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Original Research Article

COMPARISON OF LOW BACK EXTENSORS, ABDOMINAL CORE AND ABDOMINAL MUSCLE ENDURANCE IN NORMAL AND OVERWEIGHT YOUNG FEMALES

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ABSTRACT

Background: High Body Mass Index(BMI) has been linked with increased risk of low back pain(LBP) in females. High BMI has been linked with an increased risk of low back pain. Increased body fat could increase the mechanical load on the spine by causing a higher compressive force or increased shear on the lumbar spine structures during various activities. In LBP, the muscular endurance of the back muscles mainly, the abdominal core, back extensors and abdominals is reduced. Hence, there is a need to assess muscular endurance of the trunk muscles in overweight females so as to determine a cause for LBP. The objective of this study is to compare back extensors, the abdominal core and abdominal muscle endurance in overweight and normal females in the age group of 20-30years.

Method: A group of 120 healthy females were included in this study. Out of these, 60 females were with normal BMI and 60 were overweight. Back extensor endurance was evaluated by Beiring-Sorenson's test. The core muscle endurance was assessed by Sphygmomanometer method in prone lying. In both the tests, holding time was measured by stopwatch. The abdominal muscle endurance was assessed by Partial curl-up test. Curl-ups were done according to the metronome beats. The number of repetitions performed was measured. A comparison was done between normal and overweight females.

Results: In normal females the mean age was 21.18 with mean BMI of 21.96 whereas in overweight females the mean age was 21.27 with mean BMI of 27.44. The mean back extensor, core and abdominal endurance in normal females were 59.053,10.81 and 18.97 respectively was high as compared to overweight which was 30.33,6.13 and 11.27 respectively. Data analysis was done using unpaired t-test. The muscular endurance was significantly reduced ($p<0.00$) in overweight females as compared to the normal females.

Conclusion: This study concluded that back extensor, core and abdominal endurance are significantly reduced in overweight females as compared to normal.

KEY WORDS: Back Pain(LBP), Back Extensor, Abdominal Endurance, Overweight Females.

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INTRODUCTION

According to the National Family Health Survey (NFHS), the percentage of ever-married women aged 15-49 years who are overweight or obese increased from 11% in NFHS- 2 to 15% in NFHS-39 [1]. Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults [2]. WHO defines overweight as a BMI equal to or more than 25 and less than 30 [3]. Although high BMI is most commonly caused by increased energy consumption relative to the energy expenditure, its etiology is highly complex and includes genetic, physiologic,

environmental, psychological and other factors that interact in varying degrees to promote the development of obesity [4].

High BMI has been linked with an increased risk of low back pain [5]. Increased body fat could increase the mechanical load on the spine by causing a higher compressive force or increased shear on the lumbar spine structures during various activities. Low back pain (LBP) is a major health problem all around the world. In India, nearly 84% of the population has significant low back pain at some time in their life [6]. Women who are overweight have an increased likelihood of LBP [7]. both Physical Activity and BMI are related to persistent LBP. Also, the prevalence of persistent LBP became higher when PA_{low} and high BMI are combined r ather than the group of PA_{high} and low BMI c ombination.

The back extensors and the core muscles especially the Multifidus and Erector Spinae contribute to the support and control of the orientation of the lumbar spine and the stabilization of the lumbar segments. Multifidus controls the lumbar lordosis, allowing equal distribution of forces. Contraction of the poly-segmental Multifidus fascicles can restore the lumbar lordosis [9,10].

The abdominal muscles such as obliques and transverses abdominals are considered to provide an important stiffening effect on the spine by increasing the intra-abdominal pressure and fascial tension, thus enhancing the lumbo-pelvic stability [11].

Stronger muscles can enhance spine's ability to withstand various degrees of external loads. Weakness of these back muscles can cause low back pain. The Multifidus muscle is adversely affected and dysfunction occurs from the first episode of back pain. The abdominal muscles are also affected in LBP [11].

Thus, good endurance of these muscles is an important factor in prevention of LBP. Poor endurance indicates early fatigability. Studies have proved that the application of endurance exercises incorporating back extensors and abdominals have helped in reduction of LBP [12].

