# Functional Changes in Back Muscle Activity Correlate With Pain Intensity and Prediction of Low Back Pain During Pregnancy

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ABSTRACT. 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;79:1210-2.

**Objective:** To assess low back pain (LBP) intensity and subjective disability during pregnancy and compare the pain scores with lumbar motion patterns.

**Design:** A prospective study of pregnant back pain sufferers and healthy controls.

**Setting:** Kuopio University Hospital, Kuopio, Finland.

**Participants:** Study group consisted of 32 pregnant women with LBP; control group consisted of 21 healthy pregnant women.

**Main Outcome Measures:** Back pain intensity was assessed by visual analog scale (VAS), and subjective disability index was measured by Oswestry Low Back Disability Questionnaire, at 20 and 36 weeks of pregnancy. Back muscle activities were recorded by surface electromyography, and movement sensors were used to detect lumbar motion.

**Results:** In the study group current pain scores (VAS) at first and last trimester correlated strongly ($r = .82$, $p < .00$). Pain scores correlated with body weight at the first trimester ($r = .54$, $p = .003$) and at the last trimester ($r = .67$, $p < .00$). Significant correlation was noted between current pain intensity and back muscle activity level during forward body flexion at first trimester ($r = .704$, $p < .00$). Back muscle activity during bending measured at first trimester significantly correlated with pain intensity at last trimester ($r = .703$, $p < .00$). Back muscle activity during the first trimester of pregnancy had a negative correlation with current ($r = -.57$, $p = .002$) and later subjective disability index ($r = -.42$, $p = .02$). It correlated inversely ($r = -.54$, $p = .003$) with pain score at last trimester of pregnancy, ie, the lower the back muscle activity at the beginning of pregnancy, the more pain and disability throughout pregnancy. In the control group, three women developed LBP and disability feelings during pregnancy. They had increased muscle activity during flexion at delivery, ie, disturbed flexion relaxation.

**Conclusions:** Prepregnancy LBP predicts renewed pain during pregnancy, and dysfunction of back muscles has been established in LBP. In this study, disturbance in the relaxation of the back muscles was linearly related to current, and also to later, pain scores. In addition, back muscle activity level was inversely related to the disability index. For the first time, it has been shown prospectively that the function pattern of back extensors seems to predict, and is related to, future back pain. Simple function testing is promising and might be valuable in identifying mothers with a high risk of pregnancy-related back pain and in directing preventive intervention to high risk women by making them aware of self-treatment methods.



LOW BACK PAIN (LBP) is common in the general population and is a very common symptom during pregnancy, where the incidence is as high as 50%. Factors that most often correlate with LBP during pregnancy are LBP before pregnancy, work load, smoking, and body mass index.[1] It cannot yet be predicted which women will develop the symptoms and difficulties related to LBP. In addition, during pregnancy many standard examinations cannot be done and many treatment methods are contraindicated.

Previously, changes in back muscle function have been used to objectify current LBP. The absence of flexion relaxation of paraspinal muscles in LBP patients is the most common measure of erector spinae activity when compared with normal subjects.[2,3] In this study, we prospectively evaluated the pain intensity and subjective disability rating caused by LBP in pregnant women and showed the association between these measures and functional activity of the paraspinal muscles in back pain sufferers and healthy control subjects (fig 1).

## PATIENTS AND METHODS

The study group consisted of 32 pregnant women (mean age 28 years, range 17 to 39 years) who had experienced LBP before pregnancy. They neither smoked nor had occupations that demanded heavy physical labor. Twenty-one healthy pregnant women (mean age 28 years, range 22 to 37 years), free of LBP, served as the control group. All women were examined clinically at 20 and 36 weeks into pregnancy. Fetal presentation, size, and placental location were determined during the latter visit. In the study group, no signs of nerve root damage or dysfunction were noted; reflexes and muscle force in the lower extremities were normal, although gluteal and posterior thigh pain was common, as has been described in a recent article on posterior pelvic pain.[4] A 100-mm visual analog scale (VAS) was used to measure the intensity of current and the worst LBP assessed, with 100 representing totally unbearable pain. The Oswestry Low Back Disability Questionnaire[5] was used at 20 and at 36 weeks of pregnancy to measure subjective disability index. Surface recordings of electromyographic (EMG) activities in the paraspinal muscles were taken on both sides at the L4-L5 lumbar level (fig 2). The EMG and motion signals were recorded during forward flexion and extension, ie, lumbar-pelvic rhythm, as published earlier.[3,6] The degree of flexion relaxation was measured, and for comparison of paraspinal

