Risk factors for diastasis of the recti abdominis

Giulio Candido
University of Lugano

Patricia Janssen
University of British Columbia - Vancouver

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G. Candido
Department of Physiotherapy, Children's and Women's Health Centre of British Columbia, Vancouver, British Columbia, Canada

T. Lo
City Square Physiotherapy Centre and Fairchild Square Physiotherapy Centre, Vancouver, British Columbia, Canada

P. A. Janssen
Department of Health Care and Epidemiology, University of British Columbia, Vancouver, British Columbia, Canada

Abstract
The present study reports the prevalence and associated risk factors for diastasis of the recti abdominis (DRA) in the immediate postpartum period in an unselected population of women. Women at BC Women's Hospital, Vancouver, British Columbia, Canada, were recruited within 48 h of giving birth. Risk factors were compared among women with and without diastasis, and according to the degree of diastasis, i.e. none or mild versus moderate or severe. Women were assessed in a supine position using a tape measure to quantify gaps between the border of the two bellies of the recti abdominis muscle at the umbilicus, and at the widest gap above and below the umbilicus. Overall, the prevalence of DRA was 34.9% (n=76) among the 208 study participants. Among multiparous women, women with diastasis were significantly more likely to be providing childcare (P<0.001). Women with no or only mild diastasis were more often engaged in vigorous regular (three times a week or more) or regular walking/exercise (twice a week or less) compared to women with moderate or severe diastasis.

Keywords: abdominal wall, physical therapy, postpartum period, pregnancy, rectus abdominis.

Introduction
Diastasis, or separation, of the recti abdominis is known to occur in pregnancy, appearing in the second, or more frequently, the third trimester (Boissonnault & Blaschak 1988). Hormonal and mechanical stresses placed upon the structures of the abdominal wall are believed to play an important role in causing the rectus muscle to separate (Noble 1988). The diastasis may range from a small vertical gap 2–3 cm wide and 12–15 cm long to a space measuring 12–20 cm in width and extending nearly the whole length of the recti muscles (Polden & Mantle 1990). Gilleard & Brown (1996) demonstrated that, even among healthy fit women, there were gross morphological changes in the rectus abdominis and the ability of the abdominal muscles to stabilize the pelvis against resistance was compromised in most women at 8 weeks postpartum. Failure to treat diastasis recti abdominis (DRA) successfully can lead to long-term sequelae, including abnormal posture, (Boissonnault & Blaschak 1988), back pain, (Porterfield 1985) and cosmetic defects (Elbaz & Flaguel 1976). To date, research on risk factors for this debilitating condition has been limited to studies of less than 50 women (Boissonnault & Blaschak 1988). The purpose of the present study was to determine the prevalence of DRA in the early postpartum period in an unselected population of women and to describe associated risk factors.

Correspondence: Patricia Janssen PhD, Department of Health Care and Epidemiology, University of British Columbia, 5804 Fairview Avenue, Vancouver, British Columbia V6T 1Z3, Canada (e-mail: pjanssen@interchange.ubc.ca).

Subjects and methods

The study took place at BC Women's Hospital, Vancouver, British Columbia, Canada. BC Women's is the largest maternity centre in Canada and the only maternity hospital with a dedicated physiotherapy department. The hospital provides primary and secondary care to women living in the geographical catchment area of south-eastern British Columbia and tertiary care for women in the Province of British Columbia. Seventy-two per cent of births in the City of Vancouver take place at BC Women's Hospital.

Subjects

Women who had given birth in the preceding 48 h at BC Women's Hospital were recruited between 3 April 1998 and 1 October 1999. At the time of the study, the average length of post-partum stay for an uncomplicated vaginal delivery was 72 h. Exclusion criteria included endometriosis or abdominal infection, spinal headache, physical handicap or obstetrical conditions which would preclude participating in a treatment programme. Eligible patients were approached for consent by one of two physiotherapists. Previous work has reported a correlation (r) of 0.75 for measurement of diastasis using the finger-width method between two experienced physiotherapists (Bursch 1987). During a brief interview, women were asked their occupation and whether or not they performed: (1) housework; (2) childcare; (3) activities of daily living; and (4) exercise, both before and during pregnancy. In addition, they were asked what type of exercise they undertook, and the duration and frequency. The women were also asked if they had a past history of abdominal, neck or back surgery. Other variables of interest were ascertained from the patient chart, such as age, height, pre-pregnancy weight, weight gain during pregnancy, parity, gestational age at delivery, complications of pregnancy including twin gestation and diabetes, and mode of delivery. Ethnicity was observed during the examination. Following the interview, the physiotherapist examined study subjects for the presence of DRA.

