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Effect of core muscles endurance in professional athletes with and without lower limb injuries

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Abstract

BACKGROUND: This research investigates the impact of core muscles endurance among professional athletes, both those with and without lower limb injuries. The primary aim is to demonstrate a correlation between lower core endurance values and a heightened likelihood of lower limb injuries in athletes.
METHODOLOGY: The study takes the form of a cross-sectional, comparative investigation spanning a duration of one year. A total of 60 participants, aged between 16 and 35, were carefully chosen. They were then divided into two groups, A and B, each consisting of 30 individuals, with Group A comprising athletes without lower limb injuries. Core muscle endurance was evaluated using the McGill core endurance test.
RESULTS: The analysis revealed significant findings in McGill extension and side plank exercises, whereas the McGill flexion test yielded non-significant results.
CONCLUSIONS: In summary, the study concludes that there exists a statistically significant relationship between core muscle endurance and lower limb injuries in professional athletes, emphasizing the importance of addressing and enhancing core strength to potentially mitigate the risk of such injuries.

Keywords: core stability, core muscles endurance and lower limb injuries.

Introduction

Physical activity done on regular basis is the most important factor in determining the health of a population. But the cost of physical activity is extracted in the form of activity-related injuries. Sports injury in an athlete occurs when they are open to the elements to their particular sport and they happen under certain conditions, at a specific time and place. Few researches have stated a severe sports injury as the one which make an athlete to let pass five games as a consequence, whereas, some researches categorize a severe injury as the one which requires the athlete to fall out of competition for five weeks to heal properly. But evidently these comparisons are not attuned for the games which are played once a week. [1, 2]

There are extrinsic factors and intrinsic factors which add to the sports injuries. The extrinsic factors include: the condition of the practice surfaces and hardness of the practice surfaces, return to play after a break or a holiday period, improper footwear, high intensity training session, the level of practice done, playing in competitions repeatedly, weather conditions, equipment used, rules of the game playing and any foul play. [3, 4, 5, 6]

The intrinsic factors include prior injuries which pose as a major risk factor chances for re-injury. Especially in the aged athletes the injuries recurring of the similar type and on the same site can progress from acute to chronic injuries. Approved literature has stated the injuries increases with the age. In aged athletes the intense practice hinders the optimal period of recovery for different types of tissues. Therefore, the risk of recurring injuries increases in the after years. [7, 8] The most common and widely seen example of lower limb is of hamstring musculature which accounts for large number of injuries seen that rises with the age. And it is mostly due to the poor quality of scar tissue formed especially at the myotendinous junction. [9] Similarly the soft tissues injuries which account for recurrences are in the ankle's external ligament complex. The injury of the joint tissue leads to decline in the proprioceptive capacity which in turn causes errors in the precision of the position of the joint. The persisting alteration of the proprioception of the ankle joint may lead to recurrence injury or even manifestation of new injuries. It can also lead to decreased stability of the joint. Another intrinsic factor is the force deficit between the two groups of the muscle. Stability of the joint depends on the passive structures and the muscles of the joint act as an active stabilize. Therefore, decrease in the joint control can occur due to an alteration in the production of force.

Due to increased joint mobility in women, low proprioceptive alertness is found in certain ligaments when preventing potentially harmful movements, like hyperextension of the knee. [10] Increased range of motion and increased compliance in the tissues of the joints due to joint laxity which increases the risk of injuries to soft tissues. As there is a well-known relationship between joint laxity and electromechanical delay of the muscle

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tissue, it may be become a contributing factor in the injuries of hamstring muscles. [11] Researches on differences of risk relative to gender suggest that the frequency and severity of ACL rupture is higher in female athletes than the non-athletic population. It is seen biomechanically that female athletes develop certain motor patterns that stimulates greater sports injuries in comparison to their male counterparts. Studies have been conducted to see if there are any hormonal factors which affect the incidence of injuries. It has been found that the ACL rupture is most commonly seen due to varying joint laxity with women's menstrual cycle [12] and mainly most injuries occur during the preovulatory phase of the menstrual cycle. Disruptions in menstrual cycle also contribute to incidences of sports injuries in female athletes. In amenorrhoeic females, the incidence of stress fractures is higher than females who are normally menstruating. This is because of low bone density. Other mechanism by which disturbed menstrual cycle increases the risk of stress fracture is alteration in formation of the bone. Along with alteration in bone formation, other factors which can have an impact on development of stress fracture are low BMI, low calcium intake and greater training load. [13]

The core muscles stability provides several benefits to the musculoskeletal system which comprises of maintaining health of the lower back area to the prevention of ligamentous injuries of the knee joint. As there is a relationship between activities of muscles of trunk and the movements of the lower limbs, the recent studies suggest that, decreased stability of core muscles may predispose a person to injuries, and appropriate training of core muscles may reduce the risk of injuries.

