

# Prevalence of diastasis of the rectus abdominis muscles immediately postpartum: comparison between primiparae and multiparae

Prevalência de diástase dos músculos retoabdominais no puerpério imediato: comparação entre primíparas e múltiparas

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## Abstract

**Objectives:** To investigate the prevalence of diastasis of the rectus abdominis muscles (DRAM) among primiparae and multiparae immediately after vaginal delivery, and to compare DRAM above and below the umbilicus and correlate these with the mother's age, body mass index, gestational age and duration of labor. **Methods:** A cross-sectional study was carried out. Personal information, obstetric history and DRAM measurements 4.5 cm above and below the umbilicus were recorded. DRAM was graded by the number of fingerbreadths (approximately 1.5 cm each) between the medial edges of this muscle. DRAM was considered present and relevant if the separation was > 2 cm at any measurement point. **Results:** Data from 467 women were analyzed. Above the umbilicus, the prevalence of DRAM >2 cm was 68%. Below the umbilicus, the prevalence of DRAM > 2 cm was 32%. The prevalence of DRAM above the umbilicus among primiparae and multiparae was identical (68%), and the prevalence below the umbilicus was greater among multiparae (19.8% and 29.2%). The mean DRAM above the umbilicus was 2.8 cm ( $\pm 1.2$ ) and the mean DRAM below the umbilicus was 1.5 cm ( $\pm 1.1$ ), representing a significant difference ( $p=0.0001$ ) and a weak correlation ( $r=0.461$ ). The mean DRAM below the umbilicus was significantly greater among the multiparae ( $p<0.018$ ) and there was no correlation with the mother's age, body mass index, gestational age or duration of labor. **Conclusions:** The prevalence of DRAM and mean DRAM were greater above the umbilicus both among multiparae and primiparae. Below the umbilicus, the mean DRAM was significantly greater among multiparae. DRAM below the umbilicus presented a weak correlation with DRAM above the umbilicus.

**Key words:** postpartum period; diastasis; rectus abdominis; physical therapy; delivery.

## Resumo

**Objetivos:** Verificar a prevalência da diástase dos músculos retoabdominais (DMRA) em primíparas e múltiparas no pós-parto vaginal imediato, comparar a DMRA supraumbilical e infraumbilical e correlacioná-las com a idade materna, o índice de massa corporal (IMC), a idade gestacional (IG) e o tempo de trabalho de parto (TTP). **Métodos:** Foi realizado um estudo transversal, sendo registradas informações pessoais, antecedentes obstétricos e a DMRA supra e infraumbilical. Os pontos de medida foram 4,5 cm acima e abaixo da cicatriz umbilical, sendo graduada pelo número de dedos entre as bordas mediais dessa musculatura. Para cada dedo, foi estimado 1,5 cm. A DMRA foi considerada presente e relevante quando houvesse um afastamento >2 cm na região supra e/ou infraumbilical. **Resultados:** Foram analisadas 467 fichas de dados, sendo a prevalência da DMRA supraumbilical >2 cm de 68% e infraumbilical de 32%. A prevalência supraumbilical entre as primíparas e múltiparas foi idêntica (68%) e infraumbilical maior nas múltiparas (19,8% e 29,2%). As médias da DMRA foram 2,8 ( $\pm 1,2$ ) cm supraumbilical e 1,5 ( $\pm 1,1$ ) cm infraumbilical, apresentando diferença significativa ( $p=0,0001$ ) e fraca correlação ( $r=0,461$ ). A média da DMRA infraumbilical foi significativamente maior nas múltiparas ( $p<0,018$ ). Não houve correlação com a idade materna, IMC, IG e TTP. **Conclusões:** A prevalência e a média da DMRA foram maiores na região supraumbilical tanto nas múltiparas quanto nas primíparas. Na região infraumbilical, a média DMRA foi significativamente maior nas múltiparas. A DMRA infraumbilical apresentou fraca correlação com a supraumbilical.

**Palavras-chave:** puerpério; diástase; reto do abdome; fisioterapia; parto.

**Received:** 17/12/2007 – **Revised:** 16/06/2008 – **Accepted:** 12/12/2008

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## Introduction : : : .

The period after delivery is called puerperium or postpartum period, when local and systemic changes caused by pregnancy and delivery return to the pre-pregnancy state. The postpartum period lasts 6 to 8 weeks and is classified as immediate (1 to 10 days after birth), late (from 11 to 45 days) and remote (more than 45 days)<sup>1</sup>.

