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## REVIEW ARTICLE

# INFLUENCE OF TENNIS SPECIFIC ENDURANCE TRAINING ON SPEED AGILITY AND MAXIMAL OXYGEN UPTAKE IN MALE TENNIS PLAYERS

<sup>1</sup>Sathishkumar, D. and <sup>2</sup>Mahendiran P.

<sup>1</sup>PhD Scholar, Department of Physical Education, Annamalai University, Tamilnadu

<sup>2</sup>Assistant Professor, Department of Physical Education, Annamalai University, Tamilnadu

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#### \*Corresponding Author:

Sathishkumar, D.

### ABSTRACT

The purpose of the present study is to assess the influence of tennis specific endurance training for twelve weeks on speed, agility and maximal oxygen uptake in male tennis players. Twenty (20) male tennis players were selected at random as subjects, who volunteered to participate in this study. All players were classified randomly into two groups tennis specific endurance training group (EG) (n = 10) and control group (CG) (n = 10). These players were selected from National Tennis Academy, SIPCOT, Ranipet, Tamilnadu during the academic year 2018 – 2019. Speed, agility and maximal oxygen uptake were selected as criterion variables. The twelve weeks of tennis specific endurance training were supplemented to EG and CG carried out their regular training. The result of the study revealed that EG from pre to post test showed significant improvement in speed ( $F(1, 18) = 32.94, p = 0.000$ ), agility ( $F(1, 18) = 32.12, p = 0.000$ ) and maximal oxygen uptake ( $F(1, 18) = 36.86, p = 0.000$ ) but the CG failed to show significant changes ( $p > 0.05$ ). It is concluded that twelve weeks of tennis specific endurance training is likely to improve speed, agility and maximal oxygen uptake in tennis players. This study also displayed the effectiveness of 30-15 IFT audio which can also be used for training and it is evident in improving the speed, agility and maximal oxygen uptake in tennis players.

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## INTRODUCTION

Tennis is an intermittent sport which constitutes high intensity exercise bouts followed by longer rest periods over an extended period of time (Bergeron *et al.* 1991). In professional tennis an average point lasts approximately 5 seconds and average rest period lasts approximately 15 seconds, which results in a 1:3 work rest ratio (Kovacs *et al.* 2004). Tennis involves specific training for the specific purpose to improve fitness parameters. Coaches utilize or apply specific fitness training that replicate the game thereby players get benefits of improving both fitness and skill. Tennis players undergo endurance conditioning with scientific support. The design of a training should be coined with Frequency, Intensity, Time, and Type (FIIT). Endurance training administered from low, moderate and high intensity or volume, interval or continuous method, on – or – off - court, tennis specific movement drills with and without playing the ball that raises the heart rate but are generally below the lactate threshold intensity when compared to distance running and cycling. Playing tennis and game associated fitness conditioning for tennis can improve cardiorespiratory endurance, which further enhances the

aerobic-like physiological responses observed during play. Therefore, the purpose of the present study is to assess the influence of tennis specific endurance training for twelve weeks on speed, agility and maximal oxygen uptake in male tennis players.

## METHODS

**Subjects:** Twenty (20) male tennis players were selected at random as subjects, who volunteered to participate in this study. All players were classified randomly into two groups tennis specific endurance training group (EG) (n = 10) and control group (CG) (n = 10). These players were selected from National Tennis Academy, SIPCOT, Ranipet, Tamilnadu during the academic year 2018 – 2019. The selected subjects gave their willingness to participate in this study.

**Variables and test:** In the current research standardized tests and procedures were used to assess the selected criterion variables which are presented in Table 1.

Table 1. Variables and Tests

Sl. No	Variable	Methods/Tests/Equipment
1	Speed	20 m dash
2	Agility	5-0-5 agility test
3	Maximal oxygen uptake	30-15 Intermittent Fitness Test (28m version)

**TRAINING PROTOCOL:** The experimental group was administered with tennis specific endurance training protocol 1 for twelve weeks on Monday and Friday. The EG commenced their session with 15 minutes of standard warm-up followed by tennis specific endurance training (Table 4). In this tennis specific endurance training involves players moving in multidirectional movements along with tennis skills like forehand and backhand strokes into the target area while exerting maximum effort during mostly baseline play, were performed according to the procedures prescribed in Reid's study (2008). During the tennis specific endurance training, an experienced tennis coach continuously hand-fed tennis ball to the players to their running speed for 30 seconds followed by active recovery for 30 or 15 seconds. After playing each stroke the player has to run to the next corner to play the next stroke (Figure 2). However, the CG performed their regular training.

**Description of movement in tennis court:** Starting with the beep sound player sprint to point 1 and play the forehand stroke when the coach drops the ball next to the player at point 2, who hits it after a bounce (Figure 1). This has to be performed before the next beep sound. After playing the forehand stroke at point 2 he makes 180° turns and sprints towards point 1 and plays the backhand stroke when the assistant coach drops the ball next to the player at point 1, who hits it after a bounce (Figure 1).

