Original Article

Comparison of core endurance in individuals with and without lower crossed syndrome

Esha Chaudhary,[1] Areeka Riasat,[2] Tehreem Zahra, [3] Parsa Saghir,[4] Saman Shaukat,[5] Qurat-ul-ain Saeed[6]

Abstract

Objective: The purpose of current study was to assess the core endurance in individuals with and without lower crossed syndrome.

Study design: It was a cross sectional study.

Place and duration of study: The study was conducted at Foundation University, Islamabad from February 2023 to January 2024.

Material and Methods: This comparative cross-sectional study included 158 participants (aged 19-30) through purposive sampling technique. Written consent was obtained from the participants before participation. McGill's Core Endurance Battery was used to measure the core endurance and analysis was done using SPSS version 21.1.1

Results: This study included 158 participnts, with mean age of 21.81 ± 2.43 years. This study showed that for individuals with LCS, mean trunk flexor endurance time was 12.38±8.36 seconds, trunk extensor endurance time was 6.73±4.92 seconds. For the right lateral endurance, it was 3.89±2.61seconds and left lateral endurance test was 3.87±3.0 seconds. Whereas for individuals without LCS, mean trunk flexor endurance time was 14.67±11.69 seconds, trunk extensor endurance time was 9.35±8.62 seconds. For the right lateral endurance, it was 7.67±7.58 and 7.26±7.73for left lateral endurance.

Conclusion: This study concluded that there are significant differences regarding the measured core endurance for extensor, left lateral and right lateral endurance tests between the healthy group and the lower cross group ($p < 0.05$) and there was no significant difference in flexor endurance ($p \geq 0.05$) between individuals with and without lower crossed syndrome.

Keywords: Low Back Pain, Muscle Weakness, Abdominal Muscles, Back muscles, Physical Endurance, Postural Low Back Pain

1. Introduction

Lower crossed syndrome (LCS) is characterized by tightness of erector spinae (lumbar extensors) and iliopsoas and rectus (hip flexors). Whereas there is weakness of deep abdominals (trunk flexors) and gluteal maximus (hip extensor).[1] The lower crossed syndrome (LCS) is also called as pelvic crossed syndrome (PCS).[2] The biomechanical cause of muscle imbalance are considered to be these constant stresses that these muscles experience due to recurring movements and prolonged postures.[3] Earlier researches have suggested that lower crossed syndrome is caused by muscular tightness and weakness in the lumbo-pelvic region. Which in return causes pelvis to rotate resulting in increased or decreased lumbar lordosis which is related with the low back pain (LBP).[4] The term endurance is defined as the time period between the start of physical activity by an individual and the end of physical activity as a result of exhaustion.[5] Theoretically, with a good core endurance, there is a prolonged duration of stability. Which facilitates transient and constant force transmission during activities of sports and daily life.[6] According to a study, 85 % of the low back pain is contributed by muscular imbalances, which is most often caused by prolonged postural irregularities recognized as lower crossed syndrome.[1] These persistent pains lead to significantly reduced anterior and posterior core endurance.[7] Literature suggests that with postural defects there will be muscular imbalances and with that there might be changes in core endurance.

Student, Foundation University Islamabad,[1,2,3,4] Lecturer, Foundation University Islamabad,[5] Assistant Professor, Foundation University Islamabad.[6]
Correspondence: Areeka Riasat, Foundation University Islamabad **Email:** arikariasat4830@gmail.com

So, the aim of our study is to find a comparison of core endurance in individuals with muscular imbalance such as lower crossed syndrome and healthy individuals. Our study will also help to identify the muscular defects and their effects on endurance of core muscles.

2. Materials & Methods

An analytical comparative cross-sectional study was conducted where data was collected from young adults of Islamabad and Rawalpindi. A total 158 participants were included in our study via non-probability purposive sampling technique. The participants were selected on the basis of inclusion and exclusion criteria. The participants were divided into two groups on the basis of participant with and without lower cross syndrome. The outcome measurement tool of study was McGill Core Endurance battery flexor endurance, extensor endurance, right lateral endurance and left lateral endurance.

