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Association of Inspiratory Muscle Strength with Sports Performance in Football Players

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Abstract
There is large population interested in football and have been playing since years. This is a multifaceted sport that not only requires strength and endurance but also requires well developed physic that are important co-determinants of football performance. Football (soccer) player have to maintain a high level of intensity throughout the whole game and so the need to evaluate the association of inspiratory muscle strength with the sports performance in football players by using Inspiratory muscle training device and YO-YO Intermittent Recovery Test Level 1.Analytical study was carried on total of 126 football players with mean age 20.58±2.57 and year of experience with mean 6.19±3.34 were evaluated by using Inspiratory muscle training device and inspiratory muscle strength was checked and then the players completed YO-YO intermittent recovery test level 1 and VO2max was calculated. Spearman coefficient correlation(r) was used to assess the correlation and on statistical analysis spearman coefficient between inspiratory muscle strength and predicted VO2max is 0.24.VO2 max peak was more sensitive to decreasing orifice diameter in trained endurance football players than untrained individual. There is increase in circulatory capacity with endurance training which is increased by IMT, whole body aerobic capacity increases thus increase in VO2 max. This study concluded that there is weak correlation between inspiratory muscle strength and VO2max.
Keywords: *Fitness, Yo-Yo intermittent recovery test, VO2 max, inspiratory muscle training (IMT) device.*

Introduction

Football is most widely played sports in the world, it is a multifaceted sport that not only requires well developed physical fitness but also players need technical, tactical, and physical skills to succeed. [1]

Football requires strength and endurance and also requires well developed physic that is important co-determinants of football performance. Football is widely known as a high intensity prolonged duration intermittent activity. Football is a dynamic sport that requires the athlete to perform

many different movements and skills such as rapid acceleration and deceleration, quick changes of directions, jumping, kicking, and sliding [2][3][4]

However, studies to improve football performance have focused on technique and tactics of physical resources and important co-determinants like endurance, strength, and speed and a professional football (soccer) player has to maintain a high level of intensity throughout the game. [1]

Football players run approximately 10-12 km for 90 minutes duration of the game. In non-elite football players maximal strength training have shown improve running economy. In footballer's aerobic capacity with its key factor VO2max is very important during a match to fuel the extensive running and movement required where a player covers 8– 12 km at an average intensity of 80 – 90% of maximal heart rate (fc max), or close to lactate threshold (LT). [5] [6]

During a match VO2max increases the distance covered. It has now become evident for best effects that strength and endurance training require maximal efforts and high intensity. Strength and power-demanding activities often comprise the decisive parts of a football match. [6]

The respiratory muscles that are composed of the diaphragm, external and internal intercostals, parasternal, sternomastoid, scalene, external and internal oblique and abdominal muscles. In order to work properly during the competition, the footballers require more amount of oxygen as they take thousands of breaths during the game.[5]

It has been found that among athletes increase in respiratory muscle strength can delay respiratory muscle fatigue and the onset of breathlessness. In healthy subject's respiratory muscle fatigue is known to compromise exercise performance. Evidence is that fatigue of respiratory muscles may affect exercise performance via the so-called metaboreflex i.e. accumulation of metabolites, such as lactic acid, in the respiratory muscles. This consequently increases limb muscle fatigue during exercise and results in earlier exercise termination compared with conditions where respiratory muscle fatigue is prevented. During exercise inspiratory muscle training has shown to reduce the development of respiratory muscle fatigue. [2] [7]

During a game, heart rate increases and so VO2 Max also increases and while rest period the values decreases with time. It is recently developed that by (POWER breathe KH1) device, IMT is performed, this device provides resistance which applies an inspiratory load that is provided by an electronically controlled valve.[8]

Inspiratory muscle training (IMT) is a device used for training of inspiratory muscles against resistance. Device have been developed to increase inspiratory strength. The device typically uses basic principles of resistance training. Ventilatory muscles have shown similar adaptations to training as that of the other skeletal muscles by using training principles. The functional improvement and adaptive changes in structure of ventilatory muscles in response to inspiratory muscle strength are similar to those changes seen in limb muscles.[9]

A recent precedent for using IMT as an addition to existing training practice. Research also suggests that IMT may evoke lower post exercise blood lactate (BLa) levels as a result of increased breathing efficiency after IMT, which in turn could increase oxidative or lactate transport capacity or even both. Conversely, it has also been suggested that IMT could compromise limb blood flow (increasing BLa) during maximal exercise as a result of an increased cost of breathing. It has been postulated that improvement in performance in exercise tolerance as a result of IMT are most likely because of positive sensations of respiratory efficiency, which lead to greater cardiorespiratory comfort, confidence, and voluntary willingness to extend duration.[3]

The Yo – Yo Intermittent Recovery (IR) tests have rapidly become some of the most extensively studied fitness tests in sports science. The two Yo-Yo intermittent recovery (IR) tests evaluate an individual's capacity to repeatedly perform intense exercise and to examine changes in performance.[9] The tests have been widely applied

in many team sports due to their specificity and practicality. [10]