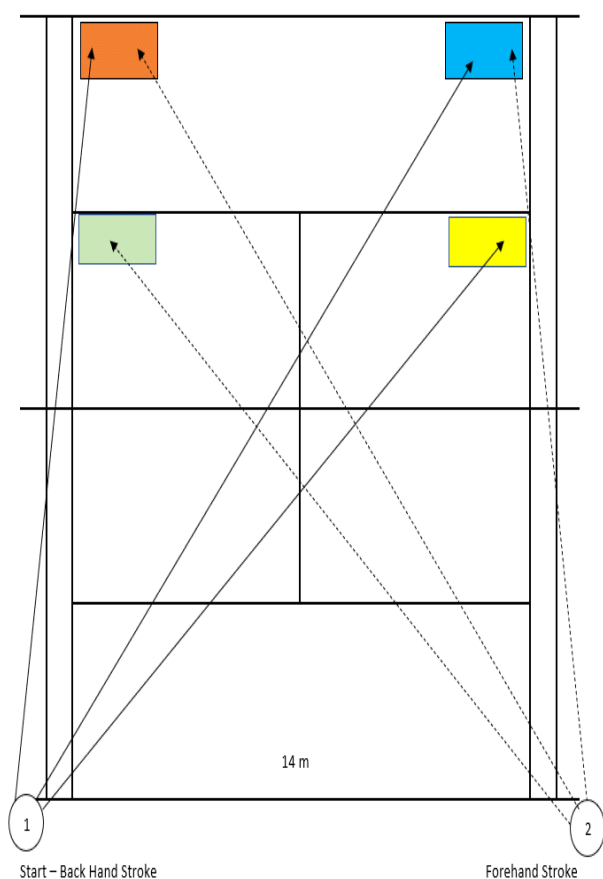


Figure 1. Position of hand-fed tennis ball to players

This has to be performed before the next beep sound. Players repeat the same procedure as performed previously. The objective is to cover the given distance and play the ball before the beep sound. As mentioned earlier the work duration is 30 seconds which was followed by passive recovery for either 30- or 15-seconds. If the player is in the midway during the course of the run from points 1 to 2 the exercise termination beep sound is produced. The player has to move towards the nearest point in the forwarding direction only not in the backward direction. He has to reach the point within the 30- or 15-second passive recovery duration. The player has to play the ball to the opponent's court which is highlighted in color (Figure 2). This will improve the accuracy and rallying ability of the players. The experimental group was also administered with tennis specific high intensity interval training for twelve weeks on Wednesday. The EG commenced their session with 15 minutes of standard warm-up followed by tennis specific endurance training (high-intensity interval training) – Protocol 2 (Table 3). The players ran around the tennis court for 30 seconds and followed by 30 seconds of active recovery through walking. Tennis specific endurance training (Protocol 2) procedure incorporated a 1:1 work rest ratio and 48 hours of recovery were provided between each training session.

**Statistical technique:** The data collected from EG and CG on selected physical fitness and physiological variables were statistically analysed to examine the changes. A two-way repeated measure ANOVA with last factor repeated with equal was applied to examine the difference between groups and testing conditions. When the interaction was significant simple effect was applied and Bonferroni pairwise comparison was applied. To elicit differences between the means more meaningful it was expressed with reference to the effect size suggested by Cohen (46) {Partial  $\eta^2$  ( $\eta_p^2$ ): 0.01 to 0.05 - Small effect; 0.06 to 0.13 - Moderate effect; 0.14 and above - Large effect. All the statistical tests were calculated using the statistical package for the social science (SPSS) for windows (Version 16). The level of statistical significance was set at  $p < 0.05$ .

## RESULTS

**Speed:** The repeated measures ANOVA on speed showed significant interaction effect ( $F(1, 18) = 16.47, p = 0.001$ ) in tennis players. The simple effect within experimental group from pre to post test ( $F(1, 18) = 32.94, p = 0.000$ ) and follow-up test which revealed a significant pairwise difference between pre to post test in experimental group [MD = 0.115,  $p < 0.05$  & Partial Eta Squared = 0.641 (Large Effect)] but control group ( $F(1, 18) = 1.35, p = 0.251$ ) failed to show significant difference between pre to post test [MD = 0.0130,  $p > 0.05$  & Partial Eta Squared = 0.013 (Small Effect)].

