Management of Symphysis Pubis Dysfunction During Pregnancy Using Exercise and Pelvic Support Belts

Background and Purpose. Symphysis pubis pain is a significant problem for some pregnant women. The purpose of this study was to investigate the effects of exercise, advice, and pelvic support belts on the management of symphysis pubis dysfunction during pregnancy. **Subjects.** Ninety pregnant women with symphysis pubis dysfunction were randomly assigned to 3 treatment groups. **Methods.** A randomized masked prospective experimental clinical trial was conducted. Specific muscle strengthening exercises and advice concerning appropriate methods for performing activities of daily living were given to the 3 groups, and 2 of the groups were given either a rigid pelvic support belt or a nonrigid pelvic support belt. The dependent variables, which were measured before and after the intervention, were a Roland-Morris Questionnaire score, a Patient-Specific Functional Scale score, and a pain score (101-point numerical rating score). **Results.** After the intervention, there was a significant reduction in the Roland-Morris Questionnaire score, the Patient-Specific Functional Scale score, and the average and worst pain scores in all groups. With the exception of average pain, there were no significant differences between groups for the other measures. **Discussion and Conclusion.** The findings indicate that the use of either a rigid or a nonrigid pelvic support belt did not add to the effects provided by exercise and advice. [Depledge J, McNair PJ, Keal-Smith C, Williams M. Management of symphysis pubis dysfunction during pregnancy using exercise and pelvic support belts. *Phys Ther*. 2005;85:1290–1300.]

Key Words: *Belts, Exercise, Pain, Pregnancy, Symphysis pubis, Women's health.*

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Women with symphysis pubis dysfunction during pregnancy often face major functional difficulties resulting in a considerable decrease in quality of life. Fry[1] described the types of symptoms that women experience as being mild to severe pain in the pubic region, groin, and medial aspect of the thigh (unilateral or bilateral), frequently accompanied by sacroiliac, low back, and suprapubic pain. The pain is worst during weight-bearing activities (particularly those that involve lifting 1 leg). Women also may hear or feel a clicking or grinding sensation in the joint, and there is often difficulty walking, so that a "waddling style" gait is adopted.

The incidence of this condition has increased significantly in recent years, with MacLennan and MacLennan[2] reporting that 31.7% of respondents to a retrospective survey had experienced antenatal symphysis pubis pain. Sheppard[3] suggested that recent increases in incidence have been attributable to previous gross underrecognition of the condition. In 1997, the United Kingdom National Clinical Guidelines for the Care of Women with Symphysis Pubis Dysfunction were published in the United Kingdom to increase awareness and promote effective management of symphysis pubis dysfunction.[4] These guidelines suggested that recognition and management of symptoms may reduce the long-term morbidity experienced by some women.

It has often been suggested that the instability of the pelvic girdle is the primary cause of pelvic (sacroiliac and symphysis pubis) joint pain during pregnancy.[5,6] This instability is thought to occur when pregnancy-related changes—in particular, an increase in the reproductive hormones or maternal hormones—produce connective tissue changes and a change in the center of gravity because of increased weight anteriorly.[7,8] These changes result in lengthening and thus weakening of the ligaments of the pelvic joints, the thoracolumbar fascia, and the surrounding muscles, all of which provide stability to the pelvic ring.[7,8]

Although no studies have addressed the management of symphysis pubis pain specifically, several studies have shown some positive effects (decreased symptoms) of management of posterior pelvic pain with or without the presence of symphysis pubis pain. Interventions used in these studies for management of posterior pelvic pain included individually designed back care programs,[9,10] exercise,[11] acupuncture,[12] and back care advice.[13]

The use of pelvic support belts to manage pelvic joint pain during pregnancy often is advocated clinically. The rationale for using belts to provide an external force that stabilizes the pelvic joints has come from biomechanical studies primarily with cadavers, and the focus has been on the sacroiliac joints.[6,14] However, a search of MEDLINE, the Cumulative Index to Nursing and Allied Health (CINAHL), Allied and Complementary Medicine (AMED), and the Cochrane Library indicated that no experimental clinical studies have investigated the effect of wearing a pelvic belt to treat symphysis pubis pain, and few studies have investigated the effect of wearing a belt on posterior pelvic pain. Nilsson-Wikmar et al[15] compared the use of education and belts with different exercise programs across 3 groups; the results showed no statistically significant differences among the groups at baseline and at week 38 of pregnancy with respect to pain intensity and activities of daily living. In their conclusion, the authors stated

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that the belts and information about the condition (which all groups received) seemed to be important for the reduction of pain intensity and the ability to accomplish activities of daily living. Ostgaard et al[9] investigated education and nonelastic pelvic support belts in different groups of pregnant women with posterior pelvic pain. They found that 83% of these women experienced reduced problems when wearing the belt, 12% experienced no relief, and 5% felt worse. The authors concluded that the use of a nonelastic sacroiliac belt reduced posterior pelvic joint problems in a large majority of the women.

