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Prevalence core muscle weakness in 18-25 years old females

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Abstract
Background and Objective: The core muscle has been referred to as the "powerhouse", the foundation or engine of all limb movements. Core muscle serves as a muscular corset that works as a unit to stabilize the body and spine with and without limb movement. In short, the core serves as the centre of the functional kinetic chain. When the core muscles function normally, they can maintain segmental stability, protect the spine, and reduce stress impacting the lumbar vertebrae and intervertebral discs hence, the core muscles are also called "the natural brace" in humans. Faulty postures due to sedentary lifestyle contribute to increased risk of musculoskeletal disorders (MSDs) cause weakening of "core" muscular network. Consequently, it can lead to excessive load on lumbar spine, poor endurance of muscles, and imbalance of hip extensor, back injuries, and instability of lower extremity which may ultimately lead to atrophy of paraspinal muscle.
Method: 212 Healthy female volunteers between 18-25 years were recruited in this study fulfilling the inclusion and exclusion criteria were explained the procedure and informed consent was taken. Each core endurance test was done using a stopwatch until the participants were unable to hold the test position; 5-minute rest period was provided between each core endurance test.
Result: Core Weakness in females for 60 Degree Flexion Test is 65.40%, for, Biering-Sorensen Extension Test is 86.73%, Right Side Plank is 83.89% and Left Side Plank is 76.30%. Level of significance of the entire four tests is below 0.5 respectively which shows significant difference in core muscle weakness of 18-25 years old females.
Conclusion: The subjects 18-25 years old females have core muscle weakness.

Keywords: core muscle, 60-degree flexion test, Biering-Sorensen extension test and right-left side plank test

Introduction
The core muscle is defined as basis of proximal stability for distal mobility and it allows for the transfer of energy from large to small muscles during everyday movements [1]. Core muscle serves as a muscular corset that works as a unit to stabilize the body and spine with and without limb movement. In short, core serves as centre of the functional kinetic chain. The core muscle has been referred to as the 'powerhouse', the foundation or engine of all limb movement [2].
The core muscles, which are primary muscle group for maintaining spinal stability, can be divided into two groups according to their functions and attributes. The first group of muscles is composed of the deep core muscles, which are also called local stabilizing muscles. These muscles primarily include transversus abdominis, lumbar multifidus, internal oblique muscle and quadratus lumborum. These muscles provide precise motor control and are thus primarily responsible for spinal stability [3].
The second group of muscles comprises the shallow core muscles, which are also known as global stabilizing muscles, including rectus abdominis, internal and external oblique muscles, erector spinae, quadratus lumborum and hip muscle groups. These muscles are not directly attached to spine but connect pelvis to the thoracic ribs or leg joints, thereby enabling additional spinal control. Secondarily responsible for maintaining spinal stability [3].
When core muscles function normally, they can maintain segmental stability, protect spine and reduce stress impacting the lumbar vertebrae and intervertebral discs hence, core muscles are also called "the natural brace" in humans [3, 4].

Core work allows to stabilize spine, which improves and controls posture. Functional core training allows to practice movement that provides optimal motion for daily tasks [5].

Rapid growth in technology in last couple of decades has led to constant reduction in physical activity and increased sedentariness in lifestyle. This in turn has reduced the work of certain muscles that were once strong and were responsible for good posture & prevented injuries. This is especially true to trunk and hip muscles that helped to maintain erect posture against the gravity. Balance between anterior and posterior group trunk and hip muscles is essential for normal postural alignment. Decreased core stability has been suggested to contribute to the aetiology of lower extremity injuries in females [6].

Faulty postures due to sedentary lifestyle contribute to increased risk of musculoskeletal disorders (MSDs). These disorders are mainly due to weakening of "core" muscular network. Consequently, it can lead to excessive load on lumbar spine, poor endurance of muscles, imbalance of hip extensor, back injuries, and instability of lower extremity which may ultimately lead to atrophy of paraspinal muscle [7].

