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Fatigability of back extensor muscles and low back pain during pregnancy

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ABSTRACT

Background: Back pain is the most frequently reported musculo-skeletal problem during pregnancy. High muscle fatigability has been associated with back pain in the general population. During pregnancy, the gradual increase in loads may have a training effect, increasing strength and endurance of back muscles. This adaptation however may be too slow, or insufficient to be significant in light of other changes during pregnancy.
Methods: Thirty-two pregnant women performed a fatigue test which consisted of maintaining a fixed load of 70 Nm for 60 s while the surface EMG of the longissimus lumborum and multifidus muscles were recorded bilaterally at 14, 24 and 34 weeks of pregnancy. The measure of fatigability was the highest absolute slope of the median frequency of the power spectrum of the EMG of the four muscles. Occurrence and severity of back pain were reported on questionnaires at 14, 19, 24, 29 and 34 weeks. Binomial logistic regressions between back pain occurrence and the median frequency slopes were calculated.
Findings: None of the five logistic analyses demonstrated an improvement of the one-predictor model over the constant-only model, which indicates that the degree of fatigability of back extensor muscles did not predict the occurrence of back pain in our sample.
Interpretation: Fatigability of back extensor muscles was not found to be a predictor of back pain during pregnancy. This result should be taken with caution due to the small number of participants and broad definition of back pain used, and should be confirmed by studies with a larger number of participants.
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1. Introduction

According to several studies (Dumas et al., 1995; Ostgaard et al., 1991), back pain affects about 50% or more of pregnant women, and for some the pain is severe enough to prevent them from continuing to work (Berg et al., 1988). Despite the incidence of pregnancy related back pain the causes remain unclear. Early research has focused on the physical changes during pregnancy, such as mass increase, changes in posture and in ligament laxity, but no strong relations between these factors and back pain were demonstrated (Wu et al., 2004).

New debates have arisen in the literature concerning the role of muscle function in low back pain in the general population (Hodges and Moseley, 2003; Panjabi, 2006; van Dieën et al., 2003). As stated by van Dieën et al. (2003), additional muscular stabilization of the spine would be necessary for back pain patients if (i) the passive stiffness of their spine was reduced due to damage to passive tissues, (ii) muscle force was reduced or (iii) sensorimotor response was disturbed. In the case of pregnancy, even without damage to tissues, the first two conditions may occur. The passive stiffness of the spine and of the pelvis is likely reduced due to increased ligament laxity. In addition, the ability of some of the muscles to produce stabilizing force, particularly the abdominal muscles, may be compromised. Changes in the geometry and function of the rectus abdominis muscle was found as pregnancy progressed by Gilleard and Brown (1996) and confirmed by Coldron et al. (2008). Fast et al. (1990) found a weakening of the abdominal muscles in pregnant subjects compared to non-pregnant controls. However, there was no significant relation between the ability to perform sit-ups and back pain. More recently, Gutke et al. (2008) found that pregnant women with pelvic girdle pain (PGP) had lower abdominal muscle endurance than women without pain. In the postpartum group, women with PGP also had lower back extensor endurance than women without pain, but the test was not performed during pregnancy. Sihvonen et al. (1998) found a relationship between low back pain and muscle activity. They

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reported that the lower the back muscles activity during the first trimester of pregnancy, the greater the chances to experience low back pain and disability throughout the pregnancy.

It has also been speculated that due to the gradual increase in loads during pregnancy, a training effect could occur, increasing strength and endurance of back muscles. This adaptation however may be too slow, or insufficient to stabilize the sacro-iliac joints and the lumbar spine. Dantas (2004) found that the longissimus lumborum muscle became less fatigable as pregnancy progressed, but there was no detectable effect for the spinalis thoracis muscle. The pregnant women also had less fatigable muscles than a group of non-pregnant women. In another study from the same group, Bisch (2006) found no relationship between muscle fatigability of back extensor muscles and back pain during pregnancy. In both studies, the number of participants was small.

The objective of the current study was to evaluate back extensor muscle fatigability and to investigate its relationship with back pain. To do so, a predictive relationship between back muscles fatigability and occurrence of back pain was developed for different times during pregnancy. No effort was made to discriminate between low back pain and pain from a pelvic origin (sacro-iliac joints).

2. Methods

2.1. Subjects

The targeted population was women less than 14 weeks pregnant, and aged 18–45 years. As the difficulty to recruit women so early in their pregnancy arose, the recruitment criterion extended to women up to 24 weeks pregnant. Recruitment was done through advertisements in newsletters, obstetrics and ultrasound clinics, general practitioners' and midwives' offices, and other appropriate locations.