John M. Mayer et al had studied the impact of core and back muscular endurance in firefighters and concluded that obesity causes reduction in core and back muscle endurance which may increase the risk of musculoskeletal injuries [5]. In general population, high BMI has also been associated with decreased performance level on physical fitness tests including abdominal muscle endurance [13]. The impact of BMI on lower back extensor was assessed in apparently healthy individuals and it stated that greater the BMI lesser will be the extensor muscle endurance [14].

Reliability of Beiring-Sorenson test for trunk extensor muscle endurance has been well established [15]. For assessment of abdominal muscle endurance, partial curl-up test [16] has been suggested and for core muscle endurance Sphygmomanometer method was used in prone lying [17]. The Biering–Sorensen test provides reliable measures of position-holding time and can discriminate between subjects with and without nonspeciûc low back pain (Reliability=0.88) [20]. Successful completion on pressure biofeedback does not indicate high TrA activation. Unsuccessful completion on pressure biofeedback may be more indicative of low TrA activation, but the correlation and likelihood coefficients indicate that the pressure test is likely of minimal value to detect TrA activation [21].

Need for Study: High Body Mass Index (BMI) has been linked with increased risk of low back pain (LBP) in females. In LBP, the muscular endurance of the back muscles mainly, the abdominal core, back extensors and abdominals is reduced. Hence, there is a need to assess muscular endurance of the trunk muscles in overweight females so as to determine a cause for LBP.

Aims and Objectives

Aim: To compare low back extensor, core and abdominal muscle endurance in normal and overweight females (20-30 years of age)

Objectives

1. To compare low back extensor endurance in normal and overweight females.

2. To compare core muscle endurance in normal and overweight females.

3. To compare abdominal muscle endurance in normal and overweight females.

Methodology:-

Study design: This study was case controlled, comparative study in which Beiring-Sorenson's test, Partial curl-ups and Sphygmomanometer method in prone lying was used.

Participants: In this study, 120 females participated which was dived into two groups for the comparison purpose.

Females were divided into 2 groups according to their BMI- Normal (60) and Overweight (60).

Criteria: In this study, inclusion criteria was females in the age group of 20-30 years both with normal and overweight BMI.

Exclusion criteria for the study was females having low back pain, Females indulged in sport activities,Pregnancy and post-pregnancy and females who have undergone spine surgeries or having any deformities.

Tools used: Sphygmomanometer, stopwatch, metronome software, weighing machine, measuring tape, notebook, pen.

Outcome measures:

1. Beiring-Sorenson's test- to assess back extensor endurance.

2. Partial curl-ups – to assess abdominal muscle endurance.

3. Sphygmomanometer method in prone lying- to assess core muscle endurance

METHODS

In this study, a group of 120 healthy females having a sedentary life-style in the age group of 20-30yrs (mean age of 21.18 in normal and 21.27 in overweight) were included. Pregnancy, post-pregnancy, those who have undergone spinal surgeries and people with low back pain were excluded from the study. Females were divided into 2 groups according to their BMI- Normal (60) and Overweight (60).

The study was approved by the institutional review board. An informed consent was taken from the subjects and they were evaluated for core, back extensor and abdominal muscle endurance.

Core muscle endurance was assessed in prone lying position using Sphygmomanometer method. The cuff was placed horizontally below the umbilicus and was inflated to 70mm Hg. The subject was instructed to perform drawing-in maneuver. If done properly, the pressure dropped 6-10mm Hg. Muscle endurance of Transversus Abdominis was assessed by the no. of seconds the subject could hold. The holding time was measured using stopwatch. The endurance was graded as follows [17].

0 – No palpable contraction of the muscle.

1 – Able to hold the contraction for 5 seconds with decrease in pressure of 0-2mmHg

2 – Able to hold the contraction for 5-10 seconds with decrease in pressure of 2-4mmHg

3 – Able to hold the contraction for more than 10 seconds with decrease in pressure of 4-6mmHg

4 – Able to hold the contraction for more than 10 seconds with decrease in pressure of 6-10mmHg

5 – Able to hold the contraction for more than 10 seconds with decrease in pressure of more than 10mmHg.

