controlled study. The randomization procedure took place after a baseline examination was

completed and eligibility was determined. The participants draw sealed envelopes (from the research physiotherapist) to assign them to the treatment group or the reference group. The research physiotherapists who conducted the follow-ups were blinded to group assignments.

Study participants

Women with lumbopelvic pain were recruited from two geographical areas in Sweden during May 2002 to December 2004 (area 1) and during April 2007 to August 2008 (area 2), respectively. In area 1, women with persistent lumbopelvic pain 3 months postpartum belonging to an ongoing cohort study were identified (8). In area 2, midwives identified women with persistent lumbopelvic pain at the follow-up visit 8–12 weeks after delivery. In both areas, the women were examined by one of two research physiotherapists.

Classification of the pain problem was based on an examination starting with a standardized history. It was followed by mechanical assessment of the lumbar spine according to the Mechanical Diagnosis and Therapy protocol (MDT) (21) and pelvic pain provocation tests performed in the mentioned order; distraction test, posterior pelvic pain provocation test, Gaenslen's test, compression test, sacral thrust (22). To consider a pelvic pain provocation test positive it had to reproduce the women's familiar pain regarding localization and quality. The active straight leg raising (ASLR) test (4-point scale, sum: 0–6) (23), hip rotation range-of-motion test, and a neurological examination were performed. The clinical examination is reliable and has been described in detail (22).

Inclusion criteria for PGP were ≥2 positive pelvic pain provocation tests, pain onset during a pregnancy or within 3 weeks from delivery and pain located distal and/or lateral to the L5–S1 area in the buttocks. In addition to the criteria for PGP, some women also had pain localized in the lumbar region, centralization or peripheralization phenomenon and/or pain/symptoms during repeated movements/positions of the lumbar spine according to the classification of MDT. These women were considered to have PGP in combination with lumbar pain (combined pain) and were also included. Exclusion criteria were: systemic locomotor disease, a verified diagnosis of spinal problems in the previous 2 months, a history of fracture, neoplasm, or previous surgery of the spine, pelvis, or femur, insufficient Swedish language skills, treatment with specific stabilizing exercises during the previous 3 months, and ongoing pregnancy. All participants received oral and written information about the study before oral consent.

Intervention

The women assigned to the treatment group were instructed to exercise ≥2 times per day and to perform each exercise with 10 repetitions. The training consisted of specific stabilizing exercises and focused on the transversely oriented abdominal, the lumbar multifidus, and the pelvic floor muscles (24). Specific stabilizing training model includes principles of motor learning theory and consists of 3 stages: (*i*) local segmental control; (*ii*) closed chain segmental control; and (*iii*) open chain segmental control; in the present study with emphasis on daily activities. An individual programme was made for each woman and exercises were chosen from among 15 standardized and predesigned exercises. The level of the exercises was progressively increased during the treatment period with the goal of reaching stage *iii*. In addition to the home training, individual guidance and adjustment of the exercise programme were performed every second week by one of two treating physiotherapists. To measure compliance with the training programme, a daily training diary was kept during the training period.

The women in the reference group had a single telephone contact with a physiotherapist. They received information about PGP and combined pain, including the fact that it is a common problem during pregnancy and that it disappears within a couple of months postpartum in the majority of the cases. They were instructed to resume their normal activities.

Assessment

In addition to the clinical examination, all participants completed questionnaires and underwent muscle function tests at inclusion approximately 3 months postpartum and again 3, 6, 12, and 24 months later. In this paper, the 3- and 6-month follow-ups are reported.

Questionnaires

Demographic data were collected at baseline, consisting of age, body mass index, physical activity level (1–6 where; 6 = most active; 1–3 = manage all household duties, including gardening and light physical activity; or 4–6: the aforementioned activities + exercises at increasing intensity) (25), current physical exercise frequency (never/sometime per month, 1–2 times/week, or > 2 times/week) urinary leakage (yes/no), number of pregnancies, and number of children. Additionally, questions regarding delivery and pregnancy, i.e. weight of the newborn, breastfeeding (yes/no), delivery mode (vaginal/caesarean), injuries during delivery (yes/no), lumbopelvic pain during pregnancy (yes/no), treatment of the lumbopelvic pain during pregnancy (yes/no), and postpartum depressive symptoms measured with the Edinburgh Postnatal Depression Scale (26) were evaluated at baseline.

Questions regarding symptom satisfaction (delighted to mostly satisfied or mixed to terrible feelings) (27) and expectations of treatment (completely restored, quite improved, not improved but to get some relief of the symptoms, or no expectations of being restored) were collected.