Football coaches commonly use the Yo-Yo intermittent recovery test (Yo-YoIR1) as a valid assessment of aerobic endurance performance in football players.[11] They also use the Yo-Yo intermittent recovery level 1 test to monitor fitness, the effectiveness of physical conditioning programmers, and prepare for further training content.[10][11]

According to a study, the speed-endurance training group have a significantly greater improvement in the Yo-Yo intermittent recovery test level 1 compared with the group performing aerobic high-intensity training. Speed endurance training has a positive effect on high-intensity intermittent exercise performance and elicits greater improvement in football-specific endurance. This outcome may be explained by the fact that this type of training taxes and induces adaptations in both aerobic and anaerobic metabolic pathways.[12]

As there is a limited study on how the inspiratory muscle strength is associated with the sports performance in these players. Hence the purpose of my study is to evaluate the association of inspiratory muscle strength with sports performance in football players which will in turn help them to improve their sports performance in future.

Material and Methods

Study Design: Analytical study

Selection of Subjects: The participants selected for the study are 126 football players with age group 18-35 years and year of experience more than 1 year in sports club. The players are selected according to the inclusion criteria exclusion criteria. Inclusion criteria are players between age group of 18-35 years, both males and females were included in the study, players playing for more than 1 year and the players willing to participate. Exclusion criteria are any recent injuries to lower limb as the players have to run in YO-YO test, any systemic injury, irregular practice session and players with intermittent practice. The aim, objectives and method of study is explained to the participants. Consent is taken on the consent form.

Material: Measuring tape, cones, stopwatch, YYIR audio, performance recording sheetis required for performing YO-YO intermittent recovery test level 1 and Inspiratory muscle training deviceis used to check inspiratory muscle strength.

Procedure

Ethical clearance was taken from the Institutional Ethical Committee, Tilak Maharashtra Vidyapeeth Department of Physiotherapy, Pune. Participations were selected according to inclusion and exclusion criteria. The aim, objectives and method of study was explained to the participants. Consent was taken on the consent form. The Yo-Yo intermittent test was conducted using standardized procedure. The inspiratory muscle strength was checked using IMT device.

YO-YO Test Procedure

The Yo-Yo intermittent recovery test was conducted at sports ground to evaluate the Vo2 max of the players. As been shown in the Fig.1, the participants begin the test from position B. The players were instructed to follow the audio commands of Yo-Yo IR test and accordingly start running towards position C so that the player reaches position C before the next audio signal. Similarly, the player had to return back to position B before the next audio signal. Once they reach the position B, they had 10 seconds recovery time during which they were instructed to jog or walk from position B to position A then return to position B before the beginning of the next shuttle. In this test the participants are withdrawn from the test after 2 consecutive fail attempts, this means if the individual does not reach from position C and back to position B in the allotted period, one fail is considered. If they fail to complete the test the 2nd time the test is eliminated. Once the test is eliminated, the individuals score must be recorded.

IMT Device procedure

IMT device was used to check the inspiratory muscle strength in the players. The players were explained about the IMT device and the use of the device. A nose clip was given to the players and asked to close the nose with that clip. Then the players were asked to put the mouth piece of IMT device in mouth and asked to do inspiration and expiration and the resistance was increased till the player feels the resistance. 1 RM was noted on the recording sheet.

Statistical Technique: Spearman's coefficient is used to assess the correlation between inspiratory muscle strength and VO2Max.

Results

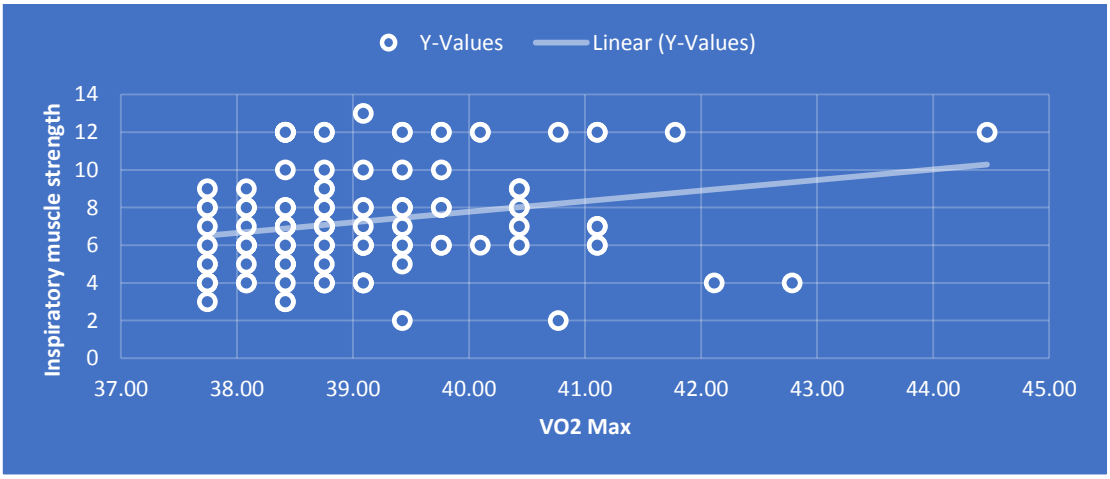
Table No. 1 Distribution of age, year of experience, inspiratory muscle strength and VO2 Max according to levels played.

