Comparison of body composition and physical performance between college and professional basketball players

Pedro Delgado-Floody[1], Felipe Caamaño-Navarrete[2], Bastián Carter-Thuillier[2], Francisco Gallardo-Fuentes[3], Rodrigo Ramirez-Campillo[3], Mauricio Cresp Barría[2], Pedro Latorre-Román[4], Felipe García-Pinillos[1], Cristian Martínez-Salazar[1], Daniel Jerez-Mayorga[5].

[1]Department of Physical Education, Sport and Recreation, Universidad de La Frontera, Temuco, Chile. [2]Faculty of Education, Universidad Católica de Temuco, Chile. [3]Department of Physical Activity Sciences, Research Nucleus in Health, Physical Activity and Sport, Universidad de Los Lagos, Chile. [4]Department of Corporal Expression, University of Jaen, Spain. [5]Facultad de Ciencias de la Rehabilitacion, Universidad Andres Bello, Santiago, Chile.

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Summary

Introduction: The body composition, anthropometrics and physical performance of basketball players are fundamental for their practice of the sport. The purpose of this study was to evaluate and compare body composition and physical performance among college and professional basketball players.
Method: The sample consisted of 2 groups of male basketball players (n=17) (age: 23.61±3.45): Group 1 college players (n=9; age: 22.48±3.79 years), and Group 2 professional players (n=8; age: 24.88±2.69 years). Weight, height, fat mass and muscle mass were measured. Physical performance was measured in throwing the ball (m/s), gripping strength (Kg), speed over 20 metres, jumping and reactive strength. The mean height of the college basketball players was 179.44±7.97 cm, weight 83.61±14.64 kg, body mass index (BMI) 25.94±3.95 kg/m^2, % body fat mass 16.64±7.07, % Muscle mass 47.59±4.01; the mean height of the professional players was 181.50±8.42 cm, weight 89.73±25.56 kg, BMI 26.94±5.87 kg/m^2, % body fat mass 19.26±8.20, % Muscle mass 46.26±4.55.
Results: There were no significant differences in the % of body fat and muscle mass, similar results to those found in handgrip strength, ball-throwing speed and speed in 20 meters with and without the ball (p >0.05). For physical performance only the Q index and the floor contact time (DJ-t) in drop jumps presented statistical differences (p <0.05), with better results achieved by the college players.
Conclusion: College and professional basketball players do not show significant differences in body composition and variables associated with physical performance, especially the vertical jump capacity that is lower in both groups compared to what is reported in the scientific literature.

Key words:
Basketball. Body composition. Physical condition.

Comparación de la composición corporal y rendimiento físico entre jugadores de baloncesto universitario y profesional

Resumen

Introducción: La composición corporal, antropométrica y el rendimiento físico de los jugadores de baloncesto, son fundamentales en el desempeño deportivo. El propósito de este estudio fue evaluar y comparar la composición corporal y el rendimiento físico entre jugadores de baloncesto universitario y profesional.
Método: La muestra estuvo constituida por 2 grupos de jugadores de baloncesto varones (n=17) (edad: 23,61±3,45), el grupo 1 por universitarios (n=9; Edad: 22,48± 3,79 años) y el grupo 2 por profesionales (n=8; Edad: 24,88± 2,69 años). Se evaluó peso, talla, masa grasa y muscular. El rendimiento físico se midió a través del lanzamiento de balón (m/s), fuerza prensil (Kg), velocidad en 20 metros, capacidad de salto y fuerza reactiva. El grupo de jugadores de baloncesto universitario presentó una talla promedio de 179,44 ± 7,97 cm, peso corporal 83,61 ± 14,64 kg, índice de masa corporal (IMC) 25,94 ± 3,95 Kg/m^2, % masa grasa 16,64±7,07, % masa muscular 47,59±4,01, en cambio los profesionales presentaron una talla de 181,50 ± 8,42 cm, peso corporal 89,73 ± 25,56 kg, IMC 26,94 ± 5,87 Kg/m^2, % masa grasa 19,26 ± 8,20 y % masa muscular 46,26 ± 4,55.
Resultados: En la comparación del % de grasa corporal y masa muscular no existieron diferencias significativas, resultados similares a los encontrados en fuerza prensil, velocidad de lanzamiento del balón y velocidad en 20 metros con y sin el balón (p >0,05). En relación al rendimiento físico solo el índice Q y el tiempo de contacto en Drop Jump (DJ-t) presentaron diferencias estadísticas (p <0,05), con mejores resultados en el grupo universitario.
Conclusiones: Los jugadores de baloncesto universitario y profesional no muestran diferencias significativas en la composición corporal y las variables asociadas con el rendimiento físico sobretodo la capacidad de salto vertical que es menor en ambos grupos comparado con lo reportado en la literatura científica.

Palabras clave:
Baloncesto. Composición corporal. Condición física.

