



## Original Article

### Predictors of Disability Attributed to Symptoms of Increased Interrecti Distance in Pregnant and Postpartum Women with Diastasis Rectus Abdominis

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#### Abstract

**Background:** Physically and physiologically, pregnancy and parturition are the phases of transformation for women. During pregnancy, the rectus abdominis muscles move laterally, and the interrecti distance increases and may remain increased in the immediate post-birth period which can lead to disability. **Objective:** To investigate various physical and physiological factors that can cause disability attributed to symptoms of increased interrecti distance after childbirth. **Methods:** This cross-sectional survey was conducted from after approval from the ethical committee. About 239 postpartum females with age ranges of 25 to 35 years having an interrecti distance of at least 2 cm and whose youngest child ages between 1 to 8 years were included. Correlation analysis was applied for different variables using Pearson correlation with a disability as the outcome variable and fear-avoidance beliefs, emotional distress, body mass index, lumbopelvic pain, increased interrecti distance, and physical activity level as predictor variables. **Results:** Four strong predictors were considered that cause disability in the postpartum females with almost 2 finger-width increased interrecti distance at baseline. All patients reported disability caused by symptoms produced by these strong independent predictors like body mass index, fear-avoidance, depression/anxiety, and lumbopelvic pain. The disability was caused by symptoms of body mass index of 22%, with Tampa scale of kinesiphobia questionnaire fear-avoidance belief cause disability 23.4%, with hospital anxiety and depression score was 10%, and with lumbopelvic pain 16% or mean value of visual analog scale 5.78% and total score of pain disability index was reported 9%. The p-value for correlation of all predictor variables with disability outcome variable shows a significant correlation between them. **Conclusion:** The intensity of lumbopelvic pain, fear-avoidance attitudes, body mass index, and emotional distress are the primary causes of disability related to symptoms of an increased interrecti distance after childbirth. These four predictor variables show a significant correlation with disability.

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## Introduction

The changes in the female body in the course of being pregnant and after childbirth may additionally affect the woman's physical and mental health. Negative body image in the last trimester of being pregnant is related to poor maternal-fetal attachment and extra tough and long labor.<sup>1</sup> The anterior abdominal wall is made up of four muscles that are connected anatomically. Muscle fibers are arranged vertically, horizontally, and obliquely. In the process of pregnancy, as the contents of the uterus increase, it also increases the weight which can affect the structure and function of trunk muscles. During pregnancy, as the inferior diameter of the thoracic cavity increases, it affects the superior and inferior abdominal muscle attachments. The distance between the anterior and lateral muscle attachments increases which elongates the muscle lengths. During pregnancy, in most women, the rectus abdominis (RA) muscles move laterally and the interrecti distance (IRD) increases and may remain increased in the immediate post-birth period.<sup>2</sup>

The linea alba connects RA muscles. It's a crucial structure as it holds the RA muscle's major insertion site, as well as three other significant muscles. Both sides of the abdominal muscles: internal and external oblique muscles, and transverse abdominis (TA) muscles.<sup>3</sup> These four muscles pass Linea Alba from either side called the way by their thin and wide tendons aponeurosis. This connection is during pregnancy, uterine dilation followed by stretch coupled with the abdominal muscles. Hormonal changes include increased progesterone, estrogen, and relaxin levels.

Increased interrecti distance also known as diastasis rectus abdominis (DRA) is often unnoticed by the patient. DRA is the fractional or complete partition of RA muscle (the six-pack muscle) at focal line connective tissue called the linea alba.<sup>4</sup> It causes the linea alba tissue to thicken, which can cause abdominal pain or discomfort that worsens with movement,<sup>5</sup> bulging of the abdominal wall also called herniation,<sup>6</sup> pelvic floor dysfunction, lower trunk muscle rotation, lumbopelvic pain, urogynecological symptoms such as pelvic organ

prolapse, fecal and urinary incontinence.<sup>7</sup> Females are more inclined to DRA during pregnancy, postmenopausal and postpartum periods. Be that as it may, it can likewise happen in males due to enthusiastic stomach practices without legitimate direction.<sup>8</sup> A hormone called "relaxin" is released during the gestation period for the compensation of physiological changes that occur due to the growing uterus which increased pressure and stress on the walls of the abdomen. As the process of pregnancy progresses the strain on abdominal walls further increases, which stretches the abdominal muscles away from the midline, which may result in IRD.<sup>4</sup> An extremely enormous IRD influences the capacities involving the abdominals, for example, respiration, delivery of a baby, posture, and trunk biomechanics and movements. Any harm or disturbance of the stomach divides muscles or then again of RA muscle or linea alba can strongly compromise these activities.<sup>9</sup>

