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Anthropometric and Physical Characteristics of U12-U18 Basketball Players at International and National Level

Anthropometrische und physische Charakteristika von U12-U18-Basketballspielern auf internationaler und nationaler Ebene

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Summary

› **Objective:** To describe the anthropometric and physical fitness parameters of young basketball players aged 12 to 18 years, as well as to assess differences between male and female players across different categories.

› **Methods:** A sample of 126 international and national level players (71 males and 55 females) was evaluated for height, arm span, body mass, body fat percentage, and various physical tests, including vertical jumps, manual grip strength, balance, and reaction time.

› **Results:** The results revealed significant differences between genders, particularly in arm span, jumping ability, and grip strength, where males outperformed females ($p<0.001$). However, no significant differences were found in body mass, body mass index (BMI), or flexibility. The study also found that certain anthropometric and physical traits, such as arm span and grip strength, correlated with on-court performance metrics like points per game and three-point shooting accuracy. These findings contribute to the literature by providing updated reference values for the assessment of young basketball players, which could aid in talent identification and personalized training programs.

› **Conclusion:** Despite its contributions, the study is limited by its cross-sectional design. Future research should explore longitudinal developments and extend the sample to different levels of competition and regions to enhance the generalizability of the findings.

KEY WORDS:
Talent Identification, Young Athletes, Performance, Development

Introduction

Understanding that basketball, in terms of physical needs, is a dynamic and complex sport, which requires a unique combination of physical skills, with explosive movement such as sprinting, stops, changes of direction, accelerations and jumps, to which we must add technical-tactical skills and psychological factors (16). Equally important will be the anthropometric characteristics of athletes (2) generating, with all this, a holistic view of performance and success, being able to affirm that basketball performance responds to multifactorial factors. The control of these parameters will be especially important to improve the possible performance in the game, being explosive strength, jumping power, speed and agility, capabilities that contribute significantly to the effectiveness in both movements with and without the ball, and therefore, can be limiting for all types of players, as well as in the results of the game, such as shooting (9).

On the other hand, in line with recent research, we know that adequate anthropometric values are key in reducing the risk of injury in basketball as we can see in terms of ankle dorsal flexion (1) and asymmetries in dynamic balance tests between one limb and another, which can be significantly associated with non-contact injuries (17), as well as the importance of height, weight and body mass as the main anthropometric characteristics in the search for the profile of basketball players (2).

To associate the motor skills of the players to the physical and anthropometric characteristics, we rely on the results obtained from the competition statistics, thus associating it through quantitative data, being able to think that there is a transfer between the performance in competition and the same, as an example, we could highlight the shooting statistics, understanding as the jump can be determinant in the accuracy of the same coming to determine the winner or loser of the competition (9).

In this way, and based on previous research, we designed a battery of physical tests that are simple to measure in young players and that we consider important to achieve the best results in basketball today (11).

Therefore, this article must focus on describing the results of physical and anthropometric tests ›

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Table 1

Anthropometrics results. Average±SD; BMI=body mass index; cm=centimeters; kg=kilograms; kg/m²=kilograms per square meter.

VARIABLE	ALL (N=126)	MALE (N=71)	FEMALE (N=55)	P VALUE
Age (years)	14.53±1.65	14.72±1.65	14.29±1.65	0.876
Height (cm)	177.09±13.16	183.08±12.88	169.36±8.84	0.4
Wingspan	178.90±14.59	185.77±14.33	170.02±9.17	0.004
Weight (kg)	65.49±15.15	69.04±15.75	60.91±13.11	0.181
Fat percentage (%)	18.08±6.40	13.61±3.94	23.85±3.82	0.874
BMI (kg/m²)	20.61±2.8	20.30±2.69	21.02±2.90	0.77

Table 2

Descriptive data of physical test. Average±SD; AB=Abalakov; cm=centimeters; CMJ=Counter Movement Jump; kg=kilograms; °=degrees; RSA=Repeated Sprint Ability; SJ=>Squat Jump; sec=seconds; Y Balance R12 (cm)=right front dynamic balance; Y Balance L12 (cm)=left front dynamic balance; Y Balance SR=summation right dynamic balance; Y Balance SL=summation left dynamic balance.