Hides *et al*., conducted a study to compare multifidus size and symmetry in asymptomatic individuals with chronic low back pain (LBP). This study found that asymptomatic male subjects had significantly larger multifidus cross sectional areas compared to asymptomatic females. Females have lower blood volume, fewer red blood cells (RBC) and lower amount of Haemoglobin. This results in a lower oxygen carrying capability in their blood leading to lower capacity to increase their arterial venous oxygen difference. Females also have smaller and fewer muscle fibers although distribution of muscle fibers types is similar between genders [8]. The Muscular Endurance Test (Lateral Musculature Test, Flexor Endurance Test and Back Extensors Test) designed by Stuart McGill was most recognized and used to evaluate core muscles endurance. It was proved that the tests had reliability coefficients of >0.97 for the repeated tests on five consecutive days and eight weeks later again [McGill, Childs & Leibenson (1999)].

Core strength tests included in this investigation are right and left sideplank test, 60-degree flexion test and Biering-Sorensen Extensor Endurance Test. Having normative values for these simple clinical tests will be beneficial in determining risk for injury without invasive and time-consuming EMG testing [2].

Adults adapt to faulty postures due to prolonged hours of work leading to muscular imbalances which highly contribute to the increased risk of musculoskeletal disorders. These disorders mainly occur due to weakening of "core" musculature i.e. central musculature of the body. This in turn may lead to excessive load on lumbar spine, back, poor endurance of muscles, muscle imbalance and lower extremity disorders. Moreover, studies have been conducted to assess core strength among 18-25 years of females. It is important to find out prevalence of core muscle weakness in young females, so as to help them from losing the working hours, improving posture and avoiding musculoskeletal disorders caused due to core muscle weakness.

Aims and Objectives

Aims

To find out the prevalence of core weakness in 18-25 years of females.

Objectives

- To evaluate core weakness in 18-25 years females by 60-Degree Flexion Test, Biering-Sorensen Extension Tests, Right-Left Side Plank Test.

Hypothesis

Experimental hypothesis

- There is significant prevalence of core weakness in 18-25 years of females.

Null hypothesis

- There is no significant prevalence of core weakness of 18-25 years of females.

Methodology

- **Study design:** An observational study
- **Sampling technique:** Simple convenient sampling
- **Sample size:** 212 students
- **Study duration:** 6 -month

Selection Criteria

Inclusion Criteria

- Age group 18-25 years healthy females

Exclusion Criteria

- Back Pain, Any Recent Injury

Materials to be used: Plinth, Quadriceps Board, Stopwatch, Consent Form, Straps, Pen and Paper, Weighing Scale, Stadiometer

Procedure

Healthy female volunteers between 18-25 years were recruited in study fulfilling the inclusion and exclusion criteria. All the participants were explained the procedure and was informed the consent form. Each core endurance test was done using a stopwatch until participants were unable to hold test position; 5-minute rest period was provided between each core endurance test. Subjects were observed for any adverse reaction like fatigue, pain, breathing difficulty and were instructed on the risk of muscle soreness following test procedure.

Clinical Tests

Core endurance tests included 60-DegreeFlexion Test, Biering -Sorensen Extensor Endurance Test and Right-Left Side Plank Test. For each test, subject was given a verbal explanation of the test of correct and incorrect positions were explained, and a demonstration of the testing position was provided if necessary. Subject was instructed to hold the position for as long as possible without deviating from the test position. Data were collected and recorded in seconds [1].

60-Degree Flexion Test

Flexion endurance test was originally described by Mcgill in 1999. Place the upper body against support with an angle of 60-degrees from the test bed. Both knee and hip were flexed at 90-degree. Arms were folded across the chest with the hands placed on the opposite shoulder and toes and foot were placed under straps. Subjects were instructed to maintain the body position while supporting wedge was pulled back 10 cm to begin the test. The test ended when the upper body fell below the 60-degree angle [1].

Biering-Sorensen extension test

For trunk extension test, also known as Biering-Sorensen Test, participants were instructed to lie prone off the edge of a plinth with all body parts above their anterior superior iliac spines hanging off the table. Two straps were used to hold lower extremities onto the table: one at the gluteal fold, and one just above the ankles. Participants could rest their upper extremities on a chair prior to start. They were then instructed to cross their arms in front of their chest and to lift their upper body up until their trunk was horizontal to the ground. Time was started when the subject achieved the starting position. This position was held until fatigue or until their body deviated from horizontal, ending the test [1].