The increased IRD might be available innately, yet all the same most generally creates during pregnancy and in the early post-pregnancy.<sup>10</sup> Physically and psychologically, gestation and parturition are the phases of transformation for women. During pregnancy, the female body undergoes significant physical changes. RA muscle bellies are pushed away, resulting in greater IRD. Even after the gestation period, most women's interrecti distance increases.<sup>11</sup> The Diagnostic and Statistical Manual of Mental Disorders defines postpartum depression, the most well-known complication of childbirth, as "any burdensome problem that occurs from the beginning of pregnancy or within about a month of delivery."<sup>12,13</sup>

Pregnancy or labor are the key risk factors for the progression of female pelvic floor dysfunctions, especially stress urinary incontinence (UI) that have been reported to range from 20 to 73% during pregnancy and from 6 to 31% in the postpartum period.<sup>14</sup> A few studies have shown that muscles of our pelvic region collaborate with abdominal muscles, which are important during everyday activities such as coughing, gasping, exercise, and other activities. These exercises cause an increase in intra-abdominal pressure that may be seen down to

the pelvic floor.<sup>15</sup> A change in the collective energy of abdominal muscles and pelvic floor muscles (PFM) was seen in females with debilitating perineal muscles. This could be the cause of the spinal disorders, which can lead to lower back pain or stress UI.<sup>16</sup> DRA after delivery can result in abdominal muscle weakness, which can have an impact on the mechanics of the storage compartment, respiration, and lumbar-pelvic stability.<sup>17</sup> Nonetheless, the evidence linking DRA to a lack of strength in the PFM is controversial.<sup>18</sup> According to the anatomic links between the two muscles and the linea alba, it may justify the inclusion of specified activities for the TA and RA muscles.<sup>19</sup> Although numerous females experience some complications and these could include decreased personal satisfaction, mental breakdowns, sorrow, weakness, apprehension about hurting the child, and a reluctance to breastfeed.<sup>13</sup>

Gestation and parturition have a significant impact on the structure of the abdominal wall, causing IRD. According to various studies, postpartum women had a bigger gap between their RA muscles than nulliparous women. This increased IRD might last for up to a year following the birth of the child. This continued rise in interrecti distance after delivery can cause abdominal muscular weakness, which can compromise the normal mechanics of the entire body, particularly the trunk, breathing mechanism, and lumbopelvic region stability.<sup>20</sup>

Gestation results in numerous physiological and anatomical modifications to the body. Among those is the increase in girth of the abdominal wall which stretches, approximately 115 % on average. DRA impacts a vast quantity of females throughout the gestation and after childbirth, with an incidence rate of 32.6 % at one year postpartum.<sup>21</sup> The incidence of DRA is 27 to 100% in pregnant women, 30% in late pregnancy, and 68% in postnatal women.<sup>22</sup> The lumbar pelvic area is crucial to the musculoskeletal system's proper functioning. The abdominal region that contains the bone framework of the pelvis, floor muscles, diaphragm, and abdominal muscles transmits loads.<sup>23</sup> Changes in RA related to pregnancy have been linked to poor abdominal muscle performance. To modulate pelvic

movements against resistance, abdominal muscles are used.<sup>2</sup> Biomechanical alterations occur in the structure and function of the abdominal wall as a result of increased IRD. Research findings showed that this increase in distance after childbirth is negatively associated with functions of abdominal muscles. There appears to be no proof associating the situation of enhanced IRD with reduced body functions.<sup>24</sup>

After childbirth, increased IRD not only affects the female body physically but also psychologically. Childbirth is often associated with mood changes or postnatal stress. Various systematic evaluations point to bodily activities as an important component in preventing and reducing mood swings; yet in comparison to women without children, mothers' level of performing body functions is low. Some of the identified hurdles include a lack of spare time, infant care, fatigue, tiredness, and function conflicts.

