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PHYSICAL PROFILE OF HYDERABAD YOUNG TENNIS PLAYERS IN THE TENNIS MATCH-PLAY USING GLOBAL POSITIONING SYSTEMS

Physical Education

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ABSTRACT

The physical profile in matches played by young tennis players using GPS technology.

Methods: Seventeen female and twelve male young high-level tennis players (age 14.0 ±2.1 years) took part in the study. Portable GPS (10 Hz) devices (MinimaxXv.4.0, Catapult Innovations) were used to assess physical variables in the Hyderabad tennis assosiation. Dependent variables were: maximum and average speed, total distance covered per minute and at speed zones, acceleration distance covered. Independent variables were: ranking and gender of players. Results: The majority of the distance were covered by players was accelerating (89.7%). High ranked players covered more distance per minute than low ranked ones (HiR=46.7 ±8.9 vs. LR=44.5 ±7.3 m; F (1, 94)= 12.96; p <0.001; ɳ2p =0.121) and developed a significant greater maximum speed (HiR=4.3 ±0.6 vs.LR =3.9 ±0.4 m•s-1; F (1, 94)= 10.99; p <0.001; ɳ2p =0.104). Male players covered more distance per minute thanfemale players at all speed zones. Conclusions: The GPS technology allows us to know the physical demands oftennis. Therefore, coaches must use this data to propose specific training, similar to the demands of match play.

KEYWORDS

Racquet sports, GPS, physical demands, motion-analysis, performance, accelerations.

Introduction:

The recent development of Position System (GPS) devices has permitted the wider application of this technology in a variety of sports, providing an additional means of describing and understanding the physical demands on players (Baiget, 2011). Player tracking describes the physical profile of the demands of each sport and it allows us to assess competition performance (Carling, Bloomfield, Nelsen, and Reilly, 2008).

In the last few years, scientists have used portable GPS units to investigate the physical demands in training and match-play in different sports (Cummins, Orr, O'Connor, and West, 2013). Accordingly to that, GPS technology has been used in soccer (Buchheit, Méndez-Villanueva, Simpson, and Bourdon, 2010; Harley et al., 2010; Njororai, 2012), Australian football (Brewer, Dawson, Heasman, Stewart, and Cormack, 2010) and cricket (Petersen, Pyne, Dawson, Portus, and Kellett, 2010). Player tracking describes the physical profile of each sport and it assesses competition performance (Carling et al., 2008).

In tennis, these physiological demands are different from the rest of intermittent sports. . The internal load of tennis match-play has been analysed through match duration, effective playing time, and the rest time ratio. Tennis match-play involves high intensive work periods interspersed with moderately long rest periods. However, these researches it seem to be not enough to describe the tennis player profile in match-play because it did not analyse other variables such as: distance covered, speed or acceleration. In relation to that, the majority of the studies applied to tennis have analysed training sessionsinstead of match-play.One of the first research works on tennis training, which assessed the velocity and distance covered for tennis playerssuggested that in the training drills proposed by coaches the movements are short and of high intensity due to the small size of the tennis court.

Hoppe and colleagues (2014) analysed the velocity, accelerations and decelerations of adolescent tennis players in simulated match-play. They concluded (Hoppe et al., 2014) that the physical activity of tennis players was characterized by high accelerations and decelerations but low velocities, reaching values of almost 90% of the distance covered by players accelerating or decelerating. According to that, Fernández et al. (2005), who concluded that physical demands in tennis match play are not the same in training as in small-side games in football trainings.

In this sense,the coachesare aware of the current knowledge about physical profile in match- play of young tennis players is not enough? It is for this reason that the aim of this work is to describe the physical profile in match play of young tennis players using GPS technology in order to improve the knowledge of the physical demands of tennis, assessing variables like: distance covered, speed of movement, velocity and acceleration considering gender and ranking. The results of this research will provide further information regarding the physical demands from matches-play on young tennis players. Tennis coaches should take into account the values obtained by tennis players in order to design specific trainings.

Material & Methods

Participants: Seventeen female and twelve male young high-level tennis playerstook part in the study (age 14.0 ±2.9 years). They were members of different age divisions (beginner: under 12 years old; youth: under 14 years old; teenager: under 15 years old; and junior: under 18 years old) of the High Level Performance Centre in the Hyderabad Tennis Federation. They had been playing in high-level competitions for between 2 and 5 years, and at the time this study was carried out they were among the top few in the state ranking. All the tennis players were tracked in 1 to 3 matches (n=98). All of them were notified of the research design and its requirements, and the potential benefits and risks, and all gave their informed consent before the start.

Table I. Participants.

	Male=49		Female=49	
Beginner	10	7	4	6
Teenager	8	8	4	6
Youth	5	4	10	3
Junior	4	3	7	9

Note: HiR is high ranking players and LR is low ranking players.

Variables: The independent variables used were: gender (male n=49 and female n=49 records), and ranking of players (high ranked players, HiR n=52 and low ranked players, LR n=46 records). The dependent variables to describe the physical demands were: (a) Global indicators, including distance covered (Dc), distance covered per minute (DcM), number of rallies of match-play (N), maximum speed (MxS), average speed (AvS), player load per minute (PLmin) , that is, an external load indicator of players acceleration distance covered per minute (DcMA), that is, the accelerating distance covered by player per each minute of match, percentage of acceleration distance covered (%DcA); (b) Distance covered per minute at speed zones. These speed zones were supported in a previous study.