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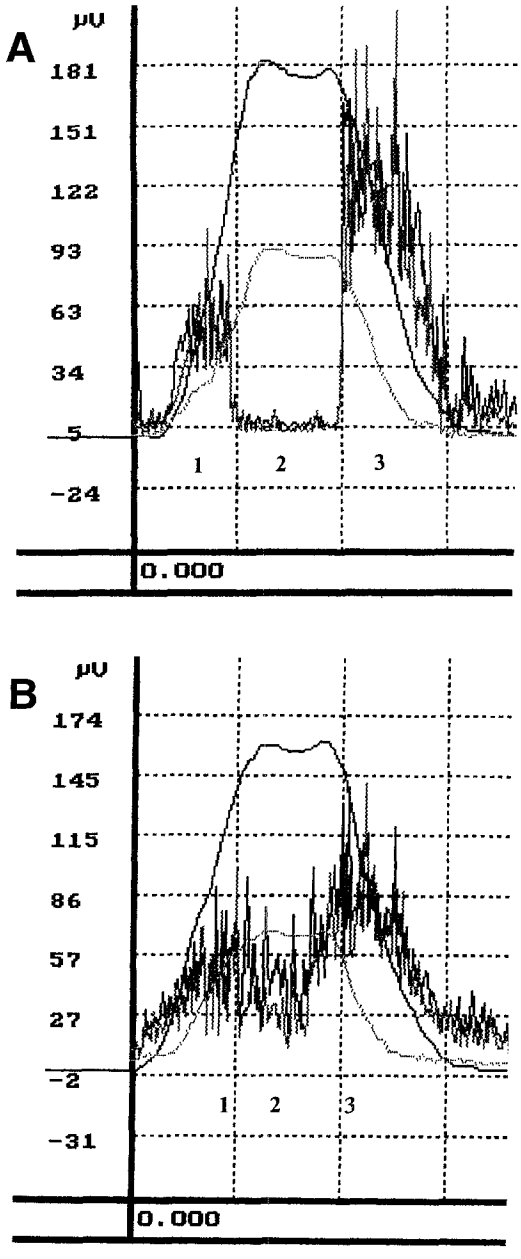


**Fig 1. (A) Typical function graph from one forward flexion-extension cycle measured simultaneously from the left and right L4-5 lumbar paraspinal muscles of a 23-year-old pregnant woman without back pain. Averaged EMG pattern shows activity phases of the paraspinal muscles in flexion (1) and in extension (3). In full flexion (2), there is full relaxation of muscle activity. From the signals of the movement sensors, the total mobility (upper uniform curve), the rotation of the pelvis (lower uniform curve), and the lumbar flexion (the difference or the area between the uniform curves) can be confirmed. (B) A function graph from another woman with LBP. Flexion relaxation (2) of the paraspinal muscles is absent.**

muscle activity levels between persons, the ratio of back muscle activity level during extension to flexion was used as published originally.[3] EMG signals were recorded from a fully rectified and integrated band of 20 to 500Hz frequency with sampling frequency of 2kHz with real-time monitoring of the signal amplitude for off-line analyses. Lumbar and pelvic motion were recorded simultaneously by using a two-inclinometer method.[7] SPSSpc+[a] was used to analyze Pearson's correlations.

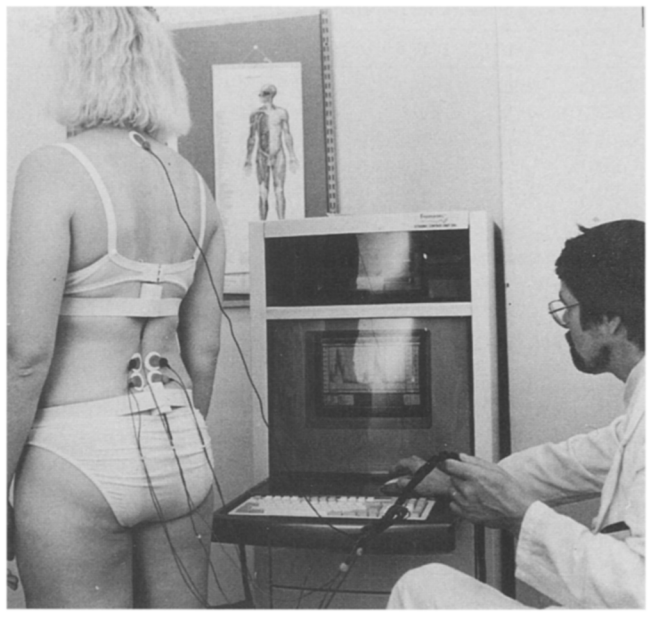

**Fig 2. The set-up of real-time monitoring of body sagittal flexion and extension, ie, lumbar-pelvic rhythm, with the help of surface EMG from the paraspinal muscles and electronic movement sensors fixed at the sacrum and at the thoraco-lumbar area.**

## RESULTS

The summary of raw data for both groups is presented in table 1. The groups did not differ with respect to anthropometric data. Correlations between measures and their significance are shown in table 2. Of the persons in study group, 79% experienced pain at onset, and 71% had pain at delivery.

