

PELVIC PAIN AND LOW BACK PAIN IN PREGNANT WOMEN***Hanan Jasim Mohammed and Dhamyaa Yousif Fattah**

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ABSTRACT

Low back pain (LBP) is a common complaint amongst women during pregnancy, having a great impact on their quality of life. Low back pain during pregnancy has been known and recognized for many centuries and was described by Hippocrates, Vesalius, Pineau, Hunter, Velpeau and many others. In 1962 Walde was the first who recognized the differences between Pelvic Girdle pain (PGP) and Lumbar pain (LP). Later, Ostgaard et al. set the criteria for the differentiation between these two entities.^[1] It has been estimated that about 50% of

pregnant women will suffer from some kind of low back pain at some point during their pregnancies or during the postpartum period.^[2-4] Pregnancy-related low back pain seems to be a result of quite a few factors, such as mechanical, hormonal and other.^[2, 3, 5-12] PGP and LP are two different patterns of LBP during pregnancy, although, a small group of women suffer from combined pain. PGP is common during pregnancy and postpartum period and approximately four times as prevalent as LP. It is described as deep, stabbing, unilateral or bilateral, recurrent or continuous pain, presenting between the posterior iliac crest and the gluteal fold, possibly radiating to the posterolateral thigh, to the knee and calf, but not to the foot.^[13] PGP is more intense during pregnancy than during postpartum period and may convert the natural discomfort of pregnancy into a pathophysiologic condition, which minimizes physical activity, and causes withdrawal from social interactions¹⁴. Pain provocation tests are the best tests available for differentiating PGP from other conditions. The posterior pain provocation test (PPT) is positive, in case of PGP.^[2,3,6,15,16] LP during pregnancy is very similar to lumbar pain experienced by women who are not pregnant and it appears as pain over and around the lumbar spine, above the sacrum, making the differentiation between PGP and LP easy. LP may or may not radiate to the foot, in contrast with PGP. Tenderness over paravertebral muscles is a common finding.^[14] LP aggravates at postpartum period and usually exacerbates by certain activities and postures (e.g. prolong

sitting) but it seems to be less disabling than PGP.^[14] The posterior pain provocation test is negative.^[3]

KEYWORDS: Low back pain, pelvic girdle pain, pregnancy, review Prevalence.

INTRODUCTION

LP and PGP should be diagnosed and differentiated early since the treatment is different for each condition. Detailed history and clinical examination are essential.^[17] Although motion palpation findings have limited value in differential diagnosis, it is one of the most commonly used diagnostic tools. Notably, its sensitivity, specificity, and validity, in general, have not been adequately studied.^[18]

Pregnancy-related low back pain affects women lives dramatically. Low back pain is the most common cause of sick leave after delivery.^[2,3,7,8] Taking under consideration the individuality of every woman and pregnancy, early identification and treatment will lead to the best possible outcome. Conservative management is the gold standard including physiotherapy, stabilization belts, nerve stimulation, pharmacological treatment, acupuncture, massage, relaxation, and yoga.^[2,3,8,19,20]

In general, pregnancy-related low back pain has a benign prognosis provided that early recognition and treatment have been made. The aim of this article is to review the related studies reporting their clinical data for the diagnosis and management of pregnancy-related back pain and to highlight specific treatment recommendations.

Pregnancy-related low back and pelvic pain (LBPP) are very common, with 45% of woman affected to some extent (Vermani *et al.* 2010). Concerns for potential harm to the fetus mean that pharmacological pain management may be limited, and with increasing pain, there may be some degree of functional disability. Prior to and during pregnancy, it has been found that the use of exercise programs can provide effective pain management for LBPP. However, the quality of the evidence available is lacking due to many limitations with the research (Pennick and Liddle 2013). The study in question (Ozdemir *et al.* 2015) was carried out to provide a more robust investigation into whether individualized exercise programs increase functional capacity and relieve LBPP in pregnant woman.

The was a well-designed randomized control trial (RCT). 209 participants were assessed for eligibility and 113 were either excluded or declined to participate. This left 96 participants

who consented and met the eligibility criteria. The intervention included education, training in protection methods and a standardized exercise program on top of usual care. A control group received usual care.