Correspondencia: Daniel Alejandro Jerez Mayorga
E-mail: daniel.jerez@unab.cl

Introduction

Basketball is one of the most popular sports in the world[1]. It has been described as intermittent[2], requiring players to alternate high intensity activities like jumping and sprinting with low intensity movements like walking[3]. It has been established that anaerobic fitness is important for tactical movements (i.e. transitions between defensive/offensive play) and technical actions like shooting, however the 40 minutes that a match lasts require an important contribution by the aerobic metabolism[4], while every position in the game makes different physical demands[5].

Speed and agility are the essential aspects of almost all defensive and offensive movements carried out by basketball players in training sessions and matches[6]. The ability to repeat high intensity sprints interspersed with short recovery periods is considered to be a critical performance factor[7], and testing the athlete's power and aerobic capacity is fundamental in the modern sport[8]. Therefore to be successful, basketball players must develop a high level of physical aptitude and muscular strength appropriate to their role in the team, and also possess optimum body composition.

Study of the anthropometric characteristics and body composition of basketball players plays an important role in the selection process, since they may have a significant impact on performance[9]. Moreover basketball is influenced by body components, which offer a good biomarker for physical capacities[10]. Recent studies have found an association between anthropometric measurements and handgrip strength in basketball players, which would facilitate certain tasks such as gripping and throwing the ball[11-13].

However little data exists comparing the physical capacity and the anthropometrics of players with different skills.

Considering the above, the aim of this study was to evaluate the body composition and physical performance of basketball players as well as determining the influence of athletic performance level (college *vs.* professional).

Material and method

The investigation was a comparative descriptive study with transversal design and a quantitative approach. The sample was intentional and non probabilistic.

Participants

The sample consisted of 2 groups of male Chilean basketball players (n=17) (age: 23.61±3.45). Group 1 (G1) (n=9; age: 22.48±3.79) consisted of college players. Group 2 (G2) (n=8; age: 24.88±2.69) consisted of professional players of the second Chilean division. Both groups participated in basketball competitions in Chile.

The inclusion criteria were: (i) players should have at least 2 years experience in college and/or professional leagues (as appropriate); (ii) aged over 18; (iii) Chilean and; (iv) with no injury of any kind at the time of the physical assessment. Athletes who had not attended training sessions during the previous week were excluded.

The research respected the conditions of the 2013 Helsinki Declaration, and each player signed an informed consent to participation in the investigation.

Procedures

The assessments were carried out in March 2016, in a wooden-floored gymnasium with the regulatory dimensions for professional basketball. The anthropometric evaluations were carried out in one session at 09.00 h, after fasting ≥8 h. They were preceded by a general warm-up lasting 12 minutes, with cardio-respiratory activation, joint mobility, skipping, and changes of rhythm, direction and speed. Body composition was determined using a Biospace Inbody 120 segmental multi-frequency system (Biospace Inc, Japan®). The players stood upright on the machine and the information was obtained through 8 electrodes placed on the feet (metatarsus-calcaneus) and hands (metacarpals of the 2nd-5th finger and phalanx of the thumb). The results produced impedance measurements in 2 different frequencies (20kHz and 100kHz), recording mean values for body water content (L), proteins (Kg), minerals (Kg), body fat mass (Kg), muscle mass (Kg), BMI , % body fat mass, % fat-free mass, % muscle mass.

To assess ball-throwing, a ball weighing 8 pounds was used, brand Assess2Perform (Ballistic Ball™), fitted internally with a wireless accelerometer. The subjects had to lean their backs against a wall with legs at a 90° angle, thus eliminating any function of the trunk. From this position they were asked to throw the ball as far and as fast as possible. The best performance in metres per second (m/s) achieved in the 3 attempts allowed was recorded.

The handgrip strength was determined using a Baseline® dynamometer (±1 kg) (Enterprises Inc. USA). The test protocol consisted of three maximum isometric contractions for 5 s, standing with the arm bent at 90°, with rest periods of 60 s; the best result was recorded. All the athletes used their dominant hand.

Speed over 20 metres was timed using an electronic timing system (Brower Timing System, Salt Lake City, UT). The participants sought maximum possible acceleration. To record the intermediate times, wireless photosensitive cut-out switches were placed every 5 metres. The speed over 20 m with a basketball was also evaluated, using the same protocol and materials described above plus a ball. The players had to achieve maximum speed over 20 metres while dribbling the ball. In each of these tests the players did a familiarisation test and then had three attempts, with the best time being recorded.

To measure jumping capacity and reactive strength a jumping platform was used (AXON JUMP 4.0, Bioengineering Sports, Argentina)[14] for the following standardised tests: Squat Jump (SJ), Countermovement Jump (CMJ), Abalakov, Drop Jump (DJ) from a height of 50 cm. In all the tests the height achieved was recorded, and in the DJ the reactive strength (Q) and the floor contact time (DJ-t) were also measured. In all the jump tests the players did several familiarisation jumps, and were then allowed three attempts with the best result being recorded.