Other studies examining the effectiveness of pelvic belts in the management of pelvic joint pain have provided more limited information. A prospective study by Berg et al[16] showed that, of 54 pregnant women who had low back pain and who used a rigid trochanteric belt, 39 experienced pain relief during its use. They did not state whether these women also received other treatment or the degree of relief that they experienced. More recently, in a retrospective questionnaire study of Dutch women with peripartum pelvic pain, Mens et al[17] reported that a pelvic belt was effective in the management of this condition but was less effective during pregnancy than after delivery. About half of the pregnant subjects experienced some relief with the belt; however, the authors commented that in some subjects (no data provided), the application of a belt led to increased pain.

Given the limited and inconclusive information available from existing studies concerning the effectiveness of belts during pregnancy, the purpose of the present study was to compare 3 methods of pelvic stabilization in managing symphysis pubis dysfunction during pregnancy. These 3 methods were exercise and advice, exercise and advice in conjunction with a nonrigid pelvic support belt, and exercise and advice in conjunction with a rigid pelvic support belt. The comparison focused on differences in perceived function and pain.

Method

Subjects

All pregnant women in New Zealand register with a Lead Maternity Carer, and this individual is responsible for their ongoing care in all aspects of the pregnancy. The normal procedure for the management of problems requiring physical therapy in the National Women's Hospital area (Auckland) involves the Lead Maternity Carer referring the woman to the physical therapy outpatient department for treatment when required. In this study, 90 consecutive women who were referred for the management of symphysis pubis problems were asked to participate, provided they met the study's inclusion and exclusion criteria. The results of a pilot study that used a modified form of the Roland-Morris Questionnaire[18] indicated that for a small to medium effect size (0.35) with the power set at 0.8 and the alpha level set at .05, 30 subjects were needed per group. The inclusion and exclusion criteria are presented in Appendix 1.

Experimental Procedure

All subjects completed and signed an informed consent form. Then, they were examined by 1 of 4 physical therapists at the National Women's Hospital physical therapy outpatient department. All therapists had been trained in the examination procedures and used standardized instructions. The therapists were unaware of the intervention groups to which the subjects were assigned. The researchers took no part in the collection of data, nor did they interact with the subjects at any time. All subjects completed 3 questionnaires before and after the intervention.

In the absence of any specific questionnaires to measure symphysis pubis or any other musculoskeletal pain during pregnancy, the Roland-Morris Questionnaire was chosen on the basis of its ability to yield reliable and valid measurements of decreased function in low back pain conditions.[19,20] We used a modified form of the original questionnaire described by Patrick et al.[18] The modifications involved the removal of 5 items and the addition of 3 other items from the original Sickness Impact Profile. These items related to daily work, expressions of concern for others, and the need to hold or rub areas that hurt. The words "because of my back pain" were replaced with "because of my pubic or groin pain."

In order to assess the performance of the modified Roland-Morris Questionnaire for pregnant women and to ensure consistency of data collection, a pilot study was performed before the beginning of the randomized clinical trial. The findings showed a 5-point change (from a baseline mean of 16) over a 1-week period, in contrast to the 2- to 3-point change noted by Patrick et al[18] and Roland and Fairbank[20] to be a minimal clinically important difference. Comments from subjects and therapists during the pilot study suggested that some of the activities that women were finding difficult were not included in the questionnaire and that partial improvement was not recorded. For this reason, the Patient-Specific Functional Scale described by Westaway et al[21] also was used. In this questionnaire, women are asked to give a difficulty score out of 10 for their 3 most difficult activities. The average of these 3 scores was used in the analysis. A score of 0 indicated no problem in performing an activity, and a score of 10 indicated major difficulty with an activity. This questionnaire has been shown to yield valid and reliable measurements of func-

Figure 1.
(A) Nongrid pelvic support belt. (B) Rigid pelvic support belt.

tional difficulties.[21] Furthermore, Westaway et al[21] showed that a 2-point difference in scores could be regarded as a minimal detectable change.