During pregnancy, hormonal changes caused by relaxin, progesterone and estrogen combined with uterine growth may cause stretching of the abdominal muscles<sup>1</sup>, affecting mainly the rectus abdominis muscles. Also during pregnancy, it is common to have anterior pelvic tilt with or without lumbar hyperlordosis<sup>1-3</sup>. These postural changes can affect the insertion angle of pelvic and abdominal muscles, influencing postural biomechanics. They can also generate a deficit in the support of the pelvic-abdominal organs. Furthermore, as the pregnancy progresses and the abdominal muscles stretch, there is a loss in the force vector of these muscles, and there may be a decrease in contraction strength<sup>3-6</sup>.

Thus, the biomechanical changes and stretching of these muscles facilitate the appearance of diastasis of the rectus abdominis muscles (DRAM). The DRAM is defined as the separation or spread of the muscle bundles along the linea alba<sup>4-8</sup>. The occurrence of DRAM is more common in pregnancy and immediate puerperium<sup>7</sup>, having as main predisposing factors obesity, multiparity, fetal macrosomia, flaccid abdominal muscles, polyhydramnios and multiple pregnancies<sup>8</sup>. It is more easily detected from the second trimester of pregnancy, showing decrease in late puerperium<sup>6</sup>. It may be a transitory condition<sup>5,6</sup> or may remain throughout life<sup>4,9,10</sup>.

In the literature, there are several ways to define and evaluate DRAM, therefore its prevalence varies. This hinders communication between researchers, and there is no consensus on values deemed relevant, acceptable and/or harmful. Some authors consider DRAM any separation between the rectus abdominis<sup>4</sup>, others consider only a distance greater than 1 cm<sup>7</sup>, 2 finger breadths<sup>11</sup> or 3 cm<sup>8</sup>. The simplest way to evaluate DRAM is to measure the number of finger breadths between the medial edges of the muscles, but the use of specific equipment such as calipers has been recommended<sup>8</sup>.

It is known that DRAM is not a direct cause of discomfort or pain, but excessive distension may interfere with the abdominal muscles' ability to stabilize the trunk, generating greater predisposition to lumbar pain development<sup>9,10</sup>. As a result, physical therapists working in obstetrics are unsure of what should be considered DRAM in pregnant/postpartum

patients and which measures should be adopted. Epidemiological investigations into the context of obstetric physical therapy are important because they provide tools to justify the need for early and well-founded treatment. Thus, it is essential to investigate DRAM in postpartum women treated in the public health system to establish DRAM references, define the patient profile and develop prevention and treatment strategies during pregnancy and puerperium.

Some studies evaluate pregnant women<sup>10</sup> or postpartum women at different postpartum stages<sup>9</sup>, and none of them evaluated primiparae and/or multiparae separately. Because there are few studies in this area in the national literature, the objectives of the present study were to determine the prevalence of diastasis of rectus abdominis muscles (DRAM) above and below the umbilicus immediately after vaginal delivery, to compare the mean of this diastasis in primiparae and multiparae and to investigate the correlation between the diastasis and the mother's age, body mass index (BMI), gestational age (GA) and the duration of labor (DL).

## Methods : : : .

A cross-sectional study was carried out between May and November 2006, involving postpartum women at the Public Municipal Maternity Hospital of Betim (MPMB). The present study was approved by the Research Ethics Committee of PUC Minas (CAAE 0303.0.213.000-06) and all participants signed a consent form. An average 120 deliveries are performed at this hospital every month, and it is considered reference of humane health care in the suburban area of the city of Betim. It is also the site for supervised internships in Obstetrics and Gynecology Physical Therapy.

The data from postpartum patients of the MPMB physical therapy team were routinely collected by properly trained interns. Before starting the service and data collection, the postpartum women were informed about the objectives, procedures and consent form. All of the women who agreed to participate were assessed and received routine care by the interns, which consists in specific exercises and instructions. The data used in the present study were included in a personal data sheet, previously prepared by the supervisors. On this sheet, the interns recorded information from medical chart, such as age, marital status, BMI, occupation, smoking and drinking habits, obstetric history including parity, GA and DL. On the same sheet, they recorded the DRAM above and below the umbilicus.