VARIABLE	ALL (N=126)	MALE (N=71)	FEMALE (N=55)	P VALUE
SJ (cm)	25.15±6.15	26.96±6.99	22.57±3.36	<0.001
CMJ (cm)	25.97±6.36	27.94±7.07	23.16±3.75	<0.001
AB (cm)	30.15±7.98	32.64±8.78	26.62±4.92	<0.001
Sprint (sec)	3.46±0.28	3.32±0.24	2.65±0.22	0.398
RSA average (sec)	3.36±0.86	3.32±0.72	3.51±1.02	0.183
Sit & Reach (cm)	16.88±8.37	15.19±7.71	19.00±8.75	0.132
Dynamometer (kg)	32.56±9.93	36.92±10.54	26.94±5.21	<0.001
Y Balance R12 (cm)	61.63±7.97	64.04±7.89	58.46±6.96	0.803
Y Balance SR (cm)	258.30±32.06	268.07±35.21	245.46±21.71	0.01
Y Balance L12 (cm)	62.76±8.52	65.77± 8.82	58.89±6.32	0.03
Y Balance SL (cm)	261.03±29.34	273.09±30.27	245.47±19.18	0.001
Right Ankle Rom (°)	44.77±8.77	45.98±4.72	43.21±12.03	0.008
Right Ankle Rom (°)	45.18±8.99	45.88±5.69	44.28±11.99	0.062

in young basketball athletes, in this case international and national level players (12). These results can be crucial for detecting and selecting the best athletic profiles and understanding how they influence performance and outcome in on-court play. Building on previous and recent studies that highlight the importance of assessing the potential of young athletes to predict their future performance (18), we propose that the measurement of physical and anthropometric qualities in a significant sample can serve as a reference to identify potential basketball talent (16). In addition, these measurements can provide practical recommendations for coaches and physical trainers, facilitating the development of talent selection programs and providing parameters to assess deficits and strengths in the abilities of basketball players.

Thus, the objectives of the study were to describe the different reference values for both anthropometric parameters and the different physical abilities of basketball players between 12 and 18 years of age. Likewise, to estimate the differences between the male and female genders, as well as between the different categories. Finally, to describe possible parameters associated with the detection of sports talent in basketball.

Methods

The sample consisted of 126 basketball players between 12 and 18 years of age (14.53±1.65 ages, height 177.09±13.16 cm, weight 65.49±15.15), competing at international (N=14, 6 men players and 8 women players) and national levels (N=112) (12), all participants were recruited from a same club in the Community of Madrid. There were 71 male (14.72±1.65 ages, height 183.08±12.88 cm, weight 69.04±15.75 kg) and 55 female subjects (14.29±1.65 ages, height 169.36±8.84 cm, weight 60.91±13.11 kg). Recruitment and study took place in September 2023. The inclusion criteria required that athletes were federated in their sport, trained at least three times a week in addition to the weekly competition, and had signed informed consent from their legal guardian. The exclusion criteria included any injury that prevented them from performing the planned physical tests and have been federated for less than 4 years.

The selection process began with 150 potential participants, all players from the club's 13 teams between the ages of 12 and 18. However, 24 players were excluded for various reasons: 14 did not provide signed informed consent, and 8 had injuries that

Table 3

Descriptive data on in-game performance. Average±SD; 2PM=2-points field goals made per game; 3PM=3-points field goals made per game; 2P%=2-point field goal percentage; 3P%=3-point field goal percentage; AST=average assists per game; FTM=average free throws made per game; FT%=free throw percentage; GP=games played; MIN=average minutes per game; PTS=average points per game; REB=average rebounds per game.