The primary outcome measure was disability, based on the Oswestry Disability Index (ODI) version 2.0 (28). Pain intensity was measured with a visual analogue scale (VAS) (0–100 mm) for current pain and average pain during the previous week. Pain frequency was also measured (always, day and night to several times per week, or occasionally to never). The EuroQol instrument (EQ-5D and EQ-VAS) was used to capture the women's perceived health-related quality of life (HRQL) (29). Wellbeing was measured with VAS (0–100 mm) having defined end-points (low value indicating high wellbeing).

Muscle function

Muscle function tests were performed to evaluate whether the treatment had targeted the muscle function. No encouragement was given during the tests. The tests were conducted as described below.

Pelvic floor muscles

The activity of the pelvic floor muscles was evaluated with surface electromyography (EMG). The EMG activity was recorded with Periform™ vaginal probe (Neen HealthCare, Dereham, UK). EMG signals were collected with NeuroTrac™ ETS (Verity Medical LDT, Surrey, UK). A ground electrode and an amplifier were placed on the right hip at the iliac crest in order to reduce noise from the recordings of the pelvic floor muscles. The between-trial reliability has been found to be good to high for the probe ($ICC_{(3,1)}$ = 0.80–0.98, coefficient of variation (CV) = 9.6–19.5%) (30). The woman was supine on an examination bench with the legs extended. She was asked to contract her pelvic floor muscles as strongly as possible for 5 s and then to relax for 5 s. This sequence was repeated 5 times.

Gait

The women were timed walking barefoot for a distance of 20 m "at a comfortable speed" on a horizontal floor (modified from Ljungqvist et al.) (31).

Hip extensors

Maximal voluntary isometric hip extension was measured with a dynamometer (Chatillon CSD 500 strength dynamometer, Ametek, Largo FL, USA) with a fixed sensor. A sling was placed on the women's thigh at the distal end of the femur and pulled in extension. They were instructed to pull as hard as they could. Two training repetitions were performed. The mean of the next 3 repetitions were used for analyses. Each repetition consisted of 5 s work and 5–10 s rest. The procedure was performed on both legs; all women started with the right leg.

Back flexors

Isometric endurance of the back flexors was tested with women in the supine position with arms crossed over their chest, hips bent, and

knees and feet apart. They were asked to nod and to continue to lift their head and shoulders until the inferior angle of the scapula was lifted from the examination bench, and to hold the position for as long as possible (modified from McQuade et al.) (32). The time that the position was maintained was recorded in s and the test was interrupted after a maximum of 120 s.

Back extensors

Isometric endurance of the back extensors was tested with women in the prone position with arms crossed over the chest and the trunk horizontal and transversely outside the examination bench. The pelvis and the lower legs were fixed to the examination bench by straps and by the tester, respectively (modified from Biering-Sörensen) (33). The time that the position was maintained was recorded in s and the test was interrupted after a maximum of 120 s.

Statistical analysis

Power analysis was based on a cohort of postpartum women (8). With a beta level of 80% and a difference between the groups in ODI of 10%, 21 participants per group were required. Two-group comparisons were made with Student's *t*-test for continuous data. The Mann-Whitney *U* test was used for ordinal data and the χ^2 test or, when appropriate, the Fisher's exact test was performed on nominal data. Within-group comparisons were made with paired *t*-test for continuous data, the Wilcoxon signed-rank for data on ordinal level, and the McNemar test was used for dichotomous variables. Statistical significance was set at an alpha level of 0.05. The statistical software package SPSS was used (version 17.0; SPSS, Inc., Chicago, IL, USA). The regional research ethics committee approved the study (Ö414-00, T018-07).

RESULTS

Study sample

A total of 88 women were included in the study. Sixty-five (74%) and 60 (68%) women completed the 3-month and 6-month follow-up, respectively (Fig. 1). There were no significant differences between groups from the two geographical areas at baseline. The age of the participants and weight of the newborn babies differed significantly between the treatment group and the reference group (Table I). No differences could