Fear-avoidance beliefs may also be a critical component that leads to a bodily state of no activity, as explained by the fear-avoidance model, which states that people who have destructive thoughts and avoidance behavior can become trapped in an endless cycle of incapacity, ache, and poor health.<sup>11</sup> The awareness, treatment, and rehabilitation of increased IRD are of great importance for health professionals. If it stays untreated it may result in weakness of trunk muscles, poor function, herniation, bladder and bowel incontinence, weakness of pelvic floor muscles (PFM), lumbopelvic pain, and discomfort or it may cause complications in the next pregnancy.<sup>25</sup>

Increased IRD, fitness-related quality of life, trunk muscle function and strength, and lumbopelvic pain intensity were all investigated in a recent study. However, there is insufficient evidence to develop novel treatment approaches to treat or prevent increased IRD. As a result, medical health providers and practitioners have little to no advice on how to manage this increased distance in postpartum females. Many fitness experts and health coaches have used strategies to rebuild the inner core and strengthen the PFM by training the abdominal

muscles and pelvic ground muscles to shorten the distance between RA muscles and alleviate physical symptoms in recent decades. Evidence suggests that such training no longer affects increased IRD. It's also worth noting that it's not always linked to both pelvic floor dysfunction (PFD) and lumbopelvic pain.<sup>26</sup> Previous research has shown that increased IRD is one of the common problems among women after childbirth that can affect their daily life activities in multiple ways. In Pakistan, a high prevalence of increased IRD among women is present.<sup>25</sup>

As it is a developing country but there is not enough awareness among its population about its symptoms, the consequences, and factors associated with it can lead to disability in women. Furthermore, there is also limited access to the resources and professionals that can help women suffering from the physical and psychological symptoms produced by increased IRD. The purpose of this study was to find numerous factors, both morphological and cognitive, associated with the level of impairment caused by manifestations of diastasis rectus abdominis after parturition among women. There is a need to fill up this gap, this research was undertaken to increase the awareness of increased IRD and the factors associated with it so that this matter can be considered and multiple treatment plans can be devised in our country.

## Methods

This cross-sectional observational study was conducted from November 2021 to February 2022 after approval from the ethical committee. Using the online epitool, a sample size of 239 participants was calculated (estimated true population=0.664, desired precision=0.06, and confidence interval=0.95). Data were collected from Services hospital, General Hospital, Jinnah Hospital, Mayo Hospital, and Sir Ganga Ram Hospital, Lahore. The approval from higher management at each hospital was obtained before the start of data collection. Postpartum females aged between 25 to 35 years have increased IRD of at least 2cm and the age of the youngest child ranges between 1 to 8 years. Participants could not take part in the current study

if they had any history of cerebral, autoimmune, musculoskeletal, or spinal disease.

After giving all information about the research study, each respondent attended a single session and completed a written consent form. All pertinent evidence was kept confidential. The subjects were advised that there is no harmful effect of this study performed. They were also informed that they would be free to leave the study at any time during the research process. Each participant was given a constructed self-assessment questionnaire to fill out manually.

Each participant's IRD was measured manually by a physiotherapist using the finger method with one, two, and three fingers. Each participant was instructed to lie flat on their backs and both knees flexed at 90° and both feet flat on the ground or couch. The therapist then placed his second and third fingers right above the umbilicus or navel. The participants' fingers were lined up beside each other and directed in the direction of their feet. The individual was then asked to elevate his head and shoulders off the couch as the therapist felt under his fingertips for any gaps or dips. The subject was subsequently instructed to return to the starting posture by lowering his body. A one-finger gap or width was regarded normal, but diastasis recti are clinically diagnosed as a two-finger gap or breadth. In this study, Pain Disability Index (PDI) scale was used to assess the level of disability.<sup>27</sup>

Family/home duties, relaxation, socialization, employment, sexual habits, personality, and everyday tasks were all rated using the PDI. On an 11-point scale, this indicator was graded from 0 to 10. Each domain was assigned a value of 0 to 10. Each participant was asked to rate how much of her daily tasks were restricted or limited as a result of any symptoms associated with an increased IRD. A total score ranging from 0 to 70 was generated at the end of the index questionnaire. Fear-avoidance attitudes, mental distress, pain in the lumbopelvic region, body mass index, and IRD were all predictor variables of this study. Fear-avoidance beliefs were assessed using the Tampa scale of kinesiophobia (TSK-17).<sup>28</sup> This scale was made up of 17 questions. The response of each question was assigned a score



of 1 denoting serious disagreement, 2 denoting lack of agreement, 3 denoting acceptance, and 4 denoting strong consensus. The scale's overall score was computed by summing points of all 17 statements. The overall score varies from 17 to 68. A score of 17 means minimal or zero kinesiophobia, a score of 68 means you have extreme kinesiophobia, and a score of 37 means the presence of kinesiophobia.<sup>28,29</sup> Emotional discomfort was computed using the hospital anxiety and depression score (HADS) scale.<sup>30</sup> It assesses patients' anxiety and depression symptoms.

