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ORIGINAL ARTICLE

The Effect of High Intensity Interval Training on Agility Performance

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ABSTRACT

Background and Study Aim: The aim of the study was to investigate the effects of high intensity interval training (HIIT) on agility performances of male football and volleyball players in university teams.
Material and Methods: 10 non-elite male football players (mean age 21.17 ± 0.70 years, mean height 176.88 ± 4.86 cm, and mean weight 79.12 ± 8.31 kg) and 10 non-elite male volleyball players (mean age 20.84 ± 1.54 years, mean height 185.41 ± 8.31 cm, and mean weight 78.93 ± 8.85 kg) volunteered for the study. The participants performed HIIT (30 sec exercise/30 sec rest) twice a week for four weeks. Agility T test was performed with the participants before and after the training.
Results: There found no statistical difference (p>0.05) in terms of the agility performance values of the male football and volleyball players before and after the training. The pre and post training measurements after Yo-Yo IRT 1 showed that while the group with the football players did not recover in their agility performances up to 48 hours, the volleyball players were able to recover 48 hours after the training.
Conclusion: It was found out that HIIT practises had no effect on improving agility time; however, it was effective in recovery of agility time post Yo-Yo IRT 1.
Keywords: football, volleyball, agility, high intensity interval training

INTRODUCTION

It becomes more complex to plan training sessions in team sports due to the pressure created by competition schedule and players needing to maintain their high-performance level throughout the season (Issurin, 2010). However, knowing the physiologic needs of training and competitions helps the periodization of training, in other words creating the training and competition cycle (Iacono et al., 2016).

As tight fixtures in which the number of training and matches that the athletes participate in a short period increase (Nédélec et al., 2012), it causes the physiological systems of the body to remain under pressure both during the matches and intense training sessions (Murphy et al., 2002) and leads to acute fatigue (Nédélec et al., 2012). Therefore, the application of HIIT has been suggested as a preferred exercise when there are time limitations (Burgomaster et al., 2006).

Agility is considered as the basic physical feature in intermitted team sports which consist of short rest periods interspersed in short and high intensity efforts (Sheppard et al., 2012). It is stated that sufficient speed and agility help players quickly run forward (Sheppard et al., 2008) and are physical necessities to optimize performance (Tramel et al., 2019). Furthermore, it is known that they play a significant role in performance while players rapidly change directions (Tramel et al., 2019), and the ability to change directions is an important factor affecting the success of an athlete (Hedrick, 2007).

Recovery between the matches which requires players to show high intensity moves that use the anaerobic energy system dominantly depends on the development of the aerobic energy system (Castagna et al., 2006; Karakoç et al., 2012). The improvement of anaerobic and aerobic energy systems which play an important role in both activity and recovery is off necessity to achieve success (Bangsbo et al., 2008).

Interval activities improve maximal sprint and explosive strength performances such as acceleration, deceleration, swiftness, and agility (Rannou et al., 2001) in accordance with the intermittent nature of team sports such as handball, volleyball, and football (Iacono et al., 2016).

In team sports (in handball), increasing and decreasing frequencies of training (Karcher and Bucheit, 2014) and agility and high intensity interval training (Bucheit et al., 2008) directly correlate with the factors affecting the result of the match (Hoffmann et al., 2014; Iacono et al., 2016). Moreira et al. (2004) stated that athletes that played longer time in a match experienced a decline in their agility performances, and the longer the match was and the higher intensity performance it required, this decline could become much greater.

During high intensity exercises, adenosine triphosphate (ATP) is synthesized by both the anaerobic and aerobic systems. As the resynthesis of ATP affects sportive performance, it is expected that the training goals in sports involving high intensity activity are to improve energy release from both aerobic and anaerobic energy systems (Tabata et al., 1997).

Acceleration, deceleration, and high-speed runs during HIIT affect the agility in a positive way (Iacono et al., 2015). It has also been known that HIIT practises (Fajrin and Kusnanik, 2018) and interval sprints (Shalfawi et al., 2013) improve agility performance.

This study was carried out to determine how HIIT affected the agility performances of team athletes.

MATERIAL AND METHOD

Participants: 10 non-elite male football players (mean age 21.17 ± 0.70 years, mean height 176.88 ± 4.86 cm, and mean weight 79.12 ± 8.31 kg) and 10 non-elite male volleyball players (mean age 20.84 ± 1.54 years, mean height 185.41 ± 8.31 cm, and mean weight 78.93 ± 8.85 kg) volunteered for the study.

The heights of the participants were measured with Harpenden (Holtain UK) stadiometer with a precision of ± 0.1 mm, and their body weights were measured with a Bosch digital scale with a precision of ± 0.1 kg.

