Evaluation of anthropometric and nutritional assessment of basketball players

Antonio J. Zamora[1], María L. Belmonte[2]

[1]Güel Centro de wellness. Murcia. [2]Universidad de Murcia.

Received: 16/08/2019
Accepted: 13/03/2020

Summary

Introduction: The aim of this study is to assess the nutritional status and measurement of body composition of basketball players from four teams of Valencia, three of them belonging to First National League and one belonging to the EBA League, in order to establish adequate dietary guidelines and anthropometric ideals.
Material and method: This is a study whose sample includes 17 men and 15 women. They were measured using the ISAK criteria, while intake was assessed by 3-days 24-hours food questionnaire.
Results: Significant differences ($p < 0.05$) were found in men by playing position in relaxed and flexed arm perimeters between centers and forwards, and height between guards and forwards, and guards and centers. Whereas in women there were significant differences ($p < 0.05$) in the wrist of guards and shooting guards, and shooting guards and forwards, also in the femur of shooting guards and center and height between guards and centers, and guards and shooting guards. No significant differences were found for somatotype. Statistically significant differences in the iron and fiber consumption between men and women were found. There were also statistically significant differences in fluid intake and training session time. Dietary intake was characterized by high fat and carbohydrates and protein moderate, with deficits in vitamin A, D, folic acid, calcium, zinc and magnesium for both genders. Women showed a specific deficit in iron. Furthermore, only 17.6% of men and 6.7% of women drank isotonic drinks during high intensity training, so the remaining players could worsen performance.
Conclusion: In order to enhance performance, a balanced diet which meets the physiological demands of the game could overcome these deficits.

Key words:
Anthropometry. Nutritional status. Diet. Basketball.

Evaluación antropométrica y nutricional de jugadores de baloncesto

Resumen

Introducción: El objetivo de este estudio es valorar el estado nutricional y medición de la composición corporal de jugadores de baloncesto pertenecientes a cuatro equipos de Valencia, tres de ellos pertenecientes a Liga Primera Nacional y uno perteneciente a la Liga EBA, con el fin de establecer unas pautas dietéticas apropiadas y unos ideales antropométricos.
Material y método: Se trata de un estudio cuya muestra está formada por 17 hombres y 15 mujeres, que fueron medidos siguiendo los criterios del ISAK, y cuya ingesta fue valorada mediante recuerdos 24-horas de alimentos durante 3 días alternos.
Resultados: Se encontraron diferencias significativas ($p<0.05$) en los hombres según la posición de juego en los perímetros de brazo relajado y flexionado entre aleros y pívots, y la talla entre bases y aleros, y bases y pívots. Mientras que en mujeres existieron diferencias significativas ($p<0.05$) en la muñeca de escoltas y bases, y escoltas y alteros, en el fémur de escoltas y pívots y la talla entre bases y pívots, y bases y escoltas. En cuanto al somatotipo, no se encontraron diferencias significativas. Respecto a la dieta, se encontraron diferencias estadísticamente significativas en el consumo de hierro y fibra entre hombres y mujeres. Y en el consumo de líquidos y el tiempo que duraba la sesión de entrenamiento. La ingesta dietética se caracterizaba por ser alta en grasas y moderada en carbohidratos y proteína, con déficits en vitamina A, D, ácido fólico, calcio, cinc y magnesio para ambos sexos. Las mujeres mostraron un déficit específico en hierro. Además, sólo el 17.6% de los hombres y 6.7% de las mujeres tomaban bebidas isotónicas durante el entrenamiento de alta intensidad, por lo que los restantes jugadores podrían empeorar el rendimiento.
Conclusión: Es por ello, que una dieta equilibrada a las demandas fisiológicas del juego podría solventar estos déficits y aumentar el rendimiento.

Palabras clave:
Antropometría. Estado nutricional. Dieta. Baloncesto.

Correspondence: María L. Belmonte
E-mail: marialuisa.belmonte@um.es

Introduction

Basketball is a sport in which, a combination of ability to hit, speed of movement, defensive capacity and strength with a high level of physical and technical-tactical demand takes place[1]. This sport requires a high demand of aerobic metabolism that would provide the energy required to maintain the effort during the game time, while anaerobic metabolism would serve to perform the most demanding game actions, therefore, it is the predominant metabolism in the positions with less mobility.