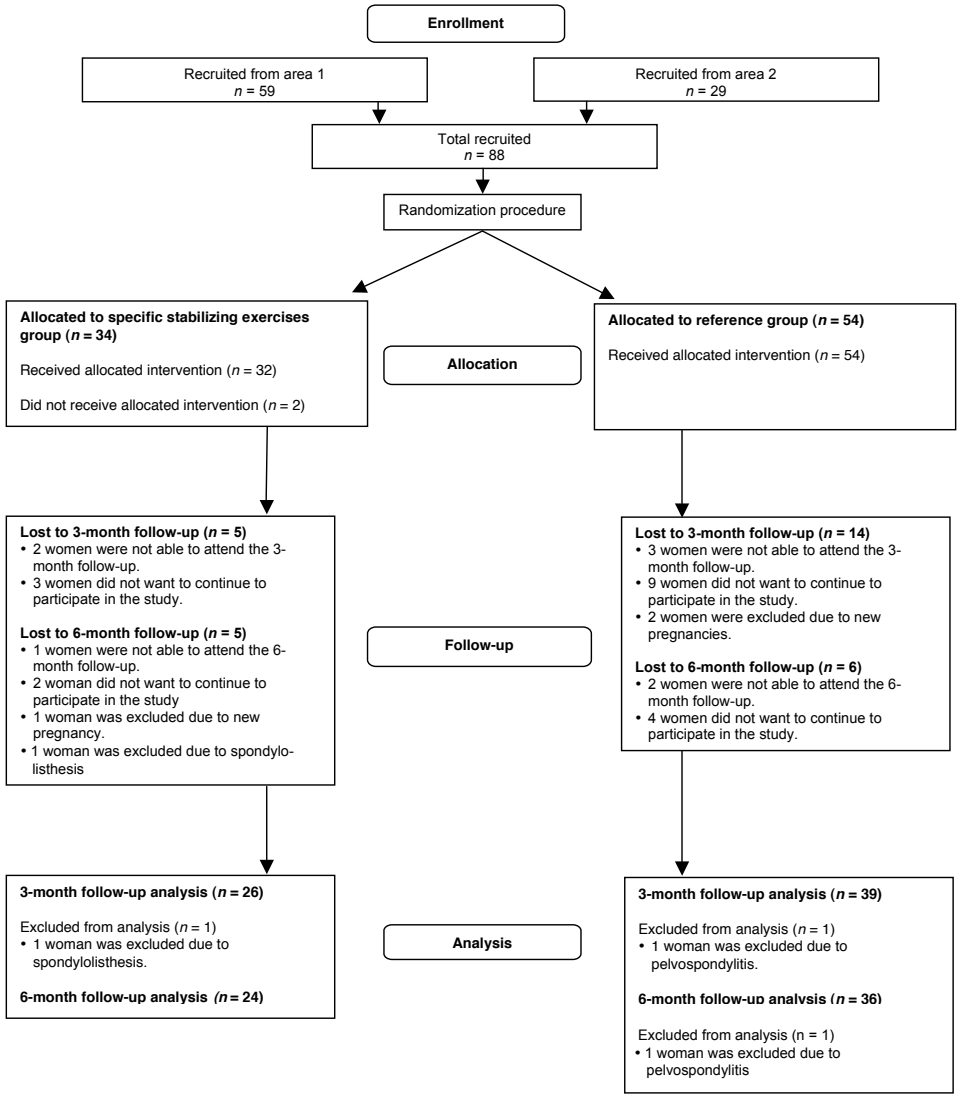

Fig. 1. Participant flow through the randomized trial.

be detected between the groups at baseline regarding disability, pain intensity, pain frequency, HRQL, or muscle parameters (Tables II and III). The severity of the PGP measured with the ASLR test did not differ between the treatment group (median score 0; range 0–2) and the references group (median 0; range 0–4) ($p = 0.150$). The only woman who scored 4/6 (none scored 3) did not participate in any follow-up.

Of the 21 participants who were not included in the 3-month follow-up, a lower proportion reported urinary leakage (2/21 (10%) vs 21/65 (32%); $p = 0.040$), had less children living at home ($p = 0.046$), and had a lower proportion of Caesarean deliveries (0/21 vs 12/65 (18.5%); $p = 0.034$) than the 65 included. The 26 participants who were not included in the 6-month follow-up, were older than the 60 included (32 years vs 30; $p = 0.040$). There was no difference in primary outcome (ODI) between women included and women not included in the two follow-ups.

Intervention outcome

On average 5 (standard deviation (SD) 3) physiotherapy sessions were performed and on average 7 (SD 3) exercises were prescribed to the women by the treating physiotherapist. No woman trained 2 times/day in average during their training period, 10 woman trained ≥ 1.5 times/day in average and 15 woman trained < 1.5 times/day. Seven diaries were not handed in. Seventy-eight percent of the women in the treatment group reached stage 3 in the treatment programme. Eight women in the treatment group received additional treatment (acupuncture, transcutaneous electrostimulation, ultrasound treatment, massage, pelvic belt) along with specific local stabilizing exercises.