This scale comprises 14 questions that are all related to depressive symptoms. Seven of the statements are about anxiety symptoms, while the remaining seven are about depressive symptoms. On a scale ranging from 0 to 3, the participant can rate each response. The final rating is computed by summing each response's score. A score of 0 to 7 is acceptable for both anxiety and depression, 8-11 is slightly abnormal, and 11-21 is abnormal.<sup>31</sup> The pain in the lumbopelvic area was measured using a visual analog scale (VAS) to assess the severity of pain. This numerical scale ranges from 0 to 11. The patient can rate pain from 0 to 10. 0 to 3 show mild, 4-6 show moderate and pain levels of 7-10 imply extreme discomfort.<sup>32</sup> The body mass index (BMI) is calculated by measuring height and weight.

It can be computed by multiplying the kilograms of body weight by the whole square of height in meters. The formula for BMI calculation is given as  $(\text{kg}/\text{m}^2)$ .<sup>33</sup> SPSS version 23 was used to analyze data. Correlation analysis was applied to determine any association found between predictor and outcome variables. Correlation analysis was applied for different variables using Pearson correlation with a disability as the outcome variable and fear-avoidance beliefs, emotional distress, body mass index, lumbopelvic pain, increased interrecti distance, and physical activity level as predictor variables.

## Results

In this study, all participants were married with age ranges 25-35 years and the number of children range was girls 44% and boys 56%. The mean value of BMI was  $25.08 \pm 2.25$ . In this study, 4 strong predictors were considered that cause disability in a female with almost 2 finger-width IRD at baseline. All patients reported disability caused by these strong independent predictors e.g. BMI, fear-avoidance beliefs, depression/anxiety, and lumbopelvic pain.

In females with 2 finger IRD disability caused by symptoms of BMI was 22%, with TSK questionnaire fear-avoidance belief cause disability 23.4%, with HADS score was 10% and with lumbopelvic pain was 16% or with VAS mean value was 5.78% and the total mean score of PDI was reported 9%. The p-value less than 0.05 for all correlation of predictor variables with disability outcome variable showed a statistically significant correlation between them. (Table I-IV) Findings showed that a decrease in BMI, fear-avoidance beliefs, depression/anxiety, and lumbopelvic pain results in a decrease in disability.

**Table-I: Pearson correlation of BMI with disability in postpartum females**

		BMI	Disability
<b>BMI</b>	Pearson Correlation	1	.067
	Sig. (2-tailed)		.029
	N	239	239
<b>Disability</b>	Pearson Correlation	.067	1
	Sig. (2-tailed)	.029	
	n	239	239

**Table-II: Pearson correlation of fear-avoidance beliefs with disability in postpartum females**

		Disability	Fear avoidance belief
Disability	Pearson Correlation	1	.137*
	Sig. (2-tailed)		.035
	n	239	239
Fear-avoidance belief	Pearson Correlation	.137*	1
	Sig. (2-tailed)	.035	
	n	239	239

**Table-III: Pearson correlation of depression and anxiety with disability in postpartum females**

		Disability	Depression and Anxiety
Disability	Pearson Correlation	1	0.132*
	Sig. (2-tailed)		.042
	n	239	239
Depression and Anxiety	Pearson Correlation	0.132*	1
	Sig. (2-tailed)	.042	
	n	239	239

**Table-IV: Pearson correlation of lumbopelvic pain with disability in postpartum females**

		Disability	Pain
Disability	Pearson Correlation	1	.156*
	Sig. (2-tailed)		.016
	n	239	239
Lumbopelvic pain	Pearson Correlation	.156*	1
	Sig. (2-tailed)	.016	
	n	239	239

## Discussion

The results showed that strong predictors like BMI, fear-avoidance beliefs, lumbopelvic pain, and

depression/anxiety have an effect in increasing attributing symptoms that cause disability in postpartum females with almost two-finger width IRD after childbirth. Total mean disability increased to 52.5 from the previous study (8.9).<sup>34</sup> This study adds insight into physical and psychological elements linked to impairment or disability in women after childbirth as a result of symptoms from an increased IRD. Although the women were told to evaluate all symptoms from the increased IRD, lumbopelvic pain was one of the strongest predictors of disability. This matches the findings of a recent study, which found that the level of pain was a predictor of impairment in women with persistent pregnancy-related lumbopelvic pain.

Another previous study aimed to investigate the clinical hypothesis that the existence of interrecti distance or DRA caused discomfort or dysfunction in the lumbopelvic region. This study comprised 39 women over the age of 18 who had given birth to at least one child and were seeking treatment for a lumbar or pelvic diagnosis. According to the findings of this study, females with increased IRD have higher degrees of abdominal or lumbopelvic pain.<sup>35</sup> This study correlates well with our recent study in which lumbopelvic pain is one of the strongest predictors which can cause disability in postpartum females. Another previous longitudinal case-control study examined the dysfunction of the lumbar and pelvic stabilizing muscles in mothers after parturition.