There are studie[2-5] in which there have been differences in anthropometric variables, body composition and somatotype of players of different sports, and even differences between athletes of the same sport according to his role in the team. specifically, in basketball, depending on the position, having shown that there is variability among athletes who practice team sports, depending on the area or position in which they play[6], there are guards, shooting guards, strikers and centers, each of them with specific anthropometric and somatotype characteristics to achieve athletic success.

In basketball, anthropometric characteristics are decisive in sports performance[7]. The kinanthropometry allows the study of the body composition using a minimally invasive method by the sum of skinfolds and corrected perimeters[8].

Establish an adequate nutrition procedure and hydration strategies are critical to success nutrition interventions, because an inadequate nutrition can impair physical performance and health in athletes. Court team sports are characterized by intermittent activity with a big requirement of dietary carbohydrate sources to maintain and replenish glycogen, so inadequate carbohydrate consumption can lead to overtraining[9]. Athletes who perform high intensity exercise do best on a diet rich in carbohydrates with a recommended amount depending on the intensity and duration of the training[10]. Moreover, micronutrients can impact on the exercise capacity and performance when intakes are less than recommendations some functional impairments occur[11]. Maintaining a correct energy balance and a nutrient dense diet with a proper training and rest are the keys to enhance performance[12]. With the purpose to optimize performance and promote healthy habits in basketball players a well-designed nutritional intervention is necessary[13].

Therefore, the aim of this study was to examine body composition differences by position and sex and assess nutritional status in male and female basketball players in order to improve their physical performance.

Material and method

A cross-sectional descriptive study of 32 male and female basketball players of Spanish lower leagues was completed. Inclusion criteria were: men and women over 18 years, not currently injured.

Height, weight, skinfolds and corporal diameters and circumferences were measured according to the International Society for the Advancement of Kinanthropometry (ISAK) criteria. Using an OMROM BF 5-11 weigh scale, a Tanita Leicester stadiometer, a CESCORF bicondylar caliper, a CESCORF Skinfold caliper and a 1.5m flexible tape.

Data about macronutrient and micronutrient intakes of each person in this study were collected using 24-hour dietary recall and food frequency intakes.

A questionnaire about lifestyle habits related to nutrition and intensity of exercise was conducted in order to calculate the total expenditure waste of each athlete. Data were collected in the form of questionnaires about sex, age, player position, training intensity, rest in sport and general lifestyle habits in order to define the study population. Both dietary questionnaires were processed by the EasyDiet Program, which is a software for design and analysis of diets, based on Spanish food composition tables and recommendations.

Patients were informed of the purpose, conditions, procedures and time schedule, accepting voluntarily participate in the study. They all signed an informed consent approved by the Ethics Committee of the University of Valencia, in order to apply the principle of patient autonomy.

In this paper, all population data were collected in Microsoft Excel 2010, and exported to SPSS version 21.0 (SPSS Inc., Chicago, IL, USA) for statistical analysis.

In order to study the characteristics of basketball players with different sex, the study population was divided into two groups: male and female players. For anthropometric valuation, every gender group was subdivided into four subgroups according to their position on the court: guards, shooting guards, forwards and centers.

The mean, standard deviation and percentages of the total population and the sample size defined by sex were calculated for all descriptive and frequency variables under study.

According to normality and homocedasticity criteria Student's *t*-test or Mann- Whitney U test were used to determine statistically significant differences between populations divided by gender respecting to the sociodemographic characteristics of the population (age, sex, exercise intensity, etc.), anthropometric (Body Mass Index, waist- hip ratio, body fat, body mass, etc.), total waste expenditure, macronutrients and micronutrients intake, and percentage of these that meet the nutritional requirements for Spanish population.

The association between qualitative variables of the two populations with different sex (sociodemographic characteristics of the population) and somatotype were determined using the Chi-square test of Pearson.

Results

Sociodemographic characteristics of total population

We can see sociodemographic data of basketball players by sex (Table 1).

Anthropometry

Table 2 shows the anthropometric differences between basketball players by sex and court position. The only one anthropometric variable with significant differences ($p<0.05$) in men by playing position were relaxed and flexed arm between forwards and centers and the height between guards and forwards, and guards and centers. On the other hand, there were found some significant differences ($p<0.05$) for women by court position in wrist diameter between shooting guards and guards, and between shooting guards and forwards. Moreover, femur

diameter between shooting guards and centers had significant differences and height between guards and centers, and between guards and shooting guards.

Table 1. Sociodemographic data of basketball players by sex.

