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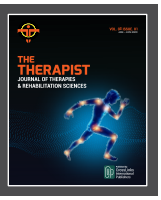

Original Article

The Prevalence of Core Muscles Weakness and Fatigue in 18-to 25-Year-Old Medical College Students

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ABSTRACT

Core muscles play a significant role in the stability of the back spine, ribcage, and lumbopelvic region by influencing daily living activities and balance. **Objectives:** To investigate core muscles weakness among male and female medical college students aged 18-25 and to evaluate their core muscle endurance using the McGill core endurance tests. Also, to assess fatigue levels among participants using the Rating of Fatigue Scale (ROF). **Methods:** A total of 246 participants were recruited from Rashid Latif Medical College (RLMC) and Johar Institute of Professional Studies (JIPS), Lahore, using non-probability convenient sampling.The sample size was determined using Epitool software.To assess core muscle endurance, the McGill Core Endurance Test was administered.Additionally, the Rating of Fatigue Scale was used to evaluate fatigue levels among participants. Data were entered and analyzed using SPSS version 27.0. Numeric data are presented as mean and standard deviation. **Results:** 92.68% of participants exhibited core muscles weakness during the 60º Spinal Flexion Test, and 96.75% of participants exhibited core muscles weakness during the Side Plank Tests. Another Rating of fatigue is a prevalent issue among the participants, with only 10.2% reporting no fatigue. The majority of participants (43.5%) experienced mild fatigue, while a significant proportion (37%) reported moderate fatigue. Furthermore, 8.5% of participants experienced severe fatigue, and 0.8% reported the worst fatigue. **Conclusions:** It was concluded that a remarkably high prevalence of core muscles weakness was found among medical college students. Furthermore, failure to engage core muscles during daily activities likely contributes to this prevalent weakness.

INTRODUCTION

The core muscles work together in coordination in order to facilitate the stability of the back, ribcage, and lumbo-pelvic region [1]. Core muscles surround the spine, abdominal cavity, hips, and Lumbopelvic area. They are essential for proper loading balance and performing movements in the neutral position of the lumbar and pelvis [2]. People experience back pain and musculoskeletal (MSK)-related issues in their daily living activities [3]. Lower back pain affects 60-80% of students worldwide, posing a significant risk factor for subsequent health problems [4]. It is difficult to maintain balance, and they have trouble lifting heavy weights during certain tasks [5]. These issues can significantly impact an individual's functions, leading to a decreased quality of life and an increased risk of falls and injuries [6]. Core muscles are classified into two different units. The outer unit is the local mobilizer, in which the internal oblique, external oblique, rectus abdominis, and superficial erector Spinae muscles help to generate movements and control range of motion (ROM) [7]. The inner unit is a global stabilizer that includes the deep erector Spinae (Multifidus), diaphragm, transverse abdominis, pelvic floor muscles, and hip girdle muscles, which help to stabilize the vertebral column, ribcage, and pelvis [8]. The inner unit creates some of the boundaries of the abdominal cavity. If the back stabilizes, the ultimate extremities with a stable base can move [9]. Core endurance is the capacity to maintain position and posture while performing multiple repetitions over an

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interval of time [10]. Core stability provides an intervertebral neutral zone within anatomical and physiological limitations [11]. Core endurance training includes low-weight exercise training with a duration of 30 to 45 seconds, and isometric exercises can significantly improve core muscles [12]. Core endurance is used for rehabilitation purposes in low back pain patients and is assessed by a battery of tests, including an isometric back endurance test, an abdominal test, and a lateral flexion test [13]. A cross-sectional study was conducted to find individual risk factors for reduced core endurance, specifically in female, along with a relationship between core endurance, fatigue, physical activity, and low back pain in 2023. After analysis, results established that there is a significant reason for reduced core weakness in females: physical inactivity that affects fatigue level. Another LBP, age, gender, body mass index (BMI), smoker, and alcohol user were not at risk of physical inactivity; they were enhancing their physical activity by improving core endurance [14]. A cross-sectional study conducted by Evia Fallahsady and his colleagues in 2022 evaluated a correlation between the McGill Test, functional movement screen (FMS) score tool, and lumbar Lordosis angle in females. After evaluation, the result established that the Functional Movement Screen score has no correlation with the McGill test except stability in the trunk pushup, and lordosis angle might impact core muscles endurance but not their functional movement pattern [15]. The group of core muscles maintains spinal stability. Weakness of core muscles can lead to poor muscles endurance and imbalance, which increase the risk of back injuries and instability of lower extremity [16]. However, treating core weakness with the core strengthening exercise plan is a powerful method [17]. Core muscles weakness is a pervasive issue among medical students, with far-reaching consequences on their overall health and quality of life [18]. Despite its significance, core muscles weakness remains poorly understood, particularly among medical college students. This knowledge gap necessitates a comprehensive investigation into the prevalence and correlates of core muscles weakness in this population.