Subjects also completed a pain intensity questionnaire (101-point numerical rating score [NRS-101]) for average pain and worst pain over the preceding week. This questionnaire asked, "Please indicate on the lines below the numbers between 0 and 100 that best describe your average pain over the past week and your worst pain over the past week." A score of 0 would mean "no pain," and a score of 100 would mean "pain as bad as it could be." This pain questionnaire has been shown to yield valid and reliable measurements of back pain.[22] At the postintervention session, subjects also were asked to provide feedback concerning whether the belt was comfortable.

Intervention

Subjects were assigned to intervention groups by an individual who was independent of the study. All therapists had been trained (one 2-hour session) in the assessment procedures and used standardized instructions in their treatments. The randomization process involved the use of a table of 3 randomly permuted blocks.[23] The following interventions were undertaken.

Exercise only. Subjects received an exercise booklet with 5 exercises aimed to increase the stability of the pelvic bones. The exercises chosen were based on research by Vleeming et al,[7] Lee,[24] and Sapsford.[25] The physical therapist demonstrated the exercises and checked that they were being performed correctly. The exercise program was required to be completed 3 times daily, and subjects were given a logbook in which to record the number of times the exercises were actually performed. The specific exercises are presented in Appendix 2. Subjects also received verbal and written education about the anatomy and pathology of symphysis pubis dysfunction and self-help management, including the modification of their daily activities (eg, correct techniques for rolling in bed, walking, and posture) (Appendix 3).

Exercise plus nonrigid support belt. Subjects received the same information and exercises as those in the exercise-only group. They also received a nonrigid neoprene support belt (Smiley Belt)* (Fig. 1) designed specifically for pregnancy. The logbook for this group

* Posture Products, 25 Sharon Rd, Browns Bay, Auckland, New Zealand.

Table 1.
Demographic Information for Subjects at Baseline

Characteristic	Exercise Only Group (n=30)		Exercise + Rigid Belt Group (n=28)		Exercise + Nonrigid Belt Group (n=29)		All Subjects (n=87)	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Age (y)	30.7	4.0	29.8	4.6	28.7	6.3	29.5	5.0
Parity	0.93	0.8	0.83	0.9	0.83	0.8	0.87	0.9
Gravida	2.2	1.3	2.2	1.2	2.2	1.4	2.2	1.3
Previous use of oral contraception (%)	70.0		70.0		66.7		68.9	
Onset of pain (wk/40)	27.9	5.4	25.2	6.5	24.8	7.7	25.9	6.7
Start of treatment (wk/40)	32.2	5.2	30.5	5.2	31.1	5.4	31.3	5.2
Initial Roland-Morris Questionnaire score (/22)	14.5	3.1	14.1	4.5	15.2	4.0	14.6	3.9
Average Patient-Specific Functional Scale Score (/10)	7.0	1.1	6.7	1.6	6.9	1.4	6.9	1.4
Average pain score (/100)	47.8	14.2	43.0	21.9	50.5	18.5	47.1	18.5
Worst pain score (/100)	78.8	10.8	72.4	22.5	79.2	16.7	76.8	17.4

requested information on hours the belt was worn as well as the number of times the exercises were performed.

Exercise plus rigid support belt. Subjects received exactly the same intervention as those in the group receiving exercise plus a nonrigid belt. However, the belt that they received was a rigid support belt (Lifecare Pubic Belt)[†] (Fig. 1) commonly used during pregnancy in New Zealand but also used for other types of pelvic dysfunction.

Each subject undertook the intervention for 1 week. This period was based on the clinical observations of physical therapists who were experienced in the practice of women's health care and who had noted immediate and significant responses to similar treatment regimens provided late in pregnancy. Subjects then returned to the physical therapy outpatient department to complete the Roland-Morris Questionnaire, the Patient-Specific Functional Scale, and the pain intensity questionnaire again.

Data Analysis

The dependent variables were modified Roland-Morris Questionnaire score, Patient-Specific Functional Scale score (average of 3 scores), worst pain score over the preceding week (NRS-101), and average pain score over the preceding week (NRS-101). Initially, data were assessed for violations of the assumptions associated with parametric statistical procedures. Analyses of variance were used to compare the groups at baseline for demographic and clinical data. To test for treatment effects, 4 two-factor analyses of variance for repeated measures were undertaken. The factors were group and time. The group factor had 3 levels, and the time factor had 2 levels (before and after). The alpha level was set at .05. Contrast tests were undertaken when appropriate to control for type I errors. The information related to the comfort of the belt was tabulated, and the frequencies of responses (uncomfortable or comfortable) were calculated for the groups.

