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Anthropometric Measurements for Young Tennis Players and Their Relation to Static and Dynamic Balance

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Abstract : The aim of this study was to identify anthropometric measurements and their relationship with static and dynamic balance among young tennis players. Seventy-three young male and female tennis players (less than 25 years) playing in their academies and schools in Delhi NCR.

Anthropometric and morphological measurements (weight, height, width, circumference and skinfold thickness) were taken. The results showed that the most important factor for static balance was body fat percentage (P=0.010). Calf circumference was the most significant in dynamic balance (P = 0.029). Based on the results, we recommend considering anthropometric and morphological measurements when selecting young tennis players. We recommend conducting similar studies on female athletes and examining and comparing physical characteristics and several age groups with the best athletes of tennis countries.

Key words: Anthropometric measurements, Static balance, Dynamic balance, Tennis player

Introduction

Tennis is the most popular sport in the world, characterized by high intensity, short-term activities and breaks of various lengths (Gupta, 2007). Not only is tennis such a popular sport, but it also has new perspectives. On the other hand, it is a sport that is a popular leisure activity and many people can move, and this sport has also become an important source of income (P. Unierzyski, 1995). The exact incidence and prevalence of tennis-related injuries has been difficult to determine. Injuries in advanced players under the age of 18 are estimated to be between 2 and 20 injuries per 1,000 hours of tennis played. (Pluim et al, 2006) in a comprehensive meta-analysis of all levels of players reported tennis injury rates ranging from 0.04 to 3.0 injuries per 1000 hours of play. Part of the variation in these statistics is always due to the different definitions of harm used in studies. For example, in studies where tennis injuries were defined as injuries that required a trip to the emergency room, the number of tennis-related injuries was very low. Other studies where the definition of injury was looser, including any injury that causes a player to seek medical attention or treatment, reported higher injury rates. It is considered an ideal sport to improve the physical activity of the general population. Those who enjoy playing tennis appear to have positive health benefits. In particular, lower body fat percentage, more favorable lipid profile, improved aerobic capacity improved the overall CVD risk profile. Many studies have identified better bone health not only in tennis players with a lifelong tennis history, but also in those who take up the sport in middle age. This requires a complete physical rehabilitation program that includes exercises to develop flexibility, agility, cardiorespiratory fitness, speed, strength, power and muscle strength. (ShibiliNuhmani et al, 2014). Tennis is an explosive sport that requires multi-directional movements and short movements. Tennis fitness focuses on explosiveness, speed, agility, balance and the anaerobic energy system with a focus on recovery times. Tennis is one of the most popular sports with an increasing number of active players. Although tennis is a non-contact sport, there are many injuries associated with it. Most tennis injuries occurred in the lower extremities and were muscle strains and joint (ankle and knee) sprains. These injuries occurred not only in adult players, but also in young tennis players. To prevent such injuries, rehabilitation specialists recommend special training programs: strengthening training programs to restore muscle imbalances, stretching exercises to reduce muscle stiffness and balance exercises proprioception (Vasiliki J. Malliou, 2010). It is also a professional sport with millions of dollars in prize money at stake for both male and female players. In the Netherlands, it is the second most popular sport among a population of 16 million, with more than a million participants. It is actually the most popular sport among Dutch women. Tennis is also on the list of popular sports in other European countries. Like many other sports, playing tennis - whether at the recreational, collegiate or professional levels - puts participants at risk of injury. While many tennis injuries are common to other sports, tennis has a unique injury profile. Differences in equipment, biomechanics and physical demands result in an injury profile that differs from other racquet and throwing sports. Sports injuries, including tennis injuries, are a common cause of disability and, in some cases, absenteeism. This can have significant socio-economic consequences at both the individual and societal levels. For these reasons, it is important to develop effective measures to prevent tennis injuries (B M Pluim, et al, 2006). Tennis is the most popular sport in the world, characterized by high intensity, short-term activities and breaks of various lengths (Gupta, 2007). To succeed in sports, players need an optimal combination of technical, tactical, physical and anthropometric characteristics and mental motivation. In fact, many experts in the field, such as coaches, managers, and researchers, believe that success in this sport can be attributed to the anthropometric characteristics of the players (USTA, 1995). Anthropometric measurements and motor skills provide important information about body size, health status, and normality of body shape (Munoz-Catol, et al, 2007). Scientists define anthropometric measurements to study the measurements of the human body and its various parts