Participants were randomized into one of two groups using sealed, opaque envelopes and a simple randomization method. To assess the primary outcomes of study, the Visual Analogue Scale (VAS) was used to measure change in participants' pain level and the Oswestry Disability Index (ODI) was used to determine participants' functional status.

Exercise levels were tracked, with participants required to keep exercise diaries. All data was collected through telephone calls once a week. After 4 weeks, a face to face interview was carried out with each participant, with their results being compared to baseline.

Along with nausea, fatigue, and swollen feet, most women experience back pain at some points during pregnancy. Pregnancy-related back pain typically affects the lower back. According to one review that looked into the complaint, low-back pain affects more than two-thirds of women during pregnancy.

Causes in the first Trimester

Back pain can also arise near the center of the back when doctors call it lumbar pain, or the tailbone when they refer to it as posterior pelvic pain.

Many factors, including hormonal and postural changes, contribute to back pain during pregnancy. The causes vary between women and may depend on the stage of pregnancy.

This article discusses the reasons for pregnancy-related back pain, and ways to treat and prevent this discomfort. Factors that can lead to back pain during the first trimester include hormonal changes and stress, as we discuss below.

Where the hormone changes, are during the first trimester, levels of progesterone the body increase rapidly. High levels of this hormone help relax the muscles and ligaments near the pelvis, which can affect the stability and alignment of the joints.

Another hormone that doctors call relaxin helps the egg to implant in the uterus wall, and also prevents contractions during the early stages of pregnancy. As labor nears, relaxin stimulates the cervix to soften and open in preparation for delivery.

Furthermore, relaxin relaxes the ligaments and joints in the pelvic region so that the birth canal can expand during delivery.

Finally, relaxin affects the ligaments that stabilize the spine, which can cause instability, postural shifting, and low-back pain.

Stress

Although many consider pregnancy an exciting life event full of changes, it also introduces new sources of stress. Stress affects more than a person's mood or psychological state of being. Stress can cause physical symptoms, such as fatigue, headaches, stiffness, and muscle pain.

Pregnancy-related low back pain is a common complaint among pregnant women. It can potentially have a negative impact on their quality of life. The aim of this article is to present a current review of the literature concerning this issue. By using PubMed database and low back pain, pelvic girdle pain, pregnancy as keywords, abstracts and original articles in English investigating the diagnosis treatment of back pain during pregnancy were searched and analyzed. Low back pain could present as either a pelvic girdle pain between the posterior iliac crest and the gluteal fold or as a lumbar pain over and around the lumbar spine. The source of the pain should be diagnosed and differentiated early. The appropriate treatment aims to reduce the discomfort and the impact on the pregnant woman's quality of life. This article reveals the most common risk factors, as well as treatment methods, which may help to alleviate the pain. Some suggestions for additional research are also discussed.

There has been a plethora of studies regarding the epidemiology of pregnancy-related LBP. Rates range from 25% to 90%, with most studies estimating that 50% of pregnant women will suffer from LBP. One-third of them will suffer from severe pain, which will reduce their quality of life. The majority of women are affected in their first pregnancy.^[21] Eighty percent of women suffering from LBP claim that it affects their daily routine and 10% of them report that they are unable to work.^[22]

Twenty percent of pregnant women will experience PGP. Pregnancy-related LBP usually begins between the 20th and the 28th week of gestation, however, it may have an earlier onset. The duration varies. A study about PGP in Netherlands shows that 38% of women still have symptoms at 3 months postpartum and 13.8% at 12 months.^[23] LBP during pregnancy is

considered to be the most important risk factor for postpartum LBP and the existing literature supports LBP as the leading reason for sick leave, as far as pregnant working women are concerned.^[2-4]

Etiology

Many studies have been conducted in various populations regarding LBP during pregnancy. However, the subject remains controversial and the etiology is poorly understood. Various explanations on the pathophysiology leading to LBP in the antenatal period have been advocated, although the scientific basis of those hypotheses is far from consolidated.

