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A COMPARATIVE STUDY ON THE PHYSICAL FITNESS AND PERFORMANCE OF MALE BASKETBALL PLAYERS IN DIFFERENT DIVISIONS[3]

ABSTRACT

There is a lack of information about the influence of different practice levels on physical fitness and performance variables of male basketball players competing in different divisions. Hence, the purpose of this study is to compare selected physical fitness and performance variables of male players in Turkey National Basketball League's Division I (D1), II (D2) and III (D3=Regional) and to evaluate whether players with different divisional characteristics have different physical fitness and performance variables.

From the Turkey basketball league, ninety male basketball players who are competing in the division I (n=30), division II (n=30) and division III (n=30) voluntarily participated in the study. Physical fitness (body height, mass and fat percentage) and performance (vertical jump height (VJH), vertical jump power (VJP), VO_{2max} and 20 m sprint) measurements were taken in three separate consecutive days following the completion of the first session.

D1 and D3 players overall weighed more and D1 players had more body fat (BF) and lean body mass (LBM) than D2. There were significant differences in VJP between divisions (D1>D2>D3= $p<0.05$), but, the differences in sprint ability and body height were not significant. Although there was no difference between D1 and D2 in VO_{2max} and VJH, their values were significantly higher than D3 ($p<0.05$).

These results showed that in spite of relatively little differences in the average physical characteristics, there were very large statistical differences between divisions in physical performance variables of male basketball players, especially VJP and LBM which is an important criterion of performance at basketball.

Key words: Aerobic capacity, power, basketball divisions

FARKLI LİGLERDEKİ ERKEK BASKETBOL OYUNCULARININ FİZİKSEL UYGUNLUKLARI VE PERFORMANSLARI ÜZERİNDE KARŞILAŞTIRMALI BİR ÇALIŞMA

ÖZET

Farklı Basketbol liglerinde yarışan erkekler oyuncuların liglere göre bazı fiziksel uygunluk ve performans değerleri arasında önemli bir farklılığın olup olmadığı konusunda bir bilgi eksikliği vardı. Bu nedenle bu araştırmada Türkiye Erkekler basketbol birinci, ikinci ve amatör liglerinde yarışan oyuncuların seçilen bazı fiziksel uygunluk ve performans değerleri arasında farklılık olup olmadığının belirlenmesi amaçlanmıştır.

Bu araştırmaya Türkiye basketbol erkekler birinci liginden (I) 30, ikinci liginden (II) 30 ve amatör liginden (III) 30 olmak üzere toplam 90 erişkin sporcu gönüllü olarak katılmıştır. Sporcuların fiziksel uygunluk ve performans değerlerinin belirlenmesi için, müsabakaların birinci devrelerinin sonunda, boy, vücut ağırlığı, vücut yağ yüzdesi, dikey sıçrama yüksekliği, 20 m sprint koşu ve aerobik kapasite (max.VO_2) değerleri test edilmiştir. Test edilen değerler arasındaki farkın önemliliği, tek yönlü varyans analizi (ANOVA) ile belirlenmiştir.

Test edilen değerlerin istatistiksel analizi sonucunda ikinci lig oyuncularının vücut ağırlığı ortalamaları birinci ve amatör lig oyuncularının değerlerinden daha düşük bulunmuştur ($p\leq0.05$). Bunun yanı sıra, birinci lig oyuncularının vücut yağ yüzdesi ve yağsız vücut ağırlığı ortalamaları ikinci lig oyuncularından daha yüksek değerlerde idi ($p\leq0.05$). Dikey sıçrama yüksekliği bakımından sadece amatör lig oyuncuların değerleri farklı iken, patlayıcı güç bakımından her üç lig arasında önemli farklılıklar (I>II>III) vardı ($p\leq0.05$). Birinci ve ikinci lig oyuncularının max.VO_2 değerleri arasında önemli farklılık olmamasına rağmen, bunların max.VO_2 değerleri amatör ligdekilerden yüksek idi ($p\leq0.05$).

Bu araştırma, ligler arasında fiziksel uygunluk bakımından kısmen çok küçük farklılıkların olduğunu göstermiştir. Basketbolda fiziksel performansın belirleyicilerinden olan özellikle patlayıcı güç ve yağsız vücut ağırlığı gibi özellikler, ligler arasındaki fiziksel performans farklılığının önemli göstergeleri olarak bulunmuştur. Buna karşın, yine basketbolda fiziksel uygunluk ve performansın önemli ölçütlerinden olan maksimal hız ve boy uzunluğunun, 2005–2006 yılı basketbol müsabaka dönemindeki ligler arasında, ligler arasındaki farklılığın belirlenmesinde önemli bir unsur olmadığı sonucuna varılmıştır.