To measure the DRAM, the postpartum women were placed in the supine position with hips and knees flexed

at 90°, feet supported and arms extended over the body. In that position, they were asked to perform a forward trunk flexion until the inferior angle of the scapula was off the bed. The reference points for DRAM measurement were three finger breadths (4.5 cm) above and below the umbilicus<sup>8,10</sup>, and when the trunk was flexed forward, the evaluator placed the finger perpendicularly between the medial edges of the rectus abdominis muscles. The diastasis was graded by the number of finger breadths between the medial edges of the rectus abdominis muscles at the reference points. Each finger breadth represented 1.5 cm, as found in the literature<sup>4</sup>. The DRAM was considered present and relevant if the separation was greater than 2 cm between the medial edges of rectus abdominis muscles<sup>9</sup>. The evaluations were carried out by the interns training at the maternity hospital and, during the study period, all were properly trained.

The present study includes data from primiparae (single delivery) and multiparae (two or more deliveries) who only had vaginal delivery and who were assessed at least 6 hours after delivery. These criteria excluded data from postpartum women who had undergone previous abdominal surgery (cesarean section) and whose data sheets were incomplete.

For sample size calculation, the software EPIINFO 6.0 was used, and a simple random sample was calculated for studies of prevalence. Assuming a population of 750 women, desired precision of 3%, estimated prevalence of 66%<sup>4</sup> and confidence level of 95%, the estimated sample was 407 women. For descriptive data analysis, central tendency (mean), dispersion (standard deviation), frequency and percentage were calculated. The Kolmogorov-Smirnov test was used to verify the probability distribution of quantitative variables. The *t* test for independent variables and Pearson's correlation test were also used. Data were analyzed with the statistical program SPSS (Statistical Package for Social Science) version 13.0, and a significance level of  $p < 0.05$  was considered in all analyses.

## Results

The data sheets of 525 postpartum women were selected, and 467 were included for analysis. Of the 88 excluded sheets, 71 indicated a history of cesarean sections, and the remaining sheets were incomplete. Of the 467 included sheets, 227 (48.6%) women were primiparae and 240 (51.3%) were multiparae. Regarding marital status, 199 (42.6%) were married, followed by 126 (27%) single, 20 (4.3%) divorced and 122 (26.1%) reported marital status as "other." With regard to occupation, 328 (70.2%) were housewives, 24 (5.1%) were students and the

remaining 115 (24.6%) had other activities. Regarding social habits, 58 (12.4%) were smokers and 18 (3.9%) were heavy drinkers.

Considering separately primiparae ( $n=227$ ) and multiparae ( $n=240$ ), Table 1 shows that the mean age of multiparae was significantly higher ( $p=0.0001$ ) and the DL significantly shorter ( $p=0.0001$ ). BMI and GA showed no significant differences ( $p=0.674$  and  $p=0.350$  respectively). Table 2 shows that the prevalence of DRAM above the umbilicus was 68% and

**Table 1.** General and obstetric characteristics of primiparae ( $n=227$ ) and multiparae ( $n=240$ ).

	Primiparae ( $n=227$ )	Multiparae ( $n=240$ )	P value
Age (years)	21.4 ( $\pm 4.8$ )	26.8 ( $\pm 5.6$ )	0.0001*
Body index mass ( $\text{kg}/\text{m}^2$ )	24.8 ( $\pm 4.2$ )	25.0 ( $\pm 3.9$ )	0.674
Gestational age (weeks)	38.9 ( $\pm 1.6$ )	38.8 ( $\pm 1.6$ )	0.350
Labor (hours)	6.55 ( $\pm 5.5$ )	4.15 ( $\pm 3.95$ )	0.0001*

\* *t* test ( $p < 0.05$ ), values are in mean ( $\pm$  standard deviation).

**Table 2.** Prevalence distribution of DRAM above and below the umbilicus of all postpartum women ( $n=467$ ), primiparae ( $n=227$ ) and multiparae ( $n=240$ ).