Core muscles stability plays an important role in proficient biomechanical functioning so as to maximize the force generation and to minimize the load on joints in all types of disciplines ranging from walking to running to throwing. The significance of core muscles functioning of the body is to stabilize and generate force in all types of activities which is done by the body increasingly. Researchers have affirmed the significance of stability of core muscles in efficient production of trunk and limb movements for generation, transfer and control of forces while performing closed kinematic chain movements.

The pattern in which there is activation of muscles while performing any task was studied during the movements done by the whole body. It was found that muscles stabilizing the core, namely, transverse abdominis, multifidus, rectus abdominis and internal and external obliques were constantly activated before any of the limb movements performed. This is known as "feed forward mechanism". These findings suggest that the muscles of core are related to the lower limb functions also. When there is the initiation of the movement of hip abduction, there is activity of transverse abdominis and obliques seen before the contraction of prime movers of hip. While performing hip extension, there is activity of transverse abdominis, rectus abdominis and obliques preceding the activation of gluteus maximus muscle in lower limb. [14] It is concluded that with movement of hip in different directions, there is activation of core muscles preceding the contraction of prime movers of the hip joint.

During core endurance test, the time a player is able to hold a position statically gives a quantitative value to determine risk for the injury. When hip and lumbar extensors are fatigued, the neural activation and trunk proprioception is reduced. Therefore, assessing core can help us to find about lower limbs injuries.

AIM: To study the effect of core muscles endurance in professional athletes with and without lower limb injuries.

NULL HYPOTHESIS (Ho): There is statistically non- significant difference between core muscles endurance in professional athletes with and without lower limb injuries.

EXPERIMENTAL HYPOTHESIS (H1): There is statistically significant difference between core muscles endurance in professional athletes with and without lower limb injuries.

Materials and methods

STUDY DESIGN: cross-sectional, comparative study
SETTING: Study was done in the sports department of DAV institute of physiotherapy and rehabilitation and other sports complexes of Jalandhar city.
DURATION OF STUDY: Total duration was of one year.
SAMPLE SIZE: A minimum of 60 subjects were selected for the study out of which 2 groups were divided of 30 subjects each.
SAMPLING: Convenient sampling was done.
SELECTION CRITERIA: Both male and female professional athletes with age 16-40 years were selected. And athletes with and without lower limb injuries from past 3 months were selected for the study. Athletes who have

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undergone any lower limb and abdominal surgeries in last 6 months (e.g.: ACL reconstruction, hernia, C-sections etc.) or athletes with lower limb deformities, spinal pathologies, any structural limb length discrepancies or any low back pathology were excluded from the study.

INSTRUMENTS: Stopwatch, plinth, mat, full circle goniometer
PROTOCOL: A thorough assessment was done for all the participants. All the participants who met the inclusion and exclusion criteria were selected for the study. A written informed consent was obtained from all the participants. All possible precautions for COVID-19 were taken as per government guidelines. Study was approved by decision of the Institutional Ethics Committee. A minimum of 60 subjects were selected for the study and were divided into the groups of 30 each. Group A consisted of injured athletes and group B consisted of non-injured athletes.

PROCEDURE: After obtaining the demographic data of the subjects, a screening form was filled for any lower limb injury. Then data was collected using McGill core endurance test. For measuring core muscles endurance, McGill et al used the flexion endurance test, side plank test and extension test to assess the endurance of core. For Flexion endurance test, subjects were asked to sit on the mat and place their upper body against a support with an angle of 60° from the mat. Both the knee and hip joints were flexed at 90°. The arms were folded across the chest, hands were placed on opposite shoulders, and ankles were stabilised. Subjects were asked to maintain this position without the support. Time was recorded until the upper body falls below 60°. For Side plank test subjects were asked to lay on their side with their legs extended and their top foot in front of the other foot for support. Subjects were then asked to support themselves by lifting their hips off the mat to maintain a straight line while supporting themselves on one elbow and their feet. The uninvolved arm was in the straight line with the body, with hand resting on the side of the thigh. The time was recorded till the subject falls to the mat. The test was performed on both the sides. For Extension test, subjects were asked to hold the prone lying position where the iliac crests were positioned such that it was out of the couch and hands were crossed on the chest. The goal was to maintain this position for as long as possible and the time was recorded using stopwatch. [15,16]
Data was analysed using latest version of SPSS software.

Results

The data was analysed using unpaired t-test and level of significance for the study was chosen to be <0.05. In inter group analysis for group A and B for McGill flexion test (table 1), there is statistically non-significant difference between the two groups. Where t value is 0.248 and p value is 0.8053 (figure 1). In inter group analysis for group A and B for McGill extension test (table 2), there is statistically significant difference between the two groups. Where t value is 2.975 and p value is 0.0043 (figure 2). In inter group analysis for group A and B for McGill side plank (right side) test (table 3), there is statistically significant difference between the two groups. Where t value is 4.193 and p value is <0.0011 (figure 3). In inter group analysis for group A and B for McGill side plank (left side) test (table 4), there is statistically significant difference between the two groups. Where t value is 4.555 and p value is <0.0010 (figure 4).