Anahtar kelimeler: Aerobik kapasite, patlayıcı güç, basketbol ligi

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INTRODUCTION

Basketball competitions are held in different divisions in almost every country of the world. Turkey Male Basketball League consists of three different divisions as Division I, Division II and Division III (regional). The levels of divisions are determined according to general team performance or team points which depend on general performances of players competing in each team. There are a lot of internal and external factors affecting the players' performance during the game. Among the physical performance characteristics, one of the important factors for basketball is the fact that it is a complex intermittent team sport which requires performing a lot of multidirectional movements such as dribbling, running, sprinting and shuffling at various velocities and intensities during the game. These movements represent the physical activities that are considered as the important aspects of the game and contribute to the high performance of the players (15,25).

Aerobic capacity and body composition, including height, mass and lean body mass or percentage of body fat are important because they play a supportive role in helping athletes perform under actual competitive conditions at basketball (8). Basketball is characterized as a sport requiring anaerobic energy metabolism. However, aerobic metabolism contributes approximately 15% to meet energy demand during the live time of basketball game (15). Although anaerobic requirement is more than aerobic, aerobic capacity or VO_{2max} is needed for the recovery from high intensity movement commons to basketball play (9,22). Vertical jump and sprint activities are one of the important components of physical performance in basketball that these movements are frequently performed by players during various defensive (blocking, rebounding, etc.) and offensive (shooting, rebounding, etc.) maneuvers. McInnes et al (1995) and Ben Abdelkerim et al (2007) reported that during the game a basketball player, on average, performed 46 and 44 jumping acts, respectively. Sprint activities cover 8.8% of live time (4) and 39% of the sprint activities approximately occur in between 2 or 3 second during a basketball matches (15). A combination of technical and tactical abilities as well as a high degree of physical fitness characteristics is required for optimal performance during basketball match (9).

The authors consider it is generally necessary to determine the specific physical fitness profiles of athletes to select them for a particular sport. Several studies which examined the physical fitness profiles of basketball players were compared according to various playing positions and gender differences (13,17,18,27). But, no study can be found on the differences players' physical performance characteristics competing in different basketball divisions. Therefore, outstanding the problem was that; were there any differences in physical fitness between divisions or was there an effect of physical fitness characteristics on the differentiation between divisions in the Turkey adult male basketball league? In fact, this study can be turned into valuable information on the differences of physical fitness of the players competing in different practice levels in the Turkey basketball league. In this study, it was aimed to determine the physical fitness of Turkey adult male basketball players and to evaluate whether players in different divisional roles have different physical fitness.

METHOD

Participants

Ninety male basketball players who competed during the 2005-2006 season in the division I (D1, n=30), division II (D2, n=30) and division III (D3, n=30) from 12 different teams in Turkish Basketball League voluntarily participated in the study. Upon supplying Information, written consent was obtained from all the groups and tests were carried out in respect of ethical rules.

Procedures

Participants were asked whether they had prior experience with the tests to be carried out. Therefore, testing protocol was separately explained to each group of participant who hadn't been previously tested on any occasions in previous seasons for training prescription purposes. In addition, all participants were requested to have their last meal three hours before the tests and not to participate in any prolonged exercise 24 hours before the tests. Physical performance measurements were obtained over three separate consecutive days following the completion of the first season.

Measurement

Demographic Characteristics: Body mass (BM) was obtained and rounded up to the nearest 0.1 kg using a balance beam scale and body height (BH) was measured using a stadiometer and rounded up to the nearest 0.5 cm

Aerobic Capacity: Maximal oxygen uptake (VO_2max) was indirectly obtained using a multi-stage run test. All participants performed the 20m shuttle run test as previously described by Leger et al. (1988).

Body fat Percentage: Body fat percentage was calculated by using skin-fold measurements taken from four sites (biceps, triceps, subscapular and calf), using Harpenden skinfold calliper and rounding up to the nearest 0.2 mm. The values were evaluated using Durnin and Womersley (1974) skinfold equation. Lean body mass was calculated subtracting body fat percentage from 100.

Vertical-jump height: Vertical-jump height was measured using the Vertec (26). Participants performed three trials with a 60-s rest period between each jump activity and the best jump was used in the analysis to determine the vertical jump power (11).

Sprint Ability: Sprint speed was taken by using an infrared timing device in an indoor court. Three 20 m maximal sprint was run with a 90-s rest period between each sprint and the best of them was used to evaluate sprint ability.

Body height and mass, skin fold thickness and vertical jump height (VJH) were used to determine players' vertical jump power (VJP), lean body mass (LBM) and body fat percentage (BF).