One of the most frequent mechanisms suggested is associated with the mechanical factors, due to weight gaining during pregnancy, to the increase of the abdominal sagittal diameter and the consequent shifting of the body gravity center anteriorly, increasing the stress on the lower back.^[3,8,9,11] Studies suggest that an anterior shift is associated with pubic symphysis problems.^[8] Postural changes may be implemented to balance this anterior shift, causing lordosis and increasing stress on the lower back.^[24] The connection between LBP and PFD (Pelvic Floor dysfunction) has been suggested. A negative Active Straight Leg Raise test (ASLR) in combination with a positive PPPT may be interpreted as an increased activity of the pelvic floor muscles, in order to compensate for the impaired pelvic stability.^[12]

Another important consequence of the mechanical alterations during pregnancy is the response of the intervertebral discs in axial loading, leading to decreased height and compression of the spine. This results in major compression of pregnant women spine with LBP after activity, which also takes longer to recover, in relation to women without LBP.^[8]

In addition, a biomechanical process suggests that the abdominal muscles of the pregnant woman stretch to accommodate the enlarging uterus, causing muscle fatigue and resulting to an extra load on the spine, which is charged with the task of supporting the majority of the increased weight of the torso.^[3,8] According to some initial pilot data, weakness of the gluteus medius is strongly related to the presence of LBP during pregnancy.^[5]

A significant proportion of women firstly experience pain, during the first trimester of pregnancy. In these latter cases, in which there is no disease or trauma to initiate the condition, mechanical changes do not yet play any role in the pain induction, producing no sound conclusion concerning the onset of a significant number of cases of LBP. So, it has

been suggested that during pregnancy the female body is exposed to certain factors causing dynamic instability of the pelvis and that LBP may be secondary to hormonal changes. Relaxin increases tenfold during pregnancy causing ligamentous laxity and discomfort, not only in the sacroiliac joint but also generalized discomfort, pain of the entire back, instability of the pelvis and misalignment of the spine. The association between circulating levels of the hormone relaxin and LBP in pregnancy is under debate since many studies do not confirm any correlation between relaxin serum levels and severity of symptoms of LBP during pregnancy.^[2,3,6-10] Another theory suggests that LBP during pregnancy, which worsens at night, may be the consequence of the expanding uterus putting pressure on the vena cava causing venous congestion in the pelvis and the lumbar spine.^[8]

Sciatica is a rather rare clinical entity of LBP during pregnancy, appearing in only 1% of women. Sciatica may be the result of herniation or bulging of an intervertebral disc, causing nerve compression.^[8] Rare causes of sciatica should also be deemed when there is no evidence of disc disease.^[25] In a small group of women, the persistent pain during postpartum period may be secondary to osteitis condensans ilii.^[26]

Risk Factors

Research on primary care population suffering from back pain has shown that Oswestry Disability Index (ODI) and Visual Analog Score (VAS) questionnaires are predictive of long-term morbidity. At the same studies, pregnancy has been reported as a major risk factor. The ODI, EuroQol, and pain VAS instruments may assist in the early identification of pregnant women at risk for long-term problems.^[8,33]

There has been a lot of debate concerning the risk factors of LBP during pregnancy and many contradictory articles have been published.

It seems that history of pelvic trauma, chronic LBP and low back pain during a previous pregnancy are the most common and widely accepted risk factors.^[8] Eighty-five percent of women with back pain in a previous pregnancy will develop back pain in a subsequent pregnancy.^[1,34,35] The number of previous pregnancies also seems to increase the risk.^[36] It is not possible to estimate the risk or to predict who will suffer from LBP during pregnancy, however, women with a history of LBP before pregnancy, are most likely to suffer from more severe pain and of a longer duration after childbirth. LP is more strongly connected with back pain history before pregnancy, compared to PGP. LBP during menstruation is an additional

risk factor for pregnancy-related LBP.^[21] On the contrary, exercise on a regular basis before the pregnancy seems to reduce the risk of suffering from LP during the pregnancy. However, the same it is not true for PGP.^[2,3,33,37] It has been published that the socio-economic status of the country plays no role as far as PGP amongst pregnant women.^[38] Diagnosed hypermobility was more common in women with LBP.^[39] However, Dongen et al found no significant correlation between joint hypermobility and the incidence of PGP6. A study using the Roland questionnaire suggests that the male sex of the fetus may be a predictive factor for back pain during pregnancy.^[40] Mac Lennan et al. suggests that PGP is associated with dysplasia of the hip and a genetic susceptibility of the hip both of the mother and of the child.^[41]