Disability

For the primary outcome, ODI, no difference could be demonstrated between the 2 groups at 3- or 6-month follow-up ($p = 0.205$; $p = 0.358$) (Table II).

Table I. *Descriptive data for all included women at baseline*

Variable	Treatment group $n = 32$	Reference group $n = 54$	Group comparisons p-values
Demographic data			
Mean (SD) age in years	32 (4)[1]	30 (4)[2]	0.041
Median number of children living at home (25th, 75th percentile)	2 (1–3)[1]	2 (1–2)[2]	ns
Median number of parity (25th, 75th percentile)	2 (1–3)[1]	2 (1–3)[2]	ns
Median body mass index (weight/height*2) (25th, 75th percentile)	26 (23–28)[3]	26 (24–28)[4]	ns
Activity level last 3 months, n (%)			
(1–6; 6 = most active)			
1–3 = Manage all household duties, including gardening and light physical activity	26 (79)	42 (81)	ns
4–6 = The aforementioned activities + exercise at increasing intensity	7 (22)	10 (19)	
Current physical exercise, *n* (%)			
Never	5 (15)	6 (12)	ns
Some times per month	4 (12)	4 (8)	
1–2 times/week	9 (27)	16 (31)	
> 2 times/week	15 (46)	26 (50)	
Urinary leakage, *n* (%)			
No	24 (73)	39 (74)	ns
Yes	9 (27)	14 (26)	
Data regarding pregnancy and delivery			
Median score of the Edinburgh Postnatal Depression Scale (25th, 75th percentile)	6 (2–8)[5]	7 (4–11)[6]	ns
Delivery method, *n* (%)			
Caesarean	5 (18)	7 (17)	ns
Vaginal	23 (82)	35 (83)	
Mean (SD) weight of newborn (grams)	3823 (585)[1]	3512 (569)[2]	0.016
Injury of the pelvic floor during delivery, *n* (%)			
No	10 (31)	22 (42)	ns
Yes	22 (69)	30 (58)	
Lumbopelvic pain during pregnancy, *n* (%)			
No	2 (6)	3 (6)	ns
Yes	31 (94)	50 (94)	
Received treatment of lumbopelvic pain during pregnancy, *n* (%)			
No	22 (71)	33 (66)	ns
Yes	9 (29)	17 (34)	
Currently breastfeeding, *n* (%)			
No	8 (26)	9 (17)	ns
Yes	23 (74)	43 (83)	
Expectations on treatment, *n* (%)			
Completely restored or quite improved	29 (88)	47 (92)	ns
Not improved but some relief of the symptoms or no expectations	4 (12)	4 (8)	

[1]$n = 33$; [2]$n = 53$; [3]$n = 30$; [4]$n = 47$; [5]$n = 28$; [6]$n = 44$.

p-values from Student's *t*-test, Mann-Whitney *U* test, χ^2 test or when appropriate, Fisher's exact test. Significance level = 0.05. ns: indicates not significant; SD: standard deviation.

Table II. *Between-group comparisons and within-group comparisons of Oswestry Disability Index (ODI), Wellbeing visual analogue scale (VAS), EuroQol (EQ-5D) instrument and Pain intensity VAS based on mean differences at 3- and 6-months follow-up. Symptom satisfaction and Pain frequency are presented as proportions at 3- and 6-months follow-up*