Back extensor endurance was assessed by modified Beiring – Sorenson test. The subject was made to lie in prone position with upper edge of the iliac crest aligned with the upper edge of the table. The lower body was fixed to the table by three straps around the pelvis, knee and ankle respectively. The subject was asked to hold her arms across the chest and maintain the upper body in horizontal position until she can no longer control the posture or has no more tolerance for the procedure or until the symptoms of fatigue have been reached. The holding time was measured by stopwatch and comparison was done between normal and overweight subjects. This test assessed the isometric muscular endurance of the back muscles [15]. Abdominal muscle endurance was tested using a partial curl-up test. The subject assumed supine position on the mat with hip and knee at 90 degrees. The arms were at the side, palms facing downwards. A metronome was set to 50 beats/min and the subject was asked to do slow, controlled curl-ups to lift the shoulder blades off the mat (trunk made a 30 degrees angle with the mat) in time with the metronome at a rate of 25/min. The test was done for 1min; the low back should flatten before curling up. The subject performed as many curl-ups as possible without pausing to a maximum of 25 beats. The

curl-ups were scored as follows [16].

No. of curl-ups	Score
25	Excellent
18-24	Very good
14-17	Good
13-May	Fair
4 and below	Needs improvement

RESULTS

It has been seen that core muscle endurance is significantly reduced(p<0.00) in overweight females as compared to normal females.

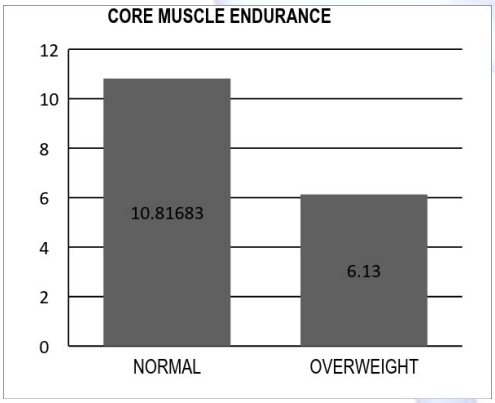
It has been seen that the back extensor endurance is significantly reduced(p<0.00) in overweight females as compared to normal females.

It has been seen that the abdominal endurance is significantly reduced(p<0.00) in overweight females as compared to normal females.

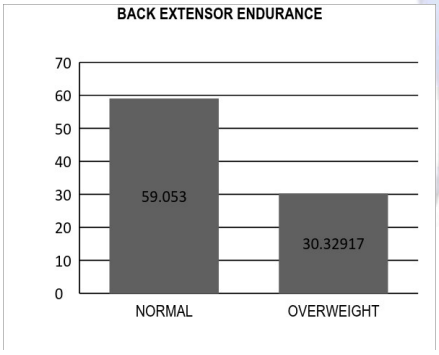
Table 1: Demographic details about the study population.

		Mean	Standard Deviation	Min	Max
AGE	Normal	21.18	1.3715	20	27
	Overweight	21.27	1.4245	20	27
BMI	Normal	21.96	1.3951	19.29	24.39
	Overweight	27.44	1.5178	25.12	29.87

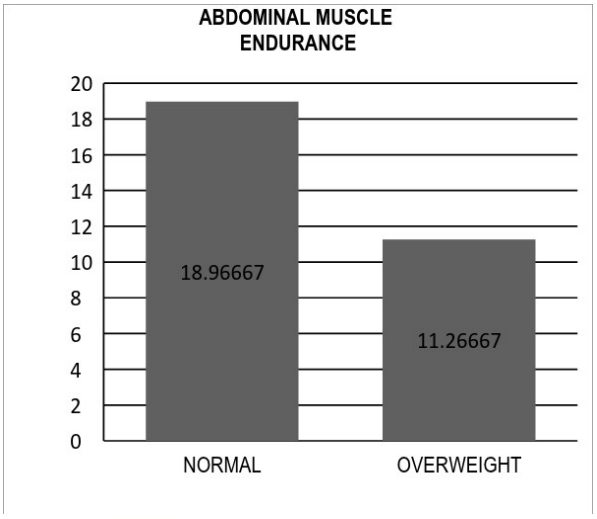
Graph 1: comparison of core muscle endurance in normal and overweight females.



