Challenges of the Pregnant Athlete and Low Back Pain

Megan L. Noon, MD and Anne Z. Hoch, DO

Abstract
Low back pain during pregnancy is a common problem with a high prevalence among pregnant athletes. The etiology of pregnancy-related low back pain remains unclear, although more evidence is supporting a biomechanical/musculoskeletal origin. This article will review the causes of low back pain in athletes and pregnant women, differentiate low back from pelvic girdle pain, and discuss the treatment and prevention of pregnancy-related low back and pelvic girdle pain.

Introduction

Low back pain (LBP) during pregnancy is a common problem often thought to be a normal part of pregnancy. The prevalence of LBP in pregnancy has been estimated at 20% to 84% (23,24,44) with a recently reported prevalence of 69% among pregnant women in the United States (45). Based on this, an estimated 2.9 million women in the United States will suffer from pregnancy-related LBP this year. This condition often is disabling, with a third of women reporting severe pain that impairs their daily function (6,18). In the United States, 11% of pregnant women will take sick leave due to LBP (45). Although pregnancy-related LBP is a common disabling problem, only 32% of women report symptoms to their physicians, and only 25% of health care providers recommend treatment (45). Heckman and Sassard (14) noted, "Because of the special condition of pregnancy, it has been thought that these symptoms should be allowed to resolve spontaneously, that overzealous intervention is inappropriate or dangerous to the mother or the fetus, or that nothing could be done to alleviate these problems short of the mother completing the pregnancy." Vermani *et al.* (43) has reported that increasing numbers of pregnant women with LBP are requesting cesarean sections and labor inductions prior to the 39th week of gestation with the hope that delivery will provide symptom relief. While it is thought that resolution of LBP will come with delivery, pregnancy-related LBP has long-term effects with 51% and 20% of women reporting continued LBP 1 and 3 years postpartum, respectively (27,32). Of women with chronic LBP, 10% report their pain started during pregnancy (39). Long-term effects also influence family planning as 19% of women with pregnancy-related LBP will elect not to have a subsequent pregnancy because of fear of recurrent LBP (6). While pregnancy-related LBP is a common problem, given its negative impact on a woman's life, it should not be accepted as a normal condition of pregnancy.

There have been multiple studies on pregnancy-related LBP and LBP in athletes; however, there are few studies on pregnant athletes with LBP. This article will review LBP in athletes and pregnancy-related LBP while bringing insight to pregnant athletes with LBP. It also will differentiate pregnancy-related LBP from pelvic girdle pain (PGP).

LBP and the Athlete

LBP is common in the general population with lifetime prevalence reported at 85% to 90% (42). LBP is also common in athletes participating in noncontact sports. Sports with a high prevalence of LBP include gymnastics, diving, weight lifting, and racquet sports (41). While multiple etiologies for LBP in athletes exist (Table 1), soft tissue injury is the most common (41). Poor muscle endurance, muscular imbalance, altered muscle-firing rates of the lumbar erector spinae, and decreased flexibility of the spine have been associated with LBP (15,17,19,25,26,33). During sports, athletes have larger forces placed upon their spines, yet it has not been proven that athletes have stronger backs to counteract these forces when compared with nonathletes (41). The increased stress on the spine, especially following a rapid increase in training frequency or duration, can lead to muscle fatigue and subsequent LBP (41). The musculature of the spine and trunk plays an important role in protecting the back. The spine musculature stabilizes the spine while hip musculature transfers the forces from the lower extremities to the spine. Poor endurance or muscle imbalance of the spine or hip can lead to LBP.

Department of Orthopaedic Surgery, Medical College of Wisconsin, Milwaukee, WI

Address for correspondence: Megan L. Noon, MD, Department of Orthopaedic Surgery, Medical College of Wisconsin, 9200 W Wisconsin Avenue, Milwaukee, WI 53226 (E-mail: mnoon@mcw.edu).