The agility test times of the participants were measured with Smartspeed (Lite) (Fusionsport, Australia) which is a two-door photocell electronic stopwatch system that measures running speed with 0.01 sec precision. Ethics committee report was received from Kırşehir Ahi Evran University Ethics Committee before the study started (2021/8/27).

Training Protocol: In addition to their routine training, HIIT protocol applied to the participants which consisted of 4 to 6 repetitions of 30 seconds of maximum running with full effort followed by a 30-second rest protocol 3 days a week (Bucheit and Laursen, 2013).

Yo-Yo Intermittent Recovery Test 1: The participants perform shuttle runs at gradually increasing speed between running lines with 2-meter width and 20-meter length. There is a 10-second recovery period between each shuttle run. The test is finalized when the athlete runs out of energy or fails to reach the finish line twice (Knustrup et al., 2003; Can and Cihan, 2013).

Agility Test: Participants exit from the photocell at the starting point and are asked to run to the cone 10 meters ahead. Then, they are asked to run to the second cone on the left, which is 5 meters away and to the third cone, which is in parallel and 10 meters away from the second cone. They run from the third cone to the first cone. Finally, they jog to the starting point and finish the test by passing through the photocell (Figure 1) (Raya et al., 2013).

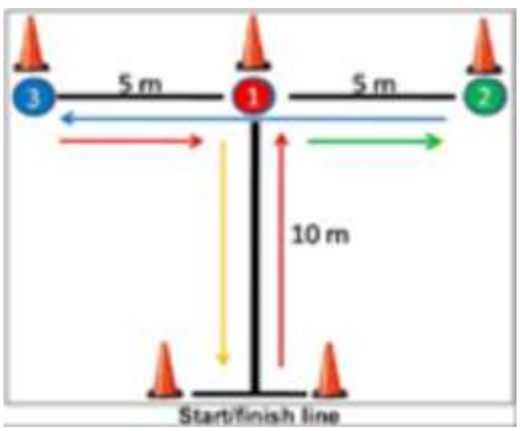

Figure 1: An Illustration Showing the Agility Test Protocol

Statistical Analysis: Using the Shapiro-Wilk test, it was determined whether the groups showed normal distribution or not. The mean of the data with normal distribution were determined by the Independent Samples T Test, and the means of the data that did not show normal distribution were compared using the Mann-Withney U Test.

Data of the percentage change was obtained using the following formula:

Percentage of Change = (New Value / Previous Value -1) * 100

RESULT

Table 1: Physical Characteristics of the Participants

Characteristics	Football n=10	Volleyball n=10
Age (years)	21.17 ± 0.10	20.84 ± 1.54
Body Weight (kg)	79.12 ± 8.31	78.93 ± 8.85
Height (cm)	176.88 ± 4.86	185.41 ± 8.31

Table 2: Pre and Post Agility Test Mean Values of Football Players

	Pre-Test n=10 (sec)	Post Test n=10 (sec)	p	df
$Agility_{ref}$	7.366 ± 0.283	7.426 ± 0.434	.515	1↑
$Agility_{0}$	8.041 ± 0.492	7.717 ± 0.305	.066	4↓
$Agility_{24}$	7.869 ± 0.430	7.553 ± 0.342	.021	4↓
$Agility_{48}$	7.650 ± 0.419	7.519 ± 0.407	.045	2↓

It can be understood from Table 2 that HIIT practises with football players did not have any effect on agility performance (p> 0.05). While the zeroth minute, 24^{th} and 48^{th} hour values of the football players could not return to the reference value, statistically significant differences were obtained with the 24th and 48th hour values pre and post the training (p<0.05).

Table 3: Pre and Post Agility Test Mean Values of Volleyball Players

	Pre-Test n=10 (sec)	Post Test n=10 (sec)	p	df
$Agility_{ref}$	7.653 ± 0.361	7.628 ± 0.124	.604	0
$Agility_{0}$	8.284 ± 0.244	7.978 ± 0.267	.015	4↓
$Agility_{24}$	8.056 ± 0.216	7.827 ± 0.237	.020	3↓
$Agility_{48}$	7.838 ± 0.103	7.559 ± 0.084	.012	4↓

It can be seen from the Table 3 that HIIT practises with volleyball players did not have any effect on agility performance (p>0.05). Unlike football players, in volleyball players post-test agility data showed statistically significant differences in all three measures (p<0.05).

DISCUSSION

Coaches ask their athletes to be always ready on the field at their desired maximal performance levels. So as to achieve the best performance in sports, it is emphasized that the relationship between training, training intensity and rest should be structured in a way to prevent excessive fatigue which could interfere with the recovery and to maximize sportive performances (Chalencon et al., 2012). Therefore, recovery or returning times after intense training are significant. Recovery is considered as reaching a previously achieved performance point or a better performance (Bishop et al., 2008).