Graph 2: Comparison of low back extensor endurance in normal and overweight females.



Graph 3: Comparison of abdominal muscle endurance in normal and overweight females.



DISCUSSION

Low back pain assessment has multi-disciplinary approach. In this study, the musculoskeletal component was being focused in which mainly the trunk muscle endurance was assessed. The findings of this study indicate that the overweight females had reduced back extensor, core and abdominal muscle endurance as compared to the normal females. The increasing age, mass ,BMI and waist hip ratio are important factors which causes a decrease in trunk muscles endurance n healthy subjects [22]. An imbalance in muscle strength i.e lower extensor muscle strength than flexor strength, might be one risk factor for low back pain [23-29].

The muscle endurance and weakness are associated with LBP and that structural factors such as the size of the lumbar lordosis, pelvic tilt, leg length discrepancy, and the length of abdominal, hamstring, and iliopsoas muscles are not associated with the occurrence of LBP [30].

A study has shown relationship between the BMI and back extensors and the results supported the above study but the method of evaluating the endurance was prone double leg raise test [14]. John M. Mayer et al evaluated the back extensor and core muscle endurance using Beiring-Sorenson's and Plank test respectively, in obese fire-fighters and concluded that the endurance was decreased in obese individuals when compared with the normal individuals. Huang and Malina have evaluated the relationship between BMI and four components of physical fitness including abdominal endurance and

concluded that high BMI was associated with decreased performance in the sit-ups test [1].

Classification of Weight Status by Body Mass Index (BMI) [23]

Classification	BMI (kilogram/m ^{2})
Underweight	<18.5
Normal weight	18.5-24.9
Overweight	25-29.9
Obesity Class 1	30-34.9
Obesity Class 2	35-39.9
Extreme Obesity Class 3	>40

Healthy body composition means the body has a higher proportion of fat free mass (composed primarily of muscles) and relatively small proportion of fat. In overweight individuals the proportion of fat is increased which has an adverse effect on morphology and physiology of muscles mainly the muscles of the trunk. Greater adiposity could yield a chronic inflammatory state which contributes to the degradation of contractile properties and decreased muscle quality [18]. This leads to earlier muscle fatigue, when the muscle is subjected to repetitive contractions. The risk of developing LBP is much higher among persons with poor performance in the static back endurance test than in those with medium or good performance [24]. The BMI of children had a positive correlation with the muscle strength of quadriceps, triceps, and abdominal muscles while a negative correlation with the endurance time of these muscles [26].

The modified Beiring-Sorenson's test used in the above study to assess back extensor endurance, depends on gravity's action on body mass for the entire load and the ability to support body mass against gravity for an extended period of time. Thus, the females with high BMI were likely at a biomechanical disadvantage during this test, because higher body loads were needed to be supported against gravity [5]. This was one of the factors contributing to lesser muscular endurance in overweight females.Good isometric endurance of back muscles seems to prevent first time experience of low back trouble in men.Indications were found that men with hypermobile back are more liable to contract low back trouble [25].

In these females, the fitness levels are reduced as well as there is reduction in perceived exertion levels in fitness tests. These reasons can also contribute to reduction in muscular endurance [13].

Poor muscle endurance causes failure of the body to maintain proper posture and body mechanics during everyday activities such as walking and lifting. In presence of the external forces and large repetitive motions, it leads to poor muscular support and has a sustained load on the inert supporting tissues due to which creeping and distension occurs, further leading to mechanical stress and injuries such as low back pain. The structural damage can lead to early degenerative changes in the spine further increasing the low back pain [19].

Additional research should be done using other factors of body composition such as waist circumference and abdominal girth and comparing them in normal, overweight and various grades of obesity. Comparison can be made between males and females.

CONCLUSION

The core, back extensor and abdominal muscles endurance was reduced in overweight

females as compared to the normal females of the same age group.

ABBREVIATIONS

BMI - Body Mass Index

LBP - low back pain

NFHS - National Family Health Survey

IIPS - International Institute for Population Sciences

WHO - World Health Organisation

PA - Physical Activity

TrA - Transverse Abdominis

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Conflicts of interest: None

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