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RESEARCH STUDY

# An Analysis of Posture and Back Pain in the First and Third Trimesters of Pregnancy

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*While the incidence of back pain during pregnancy has been shown to be high, few studies have investigated postural changes that occur during pregnancy and their relationship to back pain. The purpose of this study was to determine if posture and back pain changed from the first to the third trimester of pregnancy and whether there was a relationship between the two. Twelve healthy women who were having uncomplicated pregnancies participated in the study. During the first and third trimesters, each subject had their standing posture and back pain assessed by a Metrecom Skeletal Analysis System and a 0- to 10-cm line pain scale, respectively. Repeated measures analysis of variance and Pearson correlation coefficients were calculated on or between back pain and nine posture variables and revealed significant increases in third trimester back pain and postures compared with first trimester back pain ($p < .05$) and postures for lumbar angle ($p < .01$), posterior head position ($p < .01$), right pelvic sagittal tilt ($p < .01$), and left pelvic sagittal tilt ($p < .01$). No significant relationships were found between magnitude of or change in posture and back pain. These results suggest that in the standing position the lumbar lordosis and sagittal pelvic tilt increased and head position became more posterior as women progressed from the first trimester to the last trimester of pregnancy. These postural changes, however, were not related to back pain. This suggests that many of the posture-correcting clinical exercise regimens given to pregnant women need to be investigated.*

**Key Words:** *back pain, posture, pregnancy*

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Women commonly experience back pain during and after pregnancy. Incidence of back pain during pregnancy has been reported to range from 47 to 82% (3,6, 10,19,23–25). At the time of delivery, Ostgaard and Andersson (22) found that 67% of 817 pregnant women reported back pain directly after delivery and 37% experienced back pain 18 months postpartum. In another study involving 855 pregnant women, Ostgaard et al (23) found that back pain began early in pregnancy, with a prevalence of 25% at 12 weeks. The sacroiliac area has been described as the most common location of back pain in pregnant women (3,23). Berg et al (3), in a study of 862 pregnant women, identified two-thirds of the back pain experienced during pregnancy as sacroiliac in origin.

The etiology of back pain during and after pregnancy remains unproven. An excellent review of the different theories has been written by Rungee (26). These theories include hormonal influences causing laxity of joints in the pelvis, vascular changes, postural changes from increasing growth of the fetus, herniated nucleus pulposus, tumors, and infection (26).

Although never substantiated, postural changes have often been implicated as a major cause of back pain in pregnant women (2,5,7,9,12, 15,30). In 1949, Bushnell (7) described a parietal neuralgia of pregnancy that he stated was from "high heels, corsets, and a laissez faire attitude of posture that produced a generation of women whom were not ideal subjects for parturition." Bushnell (7) further stated that this vanity caused abnormal postures that produced the parietal neuralgia. Few studies have assessed postural changes that occur during pregnancy. Bullock et al (6) found that in 34 pregnant women lumbar lordosis and thoracic kyphosis increased between the fourth and ninth month of pregnancy. In a case study involving a 31-year-old pregnant woman, Fries and Hellebrandt (14) determined that the center of gravity was displaced posteriorly, the head elevated, the cervical spine hyperextended, and the knee and ankle joints extended over a total of nine observations taken every 2 weeks during pregnancy. In contrast, Ostgaard et al (24) measured 855 pregnant women from the 12th to 36th week of gestation and found no change in lumbar lordosis. However, lumbar lordosis was measured by an unvalidated method which involved assessing the perpendicular distance to the apex of the lumbar lordosis from a straight line connecting the apex of the thoracic kyphosis and the posterior part of the sacrum. Snijders et al (29) measured 16 women a few weeks before childbirth and then a few weeks after childbirth and found that the

spine was straighter and the women were taller before childbirth than after childbirth. Moore et al (21), using unvalidated methodology that involved wearing a special gown that allowed the placement of 10 markers along the spinous processes between T1 and L5 on 25 pregnant women, found a significant decrease in lordosis occurred between 16 to 24 weeks and 25 to 33 weeks of pregnancy and an increase in lordosis occurred between 34 to 42 weeks and postpartum.

