



Abdominal exercises affect inter-rectus distance in postpartum women: a two-dimensional ultrasound study

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Abstract

Objectives To compare inter-rectus distance (IRD) at rest between women who had a vaginal delivery with women who had a caesarean section, and to describe the effect of different abdominal exercises on IRD.

Setting Physiotherapy practice.

Design Cross-sectional experimental study.

Participants Thirty-eight postpartum primiparous mothers with a singleton baby (vaginal delivery: $n = 23$; caesarean section: $n = 15$).

Interventions Two-dimensional ultrasound images from the abdominal wall were recorded at rest and at the end position of abdominal crunch, drawing-in and drawing-in + abdominal crunch exercises. IRD measurements at rest, above and below the umbilicus, were compared between the two groups (vaginal delivery and caesarean section). IRD was also measured above and below the umbilicus during three abdominal exercises in both groups.

Main outcome measures IRD 2 cm above and below the umbilicus.

Results No significant differences in IRD, either above or below the umbilicus, were found between the vaginal delivery and caesarean section groups. IRD above the umbilicus was significantly reduced during abdominal crunch exercises compared with at rest {mean 21.7 [standard deviation (SD) 7.6] mm vs 25.9 (SD 9.0) mm; mean difference 4.2 mm; 95% confidence interval (CI) 0.5 to 7.9}. IRD below the umbilicus was significantly greater during drawing-in exercises compared with at rest [16.0 (SD 8.1) mm vs 11.4 (SD 4.9) mm; mean difference 4.5 mm; 95% CI 1.6 to 7.4].

Conclusion In contrast to existing recommendations for abdominal strength training among postpartum women, this study found that abdominal crunch exercises reduced IRD, and drawing-in exercises were ineffective for reducing IRD. Further basic studies and randomised controlled trials are warranted to explore the effect of abdominal training on IRD.

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Keywords: Diastasis recti; Exercise; Inter-rectus distance; Caesarean section; Postpartum Women; Ultrasound

Introduction

During pregnancy, the linea alba weakens as the bellies of the two rectus abdominis muscles curve around the abdominal wall, increasing their midline separation [1,2]. This gap, the inter-rectus distance (IRD), is often referred to as

‘diastasis recti abdominis’ (DRA) [3]. It has been suggested that the muscles and fascia of the lumbopelvic region are important in trunk movements and in intersegmental and intrapelvic stabilisation [4,5]. In addition, it has been suggested that women who undergo a caesarean section are at greater risk for increased IRD than women who have a vaginal delivery [6]. The drawing-in exercise, which mainly activates the transverse abdominal and internal oblique muscles, is thought to be an important exercise for the prevention and treatment of lower back pain [5], and has been recommended as a gentle exercise to narrow the diastasis recti [7,8].

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Moreover, women with DRA have been discouraged from performing abdominal crunch (AC) exercises in the supine position as it has been suggested that this could open up and increase IRD [1]. However, data on the effectiveness of different abdominal exercises during pregnancy and in the postpartum period are lacking [7,9]. In a recent systematic review, Benjamin *et al.* [7] were only able to find one randomised controlled trial (RCT), and the physiotherapeutic intervention only involved one session of a combination of several exercises directly after childbirth [10]. Hence, to date, there is not only scant knowledge regarding the effect of different physiotherapeutic approaches to prevent and treat DRA, but also a lack of basic research into how different abdominal exercises affect IRD. Recently, ultrasound imaging has been suggested as a useful method to assess muscular geometry, and as an indirect measure of muscle activation via changes in muscle thickness [3,11]. Ultrasound images have also been used to measure IRD in postpartum women [3,12]. Recently, Mota *et al.* [12] found that ultrasound is a reliable method to measure IRD in women at rest, and during abdominal crunch and drawing-in exercises.

As such, the aim of this study was two-fold: (1) to compare IRD at rest between women who had a vaginal delivery and women who had a caesarean section; and (2) to compare IRD at rest and at the end position of abdominal crunch, drawing-in and drawing-in + abdominal crunch exercises.

Methods

This cross-sectional experimental study assessed IRD during three different abdominal exercises in the postpartum period in women who had given birth vaginally or via caesarean section.

Participants were recruited from postnatal classes at a private physiotherapy clinic. The inclusion criteria were: 10 to 12 weeks postpartum; willing to participate in one additional session for training in how to perform the exercises; able to perform the exercises correctly; and primiparous with a singleton baby. Exclusion criteria were: abdominal hernia; previous abdominal surgery; and history of regular abdominal training during the previous 6 months.

The study was approved by the Ethics Council of the Technical University of Lisbon, Faculty of Human Kinetics. Signed informed consent was obtained before participation in the study.

Ultrasound images (B-mode) from the anterior abdominal wall were recorded by an ultrasound scanner (LOGIQ e; General Electric Healthcare, Hatfield, UK, 4 to 12 MHz, 30 mm linear transducer) at rest in a supine position, and at the end position of three abdominal exercises: abdominal crunch (crook lying position), drawing-in and drawing-in + abdominal crunch. The investigator was a senior physiotherapist who had been trained in image capturing and measurement of IRD. The method has been tested for

test–retest and intra- and inter-rater reliability and found to be very good (intraclass correlation coefficient >0.9) [12].

For each condition, a set of three measurements was performed above and below the umbilicus.

The best of three images was exported in JPG format for further offline processing and analysis.

In order to standardise the position of the transducer, each measurement location was marked on the skin with the subject in a supine resting position, with knees bent at 90°, feet resting on the plinth and arms alongside the body. The transducer was placed transversely along the midline of the abdomen at two locations: 2 cm above and 2 cm below the umbilicus, measured from the centre of the umbilicus.

During image acquisition, the bottom edge of the transducer was positioned to coincide with the corresponding skin marker, and moved laterally until the medial borders of both rectus abdominis muscles were visualised. The orientation of the transducer was adjusted to optimise image visualisation. Images were collected immediately at the end of exhalation, as determined by visual inspection of the abdomen, following the procedures recommended by Teyhen *et al.* [11]. Particular attention was paid to the pressure imposed on the probe to avoid a reflexive response by the participants.

The measurements were performed at a mean of 12 weeks postpartum (standard deviation 2.4 weeks, range 8 to 16 weeks).

A semi-automated image analysis was conducted offline to determine IRD following the procedures described by Mota *et al.* [12] and Pascoal *et al.* [9].

Procedure

Participants were instructed how to perform the three abdominal exercises: abdominal crunch, drawing-in and drawing-in + abdominal crunch. All exercises were performed in the supine position.

For the abdominal crunch exercise, subjects were asked to raise their head and shoulders upwards until the shoulder blades cleared the table and their fingertips touched their knees.

For the drawing-in exercise, subjects were instructed to inhale and, while exhaling, to draw in the abdominal musculature towards the spine. Activation of the transversus abdominis was confirmed by placing the transducer laterally between the iliac crest and the rib cage [13].

For the drawing-in + abdominal crunch exercise, subjects were instructed to combine the procedures used when drawing-in and abdominal crunch exercises were performed separately.

Statistical analysis

IRD (dependent variable) was analysed using standard tests for normality (Shapiro–Wilk’s test) and was found to satisfy the assumptions of normality [14]. A separate

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