RESEARCH ARTICLE

# Frequency of diastasis rectus abdominis and its association with obesity in post-menopausal women: a cross-sectional study

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## Abstract

**Objective:** To determine the frequency of diastasis rectus abdominis and its association with obesity in post-menopausal women.

**Method:** The cross-sectional study was conducted at the gynaecology outpatient department of Dr Ruth K.M. Pfau Civil Hospital and the Sindh Institute of Physical Medicine and Rehabilitation, Karachi, from December 2021 to May 2022, and comprised post-menopausal women. The body mass index, waist circumference and inter-rectus distance were recorded for general obesity, central obesity and diastasis rectus abdominis, respectively. The association of baseline characteristics with the presence of interrectus distance was explored. Data was analysed using SPSS 23.

**Results:** Of the 100 women with mean age 52.3±5.4 years, diastasis rectus abdominis was found in 20(%). Umbilical, supraumbilical and infraumbilical values were significantly different between the patients and the healthy women ($p<0.05$). Diastasis rectus abdominis had non-significant associations with baseline characteristics, physical and maternal parameters, and obesity ($p>0.05$).

**Conclusion:** Umbilical diastasis rectus abdominis was frequently found among post-menopausal women, but had no significant association with obesity.

**Key Words:** Abdomen rectus muscle, Post-menopausal period, Central obesity, Women health, Abdominal obesity.
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## Introduction

The age-related changes in the female reproductive system usually start with the deficiency of the female-specific primary sex hormone oestrogen, and enter the non-reproductive state which encompasses the peri-menopause, menopause and post-menopause stages.[1] Women who are in the peri-menopausal phase may experience irregular menstrual cycles and vasomotor symptoms that are indicative of menopause.[2] The permanent end of menstruation indicates the beginning of the natural menopause.[3] The post-menopausal period begins when a woman has not experienced menstrual bleeding for a minimum of a year unless she receives interventions, such as oral contraceptives, which might cause amenorrhoea.[2] Menopause typically occurs at or around age 50.[4] It is estimated that between 1% and 8.6% of women experience premature menopause, and between 4.9% and 9.4% experience early menopause.[5] Obesity is considered a common nutritional disorder, and energy is stored in the form of fat.[6] Post-menopausal women experience an increase in weight and waist circumference (WC) that is attributable to obesity and redistribution of android fat results in physical inactivity.[7] Post-menopausal women carry 4.8[8] times more risk of abdominal obesity than pre-menopausal women[8] The diastasis rectus abdominis (DRA) is defined as the disconnection of two rectus muscles at midline, or overstretching of the linea alba. DRA is frequently explained concerning pregnancy, but can occur immediately after birth, in post-menopausal women, and men.[9] The aetiology of DRA includes increased intra-abdominal pressure, hormonal changes and mechanical stresses placed on the abdominal wall.[10,11] DRA is associated with midline hernias, consequently impairing quality of life (QOL).[12] To date, there is no established guideline about inter-rectus distance (IRD) that suggests DRA requires a therapeutic intervention. Diagnosis of DRA can be done using computed tomography (CT), magnetic resonance imaging (MRI) and ultrasound scans. The first two are considered the gold standard in diagnosis, but due to their economic implication, ultrasound scan is the preferred diagnostic tool. Physical therapists are known to widely use finger width palpation method (96.6%), tape measure (17%), ultrasound (4.4%) and caliper (1.7%).[13]

Globally, the point prevalence of general and central obesity in post-menopausal women is not documented.[14]

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In Pakistan, the prevalence of post-menopausal general obesity is 50.8%, while central obesity, according to WC and waist-hip ratio (WHR), in post-menopausal women is 99.2% and 90% respectively.[15]

To our knowledge, no study has so far explored if obesity favours diastasis recti in post-menopausal women. The current study was planned to fill the gap in literature by determining the frequency of DRA and its association with obesity in post-menopausal women in a tertiary care setting.