There is relative agreement that excessive body weight may be a risk factor for LBP during pregnancy⁴² however, there are studies claiming that being overweight is not a risk for pregnancy-related LBP,^[4] Contraceptive pills and time interval since the last pregnancy are not considered as risk factors for LBP during pregnancy.^[2]

The association between the woman's age or between high workload and low back pain during pregnancy remains unclear.^[2,3,21] Finally, it seems that epidural or spinal anesthesia during labor is not associated with a higher risk of persistent postpartum LBP.^[43]

Prevention

Although it is rather difficult to prevent LBP, it is very important to inform future mothers, especially those on high risk to expect the discomforting symptoms of LBP and encourage them to follow some method as to reduce the possibility of suffering from pregnancy-related LBP.^[4]

Pregnant women should be educated on how they can maintain a proper posture while doing everyday activities so that their back is not overloaded and misaligned. That can be easily performed if practiced and can be enhanced by aerobic or physiotherapy exercises, preferably before pregnancy. It has been proven that a 12-week training program during pregnancy is effective in the prevention of LBP, at 36 weeks of pregnancy.^[44] Physical activity before pregnancy is correlated with a decreased risk of developing LP, which does not apply to PGP.^[13] Another study proves that there is an association between muscle dysfunction and women who develop persistent PGP.^[45] It is also very important for women to learn how to lift weights without stressing their backs, a habit that can be proven very useful throughout

pregnancy. Women should be advised to use proper seats, cushions, and beds, as well as techniques for getting in and out of bed so that the body maintains in a proper position and the spine is supported and not stressed.^[3]

Prognosis

The most important factor among others that aggravates low back pain during pregnancy is the actual progression of pregnancy.^[46]

The prevalence of LBP rapidly declines during the first-trimester post-delivery. In general, the prognosis is good for most women with pregnancy-related LBP. However, women with combined pain show the lowest recovery level. Combined pain during pregnancy is a predictor for persistent PGP or combined pain postpartum.^[47] One of the most important risk factors for postpartum LBP is previous pregnancy-related LBP. It seems that pain intensity is higher amongst women with postpartum LBP who experienced LBP during pregnancy. Whereas PGP is more intense and disabling during pregnancy, LP appears to be more severe and more common after childbirth. In general, the intensity of the pain is a prognostic factor.^[14] Overall, results indicate that postpartum LBP is a temporary disorder with a good prognosis, especially during the first months after childbirth.^[2,8,16,48] This prognosis is not negatively affected by a cesarean section, however, during the last decade, there has been a debate concerning this matter.^[43] On the other hand, there are studies suggesting that women with high postpartum weight gain and weight retention may be at higher risk for postpartum LBP. So, weight reduction may reduce the incidence of postpartum LBP.⁹ Depressive symptoms have a negative effect on the prognosis.^[23] The contribution of training and physiotherapy in the prevention of postpartum LBP is still under debate.^[33,49] It seems that a postpartum tailor-made intervention is more effective.^[48] ASLR test and the belief in improvement are predictors of clinical significance in women having PGP postpartum.^[50] Provocation tests are not as reliable during postpartum period as they are during pregnancy.^[15]

Management

Most women consider LBP as an inevitable, normal discomfort during pregnancy. Only 50% of women suffering from pregnancy-related LBP will seek advice from a health care professional and 70% of them will receive some kind of treatment.^[51] Early identification and treatment, taking under consideration the individuality of every woman and pregnancy, provide the opportunity for the best possible outcome. LBP has a very good functional

prognosis and most women recover during the first months after childbirth. Conservative management of LBP is the treatment of choice. A correct diagnosis and a differentiation between PGP and LP are of the utmost importance since the treatment is different.^[2,3,8] Some of the treatment options are physiotherapy, stabilization belts, nerve stimulation, pharmacological treatment, acupuncture, massage, relaxation, and yoga.^[8] Weight loss strategies during postpartum and prevention of weight gain may help to prevent the risk and the severity of LBP (Table 1).^[20]