and reveal its structural differences. (Zawawi et al, 2012) pointed out that anthropometric measurements depend on the calculation of the sizes of external body structures (heights, widths and circumferences). The importance of anthropometric measurements in physical education can be summarized as an important factor in the selection process of players. Anthropometric measurements also contribute to improving the physical abilities of athletes from the junior stage to the Olympic level (Sa'eid, 2008). Therefore, anthropometric and morphological requirements are seen as a determining factor in many sports and have also been related to many physical abilities (Zawawi, 2012). In addition, anthropometric measurements became very important in identifying talent and an important predictor of success in competitive sports (Abdullah et al, 2011). Many researchers have noted that each sporting skill requires a specific physical characteristic that positively affects performance (Ahmad et al 1999). This was also argued by (Al-Bisati, 1998) who indicates a high correlation between physical abilities and anthropometric measurements in different sports activities at all levels of performance. Therefore, it is important to consider body structure and physical requirements when selecting athletes for each sport (Ben Brahim et al, 2013). Coordination skills are complex motor skills that can be developed through training. During training, whole movement patterns are repeated, in which the movements of all body parts or only certain body parts are interconnected (Kostic et al 2009). Coordination skills are particularly emphasized during physical activity, sports, leisure activities, fitness or kinesiotherapy (Wang, 1991). Neuromuscular activity is a fundamental function of all forms of physical activity and is used to coordinate the movement of the body and all its parts in time and space (Liliana et al, 2014). Balance skill as one of the coordination skills. Balance plays an important role in motor skills through two types of balance, static and dynamic. Static balance is when an individual maintains balance in one situation, while dynamic balance is the body's ability to maintain balance or stability while moving or moving from one balanced situation to another (Bahman et al, 2011). Differences between both sexes in the static balance of elementary school children and their relationship with anthropometric measurements. They concluded that there is a marginal relationship between standing height, body weight, lower limb length, upper body length and static balance. It concluded that static balance performance depends on relative body weight and longitudinal measurements.(Viviane et al, 2010). The relationship of balance with age and found that balance is related to growth, because adults have more balance than young people. He also found that height and weight significantly affect children's balance. However, height and weight were not associated with balance in the young. Most studies have identified the level of motor skills, anthropometric characteristics to identify skills, the level of physical development; and body harmony (Sales, et al, 2014). The study on the high positive correlation between anthropometric measurements and coordination skills in boys and girls (Kostic et.al, 2009) There is a statistically significant relationship between the ability to press straight and the width of the shoulders and hips and this ability and the width of the open palm (Sa'eid, 2008). In some sports, athletes differ from their counterparts in many anthropometric dimensions, such as body height, shoulder width, and hip narrowness. (Abdullah et al. 2001). Tennis is considered one of the most popular racquet sports. it is an integral game due to its dependence on skill, planning, physical, mental, intellectual demands and proper body structure (Gupta, et. al 2007). Tennis players outperformed badminton players in the following anthropometric measures: age, body fat percentage, weight, fat-free mass, chest width, hip width, chest circumference, abdominal circumference, hip circumference, upper arm circumference, hip depth, and abdominal depth. (Al-Hammouri, 1996). He further reported that tennis players outperformed table tennis players in terms of body weight, upper arm circumference and chest depth. Showed a significant relationship between some anthropometric, functional measurements and abilities. The most important functional and anthropometric measurements that influenced exercise performance were (body height, arm length, upper arm circumference, heart rate before exercise, heart rate after exercise, vital capacity and maximal oxygen consumption). Considering the great importance of anthropometric measurements in the selection of young tennis players and the fact that tennis requires players to have specific body requirements and characteristics and certain physical abilities that differ from other games, there are also few studies related to tennis games. A research study was conducted on the relationship between balance and anthropometric measurements to identify the specific body characteristics required of junior tennis players. The results can play a big role in improving the performance level of the players. (Abbas, 2008).

Statement of problem

There are many studies which state an anthropometric characteristic has relation with performance, strength and power. But the anthropometric relation with static and dynamic balance in young tennis players has to be evaluated. So this study is to examine the relation between balance (static and dynamic) with anthropometric characteristics in young tennis players.

Study aim

To identify the impact of anthropometric characteristics on static and dynamic balance in young tennis players.