This study aims to identify areas for improvement and inform effective prevention and treatment strategies, ultimately promoting the physical and mental well-being of medical students.

METHODS

The study employed a cross-sectional design. Data were collected from the Johar Institute of Professional Studies and Rashid Latif Medical Complex in Lahore. The overall duration of the study was six months following the approval of the synopsis, from June 2024 to November 2024 (JIPS/SPT-24-65). The sample size for this study was calculated using Epitool software to estimate a single proportion or apparent prevalence. This calculation was based on an estimated true proportion (p) of 0.2, with a desired precision of ±5% (e=0.05) and a confidence level of 95%. Using the Z Score standard normal distribution, the estimated critical value for a 95% confidence level was 1.96. Based on these parameters, the calculated sample size (n) was determined to be 246 individuals, who were subsequently recruited for the study. A non-probability convenience sampling technique was utilized. The study included medical college students from the following disciplines: pharmacy, physiotherapy, and medical lab technology, aged 18-25 years, with both males and females participating. Participants willingly agreed to take part in the study. However, students who had suffered a fracture or undergone surgery of their back, pelvis, hips, or knees within the past year were excluded. Athletes or professional sports person were also excluded. The McGill Core Endurance Test evaluated the endurance of core muscles, including anterior, back, and oblique musculature.

60-degree trunk flexion: The participant lies on a support surface with the upper body at a 60-degree angle, knees and hips bent at 90 degrees, and arms crossed over the chest. The feet are secured under straps to maintain the position. The test ends when the body falls below a 60-degree angle. Trunk extension: The participant lies face down on a table, with the body hanging off the edge. Straps secure the lower body, and the participant lifts their arms in front of their chest until fatigued or their body deviates from a horizontal position.

Lateral musculature tests: The participant lies on their side and raises their body, supporting themselves with one elbow and foot. They maintain a straight line from head to heel and perform the test on both sides. The test ends when the participant is unable to maintain the position, and their body no longer maintains alignment, or the pelvis rotates.

Rating of Fatigue Scale (ROF): A self-reporting tool measuring fatigue severity on an 11-point scale, ranging from 0 (not fatigued) to 10 (totally fatigued) [19].

Both tools demonstrated high reliability and validity. The McGill Core Endurance Test reliability coefficients exceeded 0.97, and the ROF exhibited good face validity and convergent validity, making them suitable for assessing core endurance and fatigue in this population [19, 20]. By gathering demographic information from participants, including age, gender, height, and weight, and screening participants for inclusion and exclusion criteria to ensure suitability for the McGill core endurance test. Informed consent was taken from all participants before measurements. The data were analyzed using SPSS-27.0 software, which provided a comprehensive overview of the

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study sample's characteristics through basic descriptive statistics. These statistics included measures of central tendency (means) and variability (standard deviations), as well as frequency distributions, which were visually represented through bar charts and pie charts. This study was conducted under ethical principles, prioritizing the rights and welfare of participants. Before data collection, all subjects provided informed consent, ensuring they were fully aware of the research study's measurements and procedures. To maintain confidentiality, participants' personal information was kept anonymous and secure. The study protocol was submitted to and approved by the Institutional Ethical Review Board, ensuring compliance with ethical standards. Furthermore, all data collected were treated as confidential and will not be shared with anyone outside the research team, maintaining participants' privacy and trust.

RESULTS

Results showed that out of 246 participants, 83 (33.74%) are underweight, 139(56.50%) are Normal, and 24 (9.76%) participants are overweight (Table 1).