VARIABLE	ALL (N=126)	MALE (N=71)	FEMALE (N=55)	P VALUE
GP	21.53±3.92	22.25±3.43	20.61±4.32	0.574
MIN	17.31±2.57	17.40±2.42	17.19±3.15	0.364
PTS	6.59±3.48	7.47±3.79	5.47±2.68	0.008
FTM	0.99±0.75	1.08±0.84	0.88±0.59	0.011
FT%	53.54±14.40	56.23±15.50	50.11±12.17	0.205
2PM	2.07±1.15	2.22±1.23	1.88±1.02	0.241
2P%	81.07±22.56	81.67±21.69	80±24.38	0.282
3PM	0.52±0.49	0.65±0.56	0.35±0.32	<0.001
3P%	62.87±36.24	63.56±36.67	61.63±36.04	0.877
REB	1.05±1.28	1.02±1.36	1.13±1.06	0.206
AST	0.41±0.58	0.39±0.57	0.46±0.6	0.469
Assessment	5.51±3.75	6.36±3.97	3.97±2.76	0.031

prevented them from completing the physical evaluations. The sample was selected based on accessibility and convenience.

Before commencing the study, all subjects involved in the study, trainers and mothers/parents/guardians were informed about protocols and the potential risks and benefits of the study. A written informed consent form was informed written consent prior to participation. The study protocol was approved by the Hospital Clínico San Carlos Ethics Committee (23/415-E) and conformed to the Declaration of Helsinki.

Instruments and Methodology

For the development of the tests and data collection, anthropometric measurements were taken, and pre-season physical tests were planned. The data collection protocol was carried out in a single session without interfering with the team's training. The protocol employed followed an observational methodology. Before performing the physical tests, anthropometric values were measured with the participants barefoot; subsequently, the data collection of the physical tests was carried out; before these, the warm-up established by the research team was performed (4).

Anthropometric Evaluation

Height, wingspan, body mass and fat percentage were measured. Height was measured with a precision stadiometer with a scale of 0.001 m (SECA GmbH & Co. KG, Hamburg, Germany), wingspan was measured standing in front of a wall, with both arms extended in the frontal plane with a Lufkin measuring tape model W606PM and body mass and fat percentage were measured with the Body Compositional Analyzer Tanita MC-780MA-N (Tanita Corporation, Tokyo, Japan).

Evaluation of Physical Tests

First, dynamic balance measurements (17) were performed with the Y-Balance Test (YBT, Move2Perform, Evansville, IN). To measure dorsal flexion of the tibiotalar joint (ROM), the Weight-Bearing Lunge Test (WBLT) was performed by assessing the anterior displacement of the tibia over the talus in a loaded situation (3). To evaluate the flexibility of the hamstrings and lower back, the Sit & Reach test (14) was used through the sit & reach bench (Eveque, UK). Maximal manual grip strength was assessed using a TKK5401 Grip-D mechanical dynamometer (Takei, Tokyo, Japan) with the dominant arm in full extension and slightly separated from the body. The Bosco vertical jump Squat Jump (SJ), Countermovement Jump (CMJ) and Abalakov (AB) test were performed through the jumping platform Chronojump (Chronojump Bosco System, Barcelona, Spain) (7). Finally, Repeated Sprint Ability (RSA) measurement is carried out in 5x20 m with 30 seconds recovery between each series and the 20 m sprint (13) using the Witty Microgate tool (Microgate, Bolzano, Italy).

Collection of In-Game Performance Variables

The performance variables for the 23-24 season were collected using the Boxscore after prior training of the data takers with experts and checking the statistics collected with the application used by the Madrid Basketball Federation (Swish). Knowing that the reliability and credibility of the data in the analysis of sports performance depend on the consistency and validity of the measurements, we assume that the coefficient of agreement between observers in the statistical values is high as indicated by previously conducted studies (6). The variables analyzed were games played (GP), average minutes per game played (MIN), average points per game (PTS), average free throws made per game (FTM), 2-points field goals made per game (2PM), 3-points field goals made per game (3PM), free throw percentage (FT%), 2-point field goal percentage 2P%) and 3-point field goal percentage (3P%), as well as average rebounds per game (REB) and average assists per game (AST) and finally the average rating of each player, understood as the sum of (Points + Rebounds + Assists + Steals + Stops + Stops + Fouls Received) minus (Missed field goals + Missed free throws + Losses + Stops + Received + Fouls Made).