Results

In the exercise-only group, all women completed the trial. In the group receiving exercise plus a nonrigid support belt, 1 woman delivered her baby before her postintervention assessment. In the group receiving exercise plus a rigid support belt, 2 women delivered their babies before their postintervention assessment. Only 1 woman refused to be involved in the study. This was because she had been told by her obstetrician that she would receive a belt as part of her treatment, and so she was not prepared to be in the exercise-only group.

Table 1 shows the demographic data for the 3 treatment groups and the entire cohort. The mean age of the subjects was 29.5 years (SD=5.0), and mean parity (number of infants previously born) was 0.87 (SD=0.9). The mean time of onset of pain (in weeks of pregnancy) was 25.9 (SD=6.7, range=11–38). Almost half of the women experienced the onset of pain between 27 and 32 weeks of pregnancy, that is, at the junction of the second and third trimesters. Treatment was not sought until a mean of 31.3 weeks (SD=5.2) of pregnancy, and almost half of the women did not seek treatment until between 33 and 38 weeks. There were no significant correlations ($P<.05$) between the onset of pain and the outcome

[†] Orthotic Centre (NZ) Ltd, 614 Great South Rd, Auckland, New Zealand.

Table 2.
Subject Adherence for Exercises and Belts Over a 1-Week Period

Intervention	Exercise Only Group (n=30)		Exercise + Rigid Belt Group (n=28)		Exercise + Nonrigid Belt Group (n=29)		All Subjects (n=87)	
	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD	$\overline{X}$	SD
Exercises (times performed/21)	17.1	5.0	15.17	5.3	17.11	3.5	16.5	4.8
Belts (hours worn/wk)	0.0		45.2	36.8	43.0	37.1	44.2	36.6

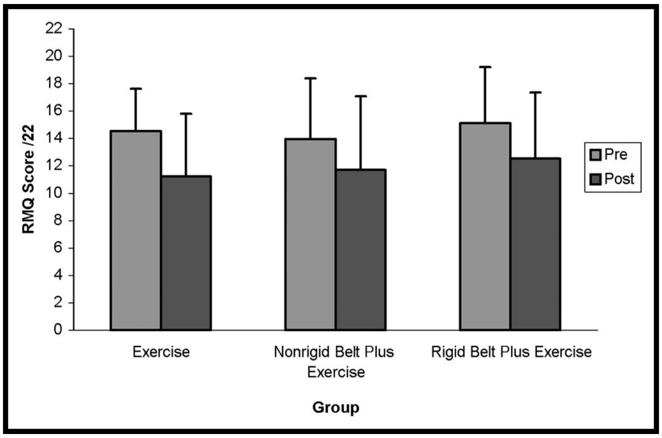

Figure 2.
Preintervention (Pre) and postintervention (Post) Roland-Morris Questionnaire (RMQ) scores (maximum possible score=22). Data are means and standard deviations.

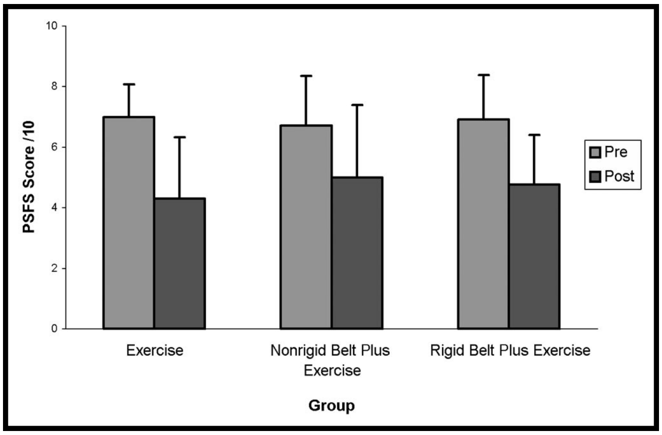

Figure 3.
Preintervention (Pre) and postintervention (Post) Patient-Specific Functional Scale (PSFS) scores (maximum possible score=10). Data are means and standard deviations.

variables. There were no significant differences ($P<.05$) between the groups for the dependent variables at baseline.

Table 2 shows the subjects' adherence for frequency of exercises and hours that the belts were worn for the 3 groups. There were no significant differences between the groups in adherence, as measured by the number of exercises performed during the week and the hours the belts were worn in the 2 groups that received belts ($P=.20$ and $P=.83$, respectively).

Figure 2 shows the preintervention and postintervention scores for the Roland-Morris Questionnaire. There was a significant time effect ($P=.000$) but no significant group effect or interaction effect for time and group ($P=.55$ and $P=.65$, respectively); therefore, the effects of time did not differ among the groups. In percentage terms, these changes in the Roland-Morris Questionnaire scores amounted to decreases of 22.7%, 15.9%, and 17% for the exercise-only group, the group receiving exercise plus a nonrigid belt, and the group receiving exercise plus a rigid belt, respectively.

