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Prevalence of Diastasis Recti Abdominis Using Dial Vernier Calliper among Overweight Males: An Observational Study

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Abstract

Diastasis Recti Abdominis (DRA) is characterized by the separation of the rectus abdominis muscles at the Linea alba, leading to a gradual thinning and widening of this central connective tissue. While commonly observed in women, particularly during and after pregnancy, DRA is also increasingly recognized in men, with distinct risk factors and implications. This study aimed to investigate the prevalence and severity of DRA among overweight males, a demographic often underrepresented in existing research. Using a cross-sectional observational design, 96 male participants aged 35 years and older with a Body Mass Index (BMI) ranging from 25 to 29.9 kg/m² were assessed using a dial vernier calliper to measure inter-recti distance. Results indicated that 54.16% of participants exhibited DRA, with 22 classified as having mild, 28 moderate, and 2 severe DRA. The findings highlight the significant occurrence of DRA in overweight males, suggesting a need for further research to explore its implications for health, particularly concerning associated conditions like hernias and chronic pain. Early intervention strategies may be necessary to mitigate the risks associated with DRA, reinforcing the importance of recognizing this condition as a relevant health issue in the male population. This study underscores the necessity for targeted research focusing on DRA in males to better understand its prevalence, severity, and associated health implications.

Keywords: Diastasis recti abdominis, Overweight males, Inter-recti distance, Linea alba

Introduction

The separation of two rectus abdominis muscles at Linea alba, which covers the front surface of the abdomen is known as Diastasis recti abdominis (DRA) ^[1]. In the Linea alba, collagen fibres from both sides of the abdominal wall muscle sheets cross in an interwoven pattern this structural characteristic ensures core stability under abdominal muscle tension which allows the accommodation of intraabdominal volume by chronic separation of the medial borders of the rectus muscles ^[2]. In DRA it involves gradual thinning and widening of Linea alba with general laxity of ventral abdominal wall ^[3]. The space formed by separation of the Linea alba in DRA called as an inter-recti distance (IRD) ^[4]. DRA can develop at three levels with respect to umbilicus - above, below or at the umbilicus and distance of 2 cm is considered normal and larger than it called as rectus diastasis ^[1, 5].

This condition is commonly seen in the childbearing woman, although it is not exclusive to this population and can also be found in men ^[6]. Current concepts about rectus diastasis are based on the development and treatment of RD in females but in male's hormones and intra-abdominal pressure play a role in the development of rectus diastasis ^[4].

The risk factors associated with males are increasing age, weight fluctuations, weightlifting full sit-ups familial weakness of abdominal muscles ^[4]. Increased intra-abdominal pressure causes tissue expansion of the abdominal wall, particularly at the line alba. Although certain conditions (such as genetic predisposition, aging, obesity, ascites, and chronic obstructive pulmonary

disease) increase the risk of developing rectus diastasis [7].

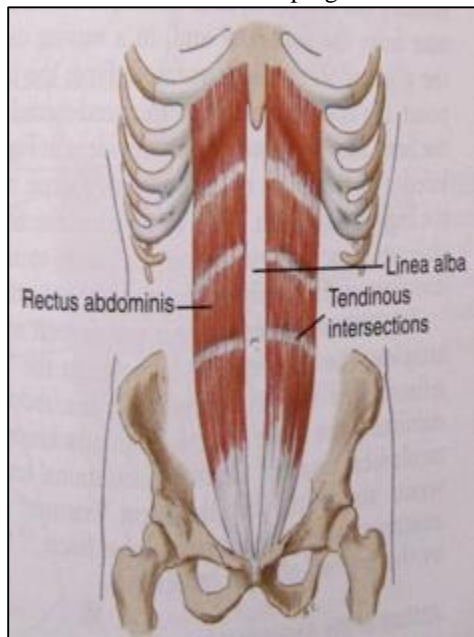


Fig 1

Rectus diastasis is associated with epigastric and umbilical hernias and some of researcher's believe that the male abdominal wall is stiffer which contributes to the coexistence of these hernias [7]. The overall prevalence of RD in males is unknown. Other common causes for Diastasis Recti are Obesity [5]. Obesity being a chronic metabolic disease leads

to ill health and a common cause of disability and death as there are increased fat stores of body. Approximately one-third of the world's adult population is overweight and is a growing public health concern [1, 8, 11].