Table 1: Frequency and Percentage of Age, Gender, and BMI

Variables		Frequency (%)
Age	18-20	28 (58.13%)
	21-23	96 (39.03%)
	24-25	7 (2.84%)
Gender	Male	111 (45.1%)
	Female	135 (59.9%)
	<18.5 (Underweight)	83 (33.74%)
BMI	18.5-24.9 (Normal)	139 (56.50%)
	25-29.9 (Over Weight)	24 (9.76%)

Results of the 60° spinal flexion test showed that out of 246 participants, 228 (92.68%) participants showed low endurance, 14 (5.69%) showed normal endurance, and 4 (1.63%) showed high endurance value. Results of the spinal flexion test showed that out of 246 participants, 210 (85.37%) participants showed Low Endurance, 24(9.76%) Normal Endurance and 12(4.88%) showed High Endurance Value (Table 2).

Table 2: Frequency and Percentage of 60 ° Spinal Flexion Test and Spinal Flexion Test

Variables	Frequency (%)
60 ° Spinal Flexion Test	
Low Endurance	228 (92.68%)
Normal Endurance	14 (5.69%)
High Endurance	4 (1.63%)
Spinal Extension Test	
Low Endurance	210 (85.37%)
Normal Endurance	24 (9.76%)
High Endurance	12 (4.88%)

Results showed that out of 246 participants, 238 (96.75%) participants showed Low Endurance, 7(2.85%) Normal Endurance and 1(0.4%) showed High Endurance Value (Figure 1).

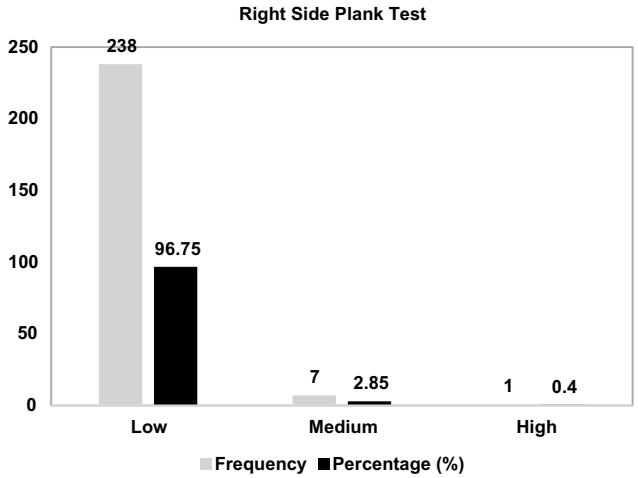

Figure 1: Frequency and Percentage of Right Side Plank Test (n=246)

Results showed that out of 246 participants, 238 (96.75%) participants showed low endurance, 6 (2.44%) normal endurance, and 2 (0.81%) showed high endurance value (Figure 2).

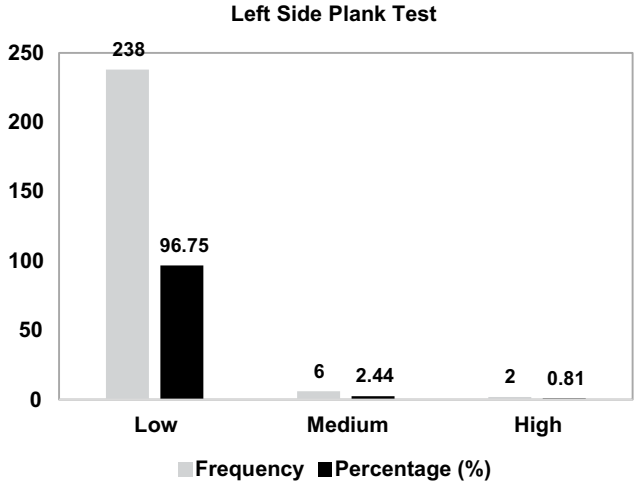

Figure 2: Frequency and Percentage of Left Side Plank Test

Results showed that out of 246 participants, 238 (96.75%) participants showed low endurance, 6 (2.44%) normal endurance, and 2 (0.81%) showed high endurance value (Figure 2).