Side Plank Test

While lying on their side on the floor, participants were instructed to prop their body up while weight-bearing only on their elbow and their feet, which were stuck on top of one another. Participants were told that their body needed to stay in straight line in all planks. Participants were time on both sides, with the order of left and right self-selected by the participant. Time was stopped when the participant could no longer hold the position, if their body dropped out of alignment in the frontal plane, or if the pelvis rotated in the transverse plane [1].

Statistical Analysis

The statistical analysis was done by using SPSS 15version for windows software. Percentage was calculated for core weakness. Z-test was used to determine the level of significance.

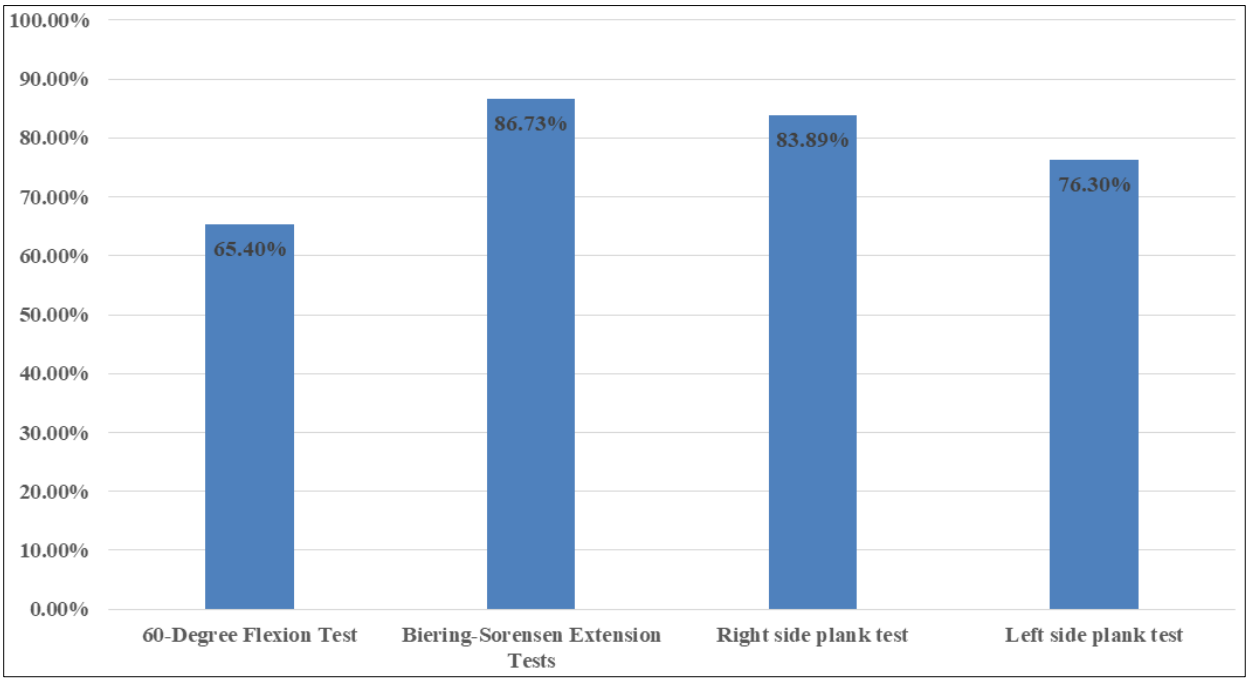
Results

Tables and Graphs

Table 1: Data analysis of core muscle weakness in 18-25 years old females

	60-Degree Flexion Test	Biering-Sorensen Extension Test	Right Side Plank Test	Left Side Plank Test
Prevalence of core muscle weakness (%)	65.40%	86.73%	83.89%	76.30%
Significance value (p value)	0.0000	0.0000	0.0000	0.0000
Total number of females with weakness	138	183	177	161

Above table shows three different core endurance test results which was compared with the normative value Core muscle Weakness in females for 60-Degree Flexion Test is 65.40%, for, Biering-Sorensen Extension Test is 86.73%, Right Side Plank is 83.89% and Left Side Plank is 76.30%. Level of significance of all the four test is below 0.5 respectively which shows significant difference in core muscle weakness of 18-25 years old females.