Statistical Analysis

Means and standard deviations were calculated for each variable. Differences between divisions were analyzed by using ANOVA and the significance was set at $p<0.05$. The relationships between participants' values were examined with Pearson product moment correlation coefficients; p values ≤ 0.01 and ≤ 0.05 were considered to be statistically significant.

RESULTS

ANOVA analyses and Post Hoc comparisons of all values were shown in Table 1.

Table 1: Physical Fitness Variables of Male Basketball Players

Variable	Division 1 (n=30) mean±SD	Division 2 (n=30) mean±SD	Division 3 (n=30) mean±SD	F	Significant
Age (yr)	24±4.7[a]	21.6±2.8[b]	22.1±2.4[ab]	4,037	0.21*
Height (cm)	197±7	194±0.5	195±5	1,687	0.191
Weight (kg)	95.3±12.5[a]	87.6±7.3[b]	91±8.6[a]	4,693	0.12*
Body Fat (%)	14.6±3.7[a]	12.5±3[b]	12.1±3.5[ab]	3,545	0.33*
Lean Body Mass (kg)	81.01±7.6[a]	76.49±4.6[b]	78.07±6.2[ab]	3,948	0.23*
VO_{2max} (ml/kg/min)	55.6±2.6[a]	57.2±2.8[a]	50.5±4.9[b]	27,519	0.000*
20 m Sprint (s)	2.7±014	2.8±0.1	2.8±0.13	2,046	0.135
Jump Height (cm)	48.2±4[a]	48.3±3[a]	45.5±4[b]	3,985	0.22*
Average Absolute Vertical Jump Power (W)	2346.7±161[a]	2214.5±130[b]	2121.1±130[c]	18,428	0.000*
Average Relative Vertical Jump Power (W/kg)	24.8±2.2[a]	24.7±1.9[ab]	23.4±2.4[b]	3,479	0.35*

[a,b,c] All data points in each row are statistically significant (P<0.05).
*p<0.05

Differences in body height and 20 m sprint times were not statistically significant between divisions. D1 and D3 players overall weighed (p<0.05) and D1 players had more body fat than D2 (p<0.05). Vertical jump height and VO_{2max} values of amateur players were lower (p<0.05) than D1 and D2 players, but no significant difference was observed between D1 and D2 players. Body fat percentage and lean body mass values of D1 were higher than D2 (p<0.05), but values of D3 player were not different from D1 and D2. No significant differences were observed in relative jump power between D1 and D2, and between D2 and D3, but D1 player had higher a value than D3 (p<0.05). There were significant differences in absolute jump power between divisions as D1 had a value higher than D2 and D3; and D2 had a value higher than D3.

Correlation between selected parameters of male basketball athletes were designed in table 2.

Table 2: Correlation between Selected Parameters of Male Basketball Athletes

Variable	AVJP	RVJP	VJH	Sprint	BF	LBM	VO_{2max}	BH
BM	.443**	-.705**	-.759**	.255*	.779**	.954**	-.371**	.807**
AVJP		.249*	.130	-.082	.327**	.416**	.106	.130
RVJP			.959**	-.401**	-.516**	-.698**	.443**	-.800**
VJH				-.352**	-.591**	-.733**	.464**	-.709**
Sprint					.135	.272**	-.168	.390**
BF						.561**	-.336**	.539**
LBM							-.344**	.805**
VO_{2max}								-.287**

**. Correlation is significant at the 0.01 level.

*. Correlation is significant at the 0.05 level.

BM= Body Mass, BH= Body Height, BF= Body Fat, LBM= Lean Body Mass, VJH= Vertical Jump Height, AVJP= Absolute Vertical Jump Power, RVJP= Relative Vertical Jump Power.

DISCUSSION

Specific physical fitness that may contribute to the performance in basketball as well as the possible structural differences between players in various divisions have been a subject of high interest for authors and coaches. Body height may be evaluated as a characteristic providing an advantage for game performance during basketball matches, especially when a player attempts to jump with the intention of getting the ball in a basket elevated 3.05 meters from ground level. Therefore, basketball teams usually consist of taller players than those in other team sports (16,19). This study showed that players' body heights were in the average between 194 and 197 cm and no statistical differences were found between players' body heights in terms of divisions. Also in this study, these profiles were determined to be appropriate for top-level basketball players (1,18). Body composition including body height and mass, body fat percentage and lean body mass may also positively or negatively influence aerobic capacity, speed, agility, jumping and power of players (15,18,25). This study concluded that there were significant negative correlations between body composition variables (LBM, BM and BF) and tested performance characteristics (VO_{2max}, VJH, VJP and AVJP). In addition, significant differences were found between divisions in LBM, BM and BF. D1 players had higher LBM values than D2 and D3. Ugarkowich et al. (2002) and Silvestre et al. (2006) separately reported that there

were strong correlations between body composition, power, and VJH; and that this relation was affecting players' game performance. Because of its effect on other physical fitness variables, this morphological structure may be considered to account for the differences between divisions and may be providing an advantage during physical contacts of players to effectively perform technical-tactical structures of the game under the actual competitive conditions of confronting the opponents. Hence, the importance of body composition in basketball is expectable as a distinctive structure to evaluate differences between divisions.