## Patients and Methods

The analytical, cross-sectional study was conducted at the gynaecology outpatient departments (OPDs) of the Dr Ruth K.M. Pfau Civil Hospital and the Sindh Institute of Physical Medicine and Rehabilitation, Karachi, from December 2021 to May 2022. After approval from the ethics review committee of Dow University of Health Sciences, the sample size was calculated using PASS 15 software based on a test for one-sample proportion with 95% confidence interval (CI), 80% power, 5% margin of error, and prevalence of diastasis in peri-menopausal and post-menopausal women 37.3%[1]. The sample was raised using purposive sampling technique. Those included were post-menopausal women aged 35-60 years[16]. The exclusion criteria comprised history of severe back pain, diagnosed condition of abdominal aortic aneurysm, history of chronic cough, chronic constipation, any history of recent midline abdominal surgery, recent spinal surgery, like discectomy and laminectomy, recent fracture, recent epidural injection, history of abdominal hernia, diagnosis of pathological connective tissue diseases, such as rheumatoid arthritis, neurological impairments that could influence muscle activity, such as multiple sclerosis, Guillain-Barré syndrome, stroke, and recent orthopaedic surgery, such as internal fixation, joint replacement surgery.

General obesity was classified using the Asian BMI scale.[17] BMI was calculated using the standard format. The participants were considered overweight if their BMI was ≥25kg/m$^2$ and obese when it was ≥30kg/m$^2$.[16]

For WC, a tape measure was placed at the midpoint between the iliac crest and the lower border of the last palpable rib in the mid-axillary line. Tape measure points were recorded at the end of normal expiration. The risk of central obesity rises noticeably with WHR >0.80.[16] Tape measure shows the strongest intrarater reliability ranging i.e. intra-class correlation coefficients (ICC) ranging from 0.77-0.83.[13] For DRA, all the participants went through screening that was done using a Vernier caliper (Model # TMT311501; Company: TOTAL-Pakistan) at three measuring points; at the umbilical region, 4.5cm above and below the umbilicus, considered supra- and infra-umbilical, respectively. The subjects had to lie supine on the couch with hip and knee flexed to 90 degrees, and upper arms alongside the trunk. They were asked to perform forward trunk flexion until the scapula's inferior angle left the couch. By keeping this position, the evaluator palpated the medial border of the rectus muscle and measured IRD on the marked position with the caliper.[1] A distance >2cm was considered positive.[10] Three readings of each location and their average were calculated to reduce the chance of potential bias in assessment. The Vernier caliper demonstrates a high reliability, with intra-class correlation coefficients (ICC) ranging from 0.80 to 0.99 and a retest reliability ICC of 1.00.[18]

Data was analysed using SPSS 23. Data was expressed as frequencies and percentages, mean ± standard deviation, or as median with interquartile range (IQR), as appropriate. Fisher's exact test was used to assess the association of baseline characteristics of the participants with DRA. Data normality was checked using the Kolmogrov-Smirnov test. Mann Whitney U test was used to compare median differences for physical, maternal and other parameters. Binary logistic regression analysis was used to estimate the odds ratio (OR) with 95% CIs using univariate and multivariate models. P<0.05 was considered statistically significant.

## Results

Of the 100 women with mean age 52.3±5.4 years, DRA was found in 20(%). Baseline characteristics showed no significant association with IRD (p>0.05) (Table 1).

**Table-1**: Association of baseline characteristics with the presence of interrectus distance.

| Variables | Presence of Interrectus Distance | | | | | |
|---|---|---|---|---|---|---|
| | Total (N=100) | Yes (n=20) | | No (n=80) | | p-value |
| | % | N | % | N | % | |
| **Age group** | | | | | | |
| 40 - 45 years | 14 | 3 | 15.0 | 11 | 13.8 | 0.59 |
| 46 - 50 years | 32 | 8 | 40.0 | 24 | 30.0 | |
| 51 - 55 years | 27 | 6 | 30.0 | 21 | 26.3 | |
| >55 years | 27 | 3 | 15.0 | 24 | 30.0 | |
| **Mean ±SD** | **52.3±5.4** | **50.9** | **±4.9** | **52.7** | **±5.5** | |
| **Occupation** | | | | | | |
| House wife | 85 | 17 | 85.0 | 68 | 85.0 | 0.99 |
| Working women | 15 | 3 | 15.0 | 12 | 15.0 | |
| **Education** | | | | | | |
| Primary | 56 | 16 | 80.0 | 40 | 50.0 | 0.06 |
| Secondary | 27 | 3 | 15.0 | 24 | 30.0 | |