Statistical analysis

The data are presented as mean±standard deviation. The normality of the variables was assessed by the Shapiro-Wilk test. Student's t test

was used for the comparison between the two groups. All these analyses were done with the SPSS programme, version 23.0. The confidence level was 95% (p <0.05).

Results

The mean height of the two groups was similar (p >0.05). The mean body fat of the college players was 16.64±7.07%, whereas the professional players was 19.26±8.20% (p >0.05). The % muscle mass was higher in the college players at 47.59±4.01% v/s 46.26±4.55%, however the difference was not significant (Table 1).

Table 2 shows that there is no significant difference between the groups in ball-throwing speed (p >0.05). In the strength of the dominant hand the college players presented higher values 47.86±12.38 kg v/s 43.68±8.43 kg but the difference was not significant. No significant difference was found in any of the jump tests, expect that in the drop jump test the floor contact time (DJ-t) was shorter and the Q index was higher in the college group, both differences being significant (p<0.05).

Table 3 shows that in the assessment with photoelectric switches for speed while dribbling the ball (CB) the college players reached 5 m in 1.14±0.05 s and covered the 20 m in 3.23±0.10 s, while the professional players reached 5 m in 1.12±0.08 s and covered the 20 m in 3.23±0.15 s. In speed without the ball (SB) the college players reached 5 m in 1.14±0.05 s and covered the 20 m in 3.42±0.14 s, while the professional players reached 5 m in 1.15±0.11 s and covered the 20 m in 3.41±0.20 s. No significant differences between groups were found over any distance, with or without the ball.

Table 1. Results (mean±standard deviation) of anthropometric characteristics and body composition.

Variables	College Players	Professional Players	p-value
Age (years)	22.48±3.79	24.88±2.69	0.159
Height (cm)	179.44±7.97	181.50±8.42	0.613
Weight (Kg)	83.61±14.64	89.73±25.56	0.548
BMI (Kg/m^2)	25.94±3.95	26.94±5.87	0.686
% body fat mass	16.64±7.07	19.26±8.20	0.491
% Muscle mass	47.59±4.01	46.26±4.55	0.531

BMI: Body Mass Index

Table 2. Results (mean±standard deviation) in ball-throwing speed, gripping strength and jumps.

Variables	College players	Professional players	p-value
Ball-throwing (m/s)	5.30±0.83	5.31±1.07	0.982
Hand gripping strength (Kg)	47.86±12.38	43.68±8.43	0.442
CMJ (cm)	36.21±5.45	33.64±5.44	0.971
Abalakov (cm)	41.78±4.38	42.15±5.09	0.873
DJ (cm)	43.10±4.97	43.56±5.59	0.859
DJ-t (ms)	272.05±34.17	43.56±5.59	0.05
Q Index	2.35±0.22	1.43±0.16	0.04

BMI: Body Mass Index SJ: Squat Jump. CMJ: Countermovement Jump. DJ: Drop Jump. DJ-t: Floor Contact Time in Drop Jump.

Table 3. Results (mean±standard deviation) of speed with and without the ball.

Variables	College players	Professional players	p-value
CB 5m (s)	1.14±0.05	1.12±0.08	0.513
CB 10m (s)	1.83±0.17	1.89±0.09	0.444
CB 15m (s)	2.58±0.08	2.58±0.12	0.964
CB 20m (s)	3.23±0.10	3.23±0.15	0.955
SB 5m (s)	1.17±0.09	1.15±0.11	0.513
SB 10m (s)	1.98±0.09	1.95±0.08	0.450
SB 15m (s)	2.71±0.09	2.71±0.14	0.937
SB 20m (s)	3.42±0.14	3.41±0.20	0.849

SB; without ball. CB; with ball.

Discussion

The aim of this study was to evaluate the body composition and physical performance of basketball players as well as determining the influence of athletic performance level (college *vs* professional). No between-groups differences (p >0.05) were found in weight, % fat mass, % muscle mass, ball-throwing speed, handgrip strength, speed and jumping ability. In the vertical jumps associated with the explosive and reactive strength of the lower limbs, the college team presented better results in DJ-t and the Q index.

In the present study, there were no significant differences in height and weight between the college group (179.44 cm and 83.61 Kg) and the professional players (181.50 cm and 89.73 Kg). Nikolaidis *et al*. described anthropometric characteristics and physical condition in different players grouped by age[15]. The elite group, which consisted of 31 players drawn from 3 first division teams, had a mean height of 195.7 cm weight of 95.3 Kg; they were compared with 35 players who had classified in the under-15 group (178.2 cm and 72.4 Kg) and 35 participants aged under 18 (186.1 cm and 79.3 Kg). The under-15 group presented the lowest values when compared to the professionals and the under-18s.