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Several studies have evaluated the biomechanical causes of LBP. Renkawitz *et al.* (33) demonstrated a strong correlation between LBP and muscular imbalance of the erector spinae in athletes with LBP. Muscular imbalance was defined as a muscle activity asymmetry of 30% or more in the lumbar paravertebral region as measured by surface electromyography (EMG). There was a significant association between the athlete's handedness and a decrease in the contralateral EMG activity of the erector spinae musculature (33). A correlation also was found between poor flexibility of the erector spinae and both LBP and neuromuscular imbalance (33). There was no correlation between iliopsoas and rectus femoris flexibility and LBP (33). Renkawitz *et al.* (33) did not find an association between maximum voluntary isometric trunk extension strength measured via dynamometer and LBP or neuromuscular imbalance. Hides *et al.* (15) revealed asymmetry of the back extensors with ipsilateral atrophy of the multifidi as measured by cross-sectional area under ultrasound in individuals with unilateral LBP compared with those without LBP. Poor endurance of the gluteus maximus measured by EMG has been associated with chronic LBP (17,19). Finally, Nadler *et al.* (25,26) utilized dynamometer testing to suggest that imbalance of hip abductor and hip extensor strength correlated with LBP in female athletes; this was not found in male athletes.

Several studies have evaluated LBP in athletes; however, few studies specifically address LBP in pregnant athletes. Bø and Backe-Hansen (5) evaluated the prevalence of LBP and PGP in a retrospective study in elite Norwegian athletes compared with age-matched controls and found a similarly high rate of pregnancy-related LBP and PGP in both groups. There was not a significant difference found in birth weight or rate of cesarean sections between the groups (5). Elite athletes in this study were found to return to their prepregnancy weight more quickly than nonathletes (5). The inability to return to prepregnancy weight has been reported as a risk factor for persistent back pain 2 years postpartum (40).

Pregnancy-Related LBP

LBP associated with pregnancy often appears at 22 weeks of gestation, although it may present at any time during pregnancy (23). The only consistently supported risk factor for pregnancy-related LBP is a history of LBP (6,23,24,45). Up to 85% of women with pregnancy-related LBP will have LBP in subsequent pregnancies (6). Women with a history of LBP are 50% more likely to have LBP during pregnancy (29). Several studies have shown conflicting data regarding maternal height and weight, weight gain, age, and infant's weight as risk factors for pregnancy-related LBP (23,24,29). Although not confirmed, it is thought that exercise reduces the risk of pregnancy-related LBP. In a retrospective study of 891 Swedish women, those participants with more years of leisure activity prior to pregnancy were less likely to have pregnancy-related LBP (22).

The exact etiology of pregnancy-related LBP is unknown, although three mechanisms have been described consistently in the literature: vascular, hormonal, and biomechanical/musculoskeletal. While the etiology of pregnancy-related LBP is thought to be multifactorial, recently, more emphasis has been placed on the biomechanical/musculoskeletal etiology of LBP.

The hormonal changes leading to pregnancy-related LBP are thought to be due to increased relaxin and estrogen levels. Relaxin is a polypeptide hormone produced by the corpus luteum in the late luteal phase of the menstrual cycle prior to pregnancy. During pregnancy, the decidua and placenta produce relaxin with peak levels found at 10 to 12 wk of gestation (7,18). Relaxin stimulates collagenase to remodel the pelvic connective tissue in preparation for delivery. It is thought that the remodeling of collagen decreases the tensile strength of ligaments leading to increased mobility of joints. Estrogen enhances the effect of relaxin by increasing relaxin receptor sensitivity. It previously was believed that pelvic distention along with weight gain during pregnancy stressed the weakened ligaments leading to LBP. MacLennan *et al.* (20) found that pregnant women most incapacitated by LBP had the highest levels of relaxin. Recent studies do not support this association. Kristiansson *et al.* (18) found a positive correlation between high relaxin levels and pain along the greater trochanter and pubic symphysis regions yet no association with LBP. Marnach *et al.* (21) found no correlation between peripheral joint laxity and relaxin levels. Schauberger *et al.* (36) found an increase in peripheral joint laxity as pregnancy progressed, yet no correlation was found between increased joint laxity and relaxin levels. Given the lack of supporting evidence for hormonal-induced LBP, this mechanism as the sole etiology of pregnancy-related LBP has fallen out of favor.

The theory of the vascular etiology of pregnancy-related LBP focuses on the effects of the gravid uterus upon the vena cava and hypervolemia that occurs with pregnancy.

Table 1.
Differential diagnosis of LBP in athletes.