There are studies demonstrating that sterile intradermal water injections induce a significant, dramatic analgesic effect for women that experience LBP during labor, lasting from 10 minutes and up to 2 hours postadministration. Sterile water injections have proved to be a justifiable alternative to the use of narcotics for birthing women and their midwives who are concerned about unwanted side effects on both mother and child. Their effect has been described as powerful, rapid and effective; with the potential to decrease or delay the use of epidural anaesthesia.^[19]

Acupuncture seems to alleviate LP and PGP during pregnancy, while it increases the capacity for some physical activities and helps diminish the need for drugs, which is a great advantage during this period. Patients who have received a 1-week continuous acupuncture treatment at specific auricular points had a significant reduction in pain compared with those of the sham acupuncture and control groups, but the treatment effect was not sustained in some of the pregnant women. Thus, long-term efficacy of auricular acupuncture treatment for LBP is still inconclusive but clearly promising.^[52]

The commonest practice in managing LP is exercising. Many relevant studies have been published, describing several fitness activities, such as individualized physical therapy, physiotherapy in groups, yoga, and water aerobics. However, there is no strong evidence concerning the effect of physiotherapy and fitness activities such as weight lifting or using the stairs, in combination with an exercise program. There is a great need for future studies, in order to consider whether a fitness activity program is required before pregnancy, in the line of prevention and in order to assess the type and duration of intervention. Further, the interference of the cost must be taken under consideration in comparison with not following any exercise program at all for managing LP.^[7,15,49,53-56] The use of a footstool, a back support while sitting and the avoidance of work that can cause muscle fatigue, are encouraged. The education of the pregnant woman is very important so that she learns how to

stand, walk or bend without causing an extra stress on the spine or muscle fatigue. Women are also encouraged to take a midday rest to relieve their muscles and to avoid prolonged walking or standing. In the line of an individualized treatment program, massage might be helpful, as well as acupuncture. Some studies advocate that acupuncture may be a complement to the existing management of LP since it helps to reduce LP during pregnancy. However, the efficacy of the method in general remains unconfirmed.^[3,8,10,57,58]

The basic management of PGP is different from that of LP. Everyday activities and exercising, which aggravate symptoms, should be avoided. During acute episodes of PGP, brief rest and lying in bed can be useful. Some exercises for bed rest, such as using pillows to support the legs and squeezing the legs together when rolling, can be useful as well. Over flexion of the hips and the spine should also be avoided, while sitting. The use of a sacral belt helps to alleviate symptoms. Return to heavy activities and exercising should be avoided for several months postpartum.^[8] Pharmacological agents are not mentioned in the literature as a possible alternative treatment during pregnancy. In cases of persistent pain combinations of therapies from various complementary and allopathic treatments should be followed.^[27]

RESULTS

This study found that over 4 weeks, using the exercise program, participants with LBPP had a statistically significant improvement ($p < 0.05$) in functional capacity and a statistically significant reduction in pain intensity compared to the control group.

Strengths and weaknesses, To be able to critically analyze this study in greater detail, the Understanding Health Research tool and CASP RCT checklist were used as a guide.

For a study to have a focused question it must address the population, intervention, control group and outcome measures (Santos et al. 2007). The research question addressed in this study clearly addressed each of these aspects.

1. To ensure the RCT had sufficient statistical power to detect a difference in the outcomes measured, it was calculated that a sample size of 48 participants for each group was needed, which the study met.
2. Having strict inclusion criteria is important for ensuring groups are similar before the start of a trial. It increases the validity of a study because, if there is an imbalance between the groups, a positive result may be observed as a result of the differing characteristics of the participants rather than a result of the different interventions being compared (Roberts

and Torgerson 1999). However, in this study, the eligibility criteria did not take into account whether or not it was the participants' first pregnancy. This means previous injuries or structural damage due to pregnancy are not taken into account. During pregnancy, there may be a detrimental effect on the structure and function of the pelvic floor muscles which means the pain experienced by woman who have already been pregnant could be higher, and their functional ability could also be at a lower baseline (Nursing Times 2009).