Protocol

In a supine position with knees bent and feet resting comfortably on the bed, the subject was asked to raise her head and shoulders off the bed with arms extended, reaching towards the knees until the spine of the scapula was off the bed. The physiotherapist observed the abdominal wall and palpated along the linea alba beneath the xiphoid process to above the symphysis pubis. Measurement between the border of the two bellies of the recti abdominis muscle at the umbilicus and at the widest gap above and below the umbilicus was undertaken using a tape measure. Diastasis was classified as follows:

(1) *normal*: any separation above, below or at the umbilicus of <2.5 cm with no bulging;
(2) *mild*: any separation, above, below or at the umbilicus of >2.5 cm and <3.5 cm, or bulging with separation <2.5 cm;
(3) *moderate*: any separation of >3.5 cm and <5 cm with or without bulging; and
(4) *severe*: any separation of >5.0 cm.

Women who were found to have diastasis (mild, moderate or severe) were offered treatment in an outpatient rehabilitation programme offered by the physiotherapy department.

Data analysis

Diastasis was analysed as a dichotomous outcome. Women with and without DRA were compared with respect to risk factors using the chi-square statistic for categorical exposure variables and the t-test for continuous exposure variables. Alpha (type I error) was set at $P<0.05$. In addition, women were compared according to degree of diastasis: none or mild versus moderate or severe. Predictive models for diastasis were constructed using logistic regression. Odds ratios and 95% confidence intervals were estimated for individual predictors using model parameters. Variables were entered into the model one at a time. The variable associated with the largest value for the chi-square statistic for the model was retained, and then the other variables added one at a time. Variables were retained in the model if their addition changed the beta-parameters by 10% or more (Maldonado & Greenland 1993). Model fit was examined using the chi-square statistic for the model.

Prior to commencement, the study was granted a Certificate of Ethical Approval from the University of British Columbia Clinical Ethics Committee and from the BC Women's Hospital Research Review Committee.

Results

A total of 210 women were approached to participate in the present study and 208 agreed. Overall, the prevalence of DRA was 34.9%

Table 1. Sociodemographic and pregnancy-related variables by diastasis of the recti abdominis

Variable	Diastasis (n=76)	No diastasis (n=132)	P-value
Mean age (years) (± SD)	31.8 ± 4.8	32.1 ± 5.2	0.78
Ethnicity [n (%)]:			
Caucasian	38 (52.1)	45 (37.2)	0.08
East Asian	32 (43.8)	64 (52.9)	
South Asian	3 (4.1)	12 (9.9)	
other	3 (3.9)	5 (4.0)	
unknown	0	6	
Mean height (cm) (± SD)	161.4 ± 6.7	160.6 ± 6.3	0.45
Mean pre-pregnant weight (kg) (± SD)	60.2 ± 9.5	57.9 ± 10.0	0.15
Mean weight gain (kg) (± SD)	15.4 ± 6.8	15.1 ± 5.3	0.77
History of abdominal surgery [n (%)]	5 (6.6)	11 (8.3)	0.64
Injury to back or neck [n (%)]	5 (6.6)	7 (5.4)	1.00
Exercise frequency before pregnancy [n (%)]:			
– none	45 (59.2)	57 (43.2)	0.07
– walking regularly or vigorous activities (once or twice a week)	22 (28.9)	48 (36.4)	
– vigorous activities (three times a week or more)	9 (11.8)	27 (20.5)	
Exercise frequency during pregnancy [n (%)]:			
– none or contraindicated	45 (59.2)	57 (43.2)	0.07
– walking occasionally or regularly	27 (35.5)	65 (49.6)	
– continued vigorous exercise	4 (5.3)	10 (7.6)	
Childcare before pregnancy – (multiparous only) [n (%)]	25 (67.6)	13 (27.7)	<0.001
Childcare during pregnancy – (multiparous only) [n (%)]	25 (69.4)	13 (29.5)	<0.001
Primiparous [n (%)]	39 (51.3)	83 (62.9)	0.10
Mean gestational age at delivery (years) (± SD)	38.9 ± 1.6	38.6 ± 2.1	0.47
Twin pregnancy [n (%)]	2 (2.6)	8 (6.1)	0.33
Diabetes in pregnancy [n (%)]	3 (3.9)	4 (3.1)	1.00
Method of delivery [n (%)]:			
spontaneous vaginal	40 (52.6)	52 (39.4)	0.17
assisted vaginal	10 (13.2)	20 (15.2)	
Caesarean section	26 (34.2)	60 (45.5)	

percentage of 76 women

percentage of 132 women

(n=76). Women with and without DRA did not differ significantly with respect to age, ethnicity, height, history of abdominal surgery or back or neck injury, weight gain during pregnancy, pre-pregnancy weight parity, gestational age at delivery, method of delivery (spontaneous vaginal, assisted vaginal or Caesarean section), or rates of multiple pregnancy or diabetes (gestational or pre-existing) (Table 1). Multiparous women were asked whether they took care of their children throughout the day. Among multiparous women, women with DRA were significantly more likely to be providing childcare (P<0.001).