Graph 1: Shows prevalence of core muscle weakness by three different core endurance tests that are 60-degree flexion test, Biering-Sorensen test and right-left side plank test

Discussion

The present study was designed to analyse the prevalence of core muscle weakness in18-25 years old females. In these study three different core endurance tests that is 60-Degree Flexion Test, Biering-Sorensen Extension Tests and Right-Left Side Plank Tests were performed and result was compared with normative value. Core Muscle Weakness in females for 60-Degree Flexion Test is 65.40%, for Biering-Sorensen Extension Test is 86.73%, Right Side Plank is 83.89% and Left Side Plank is 76.30%. Level of significance of all four tests is below 0.5 respectively which shows significant difference in core muscle weakness of 18-25years old females.

People mostly focus on staying active by walking, jogging or running, nobody really focuses on core muscle strength which is necessary for stability required to maintain the posture while carrying out the activity. The knowledge of physical activity and exercises is already known among

people, but the population of people exercising regularly is small and the amount of physical activity practiced during leisure time decrease day by day. It was reported that approximately half of the people discontinue exercise and performing physical activity regularly within 3-6 month of starting [9].

Faulty postures due to sedentary lifestyle contribute to increased risk of musculoskeletal disorders (MSDs). These disorders are mainly due to weakening of "core" muscular network. Consequently, it can lead to excessive load on lumbar spine, poor endurance of muscles, imbalance of hip extensor, back injuries, and instability of lower extremity which may ultimately lead to atrophy of paraspinal muscle [7].

Hodges and Richardson argued that this anticipatory muscle activation helps stiffening the spine to provide a foundation for functional movements. Thus, muscles belonging to the local system (e.g., lumbar multifidus, transversus abdominis) appear to primarily provide proximal stability of the trunk for distal mobility of the limbs. Of note, our core strength training protocols comprising multiple sets with many repetitions or long contraction times may have specifically induced adaptive processes in muscles of the local system (deep muscles) since those muscles are characterized by a relatively high proportion of type I (slow-twitch) fibers [10].

According to Anders *et al*., (2004) stated that strength of shoulder muscle in men were significantly higher than females during isometric exercises. If the females do not have enough strength of the shoulder to maintain the correct posture, the core muscle function could not be assessed because the females were unable to support the body in correct position by generating enough force from the shoulder despite the core muscles were not fatigue as a result core muscle function could not be evaluated accurately [11].

Core muscles training has been promoted as a preventive regimen, as a form of rehabilitation, and as a performance-enhancing program for various lumbar spine and musculoskeletal injuries [12].

Ledernan (2007) stated that weak trunk muscles, weak abdominal and imbalance between trunk muscle group are not pathological, just a normal variation. Weak or dysfunctional abdominal muscle will not lead to back pain [13] and also believes that because only a minimal level of muscle contraction is required to stabilize the spine, muscle endurance may be more important than muscle strength [14].

The researchers hypothesized that gender would have an effect on hold times, exercisers would have longer hold times than non-exercisers, exercisers who targeted core musculature would have longer hold times than those who did not, and subjects who had a history of LBP (Low Back Pain) or an extremity injury would have decreased hold times. Hip musculature, often classified as part of the core, can significantly alter the position of the hip and trunk if not strengthened properly, which has been shown to increase incidences of injuries in the knee. Core instability has also been shown to affect overhead athletes, including tennis players, by increasing loads at the shoulder [3].

Limitation of the study Small Group Size, only 18-25 years old females, there is no inter-rater reliability of their testers prior to data collection. Further recommendations both genders can be considered, different age group can be considered, different tests can be considered.

Conclusion

The subjects 18-25 years old females have core muscle weakness. The present study suggests that core muscle weakness is observed in many of the female's physical inactivity, for which, anatomical and physiological factors may be the reasons.

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