Discussion and implications

In this study, the hold times of McGill extension endurance test and side planks test were significantly lower in players with lower limb injuries, i.e. players without any lower limb injuries were able to hold extension and side plank position for a longer duration. The significant results for McGill extension endurance test are in agreement with the results of the study conducted by Abdallah et al. [17] They concluded that core endurance is an important factor which influences the potentialities of non-contact lower limb injuries. They stated the reason as the activation of multiple muscles involved during extension and side bridge. The muscles activated are internal oblique, latissimus dorsi, rectus femoris, upper rectus abdominis, gluteus maximus, vastus medialis obliques and hamstring muscles. [18, 19] Out of which lower rectus abdominis is the most activated muscle with 42% of maximum voluntary contraction. These muscles help in the maintenance of neural spine alignment, transferring the load throughout the kinetic chain and maintain optimal trunk position. [20] Thus extension endurance time can become a predictor for weak core and also can be used as a therapeutic measure to strengthen the core muscles. Our results for significant side planks endurance test values were in agreement with Zazulak et al [21] who reported that the predictor of risk of knee injury was the lateral trunk control. Our findings are also in agreement with Ekstrom et al. [18] They concluded that both side bridge and prone bridge exercises are important for the improvement of core endurance, strength and stability. This is because the muscle quadratus lumborum is more active during side bridge than the prone bridge position. During side bridge it plays an important role to maintain stability as it shows more than 50% of maximum voluntary contraction. [22, 23] According to the study's result the muscles responsible for stability like gluteus medius and paraspinal muscles, are more active during side bridge. When compared to trunk flexion and horizontal back extension, there is

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activation of multiple muscles during side bridge. Whereas there is only activation of rectus abdominis muscle during trunk flexion and very little activation of other muscles. [24] As most of the muscles responsible for the stabilization of trunk are activated during side bridge, it can be used as a pre-screening test as well along with the predictor for weak core. Previous studies have also provided with the proof that the core stability is an important component for maintaining the dynamic stability of a joint throughout the kinetic chain which extends from the lumbar spine till foot. [25, 21] This is because of the fact that lower values core endurance is associated with impaired neuromuscular control of centre of mass of the body and therefore, elevates the risk of lower limb injuries. [21, 26, 27, 28, 29, 30] In some non-injured players, low core endurance is a predictability factor that can lead to injuries. Our results of non-significant McGill flexion test values are in accordance with Leetun et al [26] who reported that external rotation of hip strength weakness was the closest predictor of injury status over the course of one athletic season. This theory is again supported by McGill et al. [31] They reported that the ability of the trunk muscles to generate force for the prevention of low back pain is lower than the value of trunk muscle endurance in non-athletic population. But in athletic population, measures of isometric hip strength are particularly more accurate predictors of lower limb injuries and low back pain in high-speed sports.

Conclusions

The result of this study concludes that there is statistically significant effect of core muscles endurance in professional athletes with and without lower limb injuries. Hence, the results obtained supported the experimental hypothesis. In future this study also acts as a prospective study to predict the risk for injuries with larger sample size and proper timed intervention.

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32. *Conflicts of interest*
33. The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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Authors' contributions
All authors contributed equally to the manuscript and read and approved the final version of the manuscript.

Ethical approval
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TABLES

Unpaired t Test	**(McGILL TESTS) FT**	
	Group A	**Group B**
Mean	40.97	42.27
S.D.	20.597	20.065
Number	30	30
Maximum	101	90
Minimum	8	8
Range	93	82
Mean Difference	1.30	

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Unpaired t Test	0.248
p value	0.8053
Table Value at 0.05	2.00
Result	**Not-Significant**

Table 1: Intergroup analysis for McGill flexion test

Unpaired t Test	**(McGILL TESTS) ET**	
	Group A	**Group B**
Mean	41.30	59.23
S.D.	15.944	28.906
Number	30	30
Maximum	90	120
Minimum	23	24
Range	67	96
Mean Difference	17.93	
Unpaired t Test	2.975	
p value	0.0043	
Table Value at 0.05	2.00	
Result	**Significant**	

Table 2: Intergroup analysis for McGill test extension test

Unpaired t Test	**(McGILL TESTS) SP (Rt)**	
	Group A	**Group B**
Mean	44.87	72.07
S.D.	20.814	28.792
Number	30	30
Maximum	100	120
Minimum	23	25
Range	77	95
Mean Difference	27.20	
Unpaired t Test	4.193	
p value	<0.0011	
Table Value at 0.05	2.00	
Result	**Significant**	

Table 3: Intergroup analysis for McGill side plank (right) test

Unpaired t Test	**(McGILL TESTS) SP (Lt)**	
	Group A	**Group B**
Mean	44.77	72.13
S.D.	17.951	27.577
Number	30	30
Maximum	90	121
Minimum	21	22
Range	69	99
Mean Difference	27.37	

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Unpaired t Test	4.555
p value	<0.0010
Table Value at 0.05	2.00
Result	**Significant**

Table 4: Intergroup analysis for McGill side plank (left) test

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