The relationship between posture and the back pain experienced during pregnancy is unclear. Moore et al (21) found a significant relationship ($r = 0.49$) between change in lordosis during 16 to 24 and 34 to 42 weeks of pregnancy and an increase in low back pain. Ostgaard et al (24) found that abdominal sagittal diameter ($r = 0.15$), transverse diameter ($r = 0.13$), and depth of the lordosis ($r = 0.11$) were related to the development of back pain during pregnancy. Bullock et al (6), in the only study that used a validated and reliable posture assessment instrument, found no relationship between spinal posture (thoracic kyphosis, lumbar lordosis, and pelvic tilt) magnitude or changes during pregnancy and back pain.

The purpose of this study was to examine head, shoulder, knee, and spinal standing sagittal posture and postural changes that occur between the first and third trimesters of pregnancy and determine whether these were related to back pain experienced during the first and third trimesters of pregnancy.

## Subjects

The study included 12 volunteer women with a mean age of 27.6 years (SD = 4.7) and a weight of 66.0 kg (SD = 10.1) who were experiencing an uncomplicated pregnancy. The participants had no known history of musculoskeletal problems of the spine or lower extremities and were in good health. Each subject signed a university approved consent document after being informed of the risks and benefits of the study. All subjects were paid $30 upon completion of the study.

## Apparatus

A Metrecom Skeletal Analysis System with incorporated Metrecom Version 2.11 software (Faro Medical Technologies Inc., Lake Mary, FL) was used to evaluate postural alignment. This system is a computerized, three-dimensional digitizer with an electromechanical linkage arm. The entire system consists of a floor base with a support column, moveable arm with a digitizer and six transducers, foot/hand switch, head restraint on a mounting block, and a computer with a printer. Smidt et al (28) evaluated the Metrecom for accuracy, repeatability and linearity, and human skeletal landmark location reliability. Smidt et al (28) concluded that the Metrecom was reliable and a valid tool in the hands of a competent examiner. Using subjects, Franklin et al (13) found the Metrecom intraexaminer intraclass correlation coefficients (ICC) for the average of three trials ranged from .66 to .97.

Back pain was assessed by measuring a mark on a 0- to 10-cm line made by the subjects, with a 0 representing no pain and 10 representing the worst pain imaginable.

## Data Analysis

Posture measurements (sagittal angles of the thoracic spine, lumbar spine, left and right pelvic tilt, right and left knee, sacral base angle, and anterior/posterior displacements of the head and shoulder) were assessed for each subject in the first and third trimester of pregnancy. Two trials were done during each measurement session for a total of four trials. Descriptive statistics were calculated for data. A repeated measures analysis of variance was performed for each of the nine posture variables to determine if there were any significant differences between the four trials. Contrasts were performed to test comparisons between means of the two trials for the first trimester to means of the two trials for the third trimester for each of the nine posture variables. Single-trial intraclass correlation coefficients (ICC) (4) and ICCs for the average of two trials using the Spearman-Brown prophecy formula (20) were calculated for the

| | First Trimester | | Third Trimester | |
|---|---|---|---|---|
| | $\bar{X}$ | SD | $\bar{X}$ | SD |
| **Postural angles (degrees)** | | | | |
| Thoracic | 31.6 | 9.4 | 34.8 | 16.0 |
| Lumbar | −31.9 | −8.7 | −37.8 | −9.6† |
| Pelvic tilt | | | | |
| Right | 6.4 | 6.0 | 10.0 | 9.5† |
| Left | 7.0 | 6.8 | 11.2 | 7.6† |
| Sacral base | 39.7 | 6.2 | 41.8 | 6.6 |
| Knee | | | | |
| Right | 1.8 | 3.5 | 2.0 | 3.8 |
| Left | 1.6 | 3.5 | 2.8 | 4.3 |
| **Anterior/posterior displacements (mm)** | | | | |
| Head | 81.2 | 20.7 | 53.5 | 25.8† |
| Shoulder | 17.7 | 23.1 | 21.4 | 16.2 |
| **Back pain raw data (cm)** | 0.4 | 1.0 | 1.6 | 1.6* |

* *Significance at $p < .05$.*
† *Significance at $p < .01$.*

**TABLE 1.** *Back pain and standing postural assessment means, standard deviations, and ANOVA results for women in the first and third trimesters of pregnancy (N = 12).*

first trimester trials and the third trimester trials.