Participants aged 19 to 30 years, of both genders, with a BMI in the Asia-Pacific normal to overweight range (18.5–24.9 kg/m²), were included in this study. The inclusion criteria specified individuals experiencing local intermittent lumbar pain characterized by mild to moderate intensity on the Numeric Pain Rating Scale (NPRS 1–6). This pain was sustained during activity, caused by prolonged loading in a sustained posture, and alleviated by changing the posture. Participants with a positive modified Thomas test, positive prone hip extension strength test, positive trunk flexion strength test, and tight erector spinae were categorized into the Lower Cross Syndrome group. Those with no low back pain and negative results on these tests were placed in the control group.

Exclusion criteria included individuals with any of the following conditions such as shoulder pain or acute flare-ups of low back pain (LBP), Centralization or peripheralization of pain, Intermittent pain at a limited end range, Leg symptoms during walking that ease in flexion (signs of spinal stenosis), pain caused by repetitive movements, Paresthesia or numbness, Structural deformities (e.g., kyphosis, lordosis, scoliosis, spondylosis, spondylolysis, spondylolisthesis), Curve reversals, Pregnancy, Post-surgical conditions and Degenerative or inflammatory spinal diseases were excluded.

All the data was analyzed using SPSS version 21.0. Kolmogorov-Smirnov test was used to assess normality. Nonparametric statistics , including Mann-Whitney U-test was applied with a 95% confidence interval

A pilot study was conducted in which 30 participants were included in each study group for calculation of sample size. Using group statistics, effect size and corresponding sample size was calculated using G power 3.1. Since the study is based on theoretical framework At-least 20% variation in independent variable is clinically important to be linked with variation in dependent variable. That is why we considered estimated sample size, based on Cohen's d value greater than 0.2. Thus, for each group 79 participants were required for an independent T-test in order to detect a 90% chance of difference in means at 5% significance level.

For outcome McGill Core Endurance battery was used to assess core endurance of participants. It includes 4 tests comprising of trunk flexion endurance, trunk extension endurance and left and right lateral endurance tests. The flexor endurance test was used to assess muscular endurance of the deep core muscles that includes transverse abdominis, quadratus lumborum, and erector spinae. The trunk lateral endurance test is used for assessment of muscular endurance for the lateral core muscles that are transverse abdominis, obliques, quadratus lumborum, and erector spinae. This test was same for both sides. The trunk extensor endurance was used in the assessment of muscular endurance for the

back extensor muscles that are erector spinae, multifidi, longissimus, and iliocostalis. All these four tests were time based, and participants were asked to maintain the position as long as possible.

3. Results

158 participants were included in our study, 79 participants in each group. Out of the 158 participants, 43 (27%) were male and 115 (72.3%) were females. Mean age of participants was 21.81 ± 2.43 years.

As shown in the table below (table 1), there was a significant difference in self-reported sitting hours (p =0.002) and self-reported standing hours (p=0.019) between the participants of healthy group and lower crossed syndrome group.

Table 1: Mann-Whitney-U test for sitting and standing hours

Variable		Median(IQR)	p value
Sitting hours	LCS present	10(3)	0.002
	LCS Absent	9(2)	
Standing hours	LCS present	4(2)	0.019
	LCS Absent	4(3)	

There was significant difference regarding the measured core endurance for extensor, left lateral and right lateral core endurance tests between the healthy group and the lower cross syndrome group ($p < 0.05$). However, there was no significant difference in flexor endurance ($p \geq 0.05$) of both groups.(Table 2)

Table 2: Mann-Whitney-U test for comparison of core endurance

McGill Endurance test	LCS Present Median(IQR)	LCS Absent Median(IQR)	p value
Flexor endurance test	10.0(8.2)	10.9(10.3)	0.286
Extensor endurance test	5.5(5)	6.2(7.2)	0.039
Right lateral endurance test	3.0(3)	4.9(7.5)	0.000
Left lateral endurance test	2.9(2.9)	4.9(6.4)	0.001