This study included 29 nulligravid women and 31 postpartum women. According to the findings of the study, females after delivery exhibited more dysfunction of the lumbar and pelvic stabilizing muscles than nulligravid women.<sup>36</sup> This study also positively correlates with our study that shows lumbopelvic pain as one of the strongest predictors of disability. A previous research study was a systemic review of women with diastasis rectus abdominis on their self-reported symptoms. In the qualitative analysis, only fourteen studies were included which met the eligibility criteria. Quality of life, body image, lumbopelvic pain, and PFD were the symptoms that were analyzed in the

studies. Results concluded a positive correlation between DRA and physical health, abdominal discomfort, and body image. Most of the data showed that disability was related to low back pain. And no correlation was found between DRA and PFD.<sup>37</sup> This study also positively correlates with our recent research findings. In our recent research study, the level of fear-avoidance beliefs was almost similar to that of a previous study but lower than that of the musculoskeletal pain population implying that the current level is comparable to that of a healthy population. Nonetheless, the link between fear-avoidance beliefs and impairment owing to IRD symptoms extends previous findings from the pain population emphasizing the necessity of taking psychological aspects into account when analyzing the impact of increased IRD on women after childbirth.

Emotional discomfort was the third-most important predictor of impairment, which emphasizes its significance. In another study, women at six months postpartum had higher IRD levels and reduced abdominal muscle function in comparison to a control group of matched women who had never been pregnant. It also offers evidence that IRD is connected with abdominal muscle function in postpartum women, and that IRD assessments taken with ultrasonography are accurate. To put it another way, when drawing-in and abdominal-crunch exercises were combined, the IRD measured below the umbilicus was significantly smaller than the IRD measured when an isolated drawing-in was performed [mean 12.6 (SD 6.8) vs. 16.0 (SD 8.1) millimeters; mean difference 3.3 millimeters; 95 percent CI 0.4-0.62 millimeters;  $p = 0.05$ ].

It has shown the reliability of IRD ultrasound measurements in the crook sleeping position (abdominal crunch).<sup>38</sup> In a previous study, an IRD of more than 2.1 cm below the umbilicus was found in five women, whereas three women had an IRD of more than 2.8 cm above the umbilicus at the start of the study. One lady had an IRD that extended over and below the umbilicus by more than 2.8 centimeters after the operation. There was a significant correlation between sedentary activity

and postnatal depression symptoms. Sedentary behavior is associated with an increased risk of developing depressive symptoms.<sup>39</sup> No studies have yet examined the role of physical activity in alleviating depressive symptoms in pregnant women, and this population may have different risk factors for postnatal depression than the general population, so the role of physical activity in reducing depressive symptoms may be different in this population.<sup>40</sup>

According to a study conducted by Skouteris H, physical and psychological aspects related to a disability during delivery had been examined in that study, and pain intensity had been identified as an important component in explaining disability. Despite the women being encouraged to evaluate all symptoms of increasing IRD, the most significant predictor of impairment was lumbopelvic pain.<sup>41</sup> Pregnancy-related lumbopelvic discomfort has been associated with impairment in the current study, and the study findings are consistent with those findings. A high degree of handicap owing to IRD symptoms implies that an elevated IRD may have an impact on everyday life. The limitations of this study were time constraints and small sample size. The duration of this study was quite short which caused a problem to cover most of the population.

## Conclusion

The intensity of lumbopelvic pain and fear-avoidance attitudes, body mass index, and emotional distress are the primary causes of disability related to symptoms of an elevated IRD after childbirth. Disability attributed to symptoms from an increased IRD is explained by the level of lumbopelvic pain but also by the degree of fear-avoidance beliefs and emotional distress. This study highlights pain intensity and psychological factors as crucial factors for understanding disability attributed to increased IRD in pregnant and postpartum women with diastasis rectus abdominis. These four predictor variables show a significant correlation with a disability which showed that a decrease in BMI, fear-avoidance beliefs, depression/anxiety, and lumbopelvic pain

results in a decrease in disability.

## Declarations

**Consent to participate:** Written consent had been taken from patients. All methods were performed following the relevant guidelines and regulations.

**Availability of data and materials:** Data will be available on request. The corresponding author will submit all dataset files.

**Conflict of interests:** None

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**Authors' contribution:** All authors read and approved the final manuscript.

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