Women with no or mild diastasis were compared with women with moderate or severe diastasis, since mild diastasis often resolves without intervention. One additional risk factor * emerged during this analysis: women with no or only mild diastasis were more often engaged in vigorous regular (three times a week or more) or regular walking or exercise (once or twice a week) during pregnancy compared to women with moderate or severe diastasis (Table 2).

Given the strong association of provision of childcare with diastasis among multiparous women, separate prediction models were created for primiparous versus multiparous women. Among primiparous women, in a multivariate model, Caucasian women were more likely to experience diastasis [adjusted odds ratio (OR)=2.68, 95% confidence interval (CI)=1.16–6.20]. Exercise was protective for diastasis since women who did not exercise regularly experienced a twofold increase in the odds of diastasis (adjusted OR=2.02, 95% CI=0.87–4.69), although this difference was not statistically significant in the present study (Table 3).

Among multiparous women, in a multivariate model, provision of childcare was significantly associated with diastasis (adjusted OR=11.82, 95% CI=3.20–43.6). The addition of pre-pregnancy to the model (OR=1.01, 95% CI=0.95–1.07) significantly improved the model

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Table 2. Sociodemographic and pregnancy-related variables by diastasis: none/mild versus moderate/severe

Variable	Diastasis None/mild (n=76)	Diastasis Moderate/severe (n=132)	P-value
Mean age (years) (± SD)	32.1 ± 5.1	31.7 ± 4.6	0.69
Ethnicity [n (%)]:	percentage of n=46	percentage of 132 women	0.25
Caucasian	56 (37.1)	27 (52.9)	
East Asian	77 (51.0)	19 (37.3)	
South Asian	12 (7.9)	3 (5.9)	
other	6 (4.0)	2 (3.9)	
unknown	6 (4.0)	0	
Mean height (cm) (± SD)	160.9 ± 6.3	160.8 ± 6.9	0.91
Mean pre-pregnant weight (kg) (± SD)	58.1 ± 9.9	60.6 ± 9.7	0.15
Mean weight gain (kg) (± SD)	15.3 ± 5.9	14.8 ± 6.0	0.67
History of abdominal surgery [n (%)]	12 (7.6)	4 (7.8)	1.00
Injury to back or neck [n (%)]	10 (6.5)	2 (3.9)	0.73
Exercise frequency before pregnancy [n (%)]:			0.08
– none	70 (49.6)	32 (62.7)	
– walking regularly or vigorous activities (once or twice a week)	57 (36.3)	13 (25.5)	
– vigorous activities (three times a week or more)	30 (19.1)	6 (11.8)	
Exercise frequency during pregnancy [n (%)]:			0.13
– none or contraindicated	67 (42.9)	34 (66.7)	
– walking occasionally or regularly	77 (49.4)	15 (29.4)	
– continued vigorous exercise	12 (7.7)	2 (3.9)	
Childcare before pregnancy – (multiparous only) [n (%)]	20 (32.8)	18 (78.3)	<0.001
Childcare during pregnancy – (multiparous only) [n (%)]	20 (35.1)	18 (78.3)	<0.001
Nulliparous [n (%)]	94 (59.9)	28 (54.9)	0.53
Mean gestational age at delivery (years) (± SD)	38.8 ± 2.0	38.6 ± 1.8	0.45
Twin pregnancy [n (%)]	8 (5.1)	2 (3.9)	1.00
Diabetes in pregnancy [n (%)]	6 (3.8)	1 (2.0)	1.00
Method of delivery [n (%)]:			0.79
spontaneous vaginal	68 (43.3)	24 (47.1)	
assisted vaginal	22 (14.0)	8 (15.7)	
Caesarean section	67 (42.7)	19 (37.3)	

Table 3. Prediction of diastasis recti abdominis among primiparous women: (OR) odds ratio; and (95% CI) 95% confidence interval

Variables	Final model* OR	95% CI	χ^2 for model
Ethnicity:			
non-Caucasian	1.00		
Caucasian	2.68	1.16–6.20	4.61, P=0.03 (one variable)
Exercise during pregnancy:			
vigorous activities twice a week or more, or regular walking	1.00		
no regular exercise	2.02	0.87–4.69	7.76, P=0.02 (two variables)

*Odds ratios are adjusted for other variables in the model. No other variables were significantly associated with diastasis of the recti abdominis.

fit (χ^2 for model change=1, d.f.=4.49, P<0.05) (Table 4). Pre-pregnancy weight is significantly associated with diastasis, therefore, after adjustment for childcare.