DRAM (cm)	Postpartum ( $n=467$ )	Primiparae ( $n=227$ )	Multiparae ( $n=240$ )
	n (%)	n (%)	n (%)
Above umbilicus			
>2 cm	317 (68.0)	154 (67.8)	163 (67.9)
$\leq 2$ cm	150 (32.0)	73 (32.2)	77 (32.1)
Below umbilicus			
>2 cm	115 (25.0)	45 (19.8)	70 (29.2)
$\leq 2$ cm	350 (75.0)	182 (80.1)	170 (70.8)

**Table 3.** DRAM above and below the umbilicus between primiparae ( $n=227$ ) and multiparae ( $n=240$ ).

DRAM (cm)	Primiparae ( $n=227$ )	Multiparae ( $n=240$ )	P value
Above umbilicus	2.7 ( $\pm 1.2$ )	2.8 ( $\pm 1.2$ )	0.389
Below umbilicus	1.4 ( $\pm 1.1$ )	1.6 ( $\pm 1.2$ )	0.018*

\* *t* test ( $p < 0.05$ ) values are in mean ( $\pm$  standard deviation).

32% in below the umbilicus. Similar values were found for primiparae and multiparae, with higher prevalence of DRAM above the umbilicus. In Table 3, when the mean DRAM of primiparae and multiparae were compared, the values for DRAM below the umbilicus were significantly higher in multiparae ( $p=0.018$ ). In the postpartum women, the mean DRAM above the umbilicus was 2.8 ( $\pm 1.2$ ) cm and below the umbilicus 1.5 ( $\pm 1.1$ ) cm, showing a significant difference ( $p=0.0001$ ). There was no association between DRAM and other variables such as mother's age, BMI, GA and DL, however DRAM below the umbilicus presented positive, but weak correlation, with DRAM above the umbilicus ( $r=0.461$ ).

## Discussion ::::

The occurrence of DRAM in immediate puerperium found in the present study is in agreement with the literature<sup>4,7,8,11</sup>, which reports a higher prevalence in the third trimester of pregnancy and immediately postpartum. However, its prevalence varies because there is no consensus in the literature on what DRAM value is considered clinically relevant. In the national literature, no similar studies were found.

Nevertheless, the results are in agreement with the international literature, which demonstrates DRAM prevalence values of 35% to 100%<sup>4,10,11</sup>. Considering a minimum separation of 2 cm above the umbilicus, Chiarello et al.<sup>10</sup> found a prevalence of 12.5% to 90% in a sample of pregnant women who underwent an exercise protocol and pregnant sedentary women, respectively. In middle aged women, values close to 66%<sup>4</sup> were found. Boissonnault and Blaschak<sup>11</sup> classified a relevant DRAM as a separation of more than two finger breadths (approximately 3 cm) and reported a prevalence of 36% above the umbilicus and 11% below the umbilicus. Bursch<sup>7</sup> found a prevalence of about 85%, considering the two regions. The results found in the present study are higher than those presented by Boissonnault and Blaschak<sup>11</sup>, however these authors evaluated only primiparae over a maximum period of 1 year after delivery. Thus, the data found in the present study were closer to those found by Bursch<sup>7</sup>, and this can be explained by the fact that the postpartum women were also evaluated in the immediate puerperium.

The DRAM evaluation and the value to be considered are especially important among physical therapists because these professionals are concerned with the functionality and physical integrity of individuals. A DRAM of more than 2.5 cm can be considered harmful<sup>4,5</sup> as it may interfere with the abdominal muscles' ability to stabilize the trunk and with functions such as posture, bowel movements,

parturition, trunk movements as well as visceral support<sup>12,13</sup> and lumbar stabilization. Poor lumbar stabilization may predispose the individual to the development of back pain, as demonstrated in a study on women submitted to surgical DRAM reduction who had a significant relief of back pain<sup>13</sup>. It is worth noting that there is relative contribution of all deep and superficial abdominal muscles to such stabilization and at different levels<sup>2,14,15</sup>.

Another important factor is the location of the measurement and how to evaluate it. Some authors recommend that the evaluated region must be near the umbilicus, 4.5 cm above and 4.5 cm below the umbilicus<sup>8-10</sup>. Other studies use imaging tests<sup>16</sup>, but the simplest and most common ways are with the caliper and the number of finger breadths<sup>8-10</sup>. Boxer and Jones<sup>9</sup> used a dial caliper, with 4.5 cm above and below the umbilicus as reference points, and found high reliability between measures.