No significant differences were found in % fat mass and % muscle mass. The mean fat mass was 16.64% in the college group and 19.26% in the professional players. The results found are higher than those reported by Zhao *et al.* in elite Chinese players with national and international experience, who presented 14.40% fat mass[16]. U-18 players of the Greek academy presented a mean fat mass of 13.7 kg[17]; in the present study both groups presented a higher fat mass in Kg. Similarly, a study of a sample of Australian players reported 13% and 17.4% fat mass respectively in players occupying backcourt and frontcourt positions[18].

The % muscle mass was higher in the college players (47.59%) than in the professionals (46.26%), although it should be noted that both groups present lower values than those reported in premier league players in Serbia (51.26%)[19].

As for the sprint performance there are no significant differences in any of the measurements of the two groups. These results can be compared to those of previous studies, since they were obtained using very reliable equipment, validated for this type of assessment[20,21]. In particular there is a previous study which compared the speed over 20 metres of team-sport players, showing that there were no significant differences in the test: 16 basketball players presented a performance of 3.14 s while a group of 20 handball players recorded 3.13 s over the same distance; this absence of a significant difference agrees with the results of the present study[22].

However, Köklü reported significant differences in maximum acceleration races when comparing basketball players of different competitive levels; there was even an inverse relation between the speed performance and the competitive level, i.e. players at a lower competitive level may be significantly faster than those competing at the highest level[5]. Other studies by contrast have shown evidence that elite basketball players in different categories, when compared with lower level players, present an association between their high performance and their physiological, morphological and maturity profiles[23,24].Thus studies exist with both positive and negative associations for the correlation between speed performance and competitive level in basketball players.

No significant differences were found in the variables SJ and CMJ when the two groups in the present research were compared. The mean result in the SJ was 33.54 cm in the college group and 34.64 cm in the professionals. These performance results are inferior compared to a young team of 18 players who took part in the Italian national championships and had six years' experience of basketball training; their SJ result was 39.3 cm[25]. They are also lower than those reported by Callejas *et al* in elite Spanish (47 cm) and Japanese players (44.6 cm)[26].

The college group achieved a mean of 36.21 cm in the CMJ, and the professionals 36.36 cm (no statistical significance). These values are lower than reported in a study which compared an elite team with three years' experience at national or international level (56.6 cm) with a college second team (51.6 cm)[27]. Struzik *et al.* propose that the CMJ may be a good measure for determining the jumping capacity of basketball players in jump shots[28]. Although the results of the present investigation are markedly lower than those previously reported[27], the specific nature of training may in the long term alter players' performance in assessments of their strength and power-producing capacity[29].

In the assessment of vertical jumps associated with the explosive and reactive strength of the lower limbs, significant differences were found in the DJ-t, which was longer in the professionals, and the Q index, which was higher in the college group. In both cases the college group obtained better results, while there were no differences in the DJ results. To date there have been few studies which focus on these variables, however earlier research has show that in team sports they have a significant correlation with speed and maximum acceleration capacity[30], as well as degree of neuromuscular fatigue[31] and fitness for sport[32]. Díaz *et al.* reported that in an analysis of the elastic component and the technical component, there were no significant differences between Spanish players classified as professionals and those classified as college. These results differ from the findings of the present study[33].

In the application of the test to assess the action of the arms when executing a vertical jump with countermovement (Abalakov), the groups presented no statistically significant differences; the same finding is reported in the study by Massuca & Fragoso, who separated a group of team sports athletes into 2 sub-groups (successful v/s less successful) and found no significant differences[34]. The vertical jump is prevalent in various technical actions in basketball, such as shooting at the basket and defensive or offensive bouncing; it should therefore be considered an important aspect to develop in the two groups in this study.

Proprioception and motor control influence the mechanics and efficiency of the shot[35], in our study there were no significant differences in the velocity of the Ball-throwing, this may be associated with the level of performance of the players.

The limitations of the study were not to present a larger number of players by their tactical position in the game, so as to complement the study with comparisons by specific position, considering the functions of each team member. In future research it is proposed increase the sample size, incorporating a wider age range and generating a broader profile of the Chilean basketball player for use by trainers, physiologists and physical trainers of the professional and university leagues.

In conclusion, the results of this study indicate that the college and professional players don´t show significative differences in the body composition and variables associated with physical performance. Consequently, it can be inferred that the difference of competitive level between these players is determined by technical variables, as well as by tactical aspects associated to the understanding of game. The results from present investigation can be useful for basketball coach like so professionals and researchers associate to sport sciences and related fields. As a prospective, it seems important to carry out more studies that consider these variables in new contexts, as well as to develop research of this type that also incorporates the analysis of tactical aspects of the players.

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