A parametric square root transformation was performed because of skewed back pain data. A parametric analysis of variance was performed on the transformed pain values to compare the mean of the first trimester to the mean of the third trimester. Pearson correlation coefficients were calculated between transformed back pain scores and posture variables (sagittal angles of the thoracic spine, lumbar spine, left and right pelvic tilt, right and left knee, sacral base angle, and anterior/posterior displacements of the head and shoulder) and posture variable changes.

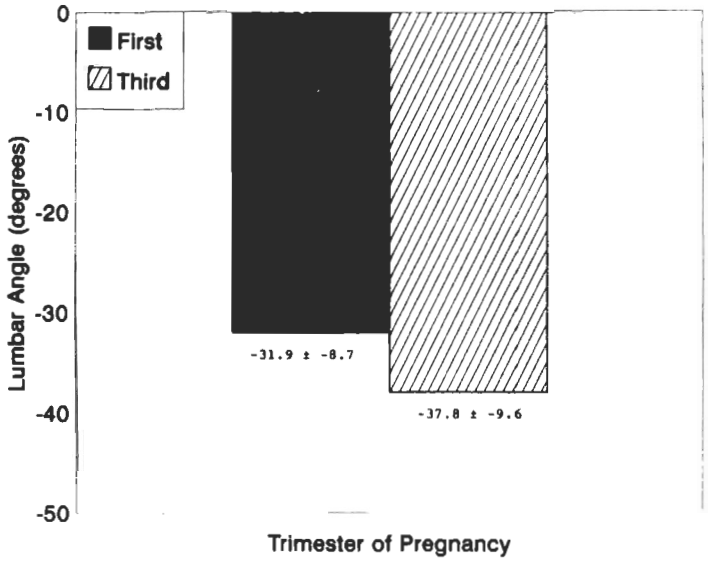


**FIGURE 1.** *Sagittal lumbar angle means and standard deviations for first and third trimester postures.*

## RESULTS

Descriptive statistics for the nine posture variables and back pain during the first and third trimester of pregnancy are presented in Table 1. Significant differences ($p < .01$) were found between first and third trimester postures for lumbar angle ($F(1, 11) = 9.1$) (Figure 1), head position ($F(1,11) = 32.6$) (Figure 2), right pelvic sagittal tilt ($F(1,11) = 5.3$) (Figure 3) and left pelvic sagittal tilt ($F(1,11) = 4.6$) (Figure 3), and transformed back pain values ($F(1,11) = 4.6$). These results suggest that in the standing position the lumbar lordosis and sagittal anterior pelvic tilt increased and head position (position of ear lobes relative to a plumbline located through the center of the medial and lateral malleolus) became more posterior as women progressed from the first trimester to the last trimester of pregnancy. Eighty-three percent (10 out of 12) of the women experienced back pain during one or both of the assessment periods. No significant relationship was found between magnitude of or change in posture and back pain scores.

Reliability estimates for a single trial and the average of two trials were calculated for each of the nine posture variables for women in their first trimester and last trimester (Table 2). Poor reliability was found for anterior/posterior displacement of the shoulder. The variables which were found to be significantly changed by the duration of pregnancy were reliable.

***No significant relationship was found between magnitude of or changes in posture and back pain scores.***

## DISCUSSION

The 12 pregnant women in this study significantly increased their lumbar angle by an average of 5.9° and pelvic tilt by approximately 4° from the first to the third trimester