3. Randomization of participants was achieved using opaque, sealed envelopes. Additionally, a nurse who was independent from study carried out this process to further minimize bias. Ideally, an electronic randomization method would be used, as this limits any chance of human bias. After randomization, the characteristics in two groups were similar, showing that the randomization was effective in creating two comparable groups. Due to study design, it was not possible to blind participants and researchers as group allocation was obvious. This could create expectations regarding the respective interventions and therefore could potentially be one reason for variance between the groups.
4. The researchers used outcome measures that were valid, reliable and appropriate for what they were wanting to measure. This, in turn, increases the validity and reliability of the results and allows for the study to be replicated.

CONCLUSION

LBP is one of the most common musculoskeletal complaints of pregnant women. For some women, it may be the outburst of chronic low back pain and for others may be disabling pain during pregnancy and for a variable period postpartum. LBP during pregnancy may be the result of mechanical, hormonal and other factors, associated with the changes of the body. Literature clearly indicates that LBP may be disabling, limiting everyday activities, impacting productivity and should not be ignored or left untreated.

The design and results of this study support the researchers' aim to provide stronger evidence for use of exercise programs to relieve severity of LBPP and to promote functional ability. The intervention group showed a statistically significant improvement in both primary outcomes up to four weeks after ongoing treatment. However, this study is focused on the short term effects; further research is needed to test whether exercise programs can help woman suffering with LBPP in the long term. Additionally, replication in more

heterogeneous samples of women is advisable, to ensure greater external validity and generalizability.

Although it may not be possible to cure LBP in some cases of persistent LBP, it can be adequately reduced. Early identification and treatment, that takes under consideration the individuality of each woman and pregnancy, provide the best opportunity for the best possible outcome. A correct diagnosis and a differentiation between PGP and LP are of the utmost importance since treatment is different. Treatment options include exercising, physiotherapy, stabilization belts, nerve stimulation, pharmacological treatment, acupuncture, massage, relaxation, and yoga, depending on the case. A more vigorous treatment should be applied in more serious cases, associated with neurologic complications, such as disc herniation or mass. Given the high incidence of LBP during pregnancy, larger studies are needed, in order to test prevention and treatment options in broader populations and contribute to improving women's health.

REFERENCES

1. Bastiaanssen JM, de Bie RA, Bastiaenen CH, Essed GG, van den Brandt PA. A historical perspective on pregnancy-related low back and/or pelvic girdle pain. *Eur J Obstet Gynecol Reprod Biol.*, 2005; 120: 3–14. [PubMed] [Google Scholar]
2. 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. [PMC free article] [PubMed] [Google Scholar]
3. Perkins J, Hammer RL, Loubert PV. Identification and management of pregnancy-related low back pain. *J Nurse Midwifery*, 1998; 43: 331–340. [PubMed] [Google Scholar]
4. Sihvonen T, Huttunen M, Makkonen M, Airaksinen O. Functional changes in back muscle activity correlate with pain intensity and prediction of low back pain during pregnancy. *Arch Phys Med Rehabil*, 1998; 79: 1210–1212. [PubMed] [Google Scholar]
5. Bowyer KJ, Beyer DC, Messenger D, Kennedy CM. Pilot data: association between gluteus medius weakness and low back pain during pregnancy. *Iowa Orthop J.*, 2009; 29: 97–99. [PMC free article][PubMed] [Google Scholar]
6. van Dongen PW, de Boer M, Lemmens WA, Theron GB. Hypermobility and peripartum pelvic pain syndrome in pregnant South African women. *Eur J Obstet Gynecol Reprod Biol.*, 1999; 84: 77–82.[PubMed] [Google Scholar]