Musculoskeletal	Infectious and Other Etiologies
Lumbar spondylolysis/spondylolisthesis	Osteomyelitis
Lumbar disc herniation	Soft tissue infection/tumor
Lumbar radiculopathy	Appendicitis
Lumbar facet arthropathy	Urinary tract infection
Lumbar stenosis	Pyelonephritis
Sciatica	Hydronephrosis
SIJ ligament sprain	Renal calculi
Stress fracture — sacrum, ilium, femur	Aortic aneurysm
Osteoarthritis of the lumbar spine, SIJ, hip	Uterine fibroids
Osteonecrosis of the hip	Ovarian torsion
Osteitis pubis	Ankylosing spondylitis
Muscular — quadratus lumborum, piriformis, gluteus medius/maximus, hamstring, iliopsoas	Rheumatoid arthritis
	Fibromyalgia

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This combination leads to venous congestion and hypoxia in the pelvic and lumbar regions, inducing LBP (8). Pain typically will occur at night when the woman is in a supine position. It is recommended that pregnant women avoid sleeping supine to decrease direct pressure upon the vena cava, which can lead to venous congestion (8).

More recently, emphasis has been placed on the biomechanical/musculoskeletal etiology of pregnancy-related LBP. It is recommended that a normal-weight woman gain 25–35 pounds during pregnancy (16). This growth will shift the center of gravity anteriorly leading to an additional flexion moment on the lumbar spine, placing an increased load upon the spinal musculature for spine stabilization. It was theorized that hyperlordosis, which often accompanies this change in body habitus, was the etiology of pregnancy-related LBP. The hyperlordosis theory has been challenged. Garshasbi and Faghih Zadeh (11) found only a weak association between hyperlordosis and pregnancy-related LBP. Ostgaard *et al.* (30) revealed that lordosis did not increase during pregnancy; however, women with hyperlordosis prior to pregnancy were more susceptible to LBP during pregnancy. A correlation was found between a woman's large sagittal and transverse abdominal diameter and pregnancy-related LBP (30). This stretch in abdominal diameter may weaken the abdominal musculature (9). Ritchie (34) noted that the anterior shift in the center of gravity caused an increased anterior pelvic tilt, placing more stress upon the sacroiliac joints (SIJ) and ligaments, as well as the surrounding spinal musculature. It is unknown if it is the shift in the center of gravity, the weakened abdominal musculature, or both that leads to pregnancy-related LBP.

Furthermore, a 20% weight gain experienced during pregnancy can increase the force on a joint by as much as 100% (34). This force in combination with increased joint laxity and muscle weakness or poor endurance may lead to low back and/or posterior pelvic pain. Sihvonen *et al.* (37) measured EMG activity of the bilateral L4 to L5 paraspinal musculature of women during the first trimester and found those with reduced EMG activity reported more pain and disability throughout the pregnancy. Gutke *et al.* (12) also found reduced muscular endurance of the back extensors and back flexors along with decreased hip extensor strength in women with pregnancy-related LBP and PGP. Norén *et al.* (27) revealed that women with pregnancy-related LBP and PGP had significantly lower endurance of the back extensors and hip abductors. Weakness of hip abductors, specifically the gluteus medius, also has been associated with pregnancy-related LBP (4). Weight gain that occurs with pregnancy will place increased stress upon the gluteus medius during stance and gait (10). The hip abductors stabilize the pelvis during midstance; weakness is noted by a positive Trendelenburg sign with single leg stance. When gluteus medius endurance or strength is reduced, there is an increased demand on the lateral trunk stabilizers, and a Trendelenburg gait pattern develops. The increased demand on the lateral stabilizers along with increased pelvic tilting can lead to posterior pelvic pain (10). The Trendelenburg gait pattern also may contribute to LBP because of abnormal segmental motion of the lumbar spine (3). Based on these studies, it seems that the etiology of pregnancy-related LBP is multifactorial.

Differentiating LBP and PGP in Pregnancy

Recently, the need to differentiate between LBP and PGP has been emphasized (Table 2). LBP is defined as pain in the lumbar region. PGP is defined as pain between the posterior iliac crest and the gluteal folds. While both are common in pregnancy, PGP has been found to be up to four times more prevalent and is thought to be more disabling (31). While PGP may be more disabling during pregnancy, it does tend to decrease at a faster rate than LBP during the postpartum period (13).

Pregnancy-related LBP has been reported as a dull, achy pain along the lumbar region that is worse with lumbar flexion. There is an associated decrease in lumbar spine range of motion (ROM), and the erector spinae are tender to palpation on physical examination. The pain is similar to LBP occurring in the nonpregnant population.