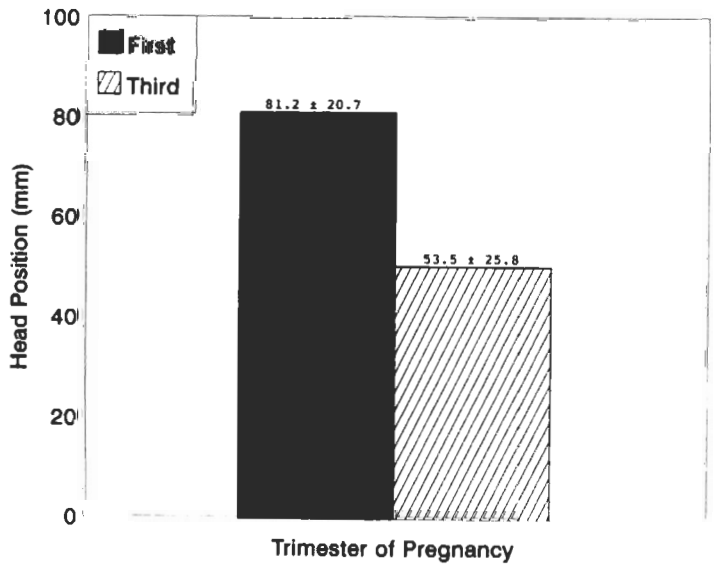


**FIGURE 2.** *Sagittal head position means and standard deviations for first and third trimester postures.*

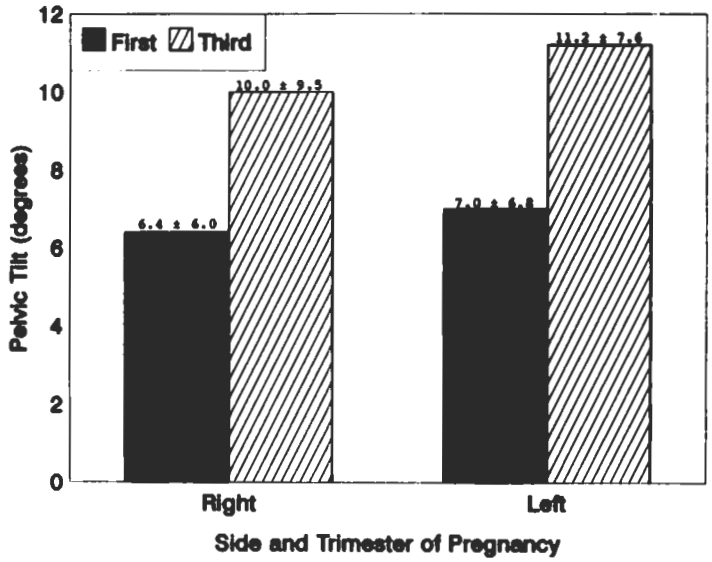


**FIGURE 3.** *Right and left sagittal pelvic tilt angle means and standard deviations for first and second trimester postures.*

of pregnancy. Bullock et al (6) also found a 7.2° increase in lumbar lordosis in pregnant women over a 16-week assessment period. In contrast, other investigators using unvalidated methodology found no change or a negative change in lumbar lordosis with advancing pregnancy (14,21,24, 29). The increased lordosis adaptation found in this study could be due to increasing growth and weight of the anteriorly displaced fetus producing anterior tilting of the pelvis.

The pregnant women in this study also developed a more posterior head position between the first and third trimester of pregnancy. Fries and Hellebrandt (14) also found that the cervical spine became hyperextended as pregnancy progressed. The posterior positioning of the head adaptation found in this study may serve to keep the center of gravity of the pregnant women from changing to an anterior position as the fetus increases in size.

Eighty-three percent of the women in the study experienced back pain during one or both of the assessment periods. Bullock et al (6) similarly reported an incidence of 82%. While the incidence of back pain during pregnancy is high, the etiology is not well understood. The mean intensity of back pain the subjects experienced in this study was low (1.6 out of 10 cm). Numerous authors have hypothesized that posture or changes in posture are related to the back pain that women experience during pregnancy (2,5,7, 9,12,15,30). In agreement with Bullock et al (6), this study found no relationship between magnitude of or change in posture and back pain. While other investigators (21,24) found small significant relationships between posture and back pain, all used unvalidated methods for measuring posture.

Further, in the nonpregnant population, a clear relationship between posture and back pain has not been found. Hansson et al (16) examined three randomly selected groups of 200 men (total = 600 men) between 20 and 63 years of age. Group 1 claimed no previous back pain history and received an X-ray for a preemployment examination. Group 2 received an X-ray examination after having their first low back injury. Group 3 had their X-ray examination while being evaluated for chronic low back disability. Hansson et al (16) found that the distribution and range of lordosis determined from spinal roentgenograms did not vary in the acute or chronic low back pain patient more than men without back pain of the same age.

