AN ANALYSIS OF SPECIFIC FITNESS TESTING IN FEMALE JUNIOR TENNIS PLAYERS

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The purpose of the present study was to determine the anthropometry, physical fitness parameters and compare with USTA normative data. Seven-teen female teenage tennis players who have the Taiwan national level were included in the study. The analysis focused on the examination of muscular strength, endurance, power flexibility, speed and agility. Results showed that (a) there were excellent performances in grip strength of the nondominant hand (7.8%) and hexagon test (8.1%) scored well relative to USTA normative data. (b) there were needs improvement performance in sit and reach (0.5%) and spider test (6.7%) relative to USTA. In conclusion, this study indicated the identification of weaknesses in flexibility, speed and agility parameters and allows designing efficient physical training programs.

KEY WORDS: physical testing, adolescents, tennis performance

INTRODUCTION: Tennis has always been a physically demanding sport. Just the last couple decades the following tennis-related articles were relevant. The Australians were famous in the 1950s for great physical training and fitness (Bloomfield, 2003). Elliott, B, C., et al. (1990) once study of physiological and kinanthropometric indicators of junior tennis performance. The result showed that the time for an agility run significantly differentiated the male high performance young players from the other two groups, while grip strength, speed and height for the vertical jump significantly differentiated female high performance young players from the other two female groups. Physical conditioning and tennis-specific training programmes had a positive effect on the development of aerobic energy capacity indicators in the examined young tennis players. However, due to the age of subjects, the effect of dynamic processes of growth and maturation on the obtained results in the aerobic capacity test cannot be overlooked (Barbaros T, P., et al. 2015). Tennis has evolved from a sport in which skill was the primary prerequisite for successful performance into a sport that also requires complex interaction of several physical components ie, strength and agility (Fernandez-Fernandez, Sanz-Rivas, & Mendez-Villanueva, 2009).

Tennis was a sport must have physical fitness, technical and mental awareness. Player's success cannot be determined by talent, preparation and training were the key factor. Standardized testing is commonly used to provide a useful supplement to subjective coaching appraisals in an attempt to assess strengths and weaknesses of a given player. Muler, E., et al. (2000) illustrate the realization of a training procedure that is highly orientated toward competition in a specific type of sport, the following conditions were necessary: knowledge of the specific parameters relevant to performance in the specific sport or discipline; tests that fully cover the sport-specific parameters and that allow for the classification of test results; training methods and exercises that fulfill the standard criteria for the specific means of training. Roetert, E. P., et al. (1996) using a U.S. Tennis Association (USTA) protocol to tested three

levels of elite junior tennis players and determine whether any of these measures may be related to tennis performance. The results shows an accurate prediction of 95.5, 91.3, and 85.7% for National Team, Development Camp and USTA area training centers players. This suggests a strong significant relationship between strength, flexibility and conditioning measures, and tennis performance. Therefore, research has been conducted with athletes of various backgrounds (e.g., age, performance level) in order to identify the most influencing factors of significance in successful tournament play.

Developed countries attached considerable importance to the planning and development of junior tennis players in today's highly competitive professional tennis. The purpose of this study was to analyze the specific fitness testing in female junior tennis players, and analyzed the comparison between elite female junior players in Taiwan and USA standards for planning a national physical training program.

METHODS: Seven-teen female young tennis players were participate in this study with an average age of 15.7±1.1 years. Each subject completed an entry questionnaire that included playing experience, history of injury and training years. The players and parents were informed of all experimental procedures and written informed consent form prior to participation. Subjects did not have any injuries during the previous 6 months. Testing began after a 20 min individual warm-up, which consisted of stretch, low intensity forward, sideways running and jumps of increasing intensity. The USTA fitness testing protocol (Bernstein, 2008) was used in this study. There were five fitness test station, including anthropometry, muscular strength & endurance, power, flexibility and speed & agility test. When the testing has begun, it was important that the players not have a chance to cool down. Consequently, the testing should be done in stations, with several tests conducted at each station. Once testing was completed at each station, the players move on to the next station.