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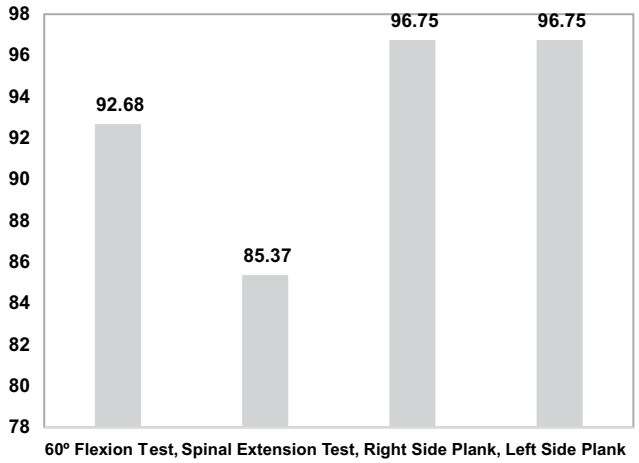

Figure 3: Grand Total Percentages of McGill Core Endurance Test

Results showed 25(10.2%) participants showed none Fatigue, 107(43.5%) mild fatigue, 91(37%) moderate fatigue, 21(8.5%) severe fatigue and 2(0.8%) participants showed worst fatigue(Figure 4).

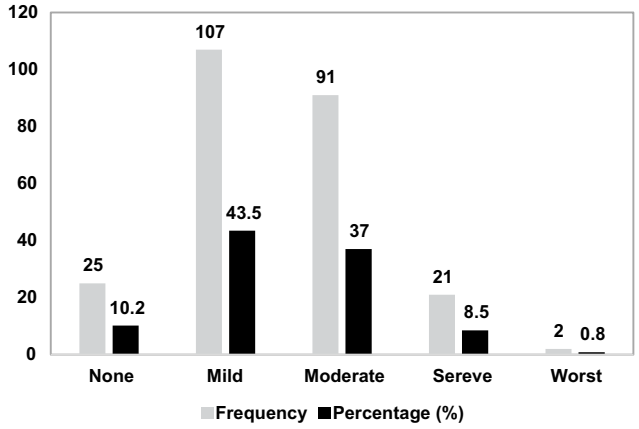

Figure 4: Frequency and Percentages of Rating of Fatigue Scale(ROF)

DISCUSSION

This study investigated core muscles weakness among 246 medical college students (111 male, 135 female) and found a significant prevalence of core muscles weakness. The results showed that 92.68% of students exhibited weakness in the 60º Flexion Test, 85.37% in the Spinal Extension Test, and 96.75% in both Right and Left Side Plank Tests. Comparison with normative values: Low Endurance (1-50 seconds), Medium Endurance (50.1-75 seconds), High Endurance (>75.1 seconds), revealed that most students had low core muscles endurance, emphasizing the need for core muscles strengthening exercises and proper postural alignment to improve overall physical fitness and well-being among medical students. According to a study conducted by Rakholiya *et al.*, founded, core weakness in females have significant weakness by testing through McGill core endurance tests, including a 60º flexion test with a weakness value of 65.40%, a spinal extension test weakness value of 86.73%, a right side plank test with a weakness value of 83.89% and left side plank weakness value 76.30% from 212 healthy female, and concluded that 18-25 year old female have weak core muscles by assessing through McGill core endurance tests [7]. However, the current study revealed even higher prevalence rates of core muscles weakness among medical college students, with 92.68% exhibiting weakness in the 60º Flexion Test, 85.37% in the Spinal Extension Test, and 96.75% in both Right and Left Side Plank Tests. These findings suggest that medical students, regardless of gender, may be at a higher risk of core muscles weakness, emphasizing the need for targeted interventions to improve core strength and overall physical fitness in this population. Bhore *et al.*, demonstrated that core muscles weakness affects older bank employees within the age range of 45-50 years [18]. The current investigation demonstrated that younger medical college students between 18 and 25 years had a substantial incidence of core muscles weakness. Normal BMI males showed weaker core muscles, but the current research indicated equal noticeable core muscles weakness between male and female medical students. Research shows core muscles weakness occurs frequently throughout various demographic groups, including aged bank employees and medical college students, thus demanding specific intervention programs to enhance core strength and physical fitness. Akduman *et al.*, analyzed the link that exists between physical exercise and core endurance within university students. McGill core endurance tests, together with the International Physical Activity Questionnaire (IPAQ), revealed that core muscles endurance fails to demonstrate a statistical relationship against physical activity level [21]. Results from this current study match the findings reported by Akduman *et al.*, because they discovered that university student core muscles endurance does not relate to physical activity levels [21]. The latest research showed that medical college students experienced significant core muscles weakness problems while continuing physical activity. Data from this study suggests that participating in physical activities only provides inadequate results for core muscles endurance improvement; thus, specialized core muscles exercises remain necessary for young adults. Priyadarshini and Gopalswami, studied how core muscles strengthening exercises affect both postural sway and fall risk in their research. The study included exercises for core strengthening, which included lower abdominal series, semi sit-ups, and lateral bridges as part of the program. When testing the stabilization effects, the core strengthening program displayed positive results yet both

