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Original Research Article

Assessment of Diastasis Recti Abdominis using Dial Caliper in Overweight and Obese Adults (18 years and above) and Its Relationship with Lumbopelvic Pain: A Pilot Study

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ABSTRACT

Background: Diastasis recti abdominis is present in both gender and is associated with increasing age, activities including regular lifting of heavy weights or sit-ups, a history of midline abdominal surgery, signiûcant hormonal changes due to replacement therapy, menopause, congenital, chronic obstructive pulmonary disease and obesity. Studies have proven physiotherapy is beneficial in managing DRA but not many studies are done to show presence of DRA. Hence our study is a small attempt at diagnosing DRA in most vulnerable population i.e. overweight and obese population.

Objective: To assess presence of diastasis recti abdominis in overweight and obese adults (18 years and above) using dial caliper. To correlate diastasis recti abdominis with lumbopelvic pain, gender and parity.

Methods: 90 subjects were allocated in this study (30 overweight, 30 obese 1 and 30 obese 2). Presence of DRA was assessed using dial caliper in them and correlated with BMI. Subjects who had DRA present, their values were correlated further with Lumbopelvic pain, gender and parity.

Results: Out of 90 subjects, 67 (74%) had DRA present [21 (23.3%) in overweight, 22 (24.4%) in obese 1, 24 (26.6%) in obese 2].There is no correlation of Presence of DRA with BMI. DRA has no correlation with lumbopelvic pain and gender. DRA has moderate positive correlation with parity.

Conclusion: There is Presence of Diastasis Recti Abdominis in overweight, obese 1 and obese 2 adults; however, they are at equal risk of having DRA. Subjects with DRA are not more likely to have lumbopelvic pain than subjects without DRA. DRA can occur in males as well as females and multiparous females are at increased risk of developing DRA than nulliparous and primiparous.

KEY WORDS: Diastasis recti abdominis, overweight, obesity, physiotherapy, lumbopelvic pain.

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INTRODUCTION

Diastasis recti abdominis (DRA) is a separation of two rectus abdominis muscles at linea alba, which covers the front surface of the abdomen [1]. To date, there are some studies about prevalence of DRA in pregnant and postpartum women [2-7] and few studies about prevalence of DRA in men [8] and nulliparous women [4]. Also there are only few studies showing correlation between DRA and obesity [2,8]. DRA is normally seen in newborns and premature infants [7]. It is frequently seen in

pregnancy as a result of hormonal changes on the connective tissue and biomechanical changes of pregnancy. It can occur during labor when there is excessive breath-holding during second stage [9].

Diastasis recti abdominis is not specific to gender and is associated with increasing age, with regular lifting of heavy weights or sit-ups, a history of midline abdominal surgery, or signiûcant hormonal changes due to replacement therapy or menopause [8-11]. Diastasis can be congenital, present with conditions that increase intra-abdominal pressure e.g. chronic obstructive pulmonary disease, obesity, etc. [8,10,11]. Although all of these may contribute to DRA, this condition is most often diagnosed in pregnancy only [9,10,12].

DRA can develop at three levels with respect to umbilicus - above, below or at the umbilicus. Separation between diastasis recti muscles greater than two finger widths at any of the above mentioned levels is considered significant [13].

This condition can be diagnosed by physical examination, and must be differentiated from hernias, although severe DRA can result into herniation of the abdominal viscera [7]. DRA causes no discomfort so often not noticed by patients, as well as health care professionals, and hence not addressed.

A large DRA may jeopardize the functions of the abdominal wall like its role in delivery of a fetus, respiration, posture, trunk ûexion, rotation, and side bending [4]. It may cause lumbopelvic pain as a result of decreased ability of abdominal musculature and thoracolumbar fascia to stabilize pelvis and lumbar spine [13].

Lumbopelvic pain is classified as low back pain and pelvic girdle pain. A Low back pain (LBP) is defined as pain located in L_2 –L_5 area with or without radiation to the lower limbs. Pelvic girdle pain is defined as localised pain in the SI joints, unilaterally or bilaterally and at the pubic symphysis [4,10].

Lumbopelvic pain has also been linked with obesity [14]. Obesity is a medical condition in which excess body fat has accumulated to an extent that it may have a negative effect on health (WHO 2015). Obesity is a growing public health concern. Approximately one-third of the world's adult population is overweight [14]. In obesity, increased body weight leads to wear and tear on joints and discs which in turn increases the physical demands on muscles and ligaments leading to early degeneration of discs which causes LBP [15-16]. Hence, we need to see if these people have DRA in common too.