Pregnancy-related PGP typically is experienced between the posterior iliac crest and the gluteal folds, predominantly around the SIJ. The pain can radiate to the posterior thigh and may be associated with pubic symphysis pain. More specifically, PGP can be divided between SIJ pain and pubic symphysis pain. Pregnancy-related PGP is intermittent and often described as stabbing, shooting, or burning. There may be pain-free intervals. Spinal ROM remains within normal limits on physical examination. Prolonged standing, sitting, and walking may exacerbate PGP (35). Stairs, twisting, and single-leg stance also tend to increase pain. PGP typically is seen in pregnancy, but it also may be seen following trauma and/or secondary to arthritis. Risk factors for PGP include a history of LBP and prior trauma to the pelvis (44).

Evaluation of Pregnancy-Related LBP and PGP

In evaluating a pregnant woman with LBP, the differential diagnosis is broad (Table 3). A complete obstetric

Table 2.
Characteristics of LBP and PGP.

LBP	PGP
Pain may be present earlier in life	New type of pain, debut during pregnancy
Pain located in the lumbar region	Pain located between the posterior iliac crest and the gluteal folds, predominantly around the SIJ
Decreased lumbar spine ROM	Normal lumbar spine ROM
Tenderness to palpation over lumbar paraspinal musculature	Tenderness to palpation over SIJ and gluteal musculature
Little problem with walking or standing	Pain with walking or standing
Constant pain	Pain-free intervals
Negative provocation test for pelvic pain	Positive provocation test for pelvic pain

[Adapted from Norén L, Ostgaard S, Johansson G, Ostgaard HC. Lumbar back and posterior pelvic pain during pregnancy: a 3-year follow-up. Eur. Spine J. 2002; 11:267–271. Copyright © Springer Science + Business Media. Used with permission.]

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Table 3.
Differential diagnosis of LBP and PGP in pregnancy.

Obstetric/Gynecologic	Preterm labor
	Placental abruption
	Chorioamnionitis
	Round ligament pain
	Uterine fibroids
	Ovarian torsion
Renal	Urinary tract infection
	Pyelonephritis
	Hydronephrosis
	Renal calculi
Musculoskeletal	Lumbar disc herniation
	Lumbar radiculopathy
	Lumbar stenosis
	Lumbar spondylolisthesis
	Sciatica
	Osteoporotic lumbar compression fracture
	Stress fracture — sacrum, ilium, femur
	Osteoarthritis of the lumbar spine, SIJ, hip
	Transient osteoporosis of the hip
	Osteonecrosis of the hip
	Pubic symphysis diastasis
	Osteitis pubis
	Muscular — quadratus lumborum, piriformis, gluteus medius/maximus, hamstring, iliopsoas
Infectious and Other Etiologies	Osteomyelitis
	Soft tissue infection/tumor
	Appendicitis
	Vertebral hemangioma
	Fibromyalgia
	Aortic aneurysm
Worsening Preexisting Conditions	Rheumatoid arthritis
	Ankylosing spondylitis

evaluation to rule out obstetric and other potential serious causes of LBP should be performed prior to assessing musculoskeletal etiologies. A thorough history and physical examination, including an evaluation for neurological signs, should be obtained. Inspection of gait, pelvic tilt, and lumbar and hip ROM; palpation of the lumbar spine, SIJ, and gluteal regions; assessment of core and lower extremity strength; and evaluation for nerve root impingement signs should be performed. The European guidelines for the diagnosis and treatment of PGP recommend specific clinical tests for the diagnosis of PGP (44). For SIJ pain, palpation of the long dorsal SIJ ligament along with the posterior pelvic pain provocation test (Fig.), Patrick test, and Gaenslen test are recommended (44). The active straight leg raise test is utilized as a functional pelvic test (44). These tests have a high specificity and low sensitivity; therefore, all tests should be performed, and PGP should not be ruled out based on one negative test (44). When evaluating pubic symphysis pain, it is recommended to palpate the pubic symphysis and perform a modified Trendelenburg test (44). A palpable defect along the pubic symphysis may be appreciated with pubic symphysis diastasis.

Imaging often is not required for the diagnosis of pregnancy-related LBP or PGP (44). Severe pain or atypical symptoms may warrant radiographs of the spine and/or pelvis (14). Pubic symphysis diastasis can be diagnosed with ultrasound, radiographs, or magnetic resonance imaging (MRI). Should "red flags" arise on history and/or physical examination, MRI may be pursued (44). The American College of Obstetricians and Gynecologists (ACOG) guidelines on diagnostic imaging during pregnancy note that there have been no adverse affects to the fetus following ultrasound, MRI, and imaging resulting in less than 5 rad of radiation exposure (1). ACOG recommends the use of ultrasound or MRI over radiographs when appropriate (1).