Figure 3 shows the average preintervention and postintervention scores for the Patient-Specific Functional Scale. There was a significant time effect ($P=.000$) but no significant group effect or interaction effect for time and group ($P=.85$ and $P=.12$, respectively); therefore, the effects of time did not differ among the groups. The Patient-Specific Functional Scale scores decreased by 38.6%, 25.4%, and 30.4% for the exercise-only group, the group receiving exercise plus a nonrigid belt, and the group receiving exercise plus a rigid belt, respectively.

On the Patient-Specific Functional Scale, women were asked to choose their 3 most difficult activities and rate these activities out of 10 for difficulty. The activities chosen and their frequencies are shown in Table 3. The most common activities were walking, rolling over in bed, getting up from a chair, and getting out of bed.

Figure 4 shows the preintervention and postintervention scores for average pain over the preceding week, measured on the NRS-101. There was a significant time effect ($P=.000$). The average pain scores decreased by 31.8%, 13.9%, and 29.2% for the exercise-only group, the group receiving exercise plus a nonrigid belt, and the group

Table 3.
Most Difficult Activities Recorded on the Patient-Specific Functional Scale

Activity	No. of Women/90 Reporting That Activity	% of Total
Walking	61	67.8
Rolling over in bed	60	66.7
Standing from chair	41	45.6
Getting out of bed	40	44.4
Getting dressed	15	16.7
Getting out of car	12	13.3
Climbing stairs	9	10
Moving legs apart	7	7.8
Prolonged standing	6	6.7
Squatting	5	5.6
Lifting another child	5	5.6

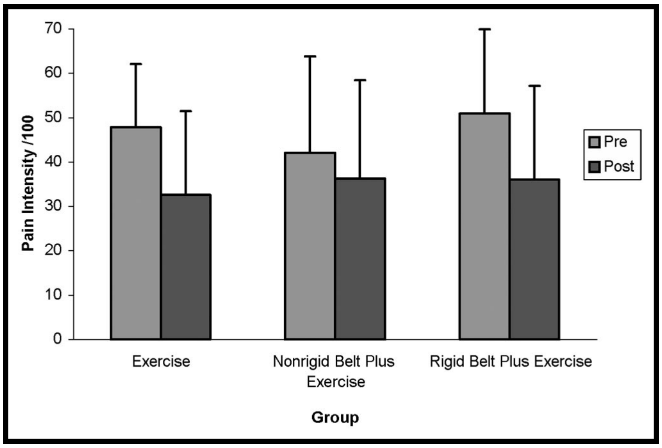

Figure 4.
Preintervention (Pre) and postintervention (Post) average pain intensity scores (maximum possible score=100). Data are means and standard deviations.

receiving exercise plus a rigid belt, respectively. There was also a significant interaction effect for time and group (P=.04). Paired comparisons showed significant average pain reductions for the exercise-only group and the group receiving exercise plus a rigid belt but not for the group receiving exercise plus a nonrigid belt.

Figure 5 shows the preintervention and postintervention scores for worst pain over the preceding week, measured on the NRS-101. There was a significant time effect (P=.000) but no significant group effect or interaction effect for time and group (P=.24 and P=.15, respectively); therefore, the effects of time did not differ between the groups. The worst pain scores decreased by 22.6%, 12.7%, and 10.8% for the exercise-only group, the group receiving exercise plus a nonrigid belt, and the group receiving exercise plus a rigid belt, respectively.

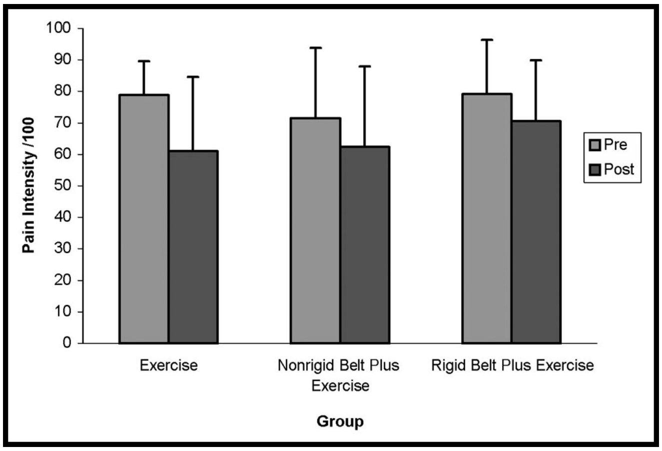

Figure 5.
Preintervention (Pre) and postintervention (Post) worst pain intensity scores (maximum possible score=100). Data are means and standard deviations.