Exclusion criteria were: 1) severe back pain (diagnostic of serious back problem or back pain requiring medical treatment, changes in occupations or leisure, or days off work in the last year), and 2) risk of miscarriage or early delivery. No testing was performed until a clearance form was returned by the physician of each eligible potential subject. All subjects signed an informed consent form, as approved by the Health Sciences Research Ethics Board of Queen's University.

2.2. Apparatus: ITEC chair and testing material

An apparatus (ITEC chair, Fig. 1) was designed and built to test back muscles fatigability. It consisted of an ergonomic kneeling posture chair in which the height of the seat and knee rest position (vertical and horizontal) were adjustable. The chair had two purposes: to offer a comfortable seating position for pregnant women, and to be minimally affected by body mass changes. The tests consisted of the subject exerting an isometric extension moment by pulling back on two load cells with a constant given force (Fig. 1). An adjustable harness to which two non-extensible straps were attached at the level of T9 was developed. The straps were connected to two 772 N (200 lbs) load cells via two cables. Two load cells were used in preference to one to control the symmetry of the pull. A CA6000 Spine Motion Analyser® (Orthopaedic Systems Inc, Union City, CA 94587, USA) was attached to the sacral and thoracic levels to monitor subject back posture in all three planes.

EMG data were collected bilaterally for the multifidus and longissimus muscles. Pre-amplified bipolar active surface electrodes were used with a bandwidth of 30–500 Hz. Raw signals from the electrodes and from the load cells were A/D converted at 2000 Hz with a National Instruments (Austin, Texas, USA) DAQ card. A Lab view program was developed to allow signal monitoring during testing trials and provide extension force feedback to the subjects. Slope of median frequency (MF) of EMG power spectrum was taken as a measure of fatigability. Load cell data were visually screened to remove data outside of the trial limits where the force was not within the 5% target window. A moving average window was used to determine the median frequency after the signals were filtered with high and low cut frequencies of 30 and 500 Hz respectively. A line of best fit was then calculated from the remaining data to determine the slope and intercept for the trial.

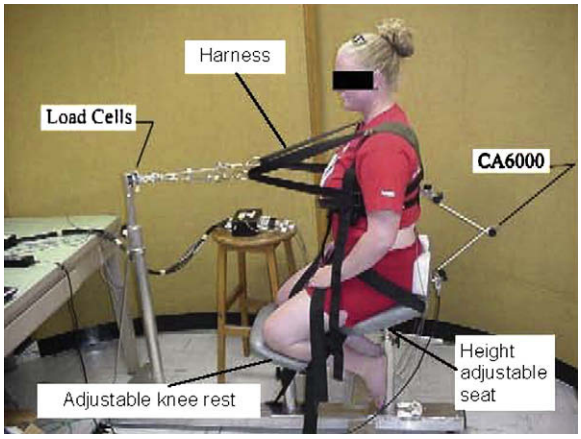

Fig. 1. The ITEC chair.

2.3. Questionnaires

2.3.1. Demographic and back pain occurrence

At their first visit, subjects filled out the "Demographics and History of Back Pain Survey". The first part of the questionnaire covered general demographic information. The second section enquired about occurrence(s) of back pain prior to the current pregnancy. For the question: "Have you ever had back pain before this pregnancy?" subjects were asked to refer to back pain as "an ache, pain or discomfort in the back, whether or not it extends from there to one or both legs".

2.3.2. Back pain questionnaire and Oswestry Disability Index (ODI)

From the first visit, and continuing throughout the testing, women were asked at each visit whether they had back pain since the beginning of their pregnancy (first visit) or since the previous visit or phone call (subsequent visits). If they answered "yes", they were asked to list the episodes of back pain during the period considered. In order to quantify the impact of back pain on daily living, the ODI (Fairbank et al., 1980) was administered to the women who reported at least one back pain episode during their current pregnancy. They were asked to complete the ODI for their worst episode of back pain during the period considered. The total score was calculated in percentages, and interpreted according to the scale given by the authors of the questionnaire.

2.4. Protocol

The experiment consisted of three testing sessions (three visits) at 14, 24 and 34 weeks, and two follow-up phone interviews conducted between visits at 19 and 29 weeks. In total, three sets of fatigability data were collected, and five sets of data on occurrence of back pain. The subjects recruited at 24 weeks completed two

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