In order to reach the highest performance level in training programs, parameters such as intensity, volume and frequency should be used together in consecutive training (Chanlecon et al., 2021). In order to achieve the best performance at the desired moment, however, it is emphasized it is necessary to guarantee a good recovery as well as controlling the training load (Kellman, 2010).

Furthermore, athletes have to do training and test practises to improve their performance. Such training and test practises might be those that cause fatigue in the organism and prolong recovery and return time. Studies done recently showed that while Yo-Yo IR1 activated the anaerobic energy system considerably, it caused maximum aerobic responses, and physiological demands of Yo-Yo IR1 were similar to those of during competition (Krustrup et al., 2003).

Considering the data obtained from the study, no difference was found between the agility values of the football players before and after the training. It is understood that 4-week HIIT practice does not improve agility performance. The agility time values taken at the end of Yo-Yo IR1 (at zeroth minute), which creates demands similar to the physiological demands of the particular sports branch after the agility test, were similar to those before the training. On the other hand, the values obtained at the 24th and 48th hour differ statistically from the pre-training values. It is seen that HIIT applications create less fatigue compared to pre-training values and provide rapid recovery.

It is seen that 4-week HIIT practise had no effect on agility performance in volleyball players. In addition, players were not able to recover from the fatigue that emerged after the Yo-Yo IR1 test performed pre-training up to 48 hours, but they performed better than the reference value at the 48th hour post-training. This shows that the HIIT practices in volleyball players do not cause long-term improvement but bring about improvement in shorter-term agility performance.

It is stated that the fact that athletes make only a few changes in their directions during HIIT practice is a less efficient training compared to other training methods (Iacono et al., 2015). The literature review indicated that training in narrow spaces improves agility performance more than interval sprint training. It is also revealed that the efforts of athletes to score goals in a narrow field, defence and one-on-one struggles improve agility performance (Iacono et al., 2016).

Howard and Stavrianeas (2017) stated that in addition to routine football training, football players doing traditional endurance training differ in their agility time values compared to football players who practice HIIT. It is advocated that the effect of traditional endurance training on agility performance is better than HIIT applications.

It is said that the coaches or the training planners need to make sure that athletes recover by the day of the competition and that they should include strategies that will ensure recovery in their weekly training schedules (Andrade et al., 2021).

Holtgeerts (2019) reported that 48th hour agility time value of groups with different recovery strategies revealed more significant results and that long rest periods would positively affect development.

Recovery strategies can be applied to eliminate the negative effects of overload during important periods when the performance is tried to be maximized (Chalencon et al., 2012). Recovery is necessary for athletes to prevent or minimize the factors that impair their performance like overtraining (Kellmann, 2010; Andrade et al., 2021).

RESULTS

An athlete has to do vigorous and comprehensive training in order to ensure performance improvement in the organism. As a result of such training and practices, specific performance outcomes such as agility are affected. The athlete goes through at least three workouts per week with decreased performance. Therefore, low performance negatively affects both the athlete and the team.

The effectiveness of the training depends on the balance between the amount of the training and the recovery status of the athlete (Bishop et al., 2008). Therefore, the capacity to recover after an intense training and a match is considered as an important determinant of success in football (Rey et al., 2018).

To keep the performance of the athletes at the highest level, as well as improving the muscle strength and endurance, alterations in the scope and intensity of the training should be made (Reeser et al., 2006; Weldon et al., 2021). Thus, it is recommended to pay particular attention to training load control and recovery time and strategies during the competition periods of professional team sports to prevent a decline in performance on the day of matches (Debien et al., 2018).

When training plans are assisted with practises such as HIIT, it will allow intense practises and tests to be made during the season. The progress can be followed not only at the beginning of the season but throughout the season.

All in all, it is seen that the reference values could not be reached in both groups until the 48th hour mark pre-training. While the football players could not reach the reference value up to 48 hours post-training, it is seen that the volleyball players achieved a better value than the reference value at the end of 48 hours. It is understood that HIIT practises in volleyball players do not improve long-term agility performance values but cause shorter-term performance improvements.

It is reported that metabolic homeostasis can take place after resting between 48 and 72 hours after matches with a high level of competition (Ispirlidis et al., 2008; Nedelec et al., 2014), and it may even be prolonged after increasing number of competitions with athletes with tight fixtures (Rey et al., 2019). Therefore, coaches need to implement recovery strategies to reduce such effects of overtraining (Rey et al., 2018).

While an optimized training stimulus contributes to appropriate adaptations (Veugelers et al., 2016), overload may negatively affect performance (Los Arcos et al., 2015). The expected adaptations of these training stimuli depend on the distribution of load and the planning of recovery (Timoteo et al., 2021). It needs to be noted that recovery after exercise is an important part of the training of an athlete and a fundamental component of improving athletic performance (Bishop et al., 2008).

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