Testing started with the measurement of player's body dimensions which included body height and body mass. Examiner should record player's scores on the fitness testing result forms. Subjects were asked to perform as grip strength of the both hand, endurance (1min sit-ups and Push-ups), power (medicine ball throw and vertical jump), flexibility (sit and reach), speed and agility (hexagon and spider test). The means and standard deviations for each test were calculated.

RESULTS: Anthropometry and fitness testing values are shown in Table1. In addition, fitness testing result were compare with USTA standard. According to the USTA competition training center coaching manual, there were four levels in which normative data for each of the five performance qualities, elite national players in the US can be classified: excellent, good, average and needs improvement. The result showed that grip strength of the nondominant hand and hexagon test achieve excellent level. Push-ups test result was showed good level. Grip strength of the dominant hand, sit-ups, four kind of medicine ball throw and vertical jump

test result were showed average level. Sit and reach, spider test result were showed needs improvement.

Table1
Anthropometry and Fitness testing result

Qualities	Measurements	U14~18(n=17)	Compare with the USTA standard
Anthropometry	Height (cm)	164.4 ± 6.8	
	Weight (kg)	58.4 ± 7.8	
	BMI	21.6 ± 2.8	
Strength	Grip strength-NDH (kg)	29.1 ± 4.2	Excellent (7.8%)
	Grip strength-DH (kg)	33.4 ± 4.5	Average
Endurance	Sit-ups (1min)	42.4 ± 7.2	Average
	Push-ups (1min)	36.9 ± 16.2	Good
power	Medicine ball throw (m)		
	Forehand	7.6 ± 1.4	Average
	Backhand	7.2 ± 1.4	Average
	Overhead	5.4 ± 1.0	Average
	Reverse	6.6 ± 1.7	Average
	Vertical jump (cm)	39.7 ± 7.3	Average
Flexibility	Sit and reach (cm)	37.5 ± 5.1	Needs improvement (0.5%)
Speed and agility	Hexagon test (s)	11.1 ± 1.3	Excellent (8.1%)
	Spider test (s)	18.5 ± 1.5	Needs improvement (6.7%)

NDH, nondominant hand; DH,dominant hand;

DISCUSSION: Unlike many other sports, which may require high levels of physical fitness in a few components, tennis players require high performances in most components (speed, mobility, strength, power, aerobic and anaerobic endurance, flexibility, balance) (Kovacs 2007). According to the result of this study, flexibility (sit and reach), speed and agility (spider test) needs improvement in Taiwan female junior tennis players. Proper flexibility will assist player in reaching those wide shots, make quick direction changes and bend for low volleys. However, throughout a match player will also be asked to sprint around the court in every conceivable direction. Therefore having excellent speed and agility was critical (Bernstein, 2008). Players may exercise static and dynamic stretching to increase flexibility. Speed comprises the ability to move at high velocity in a variety of directions, and often not in a straight line. Players not only need to be exceptional movers in a linear direction (ie, acceleration), but also laterally and multidirectionally. Agility was the ability to change position or direction of the body rapidly. Speed has been defined as the rate of change of distance with respect to time, whereas acceleration as the rate of change in speed with respect to time (Cronin & Hansen, 2005). Thus, acceleration and deceleration seem to be fundamental for tennis players. Spider test need to sprint 4~6m catch the ball and retrieve it with five direction as soon as possible.

Torres-Luque, G., et al. (2011) indicated that 80% of a player's movement around the court was within a 2.5m radius, 10% 2.5~4.5m radius, 5% anything above 4.5m radius. On average a player moves 3m every stroke, 8~12m in every point, in a best of three match, players on average perform 300~500 high intensity interval movements. Players may practice more speed and agility related training to enhance acceleration and deceleration ability.

CONCLUSION: With the results obtained from the fitness testing normative values, these national players should consider additional physical training of flexibility, speed and agility. Coaches and physical trainers may develop individual profiles of the players based on their respective strengths and weaknesses. This would lead to a more efficient design of physical training program, saving time for tennis-specific training to enhance a player's performance, reduce the risk of injury and let the athlete's playing career can be as long as possible.

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