# Ultrasound Assessment of Abdominal Muscle Thickness in Postpartum vs Nulliparous Women

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## Abstract

**Objective:** The purpose of this study was to determine the effect size in measurable change of abdominal musculature morphology using ultrasonography in postpartum women within 1 month of a healthy, vaginal delivery.

**Methods:** One hundred fifty-six participants were recruited for this study. B-mode ultrasound imaging was used to measure abdominal muscle thickness on 80 nulliparous women and 76 mothers who had delivered within the past 4 weeks. Measures were taken for the upper and lower rectus abdominus, external and internal obliques, and transversus abdominus at rest.

**Results:** Statistically significant differences were found in the thickness of the rectus abdominus muscle at both sites; upper ($P < .0001$) and lower ($P < .0001$) as well as the internal oblique ($P < .0001$). All 3 muscles were thinner in postpartum participants (8.29 ± 1.83 mm, 8.89 ± 2.29 mm, and 7.06 ± 1.82 mm, respectively) within the first month of delivery than in controls (10.82 ± 1.93 mm, 11.13 ± 2.38 mm, and 8.36 ± 1.87 mm, respectively). Large effect sizes were found for the influence of pregnancy on the rectus muscle segments (1.35 for the upper rectus abdominus and 1.00 for the lower rectus abdominus) and a medium effect size for the internal oblique (0.71). No significant differences were observed in the remaining 2 muscles.

**Conclusion:** This study showed that there are differences in morphology of the abdominal muscles in pregnant women vs nonpregnant controls. The large effect sizes reported may provide the basis for future studies examining relationships between morphology, functional change, and back pain during pregnancy. (J Manipulative Physiol Ther 2015;38:352-357)

**Key Indexing Terms:** *Back Pain; Pregnancy; Abdominal Muscles; Postpartum Period; Ultrasonography*

## Introduction

Back and posterior pelvic pain are common complaints experienced by women who are pregnant.[1–3] Estimates of the prevalence for back pain during pregnancy range from 24% to 90%,[1,4–7] and the etiology remains unknown.[8,9] The source of symptom as arising from the lumbar spine or pelvis may be difficult to discern,[10] leading to the use of various diagnostic labels including sciatica, facet joint syndrome, lumbar insufficiency, or "mixed" back pain. It has been suggested that causation may be multifactoral with proposed mechanisms including, but not limited to, the influence of altered circulating relaxin[2] on ligamentous laxity,[3] maternal weight gain, and/or biomechanical changes of weight bearing due to pregnancy.[5,9] More specifically, it has been postulated that weakened abdominal musculature to accommodate the growing baby,[3] coupled with a history of low back pain may be key factors.[9,11]

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Therefore, the purposes of this study are to evaluate the change in ultrasound morphology of the abdominal musculature, defined by healthy nulliparous women and those who are within 4 weeks postpartum, and to identify effect sizes for future studies on biomechanics of pregnancy. Knowledge of relevant ultrasound changes within muscle groups might give foundation to future clinical approaches to prevent and treat back pain associated with pregnancy.

## Methods

### Participants

Recruitment for the study was through word of mouth and poster notice within the academic institution, local obstetrician, and gynecology offices, and in local organizations. A larger sample of healthy participants was selected in order to ensure a broader distribution in morphology measure. Persons responding to recruitment information were prescreened by research staff for eligibility. All participants provided informed consent. The current study was approved by the Canadian Memorial Chiropractic College Ethics Review Board (0801X06) and Sunnybrook Health Sciences Centre (193-2009).

Postpartum women and nulliparous controls between the ages of 20 and 40 years were eligible for participation. Postpartum women, within 1 month of a normal vaginal delivery, and healthy nulliparous controls were included. The decision to evaluate women within 1 month after delivery came from the work of Coldron et al.[12] This group clearly demonstrated that rectus abdominis (RA) thickness and width had not returned to normal values by 1 day, 2 months, 6 months, or 12 months postpartum compared with controls. Therefore, thickness values within 4 weeks of giving birth would likely be representative of findings during the final month of pregnancy. Exclusion criteria included a history of abdominal surgery, with the exception of childhood appendectomy or herniorraphy, and those with significant trunk deformity identifiable on inspection such as scoliosis.

### Procedure and Data Collection

On induction into the study, participants were scheduled for a single assessment appointment lasting up to 30 minutes (Fig 1). A brief history and measure of height, weight, age, date of parturition, and presence/absence of low back pain were collected. Participants were placed in the supine position with the abdominal area exposed from the xiphoid process to the suprapubic bone landmarks. Palpation of the soft tissues about the suprapubic, xiphoid and anterior superior iliac spine along with visualization of the umbilicus was used to define the boundaries and orientation for placement of the ultrasound transducer. Ultrasound gel was applied liberally to the areas of imaging to ensure good sonic coupling between the transducer and skin.

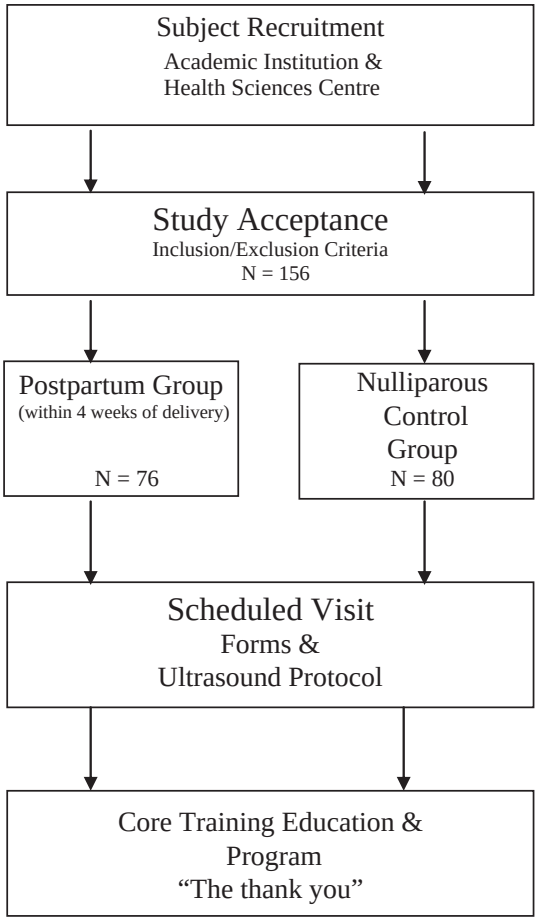


**Fig 1.** *Study design.*

The Ultrasonix RP (Ultrasound Medical Corp, Burnaby, BC) unit was used for trunk muscle image capture. A 60-mm linear array transducer captured images using a frequency range of 6 to 14 MHz and depth of 4 to 10 cm based on participant stature and image optimization.

Only images from the right side of the abdomen were obtained based on the assumption of symmetry and the work of Rankin et al.[13] Prior to obtaining images for measurement, the ultrasound was used to scan the muscle to ensure uniformity and identify landmarks.[14] Muscle thickness was measured for the abdominal wall from 3 sites.

1. The anterolateral, lower quadrant abdomen (Fig 2): the probe was placed at a point midway between the costal margin and iliac crest along the right axillary line.[14–16] This region captures the external oblique (EO), internal oblique (IO), and the distinctive terminus of the transverses abdominus (TrA) into the abdominal fascia. The TrA terminus was positioned at the center of the screen to standardize relative position for taking measures of the muscle thicknesses.
2. The mid-upper abdominal parasagittal (Fig 3): the probe was placed at a point approximately 2 to 3 cm above