The statistical package SSPS v26.0 (Inc., Chicago, IL, USA) was used for data analysis. Means and standard deviations were calculated, as well as the correlation between the following parameters: anthropometric parameters and on-court ›

Table 4

Correlation between anthropometry and performance on the court. *p<0,05; **p<0,001. 2PM=2-points field goals made per game; 3PM=3-points field goals made per game; 2P%=2-point field goal percentage; 3P%=3-point field goal percentage; AST=average assists per game; BMI=body mass index; FTM=average free throws made per game; FT%=free throw percentage; GP=games played; MIN=average minutes per game; PTS=average points per game; REB=average rebounds per game.

VARIABA2:M2	GP	MIN	PTS	FTM	2PM	3PM	REB	AST	ASSESS-MENT	FT%	2P%	3P%
Age	-0.045	-0.076	0.11	0.049	-0.0135	0.239*	0.461**	0.481**	0.11	0.281*	-0.052**	-0.274**
Height	0.041	0.309*	0.309	0.151	0.234*	0.262*	0.244*	0.144	0.320*	0.163	-0.15	-0.127
Wing-spam	0.091	0.089	0.340**	0.165	0.265*	0.289*	0.223	0.142	0.375**	0.16	-0.129	-0.1112
Weight	-0.042	0.074	0.337**	0.218*	0.287*	0.231*	0.249*	0.155	0.338*	0.165	-0.103	-0.199
BMI	-0.109	0.095	0.249	0.223*	0.253*	0.105	0.179	0.134	0.215*	0.097	-0.033	-0.178
% Fat	-0.198*	0.029	-0.129	-0.025	0.02	-0.259*	0.049	-0.004	-0.167	-0.186*	0.102	-0.09

performance, reaction speed and on-court performance, physical tests and on-court performance and finally the correlation between anthropometric values and physical tests.

Results

The anthropometric data obtained is found in table 1 we can observe the average data of the participants in age, height, wingspan, weight, fat percentage and body mass index. In this we can see that the null hypothesis is fulfilled between male and female in all cases except in the case of wingspan. When comparing the male and female group no significant differences are found, except in wingspan with a p-value ≤.04.

Regarding the analysis of each of the variables separately, we can see in table 2 the descriptive data of the variables with normal distribution with mean and standard deviation, as well as the differentiation by sex for each of them. Standing out among them the jump tests (SJ, CMJ and AB) and manual dynamometry, all of them with a value p≤.001, as well as the right summative Y Balance, left frontal Y Balance, left summative Y Balance and dorsal flexion of the right foot with a value p≤.05.

In table 3 we can observe the descriptive data of in-game performance, significant the values found in mean 3PM scored per game with a value p≤.001, as well as points per game, mean FTM scored per game and valuation having a value p≤.05.

Regarding the correlation of the different variables of anthropometry and the performance of the players on court, we have not found a great correlation between them, although we can see some values with great significance between them (<.001), it is worth highlighting the correlation between age and REB 0.461 (<.001); AST 0.481 (<.001); 2P% -0.052 (<.001) and 3P% -0.274 (<.001). Also noteworthy is the significance between wingspan and PTS 0.340 (<.001) and the correlation between weight and PTS 0.337 (<.001), as shown in table 4.

Discussion

In the present study, the anthropometric characteristics and physical abilities of 126 young basketball players of national and international level between 12 and 18 years old were analyzed, showing significant differences in several parameters between male and female genders, highlighting especially in wingspan, explosive physical abilities such as jumps (SJ, CMJ and AB) and manual grip strength. With this, we see reinforced the importance of these capabilities in current sports performance, particularly in physical skills of more anaerobic component, as well as technical qualities (16).