4. Discussion

The purpose of this analytical cross-sectional study is to compare core endurance in young adults (aged 19 - 30) with and without lower crossed syndrome. Result of our present study show there are significant differences in back extensor endurance test, left lateral endurance test and right lateral endurance test between the healthy and the lower crossed syndrome individuals ($p < 0.05$). However, there is no significant difference in flexor endurance ($p \geq 0.05$) in both groups. The participants in the lower crossed syndrome group included both individuals that were asymptomatic and individuals that were experiencing intermittent lower back pain. Our study suggested that muscle imbalance in individuals with lower crossed syndrome majorly affected the back extensor endurance, right lateral and left lateral endurance of an individual. In this study we also found a significant difference in self-reported sitting hours between the healthy and lower crossed syndrome groups (p = 0.000). According to Janda, lifestyle and lack of physical activity are major contributors to lower cross syndrome. Similarly, standing hours also differed significantly between the groups (p = 0.002, 0.000), which may explain the observed differences in core endurance. These findings suggest that future studies could explore the relationship between physical activity and core endurance in the targeted population.

Literature review related to or similar to our study was limited on the subject of core endurance in lower crossed syndrome individuals aged 19-30 years. Hence our study is the first study to determine the core endurance in healthy individuals and in individuals with lower crossed syndrome.

A study conducted in 2016 by OR Abdel raouf found a link between core endurance and back dysfunction in young male athletes, both healthy and those with non-specific low back pain. Using McGill's Torso Muscular Endurance Test, the study showed that athletes with low back pain had significantly lower core endurance compared to healthy controls.[8] Our study used the same methodology and found similar results, with participants who had lower crossed syndrome also experiencing low back pain, further supporting the association between reduced core endurance and lower crossed syndrome.

Similarly, a study involving 561 healthy adults (aged 19 to 67) used the modified Biering-Sorensen test to assess low back muscle endurance. The study confirmed that reduced back muscle endurance is linked to increased low back pain, supporting the idea that muscle fatigue and overload can lead to pain.[9] Similarly, our study found significant differences in extensor and lateral endurance between individuals with lower crossed syndrome and healthy individuals, highlighting the impact of muscular imbalance on endurance in lower crossed syndrome.

In 2014 case-control study, identified poor posture and low physical activity as significant risk factors for chronic low back pain in adults aged 18-90.[10] Similarly, our study found that prolonged sitting and standing hours are associated with low back pain, which can lead to lower crossed syndrome. The findings of this literature and our study suggest that future researches could be carried out keeping sitting and standing hours as the main variable of physical activity while comparing core endurance in individuals with back dysfunctions.

Our research suggested that core endurance can be affected in individuals with lower cross syndrome. One of the significant implications of our study is that researchers can base future interventional on individuals with lower cross syndrome and manage their impairments. One of the major impairments cofounded in participants with lower crossed syndrome was the presence of low back pain. Like quoted in another study about 85% of back pain is a result of muscular imbalances like lower cross syndrome.[11] According to the results of a current study the significant difference in core endurance of individuals with and without lower crossed syndrome. Outcome variable of our study i.e., core endurance is multi-factorial, and the obtained difference could be because of these confounding variables such as age, gender, body mass index (BMI), sitting or standing hours, lifestyle, occupation, body mechanics and ergonomics. A further detailed study of these possible factors creates a baseline for future further studies.

The reliability of the McGill torso endurance battery is influenced by multiple repetitions; however, in our study, core endurance tests were conducted at only one point in time, which may have been impacted by factors such as fatigue. Additionally, the core endurance tests were generalized, without distinguishing between local and global core muscles. Another limitation is that participants were not recruited based on their active or sedentary lifestyle. To improve the accuracy and significance of the results, future studies should involve repeating the data collection process three times, considering the participants' physical condition, which would be feasible in a longitudinal study design. Moreover, future research should consider gender-specific analysis and involve a larger sample size. Expanding the study globally would enhance the generalizability and provide more insightful findings. Other factors, such as body biomechanics, body composition, and lifestyle, can also influence core endurance, and these variables should be explored in future studies. Furthermore, interventional studies aimed at strengthening core muscles in patients with lower crossed syndrome are recommended for further investigation.

Conclusion:

This study concluded that there was a significant difference in extensor endurance, right and left lateral side endurance in individuals with lower crossed

syndrome as compared to healthy individuals but there wasn't any significant difference in flexor endurance in individuals with lower crossed syndrome comparative to healthy individuals. Muscular imbalance in lower crossed syndrome has an effect on an individual's extensor and left and right lateral endurance.

Conflict of Interest

None

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