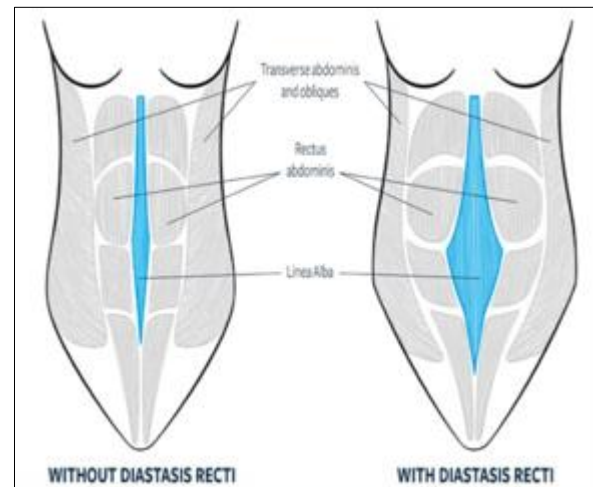


Fig 2

Body can be evaluated by Body Mass Index (BMI) calculated by body weight in (kilograms) divided by height in m^2 . Overweight patients have a BMI of 25 kg/m^2 or more, whereas obese patients are classified into 3 grades i.e., Grade 1 includes BMI of (30.0-34.9) kg/m^2 , Grade 2 includes (35.0-39.9) kg/m^2 and Grade 3 equal to or more than 40 kg/m^2 [1,8].

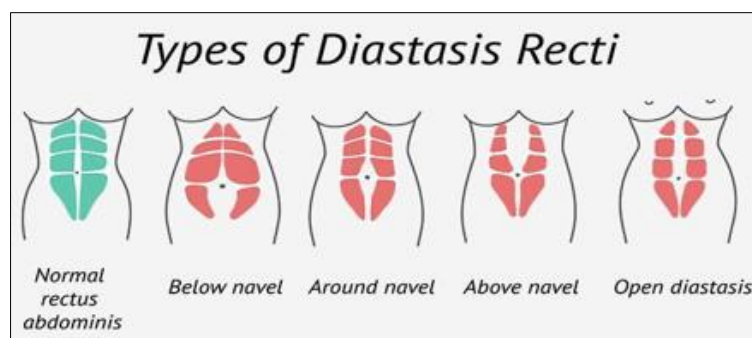


Fig 3

Need of Study

- Diastasis recti abdominis (DRA) is a separation of two rectus abdominis muscles at Linea alba, which covers the front surface of the abdomen
- In Males, diastasis recti is a rare and different concept.
- As compare to male population large scale studies are carried out in female population and rehabilitation programme is also research to overcorrect it but very few studies are conducted in male population and is under negligence.
- Also, there is lack of data among overweight males as comparative to obese male and thus it becomes crucial to gather more evidences and to carry out research in this specific population.
- Also, now a days one third of world's population is overweight and obese which leads to its morbid effect.
- So, there is a need for more research about the presence of DRA in overweight males so we can help to reduce the risk of associated factors like urinary incontinence,

faecal incontinence, urogenital prolapse, hernia, low back pain etc and can start with early intervention strategies to correct it.

Aim

The Aim of the study is to find the prevalence of diastasis recti abdominis using dial vernier calliper among overweight males.

Objectives

1. To asses diastasis recti abdominis using dial vernier calliper among overweight males.
2. To asses the categorial severity of diastatis recti abdominis.

Review of Literature

1. As Gaonkar B, Khedekar P(2021)conducted a study on Assessment of Diastasis Recti Abdominis using Dial Calliper in Overweight and Obese Adults (18 years and