With respect to the subjects' comments related to the comfort of the belts, 27% of the subjects wearing the rigid belt indicated that it was uncomfortable, and 43% of the subjects wearing the nonrigid belt indicated that it was uncomfortable.

Discussion

Demographic and Baseline Data

The present study focused on symphysis pubis dysfunction during pregnancy. This is a well-known clinical problem, yet it has not received much attention in the research literature. In the present study, the mean time of onset of symptoms was 26.0 weeks of pregnancy (SD=6.7); this time was longer than that found by Saugstad,[26] who reported that 55% of subjects in that study developed pelvic pain and pelvic joint instability before 20 weeks of pregnancy, whereas Ostgaard et al[9] showed graphically that pelvic joint pain (posterior and anterior) was reported most commonly between 14 and 22 weeks of pregnancy. The latter 2 studies investigated pelvic pain as a whole, not anterior pain alone. A comparison of their results with those of the present study suggests that posterior pain may develop earlier than anterior pain; however, additional studies would be needed before further conclusions could be drawn.

The week of pregnancy at which treatment was given (in the present study: $\overline{X}$=31.3, SD=5.2) often was not reported in other studies, probably reflecting the prevalence of retrospective questionnaire studies and general lack of studies undertaken antenatally. Noren et al[10] stated that women with posterior pelvic pain or lumbar back pain were seen for the first treatment on average in week 26 (range=11–36). In the present study, the difference of more than 5 weeks between the onset of symptoms and the administration of treatment may have been partly attributable to the onset of pain being gradual and women initially expecting that they were experiencing "normal" twinges associated with pregnancy.

The severity of symphysis pubis dysfunction can be observed from the baseline data for pain and functional status. Although no previous studies examined these variables in women with anterior pelvic pain, the level of functional disability can be assessed by a comparison of the Roland-Morris Questionnaire scores recorded in the present study with those obtained in back pain studies. In this respect, when scores are presented as percentages, Beurskens et al[27] noted that subjects with nonspecific low back pain for at least 6 weeks had a mean baseline score of 49.9 (SD=20.4). Roland and Fairbank[20] reported baseline scores of 45.4 (SD=19.6) for subjects with low back pain of less than 3 months duration and no radiculopathy and 59.2 (SD=21.7) for subjects with electromyographic evidence of radiculopathy. In the present study, the higher mean score of 66.4 (SD=17.7) indicated that the degree of functional disability in the women studied was considerable.

Function also was assessed with the Patient-Specific Function Scale. Westaway et al[21] used this scale to measure functional ability in subjects with neck dysfunction and noted a mean baseline score of 5.1 (SD=1.9); the mean baseline score in the present study was 6.9 (SD=1.4), again indicating high levels of dysfunction. The activities that women stated to be most difficult were walking, rolling over, getting up from a chair, and getting out of bed. Other activities frequently mentioned were getting dressed, getting in and out of a car, climbing stairs, moving the legs apart, and prolonged standing. These activities are very difficult to avoid. In everyday life, they must be undertaken several times a day and, even with help from other people, cannot be avoided. Even if women are able to stop working, they often still need to perform these activities on a regular basis, particularly if they have other children.

With regard to pain, in the present study, the initial mean pain intensity scores were 47.1% (SD=18.5%) for average pain during the preceding week and 76.8% (SD=17.4%) for worst pain during the preceding week. Beurskens et al[27] reported that the mean pain intensity over the preceding week in subjects with nonspecific low back pain for at least 6 weeks was 56.7% (SD=20.1%), and Westaway et al[21] reported that initial mean pain intensity in subjects with neck dysfunction was 44% (SD=21%). Studies of posterior pelvic pain that have included a pain intensity measure include that of Ostgaard et al,[9] who reported mean pain intensity scores of between 54% and 58% for women with back or posterior pelvic pain at week 36 of pregnancy. Wedenberg et al[12] reported that women with low back pain and pelvic pain during pregnancy had mean visual analog scale scores of 35% to 38% in the morning and 55% in the evening on the first day of treatment. In these 2 studies, the women were asked to estimate the severity of the pain at the requested times; therefore, a distinction between average pain and worst pain could not be made. Furthermore, because of the different time frames, it was difficult to make comparisons between these studies and the present study.

