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Relationship between strength, speed and change direction performance in field hockey players

Abstract

The aim of current study was to investigate the relationship between strength and linear or non-linear sprint performance variables in U19 male field hockey players during the midseason time. Twenty eight players from Sharkia Hockey Club participated in current study with anthropometric data of mean±SD (age=17.57±1.23 years, height=1.71±0.05 meter, body weight=66.05±5.93 kg and body mass index=22.61±1.78 kg/m^2). Participants were measured for lower limb strength (vertical height jump, power and standing long jump), liner sprint (sprint over 30meters with different short distance included) and non-linear sprint performance (L running and zigzag measures). The relationships between physical fitness qualities were assessed by Pearson product-moment correlation coefficient. There were a moderate relationship between VJ height and sprint 20m and 30m performances, (r=0.66 and 0.63), respectively. Likewise, similar moderate relationships observed between power and sprint 20m and 30m performances (r=0.62 and 0.61), respectively. In addition, no significant relationships observed with other sprint distances or change of direction measures when correlated to other variables of VJ and power results. The study concluded that, the knowledge of relationships between strength and cyclic or acyclic sprint performances at various distances would allow coaches to structure the field hockey training drills.

Keywords: muscle strength, cyclic sprint, acyclic sprint, agility

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Abbreviations: VJ, vertical jump; SLJ, standing long jump

Introduction

In recent years, field hockey has evolved and become faster paced and more physically. The strength and conditioning training programs objective is to improve the physical fitness characteristics for players in any sport and all trainers are seeking to increase the level of performance for fitness components such as strength, speed and the ability of change directions. The sprint and change of directions are important in all team sports, with field hockey players spending approximately a number of 30 sprints during the game with sprint duration of 1.8 second and maximal sprint duration of 4.1 seconds which performed over 10 to 30 meters and the frequency of sprinting is approximately 20 to 60 bouts per game, with 700 to 1000 meters of the total sprint distance.[1,2] In this regard, MacLeod et al.[3] suggested that the greater understanding of field hockey specific demands imposed upon sport performers by match play and training and the more likely it is that suitable training and recovery programmes will be improved and employed, which may lead to promote the player performance and reducing the risk of injuries.

Field hockey as a field-based team sports categorized as an intermittent sport which requires a high degree of physical fitness. The intermittent nature of this sport and the performed multi changes of direction during the match-play emphasize the importance of highly developed sprint capacity and performance in repeated sprints, as well as of an outstanding slalom sprint performance.[4] Therefore, the coaches and sports researchers advocate training programs to improve muscular strength and power in an effort to transform these improvements into decreases in sprint and change of direction times.[5] In addition, the sprinting performance requires a high level of acceleration and as such high level of muscle strength to overcome the inertia of body mass.[6] There are some studies investigated the relationship between strength and speed performance and showed that stronger players perform a better sprint performance.[6–10] The reported results of these studies demonstrate a positive relationship between strength and sprint performance which may be explained by the fact that peak ground reaction forces and impulse are strong determinants of sprint performance.[11–13]

The investigation of relationship between physical fitness qualities have been shown in previous studies in field hockey players.[14–17] A strong correlation between strength and speed tests was reported in previous studies for athletes.[5,8–10,18,19] Moreover, the relationship between strength and the ability of change direction have also been shown.[5,18,20–22] In this regard, some studies observed a non-significant or weak correlations between studied physical fitness qualities.[7,8,23,24] The inconsistency of poor correlations between the results in previous studies could be explained by different factors, in this context, Nimphius et al.[5] suggested that the correlation between two fitness component variables could be change due to a lot of factors, such as training experience, level of player, gender and the timing of training season; these reasons explain why many findings of previous studies have found differing results when compared the relationship between strength, speed and change direction performance.

There are no special studies have investigated if is any relationship between strength and sprint performances occur in U19 field hockey players, although Elferink-Gemser et al.[4] has investigated the relation between the multidimensional performance characteristics and the level of performance in talented youth field hockey players and reported a strong correlations between the time scores of the sprinting and the dribbling portions individually. Likewise, Aziz et al.[25] reported

a non-significant correlation between 40m sprint time and the maximal oxygen uptake and observed a moderate correlation between the total repeated sprint times of 8 repetitions with maximal oxygen uptake. Correlations of studied physical fitness tests remained less reported, especially in the Egyptian context. To my knowledge, the current study was planned with the hypothesis that there would be significant correlations of studied physical fitness components in U19 male field hockey players as identified by a similar previous field-based team sports studies.[9,10] Hence, the aim of this study is to determine the relationship between some strength variables with cyclic or acyclic sprint performances in Egyptian young male field hockey players.