Methodology

Study design: the correlation approach was used for its stability to the nature of the study. The sample: 73 young tennis players were selected randomly from the tennis academy and schools Delhi NCR. Table (1) shows the features of the study sample.

Table 1 sample description

variables	Age year	Height cm	Weight kg
Mean	18.56	169.83	59.17
Std.	1.65	5.82	5.23

The tools of the study:

The devices and tools used for anthropometric measurements and balance: 1) tape measures for measuring the heights and circumferences, 2) skinfold caliper to measuring the fat thickness; 3) stadiometer is used for measuring the body height 4) weighing machine is used for measuring weight of the body 5) Pelvimeter devices is used for measuring the widths; 6)
Bess score is used for measuring the static balance; 7) mSEBT (modified star excursion balance test) is used for measuring the dynamic balance.

The tests and measurements conducted
The following measurements and tests were conducted as tools for gathering data from the study sample: First: the anthropometric measurements (NHANES, 2005):Weight, heights/lengths: (total body length; total arm length; total leg length; upper arm length; forearm length; wrist length; trunk length from sitting;thigh length; leg length), Widths of (shoulders, chest, pelvic; hand), circumferences: (pelvic, thigh, chest, upper arm, calf circumference, fore arm),Body mass index and fat thickness for the following areas: (Sub

scapular, triceps, chest, abdominal, supraspinale, thigh, medial calf). After recording these measurements, the body intensity was extracted from 7 areas according to the following formula (for men): (Howley & Franks, 2002): Body intensity= 1.112 – 0.00043499(K1) + 0.0000055(K1)2 – 0.00028826 (age) where: K1 means the total of fat percentages in the pre mentioned 7 areas. K1 (2) means the square of fat percentages total in the pre-mentioned 7 areas, Then, Siri's formula was adopted for calculating the amount of fat in the body, and it is as follows: (Viviane & et.al, 2010): Fat amount= (495/body intensity) - 450 Second: the following balance tests: Tests of standing on the balance error scoring system (BESS) to measure the static balance; mSEBTfigure for measuring dynamic balance.

Procedure

A total 73 subjects were screened for the study, out of which 33 were females and 40 were males. The participant's evaluation and selection process begun with all possible participants undergoing a cursory interview with the researcher in order to exclude subjects that did not fit the criteria for the study. Participants successfully complied with this interview was be evaluated at a single consultation, during which each of them were received: a letter of information and sign an informed consent that explains the study and allow them to withdraw at any time from the study with no repercussions.

To determine whether subjects could participate in the study: a brief medical history; a history of lower back pain and shoulder pain a physical examination were performed. Also a brief training and nutritional history is been taken and recorded. Anthropometric measurements, static balance and dynamic balance were measured and recorded on data collection sheet.

Conditions for conducting measurements
There are some important conditions that were taken into consideration when conducting and implementing the anthropometric measurements:

a) Conducting measurements using one method; b) Implementing the 1st and the 2nd measurement using the same tools if it is repeated; c) Conducting measurements within a unified daily timing; d) Defining the physiological points that facilitate implementing measurements using one method (NHANES, 2005).

Data Analysis
Correlation analysis was used in its Stepwise
Method to achieve the aim using SPSS software.

Results and Discussion:

For achieving the study aim, which refers to
“identifying the anthropometric measurements and their contribution to static and dynamic balance in young tennis players", correlation analysis was used, as clarified in tables.

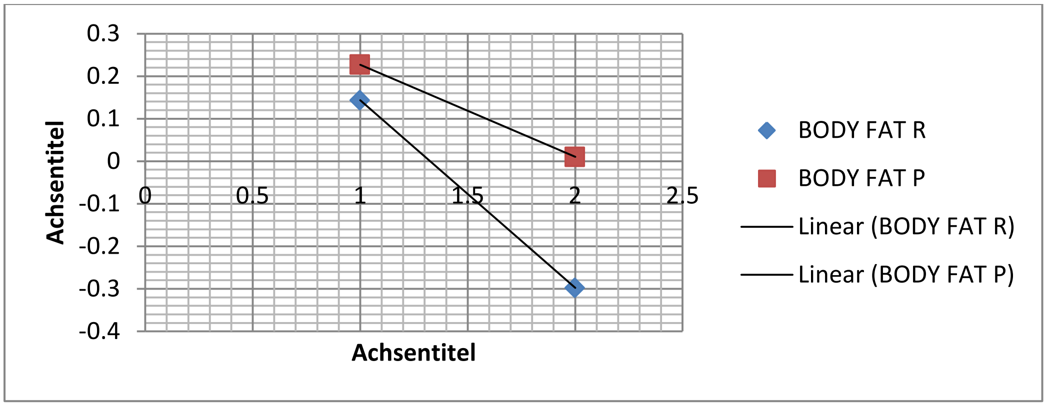
Table 2 correlation analysis results for the variable of static balance