While the present study was being undertaken, new work concerning the diagnosis of pregnancy-related pelvic joint pain was published. Albert et al[28] designed a questionnaire concerning pain and functional disability, and although it has limited validity at this time, the results concerning reliability are promising. Albert et al[28] emphasized the importance of standardization of testing and also provided data to support the procedures used for diagnosis in the present study. The present study focused on pain provocation tests to identify symphysis pubis pain and the lack of sacroiliac joint pain. Previous work by Laslett and Williams[29] showed that sacroiliac joint pain was best identified by provocation tests and, more recently, Albert et al[28] concluded that pain provocation tests for the symphysis pubis yielded more reliable data than assessment of motion by a therapist. However, more effective stratification of patients would be valuable, as it is possible that specific treatments work more efficaciously for certain subgroups of patients. These notions warrant further research.

Interventions and Outcomes

In the present study, all groups showed significant improvement in function over time, as measured by the Roland-Morris Questionnaire and the Patient-Specific Functional Scale, but there was no significant difference ($P<.05$) among groups. Nilsson-Wikmar et al[15] compared the effects of rigid belts and different exercises on posterior pelvic joint pain during pregnancy and found no difference in function, as measured by rating of 12 different activities of daily living on a visual analog scale. More recently, Wedenberg et al[12] compared the effects of physical therapy and acupuncture in women with lower back pain and pelvic pain during pregnancy by using the Disability Rating Index to measure function and found that the scores in the acupuncture treatment group were significantly better than the scores before treatment and the corresponding scores in the physical therapy treatment group.

In the present study, average pain was reduced in the exercise-only group and the group receiving the rigid belt, whereas the worst pain decreased in all groups. Three other studies provided evidence of a reduction in pain after treatment. Nilsson-Wikmar et al[15] used rigid support belts and different exercise regimens and found that pelvic joint pain decreased in all groups but did not find a difference between treatment groups with respect to pain intensity. Noren et al[10] noted a decrease in maximum pain between first visit to the physical therapist and week 36 of pregnancy in a group that received physical therapy compared with a control group (women who had back pain or posterior pelvic pain but who received no treatment). Other pain responses (minimum pain and present pain) did not reach significance. The findings of Wedenberg et al,[12] who examined the effects of acupuncture in women with lower back pain and pelvic pain during pregnancy, indicated that after treatment, the mean pain scores for the acupuncture group were significantly lower than those for the group that received physical therapy.

Although the mechanisms associated with improvement in function and reduction in pain cannot be determined from the present study design, the rapid improvement found when exercises and advice were given would suggest that the cause of pain is not totally inflammatory. A mechanical cause for pain that can be quickly altered would seem a likely cause of pain from symphysis pubis dysfunction. The lack of inherent stability during pregnancy, attributable to the effects of pregnancy-related hormones and biomechanical factors, may be sufficient to cause the movement of the bone ends at the symphysis pubis and thus stimulate mechanoreceptors with a nociceptive function, resulting in pain. Whether such receptors are present in the symphysis pubis joint is unknown; however, structures in and near the surrounding joints, including the intervertebral joint, which is a type of joint similar to the symphysis pubis joint, have been shown to contain receptors capable of producing pain from a mechanical stimulus.[30–34]

In the present study, the use of belts did not add to the effects of exercise and advice. Belts have been shown to have a mechanical effect on the sacroiliac joints. Vleeming et al[14] showed, in a study with cadavers, that a rigid pelvic support belt is able to enhance stability in the pelvis by decreasing movement at the sacroiliac joints. Snijders et al[6] used a biomechanical model to show that a pelvic belt worn with a small force is sufficient to generate a self-bracing effect in the sacroiliac joints. However, in the present study, this effect may have already been in place with the exercise regimen, which provided the bracing effect needed. The exercise program was based on the findings of previous biomechanical and clinical research[14,24,35] and is likely to induce mechanical stabilization through changes in muscle activation and motor relearning.

Both belts are commonly used for pregnancy-related pelvic joint dysfunction in New Zealand, the nonrigid belt being specifically designed for this dysfunction. Written comments made by the women at their follow-up appointment showed that 43% of the women using the nonrigid belt and 27% of the women using the rigid belt found the belt to be uncomfortable. These findings might have been attributable to the increased size and weight of the abdomen or to the additional pressure applied to the symphysis pubis. Although biomechanical studies, often with cadavers, have provided evidence for the efficacy of belts,[6,14] the findings related to discomfort together with those related to exercise raise the question as to whether belts are appropriate for pregnant women.