Regardless of parity, the prevalence and mean DRAM in the general sample was higher in the region above the umbilicus compared with the region below the umbilicus. Using three-dimensional analysis, Gilleard and Brown<sup>5</sup> found higher separation above the umbilicus (6.0 cm above and 3.2 cm below the umbilicus). It should be noted that DRAM may be lower below the umbilicus because of the anatomical difference between the arrangement of the fasciae that cover the rectus abdominis. The formation of the rectus sheath varies according to the level of the abdomen wall. The area of change is located approximately midway between the umbilicus and the pubic symphysis and is typically marked by the arcuate line. Above the arcuate line, the sheath has an anterior layer (formed by the external oblique aponeurosis and the anterior lamina of internal oblique aponeurosis) and a posterior lamina (formed by the posterior lamina of the internal oblique aponeurosis and the transverse abdominal aponeurosis). Below the arcuate line there is only the anterior layer, formed by the respective aponeuroses of each of the three muscles<sup>2</sup>. Thus, in the final portion of these muscles, the positions of the fasciae are different and prevent separation.

It is believed that women with DRAM have a greater number of pregnancies and deliveries<sup>4</sup>, however the results of the present study showed that DRAM above the umbilicus has similar prevalence in primiparae and multiparae. This may be due to abdominal muscle weakness resulting from the last pregnancy in both groups. The prevalence and mean of DRAM below the umbilicus was higher in multiparae, with a significant difference ( $p=0.018$ ). This can be explained by parity itself and the multiple pregnancies, which may contribute to cumulative mechanical stress on

the connective tissue of the abdominal wall. As the pregnancy progresses, the uterus weight and size increases, influencing the musculoskeletal morphology of the trunk, increasing the distance between the muscle insertions and producing muscle stretching. According to Chiarello et al.<sup>10</sup>, the values for DRAM above the umbilicus are also higher in women with parity of more than two deliveries.

Another important fact is that age in multiparae was significantly higher ( $p=0.0001$ ) than in primiparae, which can be considered a contributing factor in DRAM development. Spitznagle, Leong and Van Dillen<sup>4</sup> observed higher prevalence of DRAM among older women (over 50 years) and those with a greater number of pregnancies and previous deliveries. However, none of the studies found in the literature compared DRAM between primiparae and multiparae in the immediate puerperium, which limits the discussion and comparison with other studies.

It is known that in healthy women, there is a synergism between abdominal muscles and pelvic floor muscles, as shown by Sapsford<sup>12</sup>. The author comments that the pelvic floor acts together with abdominal and multifidus muscles in trunk stabilization. Thus, women who have some impairment in abdominal wall and in the local connective tissue may present mechanical changes of the fasciae which form the rectus sheath, and this may damage the pelvic floor muscles. This can be illustrated by the findings of Spitznagle, Leong and Van Dillen<sup>4</sup>, who found a relationship between DRAM and urogynecologic disorders, i.e. the chances of developing urinary and fecal incontinence and prolapse were 1.28, 2.56 and 2.25 times greater in women with DRAM.

Currently, women take better care of the body, and physical activity during pregnancy and puerperium is

recommended<sup>6</sup>. All women should receive physical therapy treatment soon after delivery for a better recovery<sup>3</sup>, but unfortunately few hospitals follow this approach. Thus, the results of the present study call attention not only to the evaluation and occurrence of postpartum DRAM but also to the need to inform women of its considerable prevalence. Physical therapists should strongly recommend abdominal exercises (especially the transversus abdominis muscle), as preventive and therapeutic measures. Chiarello et al.<sup>10</sup> demonstrated that a group of pregnant women who underwent a protocol of abdominal exercises had significantly lower DRAM values compared to sedentary pregnant women. The same was demonstrated in a national study on immediate puerperium, in which the exercise protocol was well accepted and significantly reduced DRAM<sup>8</sup>.

It is evident that DMRA must be properly assessed so that if it occurs specific exercises can be recommended in an attempt to avoid future problems, such as worsening of DRAM in a future pregnancy or impairment of urogynecologic function<sup>4</sup>. It is worth noting that, at the maternity hospital where the study was conducted, isometric abdominal and pelvic floor exercises are routinely taught and implemented after the postpartum women are evaluated. Because the study objective was to verify the occurrence of DRAM in immediate puerperium, the treatment protocol was not analyzed.

It can be concluded that the prevalence of DRAM and the mean diastasis were higher above the umbilicus in both primiparae and multiparae. Mean DRAM below the umbilicus was significantly higher among multiparae and had a weak correlation with DRAM above the umbilicus. No correlations were found with maternal age, BMI, GA and DL.

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