Materials and methods

Subjects

Twenty eight U19 male field hockey players from Sharkia Hockey Club participated in current study with anthropometric data of mean±SD (age=17.57±1.23 years, height=1.71±0.05 meter, body weight=66.05±5.93 kg and body mass index=22.61±1.78 kg/m^2). Before testing, all players were fully informed of the study procedures and provided appropriate consent to participate, with consent from the parents. The strength, sprint and change direction tests performed in the mid-season time and all players were train four sessions per week with training tasks of performance involving field hockey specific training.

Measurements

Subjects were tested at the period of midseason and all measurements were conducted over one day. The players warmed up for 20 minutes and then the testing session began with sprint and change of direction tests and followed by strength tests. This battery of tests was selected in order to provide coaches and players with useful information about the training and physical states during the season for field hockey players. Standard anthropometrics height and weight measurements were taken before the warm-up using standard techniques.

Strength tests

There are two tests performed to assess the lower limb strength and power; the vertical jump and standing long jump. During vertical jump test, the player was asked to stand side on to a wall and to reach up with the hand closest to the wall. Keeping the feet flat on the ground, the point of the fingertips was marked or recorded. This was named the standing reach height. The player then was requested to stand away from the wall and to jump vertically as high as possible using both arms and legs to support in projecting the body upwards. Finally, the player was asked to attempt to touch the wall at the highest point of the jump. The difference in distance between the standing reach height and the jump height was the score and the best of three trails was recorded.[17] The calculation of peak power was (Peak power (in watts)=78.6xVJ (cm)+60.3x mass (kg)-15.3xheight(cm)-30) used as modified by.[26] During the standing long jump, the player was asked to stand on the jump start line and jumping as far as they could. All players were allowed to perform the jumping with use of countermovement and with arms and legs. The standing long jump was recorded in centimeters from the line of takeoff to the back of the heel of the foot landing nearest the jumping line.

Sprint and change of direction tests

The sprint and change direction tests began after a five minutes warm-up jogging followed by stretching and moderate short sprints as a warm-up. The player asked to begin the liner sprint test in standing position behind the starting line and far about 40 cm from. The player asked to run as fast as possible over the total distance of 30 meter. The sprint performances assessed over the distances over 5, 10, 20, 30 meters and were performed on the field hockey pitch as a players run during their training session and matches. The time was recorded for each trial and the best of three trails was recorded. The ability of change direction was measured with (L Run) and 22 meters (zigzag) tests on the field hockey pitch. The player asked to begin the non-liner sprint tests in standing position behind the starting line and far about 40 cm from. The players asked to sprint as fast as possible to complete the total distance of 22 meter zigzag or (L Run) test courses and with multiple change of direction movements at both right and left sides including four changes of directions. The time was recorded for each trial and the best of three trails was used for analysis.[27,28]

Statistical analyses

The relationships investigations of between studied variables (lower limb strength, sprint performances and change of directions performance) were assessed by Pearson's product-moment correlation coefficient using SPSS software (version 17.0; SPSS, Inc., Chicago, IL, USA). The evidence interpretation of the amount of correlation coefficients determined using the criteria of,[29] where (r=0.40≤0.69 is moderate and 0.70≤0.99 is high). Statistical significance was accepted at an alpha level of p-value≤0.05.

Results

The mean±(SD) of strength and speed variables in current study were VJ 40.74 (8.73) cm, SLJ 173.62 (25.48) cm, Peak Power 4431.94 (848.42) watts, 5 m sprint 1.44 (0.13) sec, 10 m sprint 2.26 (0.17) sec, 20 m sprint 3.59 (0.15) sec, 30 m sprint 5.06 (0.23), L-Run change of direction 7.87 (0.51) sec and 22 m Zigzag Run 5.58 (0.04) sec. The correlation between studied strength and sprint performances during mid-season are shown in Table 1. The level of vertical jump height performance correlated moderate with the 20 m sprint time (r=-0.66, p<0.01, Figure 1), 30 m sprint time (r=-0.63, p< 0.01, Figure 2). Peak power during VJ test measure correlated moderate with the 20 m sprint time (r=-0.62, p<0.01, Figure 3), 30 m sprint time (r=-0.61, p<0.01, Figure 4) and 22m Zigzag Run time (r=-0.61, p<0.01, Figure 5). No significant correlations were found between speed (cyclic or acyclic) variables times with standing long jump values.

Table 1 Correlation between strength with sprint and change of direction performances

	Relationship to lower limb strength variables		
	VJ	**SLJ**	**Peak power (VJ)**
Sprint (5) meters	-0.04	0.33	0.01
Sprint (10) meters	-0.44	-0.28	-0.3
Sprint (20) meters	-0.66‡	-0.47	-0.62‡
Sprint (30) meters	-0.63‡	-0.47	-0.61‡
Agility (L Run) Test	0.08	-0.06	0.15
Agility (Zigzag) Test	0.4	-0.45	-0.61‡

Abbreviations: VJ, vertical jump height; SLJ, standing long jump.