Discussion

In a prospective study, the present authors report a prevalence of DRA within 48 h of giving birth of 34.9%. Boissonnault & Blaschak

Table 4. Prediction of diastasis of the recti abdominis among multiparous women: (OR) odds ratio odds ratio; and (95% CI) 95% confidence interval

Variables	Final model*		
	OR	95% CI	χ^2 for model
Providing childcare:			
no	1.00		
yes	11.82	3.20–43.6	12.97, P=0.01 (one variable)
Pre-pregnancy weight (kg)	1.01	0.95–1.07	17.46, P=0.01 (two variables)

*Odds ratios are adjusted for other variables in the model.

(1988) reported a prevalence of 53% based on a sample of eight women. The present authors could find no other prevalence studies for the purposes of comparison.

In addition, the present authors report an association of DRA during pregnancy with Caucasian ethnicity and a lack of regular exercise during pregnancy. Among multiparous women, they report a strong association between provision of childcare and DRA during pregnancy.

These findings have not been reported before to the present authors' knowledge. The role of exercise in the prevention of DRA has not been studied to date. The present data suggest that exercise itself may be a protective factor, or alternatively, women who exercise during pregnancy may have healthier lifestyles which, in turn, have ensured healthier tissues. Exercise prior to pregnancy may also play an important role. In the present study, 19.1% of women with no or mild diastasis were vigorous exercisers versus 11.8% of women with moderate or severe diastasis. This association needs to be explored further in a study designed to have adequate power to address this important variable. The association of diastasis with Caucasian ethnicity also needs to be explored in future studies. The only other ethnic group of substantial size in the present study was East Asian, largely made up of women of Chinese descent. Chinese women in the present setting tend to live with or associate closely with their extended family, and therefore, may be protected during pregnancy from strenuous household or paid work, which could, in turn, promote diastasis or prevent the complete healing of diastasis from prior pregnancies.

Multiparous women have previously been reported to have an increased incidence of diastasis (Lo *et al.* 1999). Frequent lifting and carrying of young children increases strain on the abdominal wall and increased loading of the already weakened abdominal muscles during pregnancy may favour development of DRA (Barton 2004). In addition, many women tend to employ the Valsalva manoeuvre when lifting. This puts pressure on the abdominal wall musculature, and can contribute to straining and widening of the DRA (Barton 2004). Fatigue may also play a role, making women more likely to assume poor posture or use inadequate body mechanics. Multiparous women may also be exacerbating diastasis persisting from a prior pregnancy. If separation of the recti bellies persists, even to a mild degree after the first pregnancy, mechanical stresses on the abdominal wall associated with pregnancy combined with additional hormonal effects will probably increase the diastasis.

While larger than other prevalence studies to date, the present study was still limited by its small size. The sample was drawn from a general population of women giving birth in a hospital serving 75% of the population of a major city. This approach, while improving on generalizability, did not sample a referred population as was the case in the present authors' previous work (Lo *et al.* 1999), and therefore, was not as definitive in its ability to delineate risk factors. For example, there were only 10 women in the present study with multiple pregnancies, making this potential risk factor too uncommon to study in a prospective fashion.

Assessment for diastasis of the recti abdominis should be incorporated into the obstetric care of all women. The influence of ethnicity and culture on diastasis needs to be further explored in order to distinguish between biological versus lifestyle influences. The role of exercise as a protective factor has been reported previously (Lo *et al.* 1999) and the present findings further support the importance of fitness during pregnancy. Among multiparous women, the emergence of providing childcare during pregnancy as a strong risk factor for diastasis should encourage providers of prenatal care to teach women to guard against undue stress on their abdominal muscles while tending to children.

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Gloria Candido is a staff physiotherapist at the Department of Physiotherapy, Children's and Women's Health Centre of British Columbia, Vancouver, BC. She has developed a programme for treatment of diastasis of the recti abdominis after childbirth. Theresa Lo has private practices in Vancouver and Richmond, BC. Dr Patricia Janssen is an assistant professor in the Department of Health Care and Epidemiology at the University of British Columbia, and a Faculty member at the British Columbia Research Institute for Children's and Women's Health, Vancouver.