Advice given to all women in the present study included information on the anatomy and pathology of symphysis pubis dysfunction and self-help advice, including how to modify daily activities to make them more comfortable. This advice also involved teaching women correct movement patterns, such as rolling over in bed with the legs together and the abdominal and pelvic floor muscles activated. Mantle et al[13] found that women who received advice only were less likely to have backache during pregnancy; Ostgaard et al[9] compared classes versus individual back care programs for pregnant women and found that information on muscular training and body posture reduced pain and that women in a group that also received individual education found information on ergonomics for their workplace useful. The authors concluded that an individually designed program was most effective in reducing sick leave attributable to back pain during pregnancy.

Conclusion

The functional disability associated with symphysis pubis pain in pregnancy is considerable. With respect to the effects of exercise and the use of belts, the findings showed that there was a significant improvement in all groups over time for the majority of outcome measures. The use of either a rigid or a nonrigid pelvic belt did not add to the effects provided by a specific muscle strengthening program and advice. Furthermore, it would seem beneficial in the long term for women to use their muscles to provide stability to the pelvis rather than to rely on an external device.

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Appendix 1.

Inclusion and Exclusion Criteria

Subjects had to meet all of the following inclusion criteria:
(1) Be pregnant.
(2) Be referred to the National Women's Hospital physical therapy outpatient department for treatment.
(3) Have pain in the region of the symphysis pubis, with or without radiation to the groin.
(4) Have pain of insidious onset; that is, a specific injury (eg, a fall, did not initiate the pain).
(5) Have tenderness on palpation of the symphysis pubis.[a] This symptom was tested in the supine position. Standing at the subject's side, the examiner pushed both thumbs gently down onto the symphysis pubis so that the thumbs palpated the superior aspect of the pubic bones and then moved inferiorly across the joint. Albert et al[28] showed the reliability of data for palpation of the symphysis pubis to be high (kappa=.89).
(6) Have a positive active straight leg raise (ASLR) test result.[b] The ASLR test was performed in the supine position with the legs straight and 20 cm apart. Subjects were asked to raise the legs one at a time 5 cm from the bed without bending the knees. A positive test result required the subject to experience pain or difficulty with this movement. Mens et al[c] found this test to yield data with high reliability (Kendall tau-b=.81).

Exclusion criteria were as follows:
(1) Medical conditions preventing the use of pelvic support belts, for example, some types of placenta previa.
(2) Posterior (sacroiliac joint or lumbar spine) pain that was considered by the woman to be worse than the symphysis pubis pain.

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Appendix 2.

Exercise Program

- Abdominal stabilization (transversus abdominis, external and internal oblique, and multifidus muscles)
  Subjects were given the following instructions:
  "Sitting with your feet resting on the floor, gently pull in your lower abdominal muscles as if you are hugging your baby. Hold for 5 seconds. Repeat 5 times, continuing to breathe normally."
- Pelvic floor
  Subjects were given the following instructions:
  "Sitting tall, squeeze to close around your openings. Lift and hold for 5 seconds. Repeat 5 times. Breathe normally throughout."
- Gluteus maximus muscle
  Subjects were given the following instructions:
  "Sitting or standing, squeeze buttocks together. Hold for 5 seconds. Repeat 5 times."
- Latissimus dorsi muscle
  Subjects were given the following instructions:
  "Sit on a chair in front of a table or a closed door. Grasp door handle or table with both hands and pull toward you. Hold for 5 seconds. Repeat 5 times."
- Hip adductor muscles
  Subjects were given the following instructions:
  "Sitting down, put your fist or a rolled towel between your knees. Squeeze knees together. Hold for 5 seconds. Repeat 5 times."

Appendix 3.

Self-help Management

The aim is to reduce stress on the joint.

It is essential that you tighten the muscles of your pelvic floor and lower abdomen before and during the following activities.

When getting into bed:
- Sit on the edge of the bed, keep knees close together, then lie down on your side, lifting both your legs up sideways. Reverse this to get out of bed.
- Do not attempt to pull yourself up from lying on your back.

When rolling over in bed:
- Keep knees together.
- Do not roll with your knees apart.

When getting up from a chair:
- Keep knees close together, put your hands on your knees, and lean nose over toes to stand up.

When sitting down:
- Do the reverse to sit down.
- Ensure that you feel the chair at the back of your legs first.

When getting into a car:
- Sit down first and then swing legs in, keeping knees together.

When walking:
- Take smaller steps.

When using stairs:
- Step up sideways one step at a time.
- Avoid stairs if possible.

Remember to:
- Sleep with a flat pillow between the legs.
- Take rest breaks.
- Move within the limit of pain.

Avoid:
- Sitting on soft sofas and chairs.
- Walking as an exercise.
- Active stretching and exercising with legs apart (eg, squatting, sitting cross-legged, or breaststroke kicking when swimming).