	Male players	Female players
Total population (%)	53.1%	46.9%
Age (medium ±SD)	21.3±3.2	22.1±3.1
Basketball team (%)		
Valencia basket male	41.2%	0%
Nacional paterna	58.8%	0%
Valencia basket female	0%	66.7%
El Pilar	0%	33.3%
Court position (%)		
Guard	11.8%	20.0%
Shooting guard	17.6%	13.3%
Forward	29.4%	40.0%
Center	41.2%	26.7%

SD: Standard deviation.

For somatotype components, no significant differences were found by position in endomorphy, mesomorphy or ectomorphy. The somatochart by court position of male player can be observed in Figure 1 and the somatochart of female player can be observed in Figure 2.

Nutritional status assessment

There were no statistically significant differences in thee intake of any parameter by court position. There were significant differences by sex in the percentages of the daily recommended intake of iron and fiber. In the macronutrients analysis, male players consumed 2.7±0.8 gr•kg^{-1}•day of carbohydrates while protein intake was 1.4±0.4 gr•kg^{-1}•day. For female players, carbohydrate intake were 1.4±0.4 gr•kg^{-1}•day, while protein were 1.4±0.5 gr•kg^{-1}•day. Table 3 shows the average values obtained from the 24 hours food intake recall questionnaires. Figure 3 shows the macronutrients distribution in male basketball players. This distribution also can be seen in Figure 4 for female players. Table 4 shows the percentage of people who meet the daily nutritional requirements according to the daily recommended intake.

Table 2. Anthropometric data of basketball players by sex and court position.

	Male players							
	Guard	S. Guard	Forward	Center	Guard	S. Guard	Forward	Center
Weight (kg)	87.5±1.6	93.1±18.9	85.6±4.0	96.0±9.0	69.9±12.2	63.1±4.2	69.0±2.8	70.1±4.2
Height (cm)	179±0.1	189±0.1	193±0.1	195±0.1	168±0.1	171±0.1	175±0.1	180±0.1
Arm circumference (cm)	32.0±0.8	32.8±4.2	30.8±0.6	34.7±2.1	29.0±5.2	27.0±2.1	28.0±1.6	27.4±0.8
Flexed arm circumference (cm)	34.0±1.7	34.9±5.2	32.7±1.2	37.1±1.8	28.9±4.7	26.9±1.7	28.6±1.3	27.9±0.7
Waist circumference (cm)	87.6±0.7	85.1±6.6	76.2±10.5	86.2±4.7	76.1±8.0	70.7±6.8	74.8±3.0	72.0±2.3
Hip circumference (cm)	103.4±1.6	107.7±10.7	100.4±2.5	106.1±4.7	103.4±7.9	100.0±1.0	101.9±3.3	104.1±3.4
Thigh circumference (cm)	60.8±4.9	60.0±3.5	57.2±2.8	65.8±11.1	60.5±6.2	55.7±3.5	57.4±2.6	58.0±1.9
Leg circumference (cm)	42.4±1.5	37.3±2.5	38.9±1.9	40.6±3.1	37.2±1.2	34.7±0.9	36.4±2.4	36.4±1.4
Subescapular skinfold (mm)	11.1±0.2	12.4±4.6	9.4±2.5	10.3±4.3	10.9±4.0	10.9±3.3	11.7±2.5	9.6±2.1
Tricipital skinfold (mm)	12.7±1.7	13.9±2.0	9.9±3.9	12.2±5.6	14.9±7.2	14.2±4.6	16.7±4.6	18.6±3.0
Bicipital skinfold (mm)	5.1±0.5	7±0.9	3.7±1.6	5.6±3.0	8.9±6.8	6.7±3.5	7.9±2.2	5.9±0.3
Ileocrestal skinfold (mm)	20±1.7	15.1±3.2	12.2±3.9	16.0±6.8	17.6±4.9	18.7±8.5	18.3±4.4	14.4±1.0
Supraespinal skinfold (mm)	13±1.7	11.9±1.9	7.8±2.5	12.9±6.9	17.5±9.4	12.0±5.3	13.7±3.3	12.2±2.3
Abdominal skinfold (mm)	23.7±8.8	22.1±4.5	13.4±4.7	23.2±7.6	23.7±11.0	20.0±7.8	24.7±8.6	20.7±3.9
Anterior thigh skinfold (mm)	15.1±1.9	19.2±7.9	13.0±4.9	16.4±6.2	28.9±4.7	25.6±6.9	24.9±4.9	26.8±3.3
Leg skinfold (mm)	10.2±2.8	12.1±4.5	7.4±2.0	8.0±4.1	16.0±5.3	12.5±8.5	15.2±7.8	16.5±2.0
Femur diameter (cm)	10.1±0.1	10.3±0.7	10.3±0.3	10.3±0.2	9.3±0.3	8.5±0.7	9.2±0.3	9.4±0.1
Wrist diameter (cm)	6.1±0.2	6.1±0.6	6.2±0.2	6.1±0.1	5.4±0.2	4.9±0.1	5.3±0.1	5.2±0.1
Endomorphy	3.6±0.1	3.5±0.4	2.4±0.9	3.1±1.4	4.3±1.7	3.7±1.4	4.1±0.9	3.9±0.4
Mesomorphy	5.5±0.5	3.8±2.0	3.5±0.4	4.2±1.1	3.6±0.6	2.2±0.9	2.4±0.9	2.3±0.1
Ectomorphy	1.0±0.1	2.2±1.6	3.6±0.8	2.7±1.1	1.5±1.0	2.9±1.5	2.8±0.6	3.3±0.2
Muscle mass (%)	36.3	39.4	43.6	41.5	36.7	37.1	37.7	36.7
Bone mass (%)	15	15.8	17.7	15.9	14.9	14.8	15.7	16.0
Fat mass (%)	17.7	23.7	12.2	17.0	21.6	19.0	20.7	19.0
Residual mass (%)	22.6	23.7	26.5	25.6	26.7	29.1	25.8	28.3

Figure 1. Somatochart in male basketball players by position.

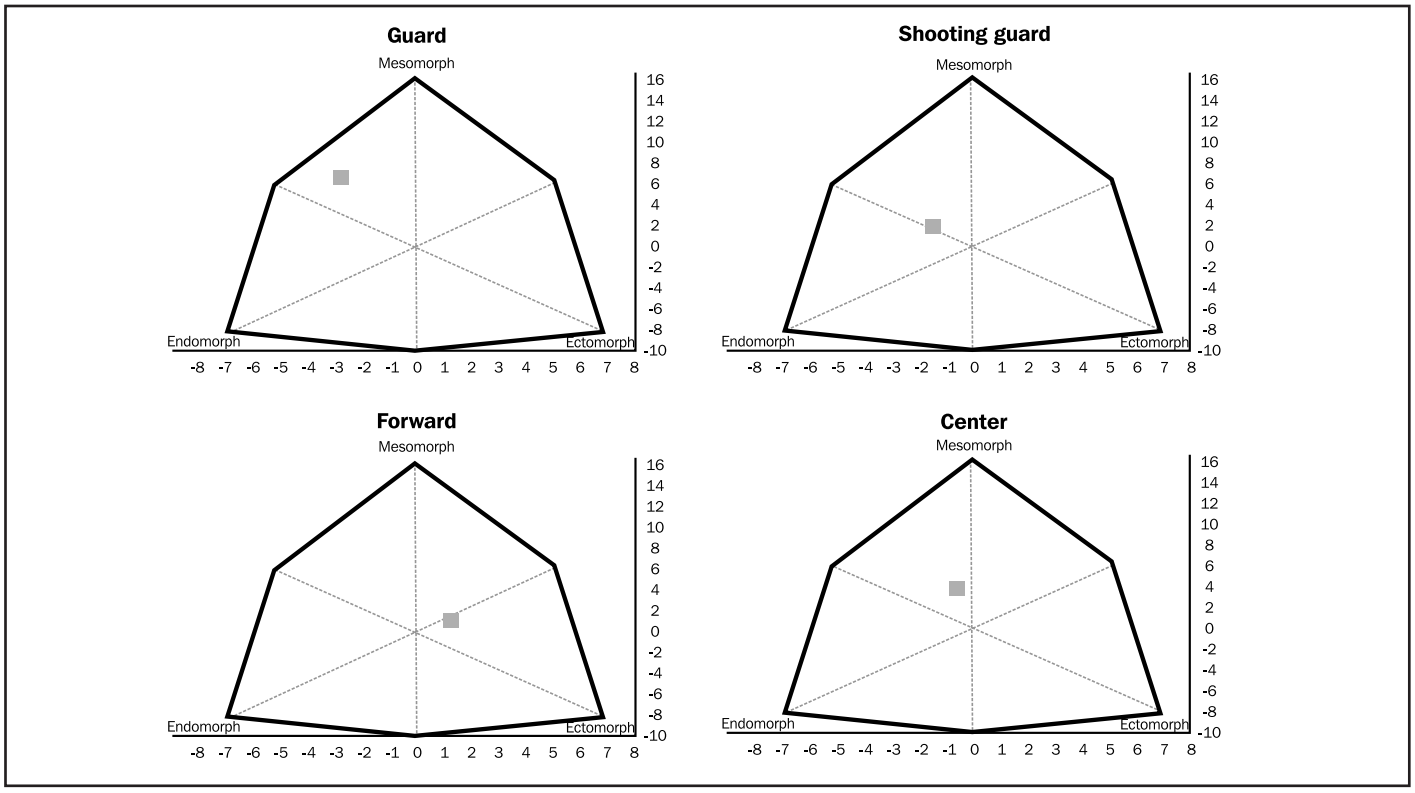

Figure 2. Somatochart in female basketball players by position.

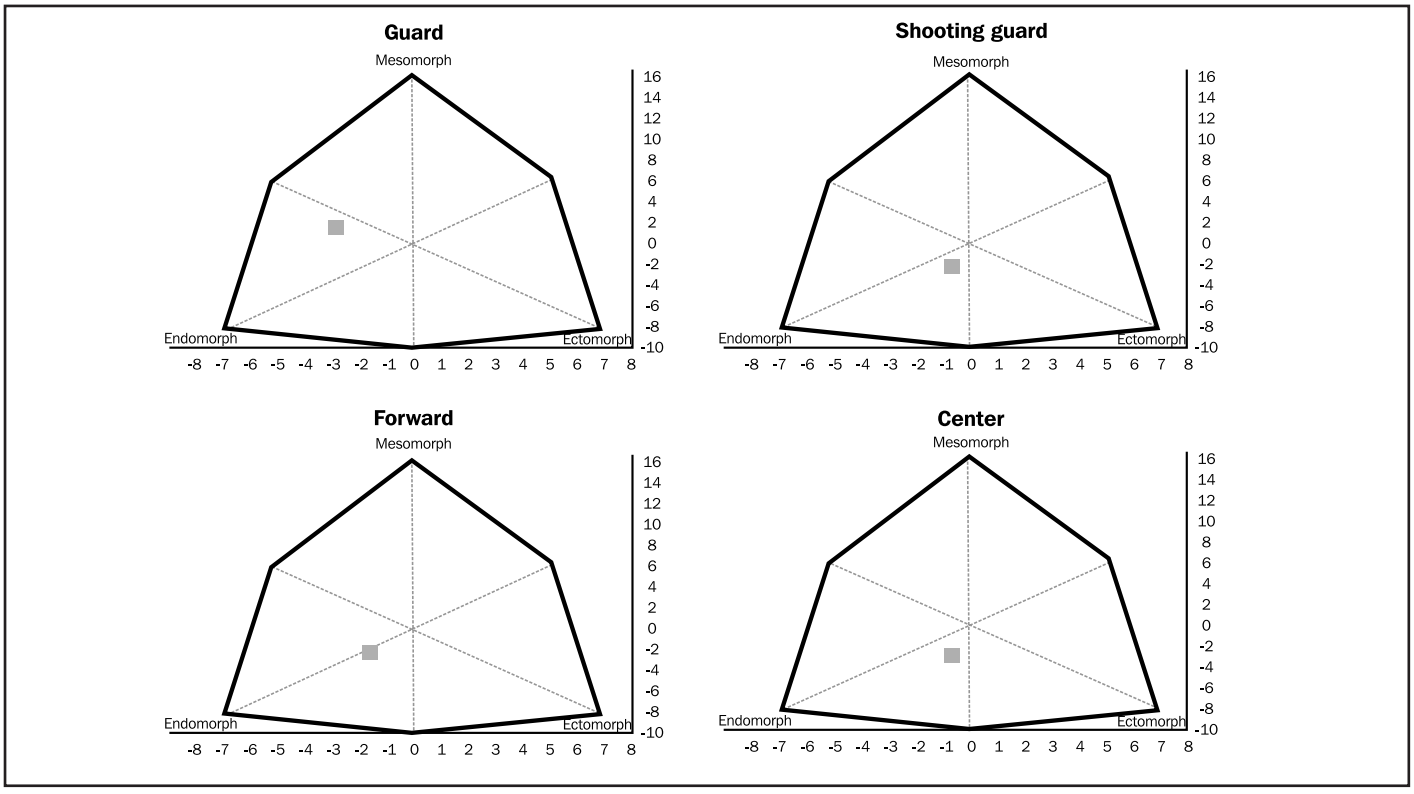

Table 3. Macronutrients and micronutrients intake obtained by 24-hours recall and percentage of the dietary recommended intake.

	Male players			Female players		
	Medium	SD	DRI percentage	Medium	SD	DRI percentage
Energy (kcal)	2313.8	380.0	73.8	1973.9	612.7	82.3
Protein (gr)	122.8	27.5	76.4	99.2	30.3	78.8
Folic acid (µg)	354.3	173.7	88.6	297.4	120.2	74.4
Monounsaturated fatty acids (gr)	43.1	9.8	168.9	41.6	14.4	190.1
Polyunsaturated fatty acids (gr)	12.1	0.7	47.0	14.3	11.4	59.6
Saturated fatty acids (gr)	27.6	8.6	133.6	24.7	12.3	138.1
Calcium (mg)	864.8	289.7	78.1	781.1	248.7	64.0
Cinc (mg)	12.4	4.1	83.0	10.1	3.4	84.2
Fiber (gr)	29.8	11.1	99.4	21.5	8.7	71.7
Phosphore (mg)	1752.7	496.5	203.5	1382.8	408.4	186.8
Carbohydrates (gr)	249.2	55.1	55.7	193.8	69.1	56.8
Iron (mg)	16.3	6.1	151.2	12.7	4.1	84.9
Fats (gr)	90.4	19.9		88.7	39.5	
Magnesium (mg)	395.0	142.2	98.7	295.0	96.0	83.6
Niacine (mg)	37.3	14.4	201.9	24.0	9.5	160.0
Potasium (mg)	3733.7	966.5	124.4	3105.3	997.2	103.5
Sodium (mg)	3032.2	950.3	202.1	1981.0	795.6	132.1
Vitamine A (µg)	852.9	414.1	85.3	784.5	552.6	98.1
Vitamine B1 (mg)	2.0	0.9	165.7	1.5	0.9	140.2
Vitamine B12 (µg)	8.7	4.0	361.3	6.6	5.0	273.9
Vitamine B2 (mg)	2.1	1.0	126.5	1.9	0.6	152.3
Vitamine B6 (mg)	3.0	1.1	199.2	2.1	0.9	160.0
Vitamine C (mg)	111.0	65.9	185.1	114.2	65.1	190.3
Vitamine D (µg)	3.4	3.0	68.3	1.7	1.2	33.1
Vitamine E (µg)	11.0	0.6	109.64	10.5	4.6	130.7

Figure 3. Macronutrients distribution of male basketball players.

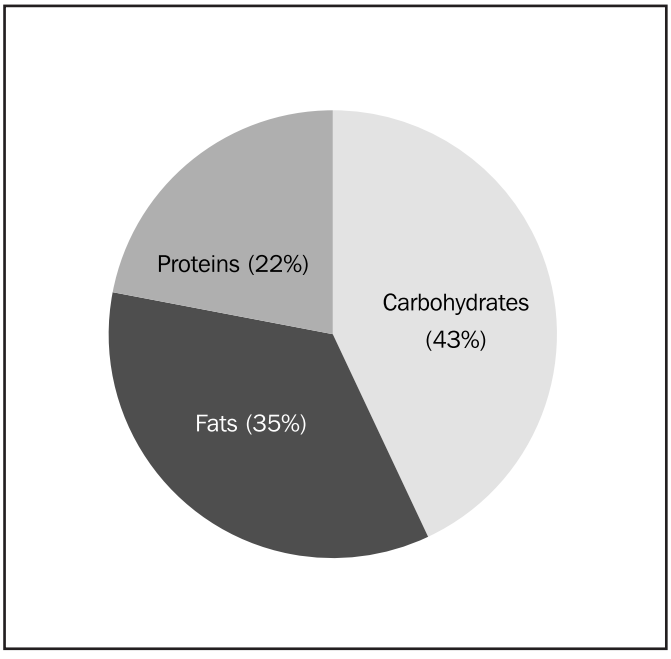

Figure 4. Macronutrients