	Baseline		3-month follow-up		6-month follow-up	
Variable, median (25th, 75th percentile)	Treatment group (*n*=32–33)	Reference group (*n*=52–53)	Treatment group (*n*=25–26)	Reference group (*n*=34–39)	Treatment group (*n*=23–24)	Reference group (*n*=32–35)
Primary outcome						
ODI Score (%)	18 (13–27)	18 (10–27)	–4 (–14; 2)*	–2 (–6; 4)	–8 (–20; 3)*	–4 (–12; 2)*
Secondary outcomes						
Wellbeing VAS (mm)	19 (10–35)	16 (11–32)	–2 (–9; 11)	–1.5 (–10; 6)	0 (–14; 5)	–3 (–14; 4)
EQ-5D	0.73 (0.70–0.80)	0.80 (0.73–0.80)	0.0 (–0.1; 0.1)	0.0 (0.0; 0.06)	0 (–0.1; 0.1)	0.0 (0.0; 0.1)
EQ-VAS	79 (70–88)	77 (70–85)	5 (–1; 10)	3 (–4; 13)	4 (–2; 11)	5 (0; 12)*
Pain intensity VAS at moment (mm)	30 (13–48)	35 (17–55)	–12 (–30; 3)**	–14 (–31; 2)**	–16 (–28; 3)**	–19 (–41; –1)**
Pain intensity VAS mean previous week (mm)	36 (23–50)	35 (20–59)	–21 (–34; 6)**	–14 (–35; 7)*	–20 (–31; 8)**	–19 (–48; 0)**
Symptom satisfaction *n* (%)						
Delighted – mostly satisfied	9 (27)	17 (33)	14 (54)*	17 (44)	15 (63)*	27 (77)*
Mixed feelings – terrible	24 (73)	35 (67)	12 (46)	22 (56)	9 (38)	8 (21)
Pain frequency						
Always, day and night – several times per week	26 (79)	45 (87)	14 (58)#	33 (87)	13 (54)	20 (59)*
Occasionally – never	7 (21)	7 (13)	10 (42)	5 (13)	11 (46)	14 (41)

#Between-group comparison $p<0.05$; *Within-group comparison $p<0.05$; **Within-group comparison $p<0.001$.

Within-group difference for the ODI was shown for the treatment group at 3-month follow-up. Both groups showed within-group differences at 6-month follow-up compared with baseline (Table II).

Pain, health-related quality of life, and wellbeing

A significant difference in pain frequency was demonstrated between the two groups at the 3-month follow-up ($p=0.011$) in favour of the tre atment group. Pain was experienced "always, day and night to several times per week" in 87% of women in the reference group and in 58% of women in the treatment group. No differences could be detected between the groups regarding pain intensity, HRQL or wellbeing (Table II).

Within-group comparisons showed that the pain intensity had decreased in the two groups both at 3- and 6-month follow-up compared with baseline (Table II). The pain frequency decreased in the reference group at the 6-month follow-up compared with baseline ($p=0.022$). Fifty-nine percent in the reference group experienced pain "always, day and night to several times per week" at the 6-month follow-up compared with 87% at baseline (in the treatment group 54% vs 79% at baseline ($p=0.180$)).

Symptom satisfaction

No differences were found between the two groups regarding symptom satisfaction at 3- or 6-month follow-up (Table II). The treatment group had improved symptom satisfaction ($p=0.039$) at 3-month follow-up. Fifty-four percent were "delighted to mostly satisfied" compared with 27% at baseline. At 6-month follow-up, both groups had improved symptom satisfaction. Sixty-three percent of the women in the treatment group were "delighted to

Table III. *Between-group and within-group comparisons of the muscle function tests based on mean differences*

	Baseline		3-month follow-up		6-month follow-up	
Variable, mean (SD)	Treatment group (*n*=19–32)	Reference group (*n*=35–52)	Treatment group (*n*=15–24)	Reference group (*n*=16–37)	Treatment group (*n*=12–23)	Reference group (*n*=17–35)
Back flexor endurance (s)	31.1 (28.8)	32.3 (29.1)	2 (27.3)	0.8 (15.2)	4.6 (23.5)	5.0 (27.2)
Back extensor endurance (s)	51.6 (36.2)	40.4 (30.6)	6.6 (15.3)	20.4 (26.3)**	18.6 (14.8)*	17.3 (33.1)*
Gait speed (m/s)	1.24 (0.19)	1.28 (0.14)	0.07 (0.12)*	0.07 (0.12)**	0.08 (0.15)*	0.05 (0.16)
Mean hip extension right leg (N)	210 (101)	203 (82)	41 (70)*	20 (57)*	35 (60) *	28 (68)*
Peak hip extension right leg (N)	249 (111)	250 (95)	41 (72)*	14 (63)	30 (733)	29 (80)*
Mean hip extension left leg N	208 (94)	197 (82)	26 (54) *	2 (64)#	30 (41)*	8 (68)
Peak hip extension left leg (N)	245 (103)	226 (84)	30 (70)	11 (60)	32 (43)*	18 (66)
Work in the PFM (μV)	34 (20)	34 (22)	4 (14)	4 (17)	0.3 (20)	2 (13)
Rest in the PFM (μV)	9 (6)	8 (5)	0.2 (4.2)	0.3 (4.5)	–1.1 (4.3)	–1.5 (4)
Work peak in the PFM (μV)	71 (42)	70 (45)	4.8 (25.1)	0.6 (30.3)	1.7 (36.9)	2 (25.5)
Onset in the PFM (ms)	229 (174)	211 (337)	0.0 (0.2)	0.1 (0.6)	0.0 (0.2)	0.01 (0.21)
Release in the PFM (ms)	268 (518)	106 (610)	0.1 (0.4)	0.3 (0.8)	–0.1 (0.4)	0.5 (0.9)*