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study groups maintained similar levels of postural sway [22]. Experimental core strengthening training methods like those applied by Priyadarshini and Gopalswami, edshow promise for improving elementary muscles strength and total fitness among medical students based on current study findings. The study conducted by Sarac *et al.*, in detail analyzed how core muscles endurance measures alongside balance and physical activity levels and fatigue and thoracic kyphosis angle relate to each other. The research demonstrated that core muscles endurance possessed meaningful links with the physical activity level and three outcome measures, including fatigue and balance, yet failed to generate connections with the thoracic kyphosis angle [23]. Results from this investigation indicate that medical students do not eliminate their core muscles weakness even though they participate in physical activity. Additional research is necessary for a complete understanding of core muscles endurance relationships with physical activity and other factors across different groups of people. Results from the present study about medical college student core muscles weakness need evaluation against Fallahasady *et al.*, which examined core muscles endurance with functional movements and lordosis-angular measurements in females. This study demonstrates that medical students should receive core muscles weakness treatment because there was no correlation between core muscles endurance and functional movement patterns [24]. The results from the present study regarding core muscles weakness in medical college students coincide with those from Abhilash *et al.*, as they established a strong connection between core endurance and static balance in students with forward head posture. The findings of this study identify core muscles weakness as a cause of reduced static balance therefore, medical students need proper core muscles endurance training to stop possible balance disorders [25]. The present study demonstrates different core muscles weakness prevalence rates in medical college students than Esfahani *et al.*, research showed no significant differences in core endurance between those with sedentary lifestyles and those without low back pain [26]. This research confirmed through its results that medical college students demonstrate significant weakness in their core muscles. Worldwide core muscles weakness in medical college students arises from physical inactivity combined with classroom-based sitting and faulty postures which create intense stress on the spine and diminish muscular strength and balance while using improper handling techniques and equipment and lower extremity health issues and unsuitable workplace positions and lack of fitness and extensive sedentary behavior [27]. Unresolved medical student health problems will lead to an increased number of core weakness cases in this population. Addressing these issues currently remains vital because neglecting them will produce permanent outcomes, including musculoskeletal disorders and weaker general health status. Firstly, the study was conducted on a limited budget, which restricted the scope of the research. Additionally, the time duration for the study was short, which may not have allowed for a comprehensive exploration of the topic. Furthermore, the sample size was limited, which may not be representative of the larger population. Lastly, the study did not delve deeply into the underlying causes and mechanisms of core muscle weakness. It is recommended to develop clinical guidelines for implementing core exercise programs in medical education to promote physical fitness and overall well-being. Conduct a cohort study to assess the progression of core muscles weakness over time and identify potential risk factors. Evaluate the effectiveness of core muscle strengthening exercises and ergonomic modifications in reducing core muscles weakness. Investigate the correlation between the core muscle weakness and factors such as stress, sleep, academics, and level of physical activity to identify potential underlying causes. Conduct a Randomized controlled trial to evaluate the effectiveness of specific exercise programs and ergonomic modifications in strengthening core muscles and reducing weakness.

CONCLUSIONS

It was concluded that the study revealed a high prevalence of core muscles weakness among medical college students, emphasizing the importance of implementing exercises to enhance core muscles strength and endurance.

Authors Contribution

Conceptualization: GA
Methodology: GA, AS
Formal analysis: GA
Writing review and editing: GA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

All the authors declare no conflict of interest.

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