Significant skeletal alignment changes that are related to back pain could be occurring at the pelvis during pregnancy but may not be directly measured by postural assessments, such as lumbar lordosis, sacral base angle, and pelvic tilt. Pelvic anatomical changes have been shown to occur during pregnancy. In an X-ray study, Abramson et al (1) found that the symphysis pubis articulation relaxed with an average change in width of 3–4 mm. Furthermore, in 25% of the pregnant women, the relaxation was much greater and was defined as a pathological separation.

| | First Trimester | | Third Trimester | |
|---|---|---|---|---|
| | ST ICC | AV ICC | ST ICC | AV ICC |
| **Sagittal plane angles** | | | | |
| Thoracic | .88 | .94 | .82 | .90 |
| Lumbar | .84 | .91 | .81 | .90 |
| Pelvic tilt | | | | |
| Left | .82 | .90 | .82 | .90 |
| Right | .82 | .90 | .84 | .92 |
| Sacral base | .52 | .69 | .64 | .78 |
| Knee | | | | |
| Left | .84 | .92 | .82 | .90 |
| Right | .86 | .92 | .83 | .91 |
| **Anterior/posterior displacements** | | | | |
| Head | .73 | .84 | .79 | .88 |
| Shoulder | .40 | .57 | .47 | .64 |

**TABLE 2.** *Intraclass correlation coefficients (ICC) of a single trial (ST ICC) and the average of two trials (AV ICC) for the first trimester and the third trimester of pregnancy standing postures for nine posture variables.*

Abramson et al (1) also found that the relaxation of the symphysis pubis joint began in the first half of pregnancy and was not related to the growth or the size of the fetus. Increased pubic mobility was found on X-ray when one leg was pulled and the other pushed in the opposite direction. The amount of excursion was greatest in the women with the greatest degree of pubic separation (1). In another descriptive X-ray study, Lynch (18) noted constant widening of the sacroiliac spaces.

Back pain treatment regimens given to pregnant and postpartum women include exercise for the reduction of lumbar lordosis through abdominal strengthening and pelvic tilt exercise (5,15,17,30), back care education on proper lifting techniques and sleeping and sitting positions (17), sacroiliac manipulations or reductions (3,8,27), and sacroiliac belt usage (3,25). The efficacy of using abdominal strengthening exercise for back pain prevention and treatment for pregnant women has not been determined. Fast et al (11) found no relationship between sit-up performance (abdominal weakness) and back pain during pregnancy. In the nonpregnant population, the relationship between abdominal strength and posture is controversial. Youdas et al (31) found no relationship between abdominal strength and pelvic inclination or lumbar lordosis in 90 normal men and women and questioned the use of abdominal muscle strengthening exercises for the correction of faulty standing posture.

While numerous articles have been written on prevention and treatment of back pain during pregnancy, only two studies have examined the effectiveness of various treatments. Daly et al (8), in an uncontrolled study of 100 pregnant women, manipulated 11 patients who met their criteria for sacroiliac subluxation. The manipulation was reported to relieve pain in 10 of 11 pregnant women. Ostgaard et al (25) divided 407 women into a control group and two experimental groups (B and C). Group B received two 45-minute classes which were taught by a physical therapist before the 20th week of pregnancy. Group C received the same class as group B but the education was given individually and for a longer period of time (five 30-minute sessions). Group C's program was also individualized based on the woman's type of back problem: back, pelvic, or a combination of both. Ostgaard et al (25) found that the incidence of back pain was 49% across all three groups and that posterior pelvic pain was four times as common as back pain. Weekly physical exercise before pregnancy was found to reduce the risk for back pain during pregnancy. Pain intensity was not found to differ among groups A, B, and C during pregnancies but was reduced more in group C, 8 weeks postpartum. A reduction of sick leave occurred in group C compared with groups A and B. However, the reduction of sick leave and postpartum back pain in group C occurred only in women with back pain, not posterior pelvic pain. Sacroiliac belts were shown to offer some pain relief to 82% of the women with posterior pelvic pain. In agreement with Ostgaard et al (24), the results of this study suggest that individualized or group exercise regimens that emphasize the reduction of the lumbar lordosis may not be beneficial for the majority of pregnant women, particularly those who experience posterior pelvic back pain during pregnancy.

***Sacroiliac belts were shown to offer some pain relief to 82% of the women with posterior pelvic pain.***

Clearly, current exercise regimens that are given to pregnant women need to be investigated and validated. Further studies need to examine the role that fitness levels and ergonomic instruction have on back pain experienced during and after pregnancy.

## CONCLUSION

This study suggests that from the first to the third trimester of pregnancy lumbar lordosis, posterior head position, lumbar angle, and pelvic tilt increases; however, the magnitudes and the changes of these posture variables are not related to back pain. JOSPT

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