Current pain scores (VAS) at first and last trimester correlated strongly ($r = .82$, $p < .00$). Pain scores correlated with body weight at the first trimester ($r = .54$, $p = .003$) and at the last trimester ($r = .67$, $p < .00$). Significant intercorrelation was noted between current pain intensity and back muscle activity level during forward body flexion (fig 1B) at first trimester ($r = .703$, $p < .00$). The most interesting finding was that back muscle activity during bending measured at first trimester significantly correlated with pain intensity at last trimester ($r = .703$, $p < .00$). Oswestry disability index correlated inversely but linearly with the intensity of back muscle

**Table 1: Summary of Raw Data for Patients and Controls**

| | Study Group | | | | Control Group | | | |
|---|---|---|---|---|---|---|---|---|
| | Mean | SD | *n* | Pain* | Mean | SD | *n* | Pain* |
| Weight | 63.56 | 13.37 | 32 | | 62.10 | 9.54 | 21 | |
| Height | 165.06 | 5.63 | 32 | | 164.90 | 4.56 | 21 | |
| VASC1 | 5.86 | 11.46 | 28 | 22 (79) | 0 | 0 | 0 | 0 (0) |
| VASC2 | 9.21 | 17.64 | 28 | 20 (71) | 14.67 | 7.51 | 3 | 3 (14) |
| OSW1 | 5.14 | 3.95 | 28 | | 0 | 0 | 0 | |
| OSW2 | 7.79 | 6.14 | 28 | | 5.67 | 1.53 | 3 | |
| FLR1 | 13.375 | 11.130 | 32 | | 8.17 | 2.31 | 21 | |
| EXF1 | 1.937 | .382 | 32 | | 2.13 | .24 | 21 | |

Abbreviations: VASC1, back pain intensity at the beginning of pregnancy; VASC2, back pain intensity at delivery; OSW1, subjective disability index at the beginning of pregnancy; OSW2, subjective disability index at delivery; FLR1, back muscle activity in body flexion at the beginning of pregnancy; EXF1, back muscle activity during back motion (usual back flexion and extension) at first trimester.
* Number (and corresponding percent) of persons with LBP when VASC1 and VASC2 were measured.

**Table 2: Correlations Between Parameters in Study Group**

| | VASC1 | VASC2 | OSW1 | OSW2 | FLR1 | EXF1 |
|---|---|---|---|---|---|---|
| Weight | .538* | .669* | −.013 | .313 | .733* | .147 |
| VASC1 | | .817* | .355 | .488† | .704* | −.433† |
| VASC2 | | | .672* | .671* | .703* | −.538* |
| OSW1 | | | | .891* | .086 | −.569* |
| OSW2 | | | | | .348 | −.421† |
| FLR1 | | | | | | .064 |

Abbreviations as for table 1.
* Correlation is significant at the .01 level.
† Correlation is significant at the .05 level.

activity during usual back flexion and extension (table 1). This muscle activity during the first trimester of pregnancy had a negative correlation ($r = -.57$, $p = .002$) with current subjective disability index and also with later disability index ($r = -.42$, $p = .02$). In addition, back muscle activity at the beginning of pregnancy correlated inversely ($r = -.54$, $p = .003$) with pain score at last trimester of pregnancy. In other words, the lower the back muscle activity at the beginning of pregnancy, the more pain and disability was experienced during the pregnancy.

In the control group with normal back function (fig 1A), three women developed LBP and disability feelings during pregnancy. They had increased muscle activity during flexion at delivery, ie, disturbed flexion relaxation. The weight of these women was not abnormally high. In addition, one healthy mother also had disturbed flexion relaxation without pain. She believed that the reason for this was probably that her stomach was so large that she could not bend forward.

## DISCUSSION

This prospective study shows that previous back pain is associated with developing pregnancy-related LBP, but does not predict LBP intensity or subjective disability index. Pain intensity and subjective disability correlated linearly. Current pain scores correlated with the womens' prepregnancy weight: in the study group, the more overweight the women were before pregnancy, the more pregnancy-related LBP occurred. In the control group, however, three women with normal weight developed LBP, and functional disturbance in back muscles was noted. It seems that in the absence of previous LBP, being overweight is not, in itself, a risk for pregnancy-related LBP.

Lumbar flexion is controlled and coordinated by the simultaneous activity cycle of the paraspinal muscles.[8] The flexion relaxation of back muscles during body flexion has been well established and its clinical significance in LBP has been confirmed.[2,3,6] In our study, the degree of relaxation of the back muscles was linearly related to the current pain score, and activity level during motion was related inversely to the disability index. For the first time, it has been shown prospectively that increased functional muscle support, ie, activity of back extensors in forward flexion, seems to predict and is also related to future LBP and disability.

Because some standard examinations cannot be done and many treatment methods are contraindicated in pregnancy, it would be valuable for personnel involved in maternity care to be able to identify, in advance, women with a high risk of pregnancy-related LBP. Preventive intervention could be directed to high risk mothers to inform them to expect annoying but not dangerous symptoms and to motivate them to be aware of self-treatment methods during the course of pregnancy. The simple noninvasive function test used here seems to be promising in the documentation of changes in neuromuscular back function and predicting LBP and disability.

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### Supplier

a. SPSS, 444 North Michigan Avenue, Chicago, IL 60611.