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|---|---|---|---|---|---|---|
| College and above | 17 | 1 | 5.0 | 16 | 20.0 | |
| **Body mass index (BMI) levels** | | | | | | |
| Underweight | 1 | 0 | 0.0 | 1 | 1.3 | 0.60 |
| Normal weight | 13 | 2 | 10.0 | 11 | 13.8 | |
| Overweight | 24 | 3 | 15.0 | 21 | 26.3 | |
| Obese | 62 | 15 | 75.0 | 47 | 58.8 | |
| Mean ±SD | 29.4±6.0 | 29.8 | ±4.9 | 29.2 | ±6.2 | |

p-value was obtained using Fisher's Exact test
SD: Standard deviation.

**Table-2:** Association of maternal parameters with the presence of interrectus distance.

| Variables | Presence of Interrectus Distance | | p Value |
|---|---|---|---|
| | Yes Median (IQR) | No Median (IQR) | |
| Age of menstrual cycle stopped | 44(48-40) | 45(48-41) | 0.44 |
| No. of pregnancies | 6(9-4) | 5(8-4) | 0.64 |
| No. of children | 5(7-3) | 4(6-3) | 0.58 |
| No. of Caesarean deliveries | 0(2-0) | 0(1-0) | 0.67 |
| No. of vaginal deliveries | 4(6-0) | 4(6-1) | 0.88 |
| Age of last delivery | 33(37-31) | 34(38-29) | 0.89 |

p-value was obtained using Mann Whitney U test
IQR: Interquartile range.

Maternal parameters were not significantly associated with the presence of IRD (p>0.05) (Table 2).

Umbilical, supra-umbilical and infra-umbilical values were significantly different between the patients and the rest (p<0.05) (Table 3).

**Table-3:** Comparison of interrectus distance (IRD) measurements at umbilical, supra-umbilical, and infra-umbilical levels in relation to the presence of diastasis recti.

| Variables | Presence of Interrectus Distance | | p Value |
|---|---|---|---|
| | Yes Median (IQR) | No Median (IQR) | |
| Umbilical | 2.05 (2.35-1.55) | 1.5 (1.77-1) | <0.01* |
| Supra-umbilical | 1.5 (1.9-1.39) | 1.05 (1.5-0.95) | <0.01* |
| Infra-umbilical | 1.6 (2.65-1.15) | 1.05 (1.5-0.95) | <0.01* |

*p-value considered significant using Mann Whitney U test
IQR: Interquartile range.

**Table-4:** Risk estimation for the presence of interrectus distance using binary logistic regression analysis.

| Variables | Presence of Interrectus Distance | | p Value |
|---|---|---|---|
| | Univariate Odds Ratio 95% C.I | Multivariate Odds Ratio 95% C.I | |
| BMI | 0.98 (0.90 – 1.06) | 0.99 (0.90 – 1.08) | 0.06 |
| WC (cm) | 0.99 (0.96 – 1.02) | 0.99 (0.95 – 1.03) | 0.08 |
| Umbilical | 0.06*(0.01 – 0.27) | 0.006*(0.00 - 0.09) | <0.01 |
| Supra-umbilical | 0.13*(0.04 – 0.43) | 0.11*(0.01 - 0.82) | <0.01 |
| Infra-umbilical | 0.08*(0.02 – 0.28) | 0.02*(0.002 – 0.16) | <0.01 |

*odds ratio considered significant with p<0.05
BMI: Body masss index, WC: Waist circumference, CI: Confidence interval..

Binary logistic regression analysis showed that IRD presence had a significant impact on umblical, supra-umbilical and infra-umbilical values (p<0.05) (Table 4).

## Discussion

The current study revealed that DRA was positive in 20% cases and there was no statistically significant association found between DRA and obesity.

In the current study, among positive cases of DRA, the majority of participants were in their late 40s, with most of them being housewives with primary education. One-third of the population was obese. Those with DRA had a higher-than-average weight of 73.5kg, and their height was shorter than the average Asian standard. The WC of positive cases of DRA was nearly 100cm. The current study did not find a significant association between DRA and these physical measurements (p>0.05).