†Correlation is significant (p<0.05).

‡Correlation is significant (p<0.01).

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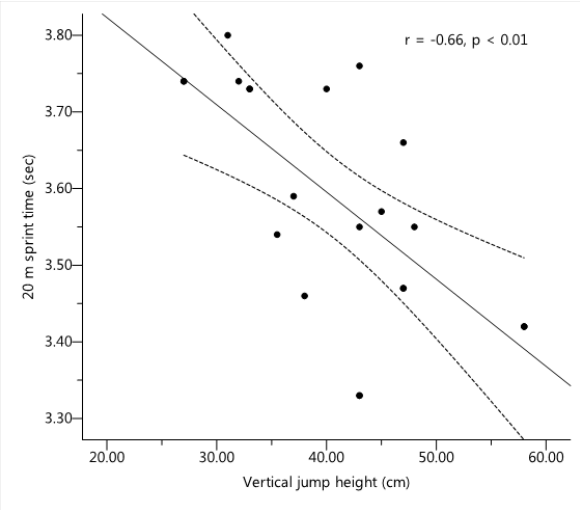

Figure 1 Relationship between VJ and 20 m sprint time.

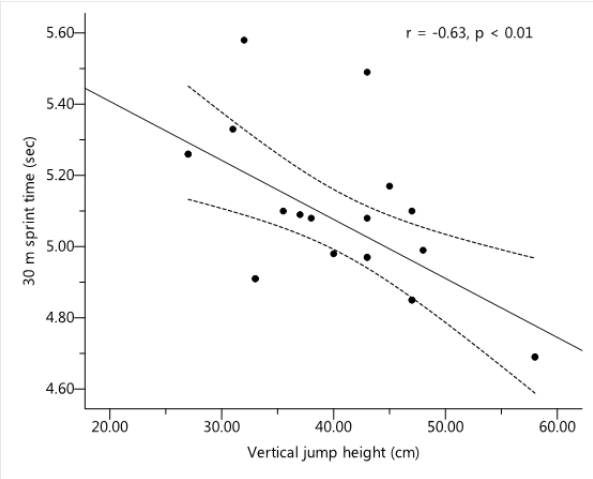

Figure 2 Relationship between VJ and 30 m sprint time.

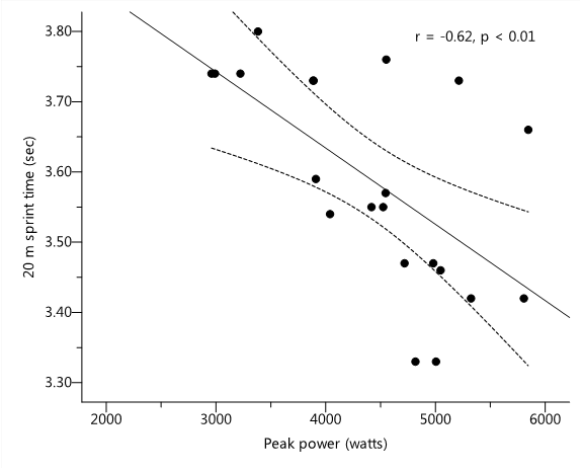

Figure 3 Relationship between peak power and 20 m sprint time.

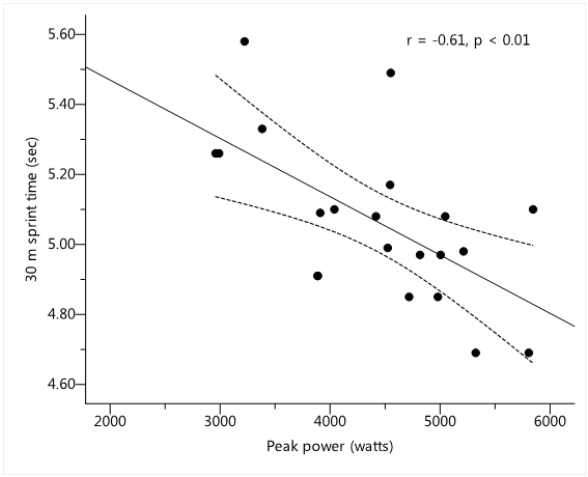

Figure 4 Relationship between peak power and 30 m sprint time.