Within-group comparison: #Between-group comparison $p<0.05$; *Within-group comparison $p<0.05$; **Within-group comparison $p<0.001$.
SD: standard deviation; PFM: pelvic floor muscles.

mostly satisfied" compared with 27% at baseline ($p=0.001$); in the reference group 77% vs 33% at baseline ($p=0.022$).

Muscle function

A significant difference was demonstrated between the two groups for the mean hip extension remaining at 3-month follow-up ($p=0.047$) (Table III). Within-group comparisons showed an improvement in several of the global muscles measured but not the pelvic floor muscles in both groups at the 3- and 6-month follow-up compared with baseline (Table III).

DISCUSSION

The main finding of this study was that the concept of home-based specific stabilizing exercises focusing on the transversely oriented abdominal muscles, the lumbar multifidus, and the pelvic floor muscles were no more effective in improving back-related disability, HRQL, or reducing pain than the clinically natural course in women with persistent postpartum PGP or combined pain.

A difference in pain frequency was demonstrated between the two groups at the 3-month follow-up in favour of the treatment group. Based on within-group comparisons, there were tendencies in the same direction with the women in the treatment group rating the disability and the consequences of their condition, lower at the 3-month follow-up compared with baseline. This may be explained by the number of comparisons done. It may also be interpreted as a tendency that the group receiving specific stabilizing exercises had a somewhat faster recovery than the reference group.

Previous studies found that treatment strategies including specific stabilizing exercises of the local muscles postpartum were more effective than interventions without (20). Our study differs from that performed by Stuge et al. (20) regarding both the total concept and type and dose of training. The training in our study focused mainly on the local stabilizing muscles, while Stuge et al. (20) also included training of global muscles. Previous studies showed that abdominal muscles, hip extensors, and back extensors are important muscles in the production of force closure (34, 35). Our results suggest that there is no automatic transfer between exercises of local muscles and improved function of the global muscles. It might be wise to include exercises for local muscles as well as global muscles in treatment strategies for PGP (20). This hypothesis is strengthened by the fact that women with persistent postpartum lumbopelvic pain have decreased muscle function in the trunk and hip muscles (16, 36).

Stabilizing exercises are reportedly more effective than other commonly prescribed treatment in patients with classification of PGP (19, 20) or a *specific* back diagnosis (17). In a review of *non-specific* low back pain (LBP), it was concluded that stabilizing exercises alone or as a supplement to another therapy, reduced pain and disability (37). However, there were great variations among the included studies, and the review did not identify any convincing evidence that stabilizing exercises were superior to other exercises.

The choice of stabilizing exercise as management for a patient should be based on clinical findings indicating dysfunction of the stabilizing components. The ASLR test has been suggested to assess load transfer in the lumbopelvic region as well as being an indicator of severity of PGP (13, 38). The women in our study scored a median of 0 out of a possible 6 on the ASLR test at inclusion, indicating minor problems with load transfer in the lumbopelvic region. The majority of women in our study might not have a load transfer problem and accordingly were not expected to benefit from stabilizing exercises as shown in women with a higher score (20). Additionally, women with persistent postpartum PGP but low scores on the ASLR test showed no difference in motor control pattern of the pelvic floor muscles compared with healthy women[1], which support the assumption that the ASLR test is an indicator for load transfer problem. The results on stabilizing exercises taken together indicate that subgroups of PGP as well as LBP may benefit from stabilizing exercises. The challenge is to identify those subgroups.

The home-based approach makes it more difficult to control for compliance and exercise frequency. It is possible that the home-training concept used in the present study for stabilizing exercises does not provide enough support to the women to reach the optimal result. Although Stuge et al.'s (20) trial also used a home-based approach; their patients met with a physiotherapist for a mean of 11 times, which is more than twice as often as our women. Regarding the dose of exercises, our women were instructed to train twice or more per day while Stuge et al.'s (20) patients trained 30–60 min 3 times per week. There was also a difference in the length of the training period. It is possible that we could have reached a different result with a longer training period. The most appropriate frequency-response rate for achieving significant results is unknown; however, these two studies on postpartum PGP indicate that close support by a physiotherapist and a training period of at least 20 weeks is needed.