Overweight and obesity is defined by body mass index (BMI). Body mass index is a person's weight in kilograms to square of the patient's height in meters [17,18].

According to WHO, BMI for Asian Indian population is [19,20]

Overweight - 23.1-24.9 kg/m^2

Obese Class I = 25 – 29.9 kg/m^2

Obese Class II = >30 kg/m^2

The traditional finger width palpation method for assessing DRA has been shown to lack reliability, thus dial caliper is used [5,21]. In DRA measurements taken during abdominal contraction, the nylon dial caliper has shown high intra-rater reliability on postpartum women (ICC= .95) [5,22]. Jones also found the dial caliper to have a high inter-rater reliability (ICC =0.90-0.93) [5,23].

Hence, the aim of the study is to assess presence of DRA using dial caliper in overweight and obese adults and its relationship with lumbopelvic pain.

MATERIALS AND METHODS

Patients: The study was conducted in physiotherapy department of tertiary care hospital with the inclusion criteria: Male and female subjects aged 18 years and above having BMI (Body Mass Index) more than or equal to 23 kg/m^2 and exclusion criteria :1) Acute illnesses requiring hospitalisation within past 2 months.2)Previous spinal or abdominal corrective surgery.3) Inflammatory backache. 4)Neuromuscular diseases.4)Women who are pregnant.5)Women who are less than 12 months postpartum.6)Patient unwilling to participate in the study.

The Institutional Ethical Committee had approved the research protocol. Subsequently,

the protocol was registered in Clinical Trial Registry of India bearing registration number CTRI/2018/09/015858. All enrolled patients gave their written informed consent, and all procedures were conducted in accordance with the Declaration of Helsinki.

Design: The design of this study was a Cross-sectional observational study, the subjects were allocated into overweight, obese 1 and obese 2 groups according to BMI. As it was pilot study [24,25], each group consisted of 30 subjects (15 males and 15 females). So the total sample size was 90 subjects.

Method: To measure the DRA, the subject was asked to lie in the supine position with hips and knees bent (hook lying position), feet supported on the treatment table and arms crossed over chest. The reference points were marked using water soluble pen at 4.5 cm above umbilicus, and 4.5cm below the umbilicus. The evaluator placed fingers perpendicularly on the reference points. Next, the subject was asked to lift head and shoulders off the table. The evaluator palpated the medial borders of the rectus bellies and then kept her fingers in place along with the dial caliper ends { High intra- rater reliability during abdominal contraction (ICC= .95) and high inter-rater reliability (ICC =0.90-0.93) [5,22,23] on the medial borders of the rectus abdominis perpendicular to the surface of the muscle. Two measurements were taken at each of the two reference points and an average of the 2 measurements was recorded. The subject was permitted to rest any time between the measurements [5]. Cut-off value of diastasis recti abdominis measurement: The subjects were classiûed into four categories depending on the largest measured inter-recti distance among the two locations: (1) non-DRA - <2 cm, (2) mild diastasis - 2–3 cm, (3) moderate diastasis - 3–4 cm, (4) severe diastasis - 4 cm or more. Observed protrusion along the linea alba was categorised as DRA even if the palpated distance was <2 cm. [2,31]. Presence of DRA was analysed as yes/no and mild, moderate and severe grade of DRA [2].

Presence of lumbo pelvic pain was assessed in subjects. Pain location was assessed with the subjects pointing out the body area in which they had pain and classified in 5 categories [2]: (1) localized low back pain, (2) low back pain with radiation, (3) pain in pubic symphysis, (4) unilateral SI (Sacroiliac) joint pain, (5) bilateral SI joint pain.

Statistical analysis: All statistical analyses were performed using the SPSS version 16.0 (IBM, Armonk, NY, USA) for Windows. Alpha level was set at 0.05 to control for Type I error, and confidence interval was set at 95% for all statistical analysis. As data did not pass normality, Spearman r correlation test was used.

RESULTS

90 subjects participated in the study. There were 30 Overweight, 30 Obese 1 and 30 Obese 2. Each group had 15 males and 15 females. Table 1 shows age, BMI, Inter-Recti Distance (IRD) distribution in each group.

Table 1: Mean and Standard Deviation.

Mean ± SD	Overweight	Obese 1	Obese 2
Age	44 ± 12.55	48.26 ± 10.70	43.93 ± 12.97
Body Mass Index (BMI)	23.90 ± 0.610	27.57 ± 1.45	33.99 ± 3.49
Inter-Recti Distance (IRD)	2.17 ± 0.91	2.17 ± 0.705	2.18 ± 0.896

Table 2 shows distribution of Presence of DRA measured by the Largest Inter-recti distance above or below umbilicus. Out of 90 subjects, 67 (74%) had DRA present. Out of 67 DRA, 37 (55%) were males while 30 (45%) were females.