In a 2022 study, DRA was less frequent, and it reported no statistically significant association between DRA and stage of pregnancy, but there was a significant association between DRA and the status of pregnancy.[19] The study found the same prevalence of DRA as did the current study, but it was conducted on pregnant women. The reason of the positive association of DRA with the status of pregnancy might be due to the increased pressure on the abdominal wall during the third trimester which causes the linea alba to stretch and separate.

In a 2020 study, the results indicated that DRA was highly prevalent among pregnant women and half of them demonstrated DRA above the umbilicus level.[20] In contrast to the current study, the higher prevalence among pregnant women was due to biomechanical stress. The supra-umbilical region might be subject to stress due to the weight and pressure of the growing foetus, contributing to the development of DRA. Despite the similar prevalence found in the study, it cannot be concluded that both pregnant and post-menopausal women have the same risk factors for the development of DRA.

A study found that a quarter of the sample of postpartum women diagnosed with pelvic floor diseases screened positive for significant uterine infection and DRA. It also found a higher prevalence of DRA among those with vaginal mode of delivery.[21] Another study found a higher prevalence for the umbilicus DRA, followed by supra-umbilical DRA and a very few cases of infra-umbilical DRA among 6-8 week postpartum women.[22] The contradictory results might be due to hormonal changes, multiple pregnancies and extra weight on linea alba during pregnancy. The increase in the number of positive cases

of vaginal delivery could be the reason of the pushing and expulsion of the baby during the second stage of labour.

Literature showed a higher prevalence of DRA at 6 weeks, followed by 6 months. The lowest prevalence of about 2% was found in 12 months after the second delivery. In contrast to the current study, the study also found a significant association between WC, twins, caesarean delivery and DRA.[23] The impact of labour and pregnancy on linea alba could be the cause of the contradictory findings of a higher prevalence and positive correlation of DRA with maternal variables.

A prospective cohort study in 2021 among women attending their early pregnancy ultrasound screening showed that there was a successive increase in linea alba width concerning each pregnancy, and there was a positive correlation between the number of pregnancies and the width of linea alba.[24] In contrast to the current study, the study took measurements from 3cm above the umbilicus, and included subjects in their first trimester. The results were contradictory since the study populations were different. Because of the increased pressure from the expanding uterus, pregnancy itself is a risk factor for DRA. The study did not consider the supra-umbilical region for IRD, while the current study measured the IRD from the supra-umbilical region as well.

In 2019, a study found the prevalence of DRA among females who attended antenatal and postnatal visits, showing that less than half of the women screened positive for DRA.[25] The prevalence of DRA during antenatal and postnatal visits might be due to the pressure from the expansion of the uterus, and the pushing of the foetus during labour. Caesarean section was positively associated with DRA because the abdominal muscles were cut and separated, which may have caused muscular weakening and DRA development.[25]

A regional study to find out the frequency of DRA and the factors that could be associated with DRA enrolled 128 participants, and, similar to the current study, it measured IRD from three locations in the abdominal region. The result demonstrated that three-quarters of participants had DRA.[26] That study also found a positive association between pregnancy and DRA. In contrast to the current study, the majority of positive DRA participants had a history of caesarean delivery.

One study showed a higher prevalence of DRA in the supra-umbilical region (36%) compared to the infra-umbilical region (6%). The DRA group showed a higher prevalence of pelvic floor dysfunction than those who screened negative for DRA. Moreover, the participants who had positive DRA were obese similar to the current study's findings. The average abdominal circumference above the umbilical was 91.03 and below the umbilical it was 97.44.[1] The study did not describe the distribution of peri-menopausal and post-menopausal women. The abdominal muscles may be the weakest in the umbilical area due to pressure from various conditions, such as hernias and post-menopausal androidal fat.

The current study has limitations, like a small sample size affecting the generalisability of the findings. Besides, the tool used to measure IRD has potential errors, and these errors can be minimised using a digital caliper or gold standard ultrasonography. Future studies with a larger sample size and gold standard tools are recommended.

## Conclusion

DRA was less commonly found in post-menopausal women, and umbilical DRA was more prevalent than any other type. There was no significant association between DRA and obesity. Participants with DRA tended to be in the obese category with a higher WC than the defined cut-off value.

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**UR:** Concept, design, drafting and agreement to be accountable for all aspects of the work.

**SSA & AAMB:** Concept, design, drafting, final approval and agreement to be accountable for all aspects of the work.