The strengths of this study include that it is clinically generalizable, since women were included from different geographical areas and more than one physiotherapist monitored the training. However, there are also methodological limitations of the study. The women in our study had quite good functional status at baseline, limiting the possibility for improvement. It should be considered that the women did not themselves seek medical care. This means that individuals with minor problems are included, another difference from Stuge et al.'s (20) study. In addition there was a 26% and 32% loss of participants at the 3- and 6-month follow-ups, respectively, which might have weaken our results. Furthermore, it was not possible to adjust for the uneven randomization to the two arms when identified in the ongoing study.

In conclusion, no difference was found between treatment consisting of home-based specific stabilizing exercises targeting mainly the local muscles and the clinically natural course in women with persistent postpartum PGP or combined pain. Regardless of which group the women were assigned to, the majority still experienced pain and some back-related disability 9 months after delivery. It is possible that these women

[1]Sjödahl J, Kvist J, Gutke A, Öberg B. The postural response of the pelvic floor muscles during the active straight leg raise test in women with and without pelvic girdle pain postpartum: an experimental study. Submitted.

represent the subset of patients that continue to experience recurrent episodes of lumbopelvic pain throughout their lives (5, 6). It is of great importance to understand the effect of both global and local muscles on lumbopelvic pain, in order to determine which subgroups of LBP and PGP are suited for specific stabilizing exercises. It is possible that some women need more than just training as treatment.