Treatment of Pregnancy-Related LBP and PGP

Without an exact etiology of pregnancy-related LBP and PGP, a clear treatment approach has not been defined. There has been promise for improved symptoms with exercise and physical therapy programs, although specifics on which exercise program is most beneficial have to be determined yet. Ostgaard *et al.* (31) revealed that individualized treatment programs were more effective at reducing pain intensity and sick leave compared with back school education. Norén *et al.* (28) also demonstrated that individualized treatment programs decreased pain intensity and sick leave.

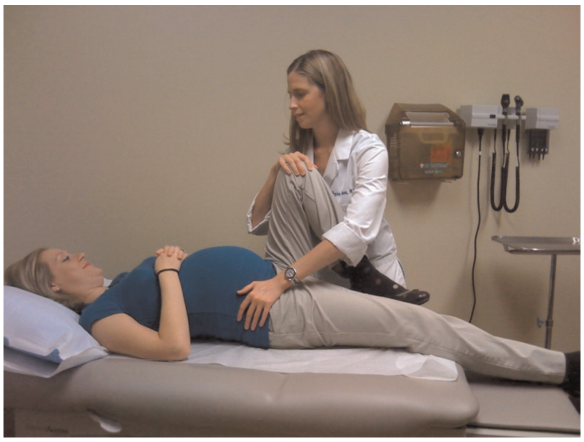

Figure: Posterior pain provocation test. Patient is in a supine position with her hip flexed to 90 degrees as the examiner stabilizes her pelvis by resting a hand on the contralateral superior anterior iliac spine and applies light pressure downward along the longitudinal axis of the femur. If pain is reproduced within the ipsilateral deep gluteal region, the test is positive. Color is available online at http://www.acsm-csmr.org.

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Unfortunately, the specifics on which muscle groups were targeted in the treatment groups were not stated in either study (28,31). Stuge *et al.* (38) revealed improvement of symptoms in the therapy group performing stabilizing exercises for the hip abductors, hip adductors, gluteus maximus, transverse and oblique abdominals, erector spinae, lumbar multifidus, quadratus lumborum, and latissimus dorsi.

The European guidelines for the diagnosis and treatment of PGP have noted the following recommendations for treatment (44):

- A pelvic belt may be used for short periods of time to decrease PGP symptoms, although it should not be the sole treatment.
- For the treatment of PGP, there has been no evidence to support back school classes, manipulation/joint mobilization, prolotherapy, or radiofrequency ablation (44).
- Massage and education on PGP may be beneficial, but should not be the only treatment.
- Acupuncture does seem to reduce LBP and PGP during pregnancy; however, higher quality studies are needed.
- Intra-articular SIJ injections, with the use of image guidance, are recommended for ankylosing spondylitis.
- Acetaminophen is the first drug of choice for pain relief.

Prevention of Pregnancy-Related LBP and PGP

Exercise prior to and during pregnancy has been found to decrease the risk of pregnancy-related LBP and improve the symptoms when LBP is present (11,22,31). The specifics on the amount or type of exercise needed to reduce the risk or improve symptoms have not been delineated clearly in the literature. Based on recent research concluding that trunk and hip musculature imbalance, in the form of weakness or poor endurance, leads to LBP and PGP in pregnancy, a strength training program focused on the erector spinae, hip extensors, hip abductors, and transverse abdominals prior to and during pregnancy may be beneficial.

ACOG Committee Opinion Number 267 stated the following recommendations on exercise in pregnancy (2):

- A clinical evaluation should be performed prior to starting exercise especially for previously inactive women.
- Moderate exercise for 30 min or more per day is recommended for women without medical or obstetrical complications.
- Athletes with uncomplicated pregnancies may continue with exercise as tolerated; further recommendations are vague given that there is limited research on strenuous exercise in pregnant women.
- Activity should be reduced during the second and third trimesters for women with histories of or risk for preterm labor or fetal growth restriction (2).

Conclusions

LBP and PGP during pregnancy are common conditions affecting 69% of U.S. pregnant women (45). Pregnant athletes have been found to have the same prevalence for pregnancy-related LBP as nonathletes. While pregnancy-related LBP and PGP may be severely disabling, the etiology and treatment remain unclear. Although more focus recently has been directed toward the biomechanical/musculoskeletal etiology, further research into the underlying mechanisms and development of specific treatment and prevention regimens is needed.

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