Anthropometric data revealed that, although there were no significant differences in weight, body mass index (BMI) and height, wingspan presented a significant difference (p<.004) between males and females; male players showed a larger average wingspan (185.77±14.33 cm) than female players (170.02±9.17 cm), which may imply advantage in skills such as rebounding, shooting height and defense in line with research by Androutsopoulos et al. (2).

As for the physical tests, male players significantly outperformed female players in the vertical jump tests (SJ, CMJ and AB), with significant differences in all tests (p<.001). For example, in the Squat Jump, male players achieved an average height of 26.96±6.99 cm, compared to 22.57±3.36 cm for female players (8). This leads us to assess the importance of jumping ability in competitive performance, as it is associated with key basketball actions such as shooting and rebounding (10).

In addition, in manual grip strength, measured with dynamometer, male players also obtained significantly higher results than female players (36.92±10.54 kg vs. 26.94±5.21 kg, p<.001), being likely that this difference may indicate a greater overall strength in males, influencing aspects such as ball protection, blocking or confrontations under the hoop (6).

Finally, correlations between anthropometric data and on-court performance revealed that wingspan and weight were positively correlated with PTS, while BMI and body fat percentage did not show a significant correlation with in-game performance (13). In addition, some physical abilities, such as hand grip strength and jumping (SJ), were also positively correlated with performance, suggesting that these physical qualities may be key factors for success in basketball.

In line with previous research by (2), in which height, weight and muscle mass were the main anthropometric characteristics when separating basketball players by positions, we also found that wingspan is a factor with some relevance in the performance of basketball players, especially in the male group. Similarly, this finding is also in line with the research of Gur et al. (10) who highlight the positive relationship between vertical jump performance and shooting in competition. While it is true that the correlation found in our sample is not significant, it does lead us to believe that the greater the wingspan and the greater the vertical jump, the greater the probability of success of the players during the game.

Similarly, we can think that in terms of physical abilities, players who have better results in explosive abilities, either jumping and sprinting and better reaction times have greater success in the face of the game and success in the same shot success (10).

Table 5

Correlation between physical and performance.*p<0,05; **p<0,001. 2PM=2-points field goals made per game; 3PM=3-points field goals made per game; 2P%=2-point field goal percentage; 3P%=3-point field goal percentage; AB=Abalakov; AST=average assists per game; cm, centimeters; CMJ=Counter Movement Jump; FTM=average free throws made per game; FT%=free throw percentage; GP=games played; kg=kilograms; MIN=average minutes per game; PTS=average points per game; REB=average rebounds per game; RSA=Repeated Sprint Ability; SJ=Squat Jump; sec=seconds; Y Balance R12 (cm)=right front dynamic balance; Y Balance L12 (cm)=left front dynamic balance; Y Balance SR=summation right dynamic balance; Y Balance SL=summation left dynamic balance; °=degrees.

VARIABLE	GP	MIN	PTS	FTM	2PM	3PM	REB	AST	ASSESS-MENT	FT%	2P%	3P%
YB Right 12	0.006	-0.056	0.08	-0.064	0.084	0.147	-0.075	-0.073	0.041	0.029	0.064	0.059
Summation YB Right	-0.01	0.02	0.176	0.086	0.155	0.188*	0.023	0.034	0.227*	0.147	-0.039	0.107
YB Left 12	0.074	-0.01	0.078	-0.097	0.061	0.201*	-0.13	-0.117	0.088	-0.029	0.108	0.148
Summation YB Left	0.064	0.099	0.249*	0.087	0.210*	0.259*	0.06	0.058	0.331*	0.099	-0.008	0.109
Dynamometer	0	0.123	0.342**	0.153	0.270*	0.298*	0.043	0.047	0.301*	0.145	-0.044	-0.044
Sit & Reach	-0.034	0.115	0.016	0.063	0.065	0.027	0.027	0.072	0.099	-0.009	0.035	0.104
Sprint 20 m	-0.049	-0.039	-0.234*	-0.086	-0.091	-0.312*	-0.082	-0.103	-0.243*	-0.151	0.157	-0.04
SJ	0.028	0.149	0.224*	0.136	0.151	0.187*	0.027	0.076	0.197	0.138	-0.069	0.042
CMJ	-0.015	0.04	0.142	0.02	0.061	0.17	0.154	0.168	0.152	0.190*	-0.174	-0.064
AB	0.019	0.088	0.183*	0.07	0.096	0.176	0.141	0.148	0.218	0.166	-0.142	-0.046
Right ankle rom	0.224*	0.069	0.139	0.117	0.082	0.116	0.088	0.069	0.226*	0.048	-0.1	-0.148
Left ankle rom	0.226*	0.044	0.1	0.082	0.058	0.102	0.061	0.091	0.205	-0.011	-0.105	-0.161
RSA (5x20m)	0.172	0.069	-0.044	0.015	0.036	-0.13	-0.035	0.036	-0.002	-0.134	0.009	-0.131