Level	Age (Mean±SD)	Year of experience (Mean±SD)	Inspiratory muscle Strength (Mean±SD)	VO2Max (Mean±SD)
District	20.3±2.39	5.37±2.70	6.95±2.47	37.77±1.30
State	24.30±11.4	6.95±2.45	7±2.66	38.04±1.50
National	21.25±3.07	8.25±4.96	8.3±2.84	38.31±1.56

Table 2: Correlation between inspiratory muscle strength and predicted VO2 max

	IMT	VO2max
Mean	7.24	39.04
Standard deviation (SD)	2.63	1.12

Graph No. 1



Interpretation

There is positive correlation between inspiratory muscle strength and predicted VO2max with r value 0.24.

Discussion

The study was aimed to seen the association of inspiratory muscle strength with sports performance in football players between age group of 18-35 years. An analytical study was performed among 126 subjects using Yo-Yo intermittent recovery test level 1 and inspiratory muscle training (IMT) device. The Yo-Yo intermittent recovery test was performed to check the VO2 max amongst players and Inspiratory muscle training device was used to check the inspiratory muscle strength in football players.

The data was collected, analysed and statistical analysis was done. In table number 1, the distribution of age, year of experience, inspiratory muscle strength and VO2Max according to levels players is statistical analysis.

Jan Helgerud, et.al (2011) underwent a study on Strength and Endurance in Elite Football Players which showed that the training effects in elite football players are of a similar magnitude as for lower level football players, however in the current study all level of players were included and out of 126 samples there were 83 district level, 23 state level, 20 national level players.[5]

Joshua H. Guy et.al (2014) underwent a study on Inspiratory Muscle Training Improves Exercise Tolerance in Recreational Soccer Players Without Concomitant Gain in Soccer-Specific Fitness which was performed on players between the average age group for experimental group was 26.6±8.2 years and controlled group was 21.3±4.9 years. Hence the current study was performed on participants of district level with mean age 20.3±2.39, state level with mean age 24.30±11.4 and national level with mean age 21.25±3.07 which was significant.[3]

The mean year of experience of 126 samples was analysed in district level players which was 5.37±2.70, in state level players mean year of experience was 6.95±2.45 and national level players mean year of experience was 8.25±4.96.

Can Ozgider, (2010) underwent a study on Four weeks of respiratory muscle training improves intermittent recovery performance but not pulmonary functions and maximum oxygen consumption (VO2 MAX) capacity in young soccer players which was performed on the players playing for 8.5 ± 0.7 (ranging from 7 to 9 years) years of experience in football. [4]

The inspiratory muscle strength mean in district level players was 6.95±2.47, state level players mean was 7±2.66 and national level players mean was 8.3±2.84.

The VO2Max mean in district level players was 37.77±1.30, state level players mean was 38.04±1.50 and national level players mean was 38.31±1.56.

Graph 1. shows the Correlation between inspiratory muscle strength and predicted VO2max shows that there is positive correlation between inspiratory muscle strength and predicted VO2max with r value 0.24 which was statically analysed. According to the study by Guy, J. H et.al (2014) underwent a study concurrent IMT and twice-weekly pre-season football training for recreational players resulted in a significant improvement in exercise tolerance as detected by accumulative distance in a running test. [3]

IMT increases respiratory muscle strength with endurance by >28% in athletes. However, some studies have shown that there are effects on maximal endurance and Vo2max and also show that there are small improvements in performance. [12] (pg.149)

According to the study by Illi SK, et.al (2012) it clearly shows that inspiratory muscle training significantly improves endurance performance, independent of the type of inspiratory muscle training or the type of sport.[6]

It is important that players develop their ability to perform repeated maximal, or near maximal, efforts, which can be achieved through aerobic high intensity and speed-endurance training. Aerobic high-intensity training elicits increases in cardiovascular parameters such as heart size, blood flow capacity, and artery distensibility. These changes improve the capacity of the cardiovascular system to transport oxygen, resulting in faster muscle and pulmonary VO2 kinetics and higher VO2max. Thus, a greater amount of energy can be supplied aerobically, allowing a player to both sustain intense exercise for longer durations and also recover more rapidly between high-intensity phases of the game. [11]

The study concluded that there is weak correlation between inspiratory muscle strength and VO2max.

Conclusion

The study concluded that there is weak between inspiratory muscle strength and predicted VO2 max with r value 0.24

Limitation of study

Both male and females were studied together and all level of players were included in the study.

Acknowledgement

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