**Agility:** The repeated measures ANOVA on agility showed significant interaction effect ( $F(1, 18) = 18.77, p = 0.000$ ) in tennis players. The simple effect within experimental group from pre to post test ( $F(1, 18) = 32.12, p = 0.000$ ) and follow-up test which revealed a significant pairwise difference between pre to post test in experimental group [MD = 0.074,  $p < 0.05$  & Partial Eta Squared = 0.614 (Large Effect)] but control group ( $F(1, 18) = 0.211, p = 0.651$ ) failed to show significant difference between pre to post test [MD = -0.006,  $p > 0.05$  & Partial Eta Squared = 0.012 (Small Effect)].

**Table 2. Tennis specific endurance training - Protocol 1**

Week	Work rest ratio	Work duration (s)	Rest duration (s)	No. of Repetitions	No. of Sets	Rest between Sets (s)	The velocity of the run for 30 seconds using 30-15 IFT audio
1	1:1	30	30	10	4	300	10 km/h
2	1:0.5	30	15	8	4	300	10 km/h
3	1:1	30	30	10	4	300	11 km/h
4	1:0.5	30	15	8	4	300	11 km/h
5	1:1	30	30	10	4	300	12 km/h
6	1:0.5	30	15	8	4	300	12 km/h
7	1:1	30	30	10	4	300	13 km/h
8	1:0.5	30	15	8	4	300	13 km/h
9	1:1	30	30	10	4	300	14 km/h
10	1:0.5	30	15	8	4	300	14 km/h
11	1:1	30	30	10	4	300	15 km/h
12	1:0.5	30	15	8	4	300	15 km/h

**Table 3. Tennis Specific Endurance Training (HIIT) – Protocol 2**

Week	Training Prescription	Total Time (min)
1	6 × 30s sprint / 30s rest	15
2	6 × 45s sprint / 45s rest	
3		
4	8 × 30s sprint / 30s rest	20
5	8 × 45s sprint / 45s rest	
6		
7	10 × 30s sprint / 30s rest	25
8	10 × 45s sprint / 45s rest	
9		
10	12 × 30s sprint / 30s rest	30
11	12 × 45s sprint / 45s rest	
12		

**Maximal oxygen uptake:** The repeated measures ANOVA on maximal oxygen uptake showed significant interaction effect ( $F(1, 18) = 17.477, p = 0.001$ ) in tennis players. The simple effect within experimental group from pre to post test ( $F(1, 18) = 36.86, p = 0.000$ ) and follow-up test which revealed a significant pairwise difference between pre to post test in experimental group [MD = 3.800,  $p < 0.05$  & Partial Eta Squared = 0.672 (Large Effect)] but control group ( $F(1, 18) = 0.26, p = 0.875$ ) failed to show significant difference between pre to post test [MD = 0.100,  $p > 0.05$  & Partial Eta Squared = 0.001 (Small Effect)].

## DISCUSSION

The present study displayed significant improvement in speed (3.27%) and agility (2.85%) performance in tennis players. The tennis specific endurance training consists of straight line running, change of directions, acceleration, deceleration which are executed with maximal effort (Brown *et al.* 2005). The improvement observed as a result of maximal firing frequency, action potential in the muscles, enhanced coordination, motor unit recruitment, and CNS activation in the muscle occur to tennis players after exposure to maximal exercise intensity (Hughes *et al.* 2012; Aagaard 2003; Milanovic *et al.* 2013; Myer *et al.* 2005). The positive changes are noticed are associated to specificity in the current training programme (Buttifant *et al.* 2002). Maximal oxygen uptake is typically used as a major marker of cardiorespiratory fitness of tennis players. The maximal oxygen uptake values in elite male tennis players have ranged between 44 ml/kg/min and 69 ml/kg/min (Bergeron, Maresh, Kraemer, *et al.* 1991). In the present study maximal oxygen uptake was recorded greater than 45 ml/kg/min and less than 50 ml/kg/min which is within the range of the elite male tennis players.

The present study displayed significant improvement of 8.38% in maximal oxygen uptake due to tennis specific endurance training, the results are similar to those reported in a previous study analysing the effect of high intensity interval training for six weeks displayed 4 to 6% improvement in the tennis players aerobic capacity (Fernandez – Fernandez *et al.* 2012). Maximal oxygen uptake showed significant improvement due to basketball specific endurance training (Chittibabu & Akilan 2013) and also in handball specific endurance training (Chittibabu 2013; 2014). Improvement in maximal oxygen uptake after several weeks of high intensity interval training is primarily attributed on increased stroke volume, cardiac output and hematological adaptations (Nottin *et al.* 2002). Further, peripheral adaptations such as improved capillary, mitochondria density, and mitochondria enzyme reactions (Wagner 1991; Gibala *et al.* 2012).

## CONCLUSION

The twelve weeks of tennis specific endurance training is likely to improve speed, agility and maximal oxygen uptake in tennis players. This study also displayed the effectiveness of 30-15 IFT audio which can also be used for training and it is evident in improving the speed, agility and maximal oxygen uptake in tennis players.

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