7. Stuge B, Hilde G, Vollestad N. Physical therapy for pregnancy-related low back and pelvic pain: a systematic review. *Acta Obstet Gynecol Scand*, 2003; 82: 983–990. [PubMed] [Google Scholar]
8. Sabino J, Grauer JN. Pregnancy and low back pain. *Curr Rev Musculoskelet Med.*, 2008; 1: 137–141. [PMC free article] [PubMed] [Google Scholar]
9. To WW, Wong MW. Factors associated with back pain symptoms in pregnancy and the persistence of pain 2 years after pregnancy. *Acta Obstet Gynecol Scand*, 2003; 82: 1086–1091. [PubMed] [Google Scholar]
10. Wedenberg K, Moen B, Norling A. A prospective randomized study comparing acupuncture with physiotherapy for low-back and pelvic pain in pregnancy. *Acta Obstet Gynecol Scand*, 2000; 79: 331–335. [PubMed] [Google Scholar]
11. Ostgaard HC, Andersson GB, Schultz AB, Miller JA. Influence of some biomechanical factors on low-back pain in pregnancy. *Spine (Phila Pa 1976)*, 1993; 18: 61–65. [PubMed] [Google Scholar]
12. Pool-Goudzwaard AL, Sliker tenHoveMC, Vierhout ME, Mulder PH, Pool JJ, Snijders CJ, et al. Relations between pregnancy-related low back pain, pelvic floor activity, and pelvic floor dysfunction. *Int Urogynecol J Pelvic Floor Dysfunct*, 2005; 16: 468–474. [PubMed] [Google Scholar]
13. Ostgaard HC, Zetherstrom G, Roos-Hansson E, Svanberg B. Reduction of back and posterior pelvic pain in pregnancy. *Spine (Phila Pa 1976)*, 1994; 19: 894–900. [PubMed] [Google Scholar]
14. Ostgaard HC, Roos-Hansson E, Zetherstrom G. Regression of back and posterior pelvic pain after pregnancy. *Spine (Phila Pa 1976)*, 1996; 21: 2777–2780. [PubMed] [Google Scholar]
15. Haugland KS, Rasmussen S, Daltveit AK. Group intervention for women with pelvic girdle pain in pregnancy. A randomized controlled trial. *Acta Obstet Gynecol Scand*, 2006; 85: 1320–1326. [PubMed] [Google Scholar]
16. Stureson B, Uden G, Uden A. Pain pattern in pregnancy and "catching" of the leg in pregnant women with posterior pelvic pain. *Spine (Phila Pa 1976)*, 1997; 22: 1880–1883. discussion 1884. [PubMed] [Google Scholar]
17. Johnson D, Coley S. Back pain in pregnancy. *J R Soc Med.*, 1998; 91: 344. [PMC free article] [PubMed] [Google Scholar]

18. Leboeuf-Yde C, van Dijk J, Franz C, Hustad SA, Olsen D, Pihl T, et al. Motion palpation findings and self-reported low back pain in a population-based study sample. *J Manipulative Physiol Ther.*, 2002; 25: 80–87. [PubMed] [Google Scholar]
19. Fogarty V. Intradermal sterile water injections for the relief of low back pain in labor - a systematic review of the literature. *Women Birth*, 2008; 21: 157–163. [PubMed] [Google Scholar]
20. Bailey A. Risk factors for low back pain in women: still more questions to be answered. *Menopause*, 2009; 16: 3–4. [PubMed] [Google Scholar]
21. Wang SM, Dezinno P, Maranets I, Berman MR, Caldwell-Andrews AA, Kain ZN. Low back pain during pregnancy: prevalence, risk factors, and outcomes. *Obstet Gynecol*, 2004; 104: 65–70. [PubMed] [Google Scholar]
22. Mens JM, Vleeming A, Stoeckart R, Stam HJ, Snijders CJ. Understanding peripartum pelvic pain. Implications of a patient survey. *Spine (Phila Pa 1976)*, 1996; 21: 1363–1369. discussion 1369-1370. [PubMed] [Google Scholar]
23. Van De Pol G, Van Brummen HJ, Bruinse HW, Heintz AP, Van Der Vaart CH. Pregnancy-related pelvic girdle pain in the Netherlands. *Acta Obstet Gynecol Scand*, 2007; 86: 416–422. [PubMed] [Google Scholar]
24. Sandler SE. The management of low back pain in pregnancy. *Man Ther.*, 1996; 1: 178–185. [PubMed] [Google Scholar]
25. de Groot M, Pool-Goudzwaard AL, Spoor CW, Snijders CJ. The active straight leg raising test (ASLR) in pregnant women: differences in muscle activity and force between patients and healthy subjects. *Man Ther.*, 2008; 13: 68–74. [PubMed] [Google Scholar]
26. Vadivelu R, Green TP, Bhatt R. An uncommon cause of back pain in pregnancy. *Postgrad Med J.*, 2005; 81: 65–67. [PMC free article] [PubMed] [Google Scholar]
27. Ostgaard HC, Zetherstrom G, Roos-Hansson E. The posterior pelvic pain provocation test in pregnant women. *Eur Spine J.*, 1994; 3: 258–260. [PubMed] [Google Scholar]
28. van de Pol G, de Leeuw JR, van Brummen HJ, Bruinse HW, Heintz AP, van der Vaart CH. The Pregnancy Mobility Index: a mobility scale during and after pregnancy. *Acta Obstet Gynecol Scand*, 2006; 85: 786–791. [PubMed] [Google Scholar]
29. Leadbetter RE, Mawer D, Lindow SW. Symphysis pubis dysfunction: a review of the literature. *J Matern Fetal Neonatal Med.*, 2004; 16: 349–354. [PubMed] [Google Scholar]
30. Baxley EG, Gobbo RW. Shoulder Dystocia. *Am Fam Physician*, 2004; 69: 1707–1714. [PubMed] [Google Scholar]