- above) and Its Relationship with Lumborhythmic pain in 90 overweight and obese adults out of which 30 overweight, 30 obese 1 and 30 obese 2 and it is correlated with BMI and therefore it is concluded that there is Presence of Diastasis Recti Abdominis in overweight, obese 1 and obese 2 adults and they are at equal risk of having DRA, it can occur in both males and females Subjects with DRA are not more likely to have lumbopelvic pain than subjects without DRA.
2. Nienhuijs S, Berkvens E, Vries Reilingh T, Mommers E, Bouvy N, J. Wegdam (2021) ^[5]. Conducted study on the male rectus diastasis: a different concept as the middle-aged males living with obesity are the second most common group of rectus diastasis patients, the type was a non- systematic review explorative free-text multi-database bibliographic search. Study type, language or time period, describing aetiology, symptoms, classification and/ or treatment options were eligible for inclusion and it is concluded that Rectus diastasis effects both men and women but absolute intra-abdominal pressure increase by visceral obesity and relative pressure increase by exercise seem to apply more to men.
 3. Kaufmann, Reiner C, Dietz U, Clavien P, Vonlanthen R, Käser A(2021) ^[2] conducted a study on Normal width of the Linea alba, prevalence, and risk factors for diastasis recti abdominis in adults, a cross-sectional study on interrectal distance and the prevalence of DRA in computed tomography (CT) in an asymptomatic population with equal distribution according to gender and age 18-90 years with CT as an established reliable method is used to assess DRA and the interrectal distance was measured at six reference points and it is concluded that DRA is highly prevalence in 57% population and age, BMI, parity are its risk factors.
 4. Cavalli M, Aiolf A, Bruni P, Manfredini L, Lombardo F, Bonfanti M, Bona D, Campanelli G (2021) ^[3] conducted study on Prevalence and risk factors for diastasis recti abdominis: a review and proposal of a new anatomical variation as rectus diastasis is an acquired condition in which the rectus muscles are separated by an abnormal distance along their length, but with no fascia defect An extensive literature search was conducted All the articles, case reports, and case series were included in this narrative review and it is concluded as the actual prevalence of DRA is unknown because the prevalence rate varies according to the measurement method, measurement site and judgment criteria, but it is certainly an extremely frequent condition It is equally uncertain whether DRA is to be considered a pathological condition or a natural part of aging, and the risk factor for DRA have not been clearly defined
 5. Cheesborough J, Dumanian G conducted study on Simultaneous Prosthetic Mesh Abdominal Wall Reconstruction with Abdominoplasty for Ventral Hernia and Severe Rectus Diastasis Repairs it is observed that Standard abdominoplasty rectus plication techniques may not suffice for severe cases of rectus diastasis but prosthetic mesh facilitates the repair of severe rectus diastasis with or without concomitant ventral hernias, A retrospective review of all abdominal wall surgery patients treated in the past 8 years by the senior author (G.A.D.) was performed. Thirty-two patients, 29 women and three men, underwent mesh-reinforced midline repair with horizontal or vertical abdominoplasty
- Patients and rectus diastasis repair with mesh or a combined ventral hernia repair were analysed and it is concluded that patients with significant rectus diastasis, with or without concomitant hernias, the described mesh repair is both safe and durable.
6. Michalska A, Rokita W, Wolder D, Pogorzelska J, Kaczmarczyk K conducted study on Diastasis recti abdominis — a review of treatment methods to present the methods of DRA treatment based on the results of recent studies as DRA is both a common and significant clinical problem, little is known about its risk factors, prevention or management as weakening of the anterior abdominal wall may lead to epigastric and umbilical hernias and the separation of the Linea alba in DRA results in the forming of a space referred to as an inter-recti distance In the clinical practice, different measurement methods of IRD are applied. There are no strict recommendations as to the place of measurement (distance from the umbilicus), the body position (at rest in the supine position or during contraction in the head lift position) or the method. The following may be applied: palpation, tape measure, callipers, ultrasound, CT and MRI.
 7. Puri J, Sharma S, Samuel A, Chahal A(2021) conducted a study on Correlation between Diastasis of Rectus Abdominis Muscle and Low Back Pain in Obese Women as Rectus abdominis is the main core muscle, Weakness or any alteration in it may increase the pressure over the lower back in obese women diastasis of rectus abdominis muscle found to be very common condition here 72 female subjects with Body Mass Index < 30 kg/m² were recruited by snowball sampling method within age group of 35 to 55 years and asses by using vernier calliper and the study concludes a non-significant correlation between the DRAM and LBP in obese women and that it is not necessary that all obese women with low back pain always propose to have Diastasis of Rectus Abdominis
 8. Alamer A, Kahsay, Ravichandran H (2019) ^[11] conducted a study on Prevalence of Diastasis Recti and Associated Factors among Women Attending Antenatal and Postnatal Careatmekelle City Health Facilities as Discontinuity of rectus abdominis muscle weakens the abdomen and reduces the stability of lumbar spine and pelvis. This results in lumbopelvic pain, prolapse of abdominal organs and weakens the pelvic floor muscles. Institutional based cross- sectional study design was conducted in 400 women's s with the use of Urogenital Distress Inventory structured questionnaires by interview and physical examination by fingertip width method and it is concluded that prevalence of Diastasis Recti Abdominis in pregnant and postpartum women was found to be moderate in Mekelle, Ethiopia and it is associated with major risk factors like, lumbopelvic pain, parity, abdominal strengthening exercise and history of caesarean section.