We can add that the result of our study is in line with the findings studies by Covic et al. (5) and Guimarães et al. (9), although it is true that all of them do not have access to a sample as extensive as ours. Similarly, we can understand that our sample should progress in their abilities throughout their growth, reaching normative values of performance (15). Notably, no strong or very strong correlation was identified between explosive physical attributes and on-court performance.

The results obtained in this study highlight the importance of developing training programs adapted to the specific anthropometric and physical characteristics of young basketball players. For example, the significant difference in wingspan and jumping tests between male and female players underlines the need to design training that optimizes jumping ability and explosiveness, especially in female players, to improve their performance in key actions such as rebounding and shooting.

For coaches, these measurements allow identifying strengths and areas of improvement in players, contributing to better talent selection and more effective training planning, which can maximize the potential of young players in future competitions.

Limitations

A comprehensive development of the various physical capabilities in this type of sample is essential for ensuring a balanced progression across physical, cognitive, and emotional domains. However, in the limitations we found in the present study, we believe that a longitudinal evaluation would allow us to correctly analyze the evolution of these parameters and their true relevance. Similarly, it would be interesting to extend the sample to different regions to obtain more generalized data.

As for Future Research

To enhance the study's statistical power, a larger sample size would be required to differentiate more distinct profiles and enable comparisons with other populations and sports. It would be advisable to conduct longitudinal studies examining the evolution of these parameters, as well as the relationship with long-term success in basketball. It would also be interesting to investigate the possible impact of other factors such as specific training on the performance of young players.

As a possible limitation, we found a possible selection bias arises from the fact that only federated players were included, which could limit the generalizability of the results to non-federated athletes or those with less training load. In addition, given that all participants were selected from a single club, factors such as training style, methodologies applied by coaches, and club-specific selection criteria could have influenced the results, potentially limiting external validity.

Conclusions

The study described the anthropometric characteristics and physical abilities of young basketball players from 12 to 18 years of age from a national reference club at the international and national level, as well as the differences between gender and categories. Finally, we can understand that the said characteristics lead us to the achievement of the objectives in sports and, therefore, to interpret that player with such values can be considered more talented (18). The results showed that while no significant differences were observed between genders in anthropometric variables such as weight or BMI, significant differences were found in wingspan and physical performance measures. Specifically, notable dif- ›

ferences were observed in the jumping tests and manual grip strength, with male participants exhibiting higher values in these parameters.

The main contribution of this study to the existing literature may lie in the fact that it provides updated and specific information on a very relevant sample of international and national level players, as indicated by the classification of Mckay et al. (12), which can be used as a reference for future research and the detection of sporting talent in basketball in young people. In addition, the analysis of the correlations between physical abilities and on-court performance offers valuable information for coaches and physical trainers in the planning of personalized training, both by gender and by the needs of each player.

Summary Box

The research analyzes the anthropometric and physical traits of young basketball players aged 12 to 18. Significant differences were found between male and female players in arm span, jumping ability, and grip strength. These findings aid in talent identification and personalized training, with future studies needed for broader generalization.

Conflict of Interest

The authors have no conflict of interest.

Ethics Approval

The study was reviewed and approved by the Hospital Clínico San Carlos C.I. 23/415-E.

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