Table 2: Distribution of Presence of DRA [measured by the Largest Inter-recti distance (in cms) Above or Below Umbilicus].

Presence Of Dra	Overweight			Obese 1			Obese 2		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Present	12	9	**21**	12	10	**22**	13	11	**24**
Absent	3	6	9	3	5	8	2	4	6

There was no relationship between Presence of DRA and BMI. The r value (.060) was not significant at 95% confidence interval. Number of DRA present above umbilicus were consistently greater across groups as well as gender than number of DRA present below umbilicus. Out of 67 DRA, 65 (97%) subjects had DRA above umbilicus while 27(40%)

subjects had DRA below umbilicus thus 25 (37%) subjects had DRA at both the levels. 54 (81%) subjects had mild DRA (2-3 cms) while 13 (19%) had moderate DRA (3-4 cms). We did not get any severe DRA (>4cms) in our study.

There was no relationship between DRA and Gender. The r value (-.029) was not significant at 95% confidence interval.

41 out of 67 (61%) subjects with DRA present had lumbopelvic pain [Localized low back pain – 35/67 (52%) and low back pain with radiation – 6/67 (9%)]. However, 19 out of 23 (83%) subjects who did not had DRA also had lumbopelvic pain [Localized low back pain – 14/23 (61%) and low back pain with radiation – 5/23 (22%)]. In our study, we did not find any subject having pubic symphysis pain, unilateral sacroiliac joint pain or bilateral sacroiliac joint pain.

There was no relationship between DRA and Lumbopelvic pain. The r value (.188) was not significant at 95% confidence interval.

There was moderate positive relationship between DRA and Parity. The r value (.433) was significant at 95% confidence interval.

DISCUSSION

The above results indicates there is presence of DRA in overweight, obese 1 and obese 2 adults and that overweight are at equal risk of having DRA as obese adults. Thus DRA can occur with increased weight.

This result is supported by study done by Qu E and Zhang X who measured IRD at 4 locations (at the umbilical level, 3 cm above the umbilicus, 6 cm above the umbilicus, and 3 cm below the umbilicus) in 100 healthy nulliparous females and 99 postpartum females. They found positive correlation of BMI with IRD in 100 healthy nulliparous females (r = 0.286) [26].

Cheesborough JE et al in their study selected thirty-two patients, 29 women and 3 men who underwent mesh-reinforced midline repair with horizontal or vertical abdominoplasty had mean body mass index 26 kg/m^2 and average width of diastasis or hernia was 6.7 cm [27].

In another study by Palanivelu C et al. They selected 18 patients with DRA for laproscopic correction. Mean BMI of this patients was 28.6 kg/m^2 (range 25 to 32.2 kg/m^2). They concluded that obese patients had a larger IRD [32].

Doubkova L et al whose objective was to examine the association between DRA and LBP in 55 participants with chronic LBP (at least 3 months) and 54 participants without chronic LBP. Mean age was 55 years. They observed that mean BMI (28.2) was higher in participants with DRA (n=16) than mean BMI (24.6) of participants without DRA (n= 93). They suggested that there was strong correlation of BMI with DRA [33].

Percentage of DRA was high in our population. This is supported by an Indian study done by Dalal K et al in 30 women seeking medical care for lumbar and pelvic area conditions (> 18 years and had at least one child). The incidence of DRA in their study sample was 83.3% [28].

Also study done by Spitznagle TM et al reported 281 out of 541 (54%) women presented with DRA. They conclude that race (Asian or Caucasian) as one of the risk factors of DRA [9]. Thus, high percentage of DRA in the present study might be due BMI as well as race of the study sample.

There was no significant relationship between DRA and Gender. Thus, DRA can occur in males as well as females.

We found one supporting study by Doubkova L et al where out of 16 DRA participants, 9 were males and 7 were females.[33] Most of studies included only female participants.

Number of DRA present above umbilicus were greater than number of DRA present below umbilicus. Out of 67 DRA, 65 (97%) subjects had DRA above umbilicus while 27(40%) subjects had DRA below umbilicus thus 25 (37%) subjects had DRA at both the levels.

A study done by Boissonnault JS et al supports this finding. The study intended to determine the incidence of diastasis recti abdominis among women during the childbearing year and the location of the condition along the linea alba. They found that 36% of DRA cases had at the level of above umbilicus while 11% had DRA at the level of below umbilicus [4]. Rett MT et al also found in their study that

prevalence of DRA above umbilicus was 68% and DRA below umbilicus was 32% [6].