Present findings of VJH for D1 and D2 were similar, but these values were higher than D3. However, 20 m mean sprint times of players were not statistically different between divisions. Authors reported that the mean vertical jump height and vertical jump power in elite male basketball players were more than 60 cm (24) and 1700 W, respectively (10,15). VJH values in this study were lower than literature. The discrepancy in making comparisons between vertical jump height data from various studies may be related to the different testing methods and protocols employed. Vertical jump and sprint activities are the important motor components of basketball game because these movements are frequently performed by players during various defensive (blocking, rebounding, etc.) and offensive (shooting, rebounding, etc.) maneuvers (4,15). Johnson and Bahamonde (1996) and Carlock et al. (2004) indicated that vertical jump height itself is a good measurement of specific muscular performance (anaerobic power). While the findings of VJP in this study were higher than 1,700 W and this result is consentient with the information in literature, there were significant differences between divisions in VJP (D1>D2>D3). Although there was no difference between VJH values of D1 and D2, the differences between VJP of these divisions could be explained by different body mass, especially lean body mass and vertical jump height. In addition, in spite of the similar VJH and RVJP of D1 and D2, the differences between the body mass and LBM of D1 and D2 could have caused the differentiation in VJP since there was a significant relation between anaerobic power and body mass (12). It was also found, as previously aforementioned, that there was a negative correlation between anaerobic power and body mass. A higher level of muscular power would be preferable in basketball and would reduce the risk for injuries in the maintenance and rebuilding training periods and also could provide an advantage to players for success since a player averagely performs 44-46 jumping acts during a basketball match (4,15). Although these abilities depend mostly on genetic factors, there is always a training potential to be considered. These results might guide us to suggest that coaches could consider muscular power, jumping and sprint abilities of athletes as a selective criteria and training potentials. While short sprinting might be an important determinant of game performance, in this study, it was not determinative enough to prove the differences between divisions. However, vertical jump and muscular power might be evaluated as a distinctive characteristic between amateurs, professionals or sub professionals.

Basketball is generally characterized as an anaerobic sport because it includes high intensity intermittent movements for the most parts of the game. Hence, most investigators consider that the basketball was a sport whose energy requirement predominantly relies on a-lactate and the lactic acid system (9). However, aerobic metabolism was also required because an important part of the play time was spent with low intensity runs and walking (17). Repeated power output and sprint activities may reflect the rapid regenerations of ATP and PCr stores.

Although anaerobic requirement is more than aerobic, aerobic capacity or VO_{2max} is needed for rapid recovery from high intensity exercises to perform some biological tasks required to compensate for a variety of physiological disturbances, such as removal of accumulated lactate and heat dissipation (2,9,22). Thus, aerobic capacity obviously contributes to the basketball players, who require both high aerobic and anaerobic capacity to reproduce multiple repetitions of high energy output. Moreover higher VO_{2max} provides the players with a better base for on field performance regarding the intensity and the demands of basketball game. Mean VO_{2max} values of the D1 and D2 players were similar. These data were compatible with previously reported data (27), but with the other data on elite male basketball players (18). General aerobic capacity was fairly homogenous between professionals and sub-professionals, when inter-individual differences were ignored. But the amateur athletes had lower aerobic capacity than others. These results may be explained with the fact that VO_{2max} values may be influenced by training regime, match intensity and phase of season.

Generally, the ages of 20 and 30 are considered to be ideal by coaches for optimum performance in sport (3). The average age of the D1 players was higher than players of other divisions, which is in accordance with ages of elite male basketball players reported in previous investigations (17,18). Although there is not scientific information, there is a common conviction that an elderly player may have more professional experience and tactical judgment than a younger person. However, in a previous study, it was reported that age diversity was negatively associated with basketball team performance (21). Yet, the relation between age and game performance in basketball requires more investigation.

Conclusively, in this study, some physical performance differences exist, most notably power output, between players as a function of divisions (6). Although there were significant differences among divisions for some specific characteristics, the body mass, LBM, VJP and $VO_{2\ max}$ values of team players in the divisions were of similar level with those previously reported in the literature (1,10,15,18,27). Anaerobic power (VJP) and LBM seem to be a better predictor of divisional differences even though it is not clear whether such characteristics come from specific trainings in the divisions, or from selection criteria. But sprint speed and body height were not distinctive characteristics for diversity between divisions in the 2005-2006 season of Turkish Basketball League.

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