Methodology and Materials

Methodology

Study design: cross sectional -Observational study

Study setting: Residential area Dr. Uhas Patil Medical College and Hospital

Type of sampling: Convenient sampling

Study population: overweight males

Sample size: the formula to calculate minimum sample size-
 $n = z^2 pq / d^2$ Minimum sample size=96

Place of study: Jalgaon

Inclusion criteria

- Male population
- Age group 35 years and above
- BMI – 25-29.9 kg/m²
- Participants willing to participate

Exclusion criteria

- Female population
- Age below 35 years
- BMI- >25-29.9 <kg/m²
- Patients undergone abdominal and spinal surgery
- Patients having pathological back conditions (PIVD, lumbar spondylolisthesis, lumbar canal stenosis, severe low back pain etc)
- Familial Weakness
- Patients suffering from hernia
- Patients not willing to perform.

Materials

- Plinth,
- Water soluble pen,
- Paper,
- Weight machine,
- Stadiometer,
- Calliper,
- Calculator

Outcome Measures

Dial Vernier calliper

An instrument to record short lengths. By means of a screw it can be fixed at any position. A Vernier calliper consists of metallic bar which has inches on one end and centimetres & millimetres on the other. The zero of Vernier should meet zero of main scale, when both the junctions are pressed together. It has two upper jaws which are used for measuring inter diameter of pipes and hollow cylinder^[9]. Vernier calliper has been used for measuring the Inter Rectus Distance measurement: The subjects were classified 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-4cm or more

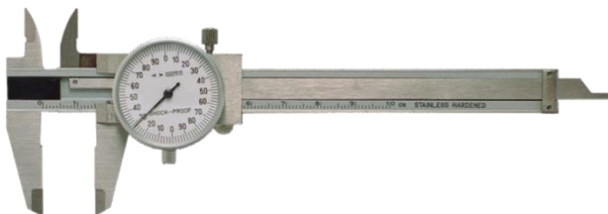


Fig 4

Procedure

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.



FIGURE 5.8. Diastasis recti test.

Fig 5

- The reference points were marked using water soluble pen at 4 cm above umbilicus, and 4 cm 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 vernier calliper 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.
- On the Cut-off value of diastasis recti abdominis measurement: The subjects were classified into three categories depending on the largest measured inter-recti distance as
 - (1) Mild diastasis - 2–3 cm,
 - (2) Moderate diastasis -3–4 cm(3) Severe diastasis-4cm or more



Fig 6

Ethical clearance was taken from the ethical committee of Dr. Ulhas Patil College of Physiotherapy, Jalgaon prior to the commencement of the study.



An Observational study was conducted and subjects were screened on the basis of inclusion – exclusion criteria.



Selected participants Demographic data was obtained and a written consent was taken .The nature and purpose of the study was explained to them.



The DRA was first assessed with palpation method and after with dial vernier calliper 2 times (To minimize the error.)



After data collection, data entry was done in the MS Excel Sheet and results were made using statistical analysis.