S.no.	Static balance		
		R value	P value
1	Body fat	-0.298*	0.010
2	Trunk length	-0.093	0.432
3	Hip width	0.170	0.150
4	Calf circumference	-0.131	0.269
5	Ankle width	-0.056	0.636
6	BMI	-0.143	0.226

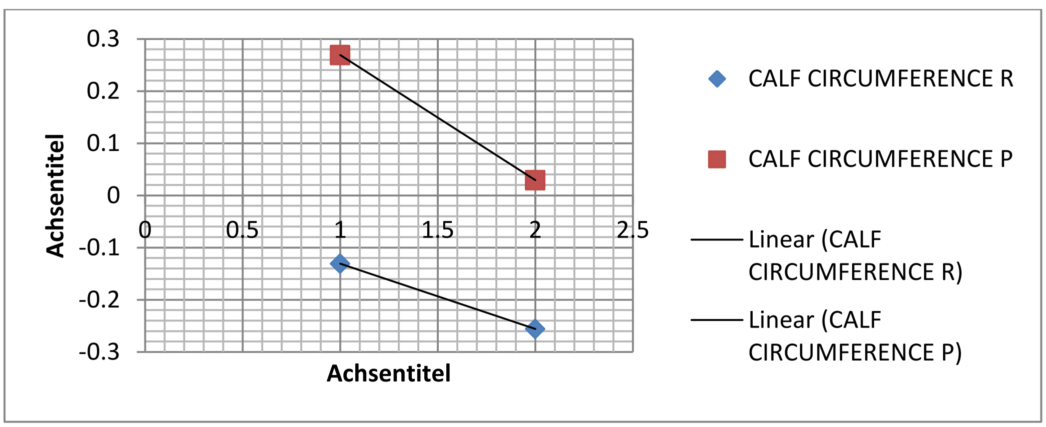
Table 3 correlation analysis results for the variable of dynamic balance

S.no.	Dynamic balance		
		R value	P value
1	Body fat	0.143	0.227
2	Trunk length	-0.076	0.523
3	Hip width	-0.138	0.244
4	Calf circumference	-0.256*	0.029
5	Ankle width	-0.056	0.636
6	BMI	-0.065	0.584

Graph:1: Body fat vs. static and dynamic balance



Graph: 2: calf circumference vs. static and dynamic balance



The table 2 and graph 1 shows that the value of correlation coefficient between the variable, static balance and the body fat, trunk length, hip width, calf circumference, ankle width and BMI which was included in the correlation formula, was to the entire contribution percentage was(0.010), (0.432), (0.150), (0.269), (0.731) and (0.226) respectively. It is also clear in the table that the value of p, which refers to the contribution amount for the body fat in explaining variance within the variable of static balance was (0.10) and this is a statistically significant value because its r value was (-

0.298), with a significance level of (p= 0.010). This indicates that the only body fat from the anthropometric measurements having a statically significant effect on the static balance was the body fat, where as other variables were not statistically significant affective on the variable of static balance. That could be explained that the body fat is to maintaining the static balance as a good base for the players. On the other hand table 3 and graph 2 shows that the value of correlation coefficient between the variable, dynamic balance and the body fat, trunk length, hip width, calf circumference, ankle width and BMI which was included in the correlation formula, was to the entire contribution percentage was(0.227), (0.523), (0.244), (0.029), (0.636) and (0.584) respectively. It is also clear in the table that the value of p, which refers to the contribution amount for the calf circumference in explaining variance within the variable of static balance was (0.10) and this is a statistically significant value because its r value was (-0.256), with a significance level of (p= 0.029). This indicates that the only calf circumference from the anthropometric measurements having a statically significant effect on the dynamic balance was the calf circumference, where as other variables were not statistically significant affective on the variable of dynamic balance. That could be explained that the calf circumference is to maintaining the dynamic balance as a good base for the players during the game. The male group demonstrated stronger correlations for overall, anterior-posterior, and medial-lateral stability index with BMI but we found the non significant correlation between BMI on static and dynamic balance in young tennis players.