31. Chalidis B, Fahel LA, Glanville T, Kanakaris N, Giannoudis PV. Management and reconstruction of pelvic instability after emergency symphysiotomy. *Int J Gynecol Obstet*, 2007; 98: 264–266. [PubMed] [Google Scholar]
32. Tile M, Helfet D, Kellam J. Fractures of the pelvis and acetabulum. Lippincott Williams & Wilkins; 2003. Management of pelvic ring injuries; pp. 168–216. [Google Scholar]
33. Mogren IM. Physical activity and persistent low back pain and pelvic pain postpartum. *BMC Public Health*, 2008; 8: 417. [PMC free article] [PubMed] [Google Scholar]
34. Stapleton DB, MacLennan AH, Kristiansson P. The prevalence of recalled low back pain during and after pregnancy: A South Australian population survey. *Aust N Z J Obstet Gynecol*, 2002; 42: 482–485. [PubMed] [Google Scholar]
35. Mens JM, Damen L, Snijders CJ, Stam HJ. The mechanical effect of a pelvic belt in patients with pregnancy-related pelvic pain. *Clin Biomech (Bristol, Avon)*, 2006; 21: 122–127. [PubMed] [Google Scholar]
36. Ostgaard HC, Andersson GB, Karlsson K. Prevalence of back pain in pregnancy. *Spine (Phila Pa 1976)*, 1991; 16: 549–552. [PubMed] [Google Scholar]
37. Larsen EC, Wilken-Jensen C, Hansen A, Jensen DV, Johansen S, Minck H, et al. Symptom-giving pelvic girdle relaxation in pregnancy. I: Prevalence and risk factors. *Acta Obstet Gynecol Scand*, 1999; 78: 105–110. [PubMed] [Google Scholar]
38. Bjorklund K, Bergstrom S. Is pelvic pain in pregnancy a welfare complaint? *Acta Obstet Gynecol Scand*, 2000; 79: 24–30. [PubMed] [Google Scholar]
39. Mogren IM, Pohjanen AI. Low back pain and pelvic pain during pregnancy: prevalence and risk factors. *Spine (Phila Pa 1976)*, 2005; 30: 983–991. [PubMed] [Google Scholar]
40. Padua L, Padua R, Bondi R, Ceccarelli E, Caliandro P, D'Amico P, et al. Patient-oriented assessment of back pain in pregnancy. *Eur Spine J.*, 2002; 11: 272–275. [PMC free article] [PubMed] [Google Scholar]
41. MacLennan AH, MacLennan SC. The Norwegian Association for Women with Pelvic Girdle Relaxation (Landforeningen for Kvinner Med Bekkenlosningsplager) *Acta Obstet Gynecol Scand*, 1997; 76: 760–764. [PubMed] [Google Scholar]
42. Mogren IM. BMI, pain, and hyper-mobility are determinants of long-term outcome for women with low back pain and pelvic pain during pregnancy. *Eur Spine J.*, 2006; 15: 1093–1102. [PMC free article][PubMed] [Google Scholar]

43. Mogren IM. Does cesarean section negatively influence the post-partum prognosis of low back pain and pelvic pain during pregnancy? *Eur Spine J.*, 2007; 16: 115–121. [PMC free article] [PubMed] [Google Scholar].