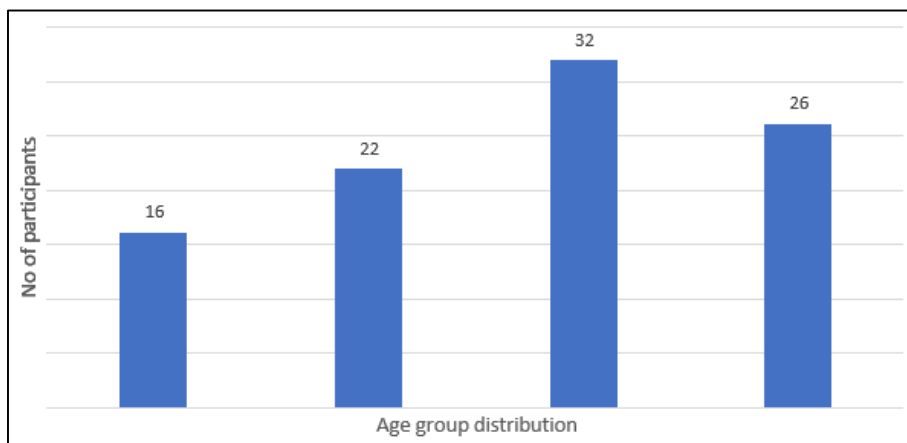
Fig 7

Statistical Analysis

Table 1: The Age Wise Distribution of Subject

Age in Numbers	No of Participants
35-39 years	16
40-44 years	22
45-49 years	32
50-55 years	26

Out of total 96 participants,32 were in 45-49 years group, 26 were in 35-39 years of group. in 50-55 years of group,22 were in 40-44 years of group,16

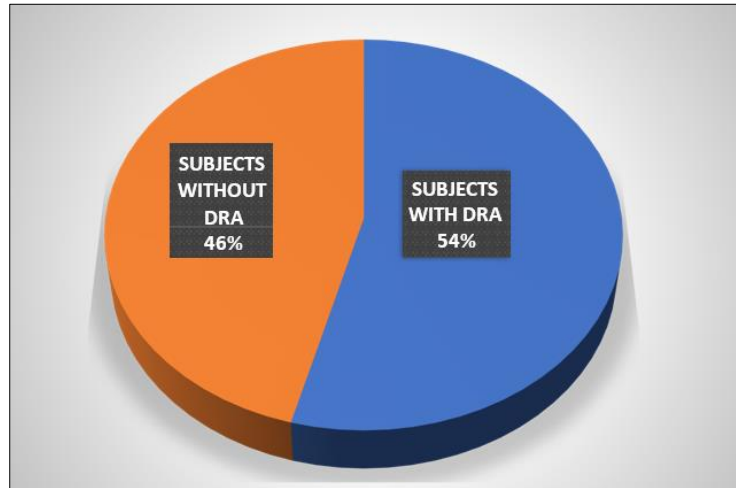


Graph 1: The Age Wise Distribution of Subject

Table 2: Of Presence of DRA in total Subject’s

Subject with DRA	Subject without DRA
52	44

52 subjects are present with DRA and 44 without DRA

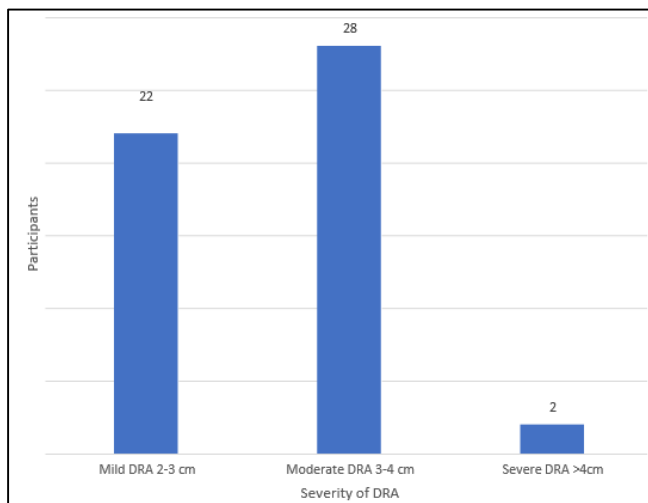


Graph 2: Pie Chart (The presence of DRA in total Subject’s)

Table 3: The Level of Severity of DRA in Subjects

Level of Severity	No of Participants
Mild DRA 2-3 cm	22
Moderate DRA 3-4 cm	28
Severe DRA >4cm	2

Out of total 52 participants with DRA 28 Participants are with moderate DRA 22Participants with mild DRA and only 2 with Severe DRA



Graph 3: The Level of Severity of DRA in Subjects

Results

- In the following study, we found that out of 96 overweight male subject’s Diastasis Recti Abdominis is present in 52 subjects (54.16%) which was calculated by using the dial vernier caliper.
- The categorial severity found was moderate diastasis recti abdominis in total 28 subjects, mild DRA in 22 subjects and severe DRA in 2 subjects.