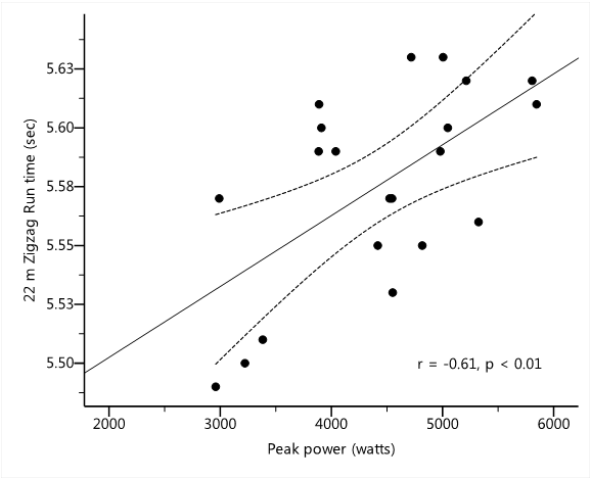

Figure 5 Relationship between peak power and 22 m zigzag run time.

Discussion

The purpose of current study is to determine the relationship between some strength variables and cyclic or acyclic sprint performances during the mid-season time for field hockey U19 players. The primary findings of this study are that, (VJ) height and peak power regarding this test have relatively moderate correlations with sprint distances of 20 and 30 meters; only the peak power and zigzag change of direction times have a moderate correlated relationship. In contrast, no relationships observed between (SLJ) with cyclic sprint performance or change of direction during mid-season time. However, the significant correlations between studied strength variables with sprint and change of directions in current study were observed moderately related, nevertheless, this findings indicate that U19 field hockey player don't participate to the combined special drills during training sessions or may be Sharkia hockey club strength training is performed on an individual basis without any controlled regimen from the trainer. Based on current study results, it is important to note that the activities or nature of field hockey players causes many players

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to be selected based on their speed and change of direction abilities, which are negatively correlated with strength qualities. In addition, strength abilities of field hockey players during competitive season, is very important infer about hitting and pushing power.

Previous studies which focused on the talent identification in field hockey have emphasized that the relevance of upper and lower strength abilities coping with physical aspects of the game. This study shows similar results of lower limb strength ability and consisted with.[14,30] There are several studies have shown significant correlations between VJ height and a measure of cyclic sprint distance performances in athletes.[8,10,19] However, current study results showed only correlations between VJ and 20 and 30 meters as a liner sprint performance and zigzag running for 22 meters as a change of direction ability. Likewise, the findings of current study consisted with,[10] who found a strong correlation between squat strength and 30 m sprint performance in elite soccer players. The moderate correlations that observed in current study may be explained by a limited number of participants or the different measure tools. In conjunction with this interpretation, Wisloff et al.[10] investigated the specificity of training responses to linear or non-liner sprint training over a 6 week period and found that a training method specific to one speed quality produced limited transfer to the other and both related to strength training. This also confirmed by Hopkins et al.[31] who suggested that small range of the data obtained when dealing with relatively homogenous populations which requires that large numbers of subjects be sampled to obtain sufficient statistical power to measure the relatedness of parameters.

There are no significant relationships showed between (SLJ) measure and cyclic sprint or change of direction measures in current study. These results could be due to the nature of field hockey sport, which don't allow players during matches to jumping highly and also some trainers don't use skill practice with jump tasks. Moreover, the correlation between the (VJ) measure in current study with maximum sprint and change of direction measures may be because of the transfer of training or learning, which occur in the ballistic leg performance during running performance, whether liner or non-linear running.[10,32,33]

The (L Run) change of direction measure shown not significant to any strength measures in current study; it could be that the U19 field hockey players indicate a lack of skill in changing directional speed and requires some additional agility training to improve their physical abilities, or the players weren't familiarized with this test as the measure of zigzag run test. In addition, the course measure of zigzag run test is similar to many field hockey activities such as slalom dribbling as a change of direction running during the field hockey game. The change of direction task involves a large component of straight sprinting, it would be expected that relationships would be stronger than when the change of direction task requires more directional changes over shorter distances.[24] Finally, the current study shows that strength and speed performance in these U19 male field hockey players displays a moderate correlations between strength measures (VJ and peak power) of a lower magnitude than those measured in well trained male field hockey players in previous studies.[4,14,17]

Conclusion

Vertical jump height determined the cyclic sprint performance in these U19 male field hockey players. Moderate correlations are observed in aspects of 20 and 30 m sprints as well as the 22 m zigzag run test when compared to peak power value of VJ test. The knowledge of relationships between strength and cyclic or acyclic sprint performances at various distances would allow coaches to structure field hockey training and more specifically by focusing on speed with explosive power drills, which including both acyclic and different dribbling, that will be supports the demands of modern field hockey play. In addition, to more accurately determine the possible relationships between physical fitness qualities in field hockey players, studies which involving a large number of subjects is required.

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Conflict of interest

Author declares that there is no conflict of interest.

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