The most important result was that no significant relationships were found between other anthropometric features with static and dynamic balance, either with eyes open or with eyes closed. Regarding the anthropometric parameters related to dynamic balance, the findings of the present study are in line with the ones reported in Berenjian et al.

Julia Greve, et.al, 2007 this research talks about The general stability index showed a correlation between BMI and postural balance – measured as imbalance (R= 0.723-dominant side and R=0.705–non-dominant side). The anteroposterior stability index – measured as instability – showed correlations on the dominant (R= 0.708) and non-dominant side (R=0.656). Lateral instability showed a correlation on the dominant side (R=0.721) and on the non-dominant side (R=0.728). The comparison of the balance indexes for dominant and non-dominant sides showed no statistically significant differences. So finally this proves only one variable (body fat) with static balance has significant difference other variable (ankle width, hip width, trunk length, pelvic width and BMI) with dynamic and static balance has no significant difference.

Finally, this indicates that the only independent variable from the anthropometric characteristics having a statistically significant effect on the dependent variable (static balance) is the body fat, whereas the other independent variables were not statistically significant affective on the variable of static balance. That could be explained in that the body fat and width contribute to maintaining static balance as a good base for the player. Also, the body fat allows a large moving scope for the players balance and consequently increases the exerted power that would in turn increase the players ability to largely overcome and achieve more strength. It also has an impact on increasing the muscular strength, the more body fat increases then less scope of the balance. (bahman, et al ,2011).

Commenting on what has been mentioned, the movement speed for the legs' muscles depends upon the functional competence of the flexor and extensor muscles in the hip, knee and foot joints. Also, the hip's muscles play a role in the legs' movements given that the hip area is where the thighs' bones start, and which is attached to the legs' bones through the knee joint. But the bottom muscles in particular play a role in extending the hip joint (thigh), especially the gluteus maximus muscle which is considered the strongest muscle in the human body, as well as rotating thighs outwards (Bahman, et.al, 2011). Since the movements of walking and running are mainly interchanging movements between flexor and extensor the hip joint (thigh), knee and the legs' pushing power on the ground which mainly depends on the hip's moving power, the hip muscles, particularly the maximums gluteus muscle, are the main muscles being trained when performing the tennis skills, in which quick exchanging movements of flexor and extensor the hip joint occur (Bahman, et.al 2011). Accordingly, that the hip width showed the impact in static balance variable through the role of the hip muscles in flexor and extensor the hip joint.

The value of correlation coefficient between the dependent variable (dynamic balance) and independent variable hip width was included in correlation formula, ($r = 0.170$) and the value of ($p = 0.150$). this shows the non significant , positive correlation.

This means that only two variables from all the independent variables related to anthropometric measurements have an effect on static balance, the body fat. This indicates that the more the more body fat increases, the decreases the body balance and strength. Consequently, the muscles' tolerance decreases as well and that directly contribute to increasing the ability to maintain balance. The leg's strength depends on the strength of foots' and thighs' muscles. In general, they are the main working muscles in the Movements of foot joint when moving in different directions while playing tennis, and they offer players the freedom of moving while maintaining balance and the move's significant compatibility (Jyoti, et.al, 2012).In light of what has been mentioned, it is clear that the body fat plays a significant role for the body balance while performing movements in different directions in doing the game's special motor skills Kreighbaum, et.al, 1990. Allawi, 1995)pointed out that the legs represent the body's balance base, the more their width increases, the more we have a good balance base. DiNucci, 2014 found positive relationship between the static balance and the heel's width, as well as simple negative relations between dynamic balance and leg's length.

Conclusions:

1) The most contributing variable of static balance is the variable of body fat, 2) the most contributing variables of dynamic balance is the variable of calf circumference.

Recommendations: 1) Considering the results of this study when selecting the junior tennis players; 2) Conducting similar studies regarding different physical abilities; 3) Conducting similar studies that involve female samples and different age groups for national clubs and teams, as well as comparing between them.

Conflict Of Interest- NONE

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