Materials: Twelve portable GPS devices (MinimaxX S4, Catapult Innovations) operating at a sampling frequency of 10 Hz were used. The MinimaxX S4 device contains a tri-axial piezoelectric linear accelerometer (Kionix: KXP94) sampling at a frequency of 100 Hz. Acceleration/deceleration variables was recorded using this accelerom eter. During matches, the GPS devices had connections with 13.3 ±0.9 satellites, and the horizontal dilution of position was 0.9 ±0.1, indicating ideal measuring conditions.

After the recording, the data were downloaded to a computer and

analysed using the software package SPRINT v.5.1.4. With respect to velocity assessment, the reliability and accuracy of the devices used in this study in short distance exercises has been assessed in previous works. Also the acceleration/deceleration assessment has previously reported as from moderate to high reliability and accuracyugh we should be aware when assess accelerations of over 4 m•s-2 because accuracy is compromised. Specifically variables such as: maximum speed (MxS); average speed (AvS); player load per minute (PLmin); acceleration distance covered per minute (DcMA) and percentage acceleration distance covered (%DcA).

Procedures: In the weeks prior to the study, the players were familiarized with the use of these devices and they chose the size of their harness in training matches.Physical demands were assessed over 81 tennis matches-play, from which 98 recordings were obtained.Match analysis was carried out byHyderabad tennis association 2014-2016. Individual matches were played on hard court in the evening from 16:00 to 20:00 in similar climatic conditions (temperature, relative humidity and wind) and at least 24 hours elapsed between each match. Thirty minutes before the beginning of the match, the players put on their harnesses and carried out standard warm-upexercises. Just before starting the match, the relevant researcher put the GPS devices into the players' harnesses. The length of the match was noted to discover the physical demands on each player.

Statistical Analysis: All the statistical analysis was performed using SPSS 20.0 for Windows. Data is expressed as mean and standard deviation (±SD). After validating the normality and homogeneity assumptions, Parametric Student t test was applied with significant being set at $p< 0.005$. The effect size statistic ($\eta 2p$) was used to assess the magnitude of difference between variables. The criteria for: interpreting differences in the mean was 0.2-0.5 (small), 0.5-0.8 (moderate), and > 0.8 (large) (Cohen, 1988). The coefficient of variation (%) was used to characterize the degree of variability in each physical variable.

Results:
Table 2 shows the general values about physical demands in tennis. The distance covered by players were 3651±1572 meters in a match-play. The majority of this distance covered by players were accelerating, so that, the 89.7% of the total distance covered by players was covered accelerating. In addition to that, tennis players disputed 19.4±5.9 rallies to cover the distance in a tennis match-play. Further more, the maximum speed of players was 4.3±0.5, whereas the average speed of them was 3.0±0.4 m•s-1. On the other hand, table 2 shows the distance covered per minute at different speed zones. The most common speed zone was jogging (0.6-1.9 m•s-1) because players covered 47.4±26.9 m•min-1 at this speed.

Table II. General variables of players

	n	Mean	SD	CV%
Dc (m)	98	3651	1572	43
DcM (m)	98	46.01	7.01	15
N (n)	98	19.43	5.97	31
MxS (m·s-1)	98	4.34	0.57	13
AvS (m·s-1)	98	3.05	0.46	14
PLmin (UA·min-1)	98	7.65	3.85	50
DcMA (m)	98	41.35	10.01	23
%DcA	98	89.75	18.10	20
Positioning (m·s-1)	98	10.02	5.24	52
Jogging (m·s-1)	98	47.49	26.98	56
Low Intensity (m·s-1)	98	7.11	4.18	58
High Intensity (m·s-1)	98	0.51	0.31	60

Note: distance covered (Dc); distance covered per minute (DcM); number of rallies (N); maximum speed (MxS); average speed (AvS); player load per minute (PLmin); acceleration distance covered per minute (DcMA); percentage acceleration distance covered (%DcA); game duration in minutes (GD), total average accelerations (TA); positioning: 0.0-0.5 m•s-1; jogging: 0.6-1.9 m•s-1, low intensity: 2.0-3.7 m•s-1 and high intensity: 3.8-5.0 m•s-1.

Discussion:
The main aim of this study was to describe the physical demands of young tennis players in official match tournaments. Until now, all researches about physical demands in tennis have analyzed tennis training or simulated match-play. As far as we know, this is the first study that describes the physical demands of tennis players using GPS in match-play. The results showed that players experienced different physical demands depending on the variables like: gender or ranking.
Nowadays, micro technology applied to different sports allows us to know the physical demands on players, such as distances covered, motion velocities or acceleration/deceleration movements. In tennis, the physical demands had been analysed in training sessions using GPS devices operating at 5Hz; in simulated matches-play and in match-play in order to optimize and individualize player training drills or assess physical performance in competitions or tournaments. However, these researches have analysed the physical demands of tennis players attending to variables like: winners or losers, qualifying round or different kind of surface. None of them, addressed variables like gender or ranking in order to know the physical profile of young tennis players.

Conclusion:
The results of this study show that GPS devices are a useful tool to quantify the strain on players both in training and match-play. In addition, GPS devices would improve tennis players' performance, through adapting specific training to individual physical demands. Therefore, coaches must use this data to propose specific training, similar to the demands of match-play. Consequently, tennis players would improve their performance. It would be interesting to compare the physical demands between match-play and training to know the relationship between: intensity, acceleration distance covered, average acceleration and distance covered per time.

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