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REFERENCES

1. Wu WH, Meijer OG, Uegaki K, Mens JM, van Dieen JH, Wuisman PI, et al. Pregnancy-related pelvic girdle pain (PPP), I: Terminology, clinical presentation, and prevalence. Eur Spine J 2004; 13: 575–589.
2. Ostgaard HC, Zetherstrom G, Roos-Hansson E. Back pain in relation to pregnancy: a 6-year follow-up. Spine 1997; 22: 2945–2950.
3. Ostgaard HC, Andersson GB. Postpartum low-back pain. Spine 1992; 17: 53–55.
4. Brynhildsen J, Hansson A, Persson A, Hammar M. Follow-up of patients with low back pain during pregnancy. Obstet Gynecol 1998; 91: 182–186.
5. Svensson HO, Andersson GB, Hagstad A, Jansson PO. The relationship of low-back pain to pregnancy and gynecologic factors. Spine 1990; 15: 371–375.
6. Biering-Sorensen F. A prospective study of low back pain in a general population. III. Medical service – work consequence. Scand J Rehabil Med 1983; 15: 89–96.
7. Fritz JM, Delitto A, Erhard RE. Comparison of classification-based physical therapy with therapy based on clinical practice guidelines for patients with acute low back pain: a randomized clinical trial. Spine 2003; 28: 1363–1371; discussion 72.
8. Gutke A, Ostgaard HC, Oberg B. Pelvic girdle pain and lumbar pain in pregnancy: a cohort study of the consequences in terms of health and functioning. Spine 2006; 31: E149–E155.
9. Gutke A, Ostgaard HC, Oberg B. Predicting persistent pregnancy-related low back pain. Spine 2008; 33: E386–E393.
10. Vleeming A, Albert HB, Ostgaard HC, Sturesson B, Stuge B. European guidelines for the diagnosis and treatment of pelvic girdle pain. Eur Spine J 2008; 17: 794–819.
11. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Reliability and validity of the active straight leg raise test in posterior pelvic pain since pregnancy. Spine 2001; 26: 1167–1171.
12. Pool-Goudzwaard AL, Vleeming A, Stoeckart R, Snijders CJ, Mens JM. Insufficient lumbopelvic stability: a clinical, anatomical and biomechanical approach to 'a-specific' low back pain. Man Ther 1998; 3: 12–20.
13. Snijders C, Vleeming A, Stoeckart R. Transfer of lumbosacral load to iliac bones and legs Part 1: Biomechanics of self-bracing of the sacroiliac joints and its significance for treatment and exercise. Clin Biomech 1993; 8: 285–294.
14. Hodges PW. Is there a role for transversus abdominis in lumbopelvic stability? Man Ther 1999; 4: 74–86.
15. Snijders C, Vleeming A, Stoeckart R. Transfer of lumbosacral load to iliac bones and legs. Part 2: Loading of the sacroiliac joints when lifting in a stooped posture. Clin Biomec 1993: 295–301.
16. Gutke A, Ostgaard HC, Oberg B. Association between muscle function and low back pain in relation to pregnancy. J Rehabil Med 2008; 40: 304–311.
17. O'Sullivan PB, Phyty GD, Twomey LT, Allison GT. Evaluation of specific stabilizing exercise in the treatment of chronic low back pain with radiologic diagnosis of spondylolysis or spondylolisthesis. Spine 1997; 22: 2959–2967.
18. Hides JA, Jull GA, Richardson CA. Long-term effects of specific stabilizing exercises for first-episode low back pain. Spine (Phila Pa 1976) 2001; 26: E243–E248.
19. Elden H, Ladfors L, Olsen MF, Ostgaard HC, Hagberg H. Effects of acupuncture and stabilising exercises as adjunct to standard treatment in pregnant women with pelvic girdle pain: randomised single blind controlled trial. BMJ 2005; 330: 761.
20. Stuge B, Laerum E, Kirkesola G, Vollestad N. The efficacy of a treatment program focusing on specific stabilizing exercises for pelvic girdle pain after pregnancy: a randomized controlled trial. Spine 2004; 29: 351–359.
21. McKenzie R, May S. The lumbar spine. Mechanical diagnosis & therapy. Waikanae: Spinal Publications New Zealand Ltd; 2003.
22. Gutke A, Kjellby-Wendt G, Oberg B. The inter-rater reliability of a standardised classification system for pregnancy-related lumbopelvic pain. Man Ther 2010; 15: 13–18.
23. Mens JM, Vleeming A, Snijders CJ, Stam HJ, Ginai AZ. The active straight leg raising test and mobility of the pelvic joints. Eur Spine J 1999; 8: 468–474.
24. Richardson CA. Therapeutic exercise for spinal segmental stabilization in low back pain. London: Churchill Livingstone; 1999.
25. Grimby G. Physical activity and muscle training in the elderly. Acta Med Scand Suppl 1986; 711: 233–237.
26. Cox JL, Holden JM, Sagovsky R. Detection of postnatal depression. Development of the 10-item Edinburgh Postnatal Depression Scale. Br J Psychiatry1987; 150: 782–786.
27. Cherkin DC, Deyo RA, Street JH, Barlow W. Predicting poor outcomes for back pain seen in primary care using patients' own criteria. Spine 1996; 21: 2900–2907.
28. Fairbank JC, Pynsent PB. The Oswestry Disability Index. Spine 2000; 25: 2940–2952; discussion 52.
29. Rabin R, de Charro F. EQ-5D: a measure of health status from the EuroQol Group. Ann Med 2001; 33: 337–343.
30. Auchincloss CC, McLean L. The reliability of surface EMG recorded from the pelvic floor muscles. J Neurosci Methods 2009; 182: 85–96.
31. Ljungquist T, Fransson B, Harms-Ringdahl K, Bjornham A, Nygren A. A physiotherapy test package for assessing back and neck dysfunction – discriminative ability for patients versus healthy control subjects. Physiother Res Int 1999; 4: 123–140.
32. McQuade KJ, Turner JA, Buchner DM. Physical fitness and chronic low back pain. An analysis of the relationships among fitness, functional limitations, and depression. Clin Orthop Relat Res 1988; 233: 198–204.
33. Biering-Sorensen F. Physical measurements as risk indicators for low-back trouble over a one-year period. Spine 1984; 9: 106–119.
34. Richardson CA, Snijders CJ, Hides JA, Damen L, Pas MS, Storm J. The relation between the transversus abdominis muscles, sacroiliac joint mechanics, and low back pain. Spine 2002; 27: 399–405.
35. van Wingerden JP, Vleeming A, Buyruk HM, Raissadat K. Stabilization of the sacroiliac joint in vivo: verification of muscular contribution to force closure of the pelvis. Eur Spine J 2004; 13: 199–205.
36. Mens JM, Vleeming A, Snijders CJ, Ronchetti I, Stam HJ. Reliability and validity of hip adduction strength to measure disease severity in posterior pelvic pain since pregnancy. Spine 2002; 27: 1674–1679.
37. Macedo LG, Maher CG, Latimer J, McAuley JH. Motor control exercise for persistent, nonspecific low back pain: a systematic review. Phys Ther 2009; 89: 9–25.
38. Mens JM, Vleeming A, Snijders CJ, Koes BW, Stam HJ. Validity of the active straight leg raise test for measuring disease severity in patients with posterior pelvic pain after pregnancy. Spine 2002; 27: 196–200.