The reason for lower percentage of DRA below umbilicus may be because of the anatomical variation in the arrangement of the fasciae that cover the rectus abdominis. The arcuate line occurs about 1/2 of the distance from the umbilicus to the pubic crest, but this varies from person to person. Above the arcuate line, the rectus abdominis is surrounded by an anterior layer of the rectus sheath and a posterior layer. The anterior layer is derived from the external oblique aponeurosis and the anterior lamina of the internal oblique aponeurosis. The posterior layer is made up of the posterior lamina of the internal oblique aponeurosis and the transversus abdominis aponeurosis. Inferior to the arcuate line, all three muscle aponeuroses make up the rectus sheath, that is now only anterior to the rectus abdominis. Thus, in the final portion of these muscles, the positions of the fasciae are different and prevent separation [6].

We did not get any severe DRA (>4cms) in our study. This finding is supported by Turan V et al study. In their study, they found out of 23 patients with DRA, 17 (74%) patients had 1.5 to 2 fingerbreadths IRD (approx. 2-3 cms) while 6 (26%) had 2.5 to 3 fingerbreadths IRD (approx. 3-4 cms). The patients in the study also did not have severe DRA [7].

There was no relationship between DRA and Lumbopelvic pain. Thus, subjects with DRA in our study were not more likely to have lumbopelvic pain than subjects without DRA. This finding is consistent with Sperstad JB et al stud. It was a prospective cohort study which followed 300 ûrst-time pregnant women from pregnancy till 12 months postpartum. At 12 months postpartum, 26 (45.6%) out of 57 DRA and 39 (32.5%) out of 120 non-DRA had lumbopelvic pain. Most of DRA present women had mild DRA (56 out of 57). Thus, they conclude that women with DRA were at no greater risk of having lumbopelvic pain than women without DRA at 12 months postpartum. They indicate that mild DRA was not associated with lumbopelvic pain [2].

In another study by Mota P et al. found that prevalence of lumbopelvic pain was similar for women with and without DRA (27.3% and 27.5% respectively). They conclude that women with DRA had the same chances of having lumbopelvic pain than those without DRA [3].

Parker MA et al found no significant difference between women with and without DRA in lumbopelvic pain. They found an association between DRA and abdominal and pelvic region pain and explained that observation of no association between DRA and LBP might be due to inclusion of women with non-severe DRA [5].

A study done by Dalal K et al however found a moderate positive correlation between DRA and lumbopelvic pain [28]. In our study, there was moderate positive relationship between DRA and Parity.

This indicates that multiparous are at increased risk of developing DRA than nulliparous and primiparous. Turan V et al supports our finding. They studied 95 patients between 19-24 years for presence of DRA. 95 patients included 19 nulliparous, 39 primiparous, 37 multiparous. They got positive correlation between parity and DRA ($r=0.77$, $p<0.001$). They did not find significant difference between DRA and type of delivery among primiparous but observed that DRA increased significantly in second C- section patients ($p=0.004$). Thus they conclude that increased parity and recurrent abdominal surgery increase risk of DRA [7]. Spitznagle TM et al reports that patients with DRA had higher gravity and parity than patients without DRA [9]. Lo T et al also concludes that there is an increased risk for developing DRA in multiparous pregnant women [12]. Chiarello CM et al also reported that women who had mean parity of 2 has high chances to develop DRA [29].

Strengths: Equal number of male and female subjects and also equal number of subjects in each group.

Limitations: Small sample size, Randomised controlled trial would have been better than convenient sampling.

Suggestions: Further studies should be carried out using normal BMI as well as overweight

and obese population. Detail studies should be carried using only males to find out prevalence of DRA in them.

Registration number – CTRI/2018/09/015858 [Clinical Trials Registry – India (CTRI), URL – http://ctri.nic.in]

CONCLUSION

There is Presence of Diastasis Recti Abdominis in overweight, obese 1 and obese 2 adults. Out of 90 subjects, 67 (74%) had DRA present [21 (23.3%) in overweight, 22 (24.4%) in obese 1, 24 (26.6%) in obese 2].

There is no correlation of Presence of Diastasis Recti Abdominis with BMI i.e overweight, obese 1 and obese 2 are at equal risk of having DRA. Diastasis Recti Abdominis has no correlation with lumbopelvic pain and gender. Diastasis Recti Abdominis has moderate positive correlation with parity.

Conflicts of interest: None

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