Discussion

- Male diastasis is a rare and different concept. Till now research on Diastasis Recti was carried only in postpartum women and other conditions in female population. This research is done in very less number in male population. Also, In recent days due to increase in the sedentary lifestyle and excessive changes in the food

- habits along with less physical activities of the body, the one third of world’s population is overweight and obese
- Thus it becomes crucial to do more research in male and overweight population to prevent them from risk factors (like low back pain, urogenital dysfunction and hernia etc.).
- The present study demands with the chief objective to see the presence of diastasis recti abdominis in overweight male population which shows the result - presence of 54% of DRA among overweight male of the age (35-55 years).
- This may be due to following reasons
- As the age progresses muscle mass along with the muscular infiltration of noncontractile elements may influence muscular performance such as strength and rapid force production.
- Skeletal muscle mass decreases with aging by 30%-50% between the age of 40 and 80 years. It is well established that loss of muscle mass contributes to muscle weakness. Several studies also demonstrated that the amount of intramuscular fibrous and adipose tissue in the muscle increases with aging in 38-40 years. In some reports, it was revealed that muscle mass along with muscle quality influences muscle strength.
- Ota *et al.* demonstrated that age-related decreases in muscle thickness of the rectus abdominis and external oblique muscles occur after 50 years of age; on the other hand, age-related changes in muscle quality, which were measured by muscle echo intensity occur after 30 years of age.
- Due to the physiological changes in the muscle, factors (like heavy weightlifting, full sit ups, familial weakness of the abdominal muscles) increases the intra-abdominal pressure which further leads to presence of Diastasis Recti Abdominis. Android obesity causes stretching and widening of the Linea alba. The Linea alba is the insertion point for the central seam of connective tissue fascia of the rectus abdominis, transversus abdominis and the oblique muscles. This lattice of collagen fibers spans the length from the xiphoid to the pubic symphysis and a thus our study demonstrated that the greatest widening occurs at the level of the umbilicus. In obesity stretching of the Linea alba occurs as a consequence of hormonal elastic connective tissue changes and the mechanical strain put on the abdominal wall by

increasing circumstance of abdomen and displacement of abdominal organs. These stresses alter the spatial arrangement of the abdominal muscles and fascia, and modify their optimal line of action reducing their ability to generate force which may leads to develop diastasis recti in overweight male.

- The result of this study was supported with the study conducted by As Gaonkar B, Khedekar P on Assessment of Diastasis Recti Abdominis using Dial Calliper in Overweight and Obese Adults (18 years and above) and Its Relationship with father pain: A Pilot Study which concluded that there is Presence of Diastasis Recti Abdominis in overweight, obese 1 and obese 2 adults and they are at equal risk of having DRA, it can occur in both males and females and further studies should be carried out male population.
- Another study conducted 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 ($r = 0.286$).
- Kaufmann, Reiner C, Dietz U, Clavien P, Vonlanthen R, Käser A conducted study on Normal width of the Linea alba, prevalence, and risk factors for diastasis recti abdominis in adults, a cross-sectional study concluded that in general population, the prevalence of DRA is as high as 57% and age, parity, BMI are independent risk factors of DRA and the mean Linea alba was 22mm (\pm SD 12.88) in an adult population of all age groups.

Conclusion

The study concluded that diastasis recti abdominis is present among overweight males.

Limitation

The study is carried out in Jalgaon city only.

Future Scope

1. In Future the accurate level of presence of DRA can be researched using Ultrasonography.
2. Rehabilitation strategies can be researched and planned in order to correct it and also to prevent the population from its risk of associated factors before it becomes a serious condition which can require surgical procedure to correct.
3. The research can be conducted in the young male population.

Clinical Implication

- This study reflects the need to focus more on the Rectus Diastasis concept in male population and to find out the prevalence in worldwide areas along with the conservative strategies to prevent from its undesirable consequences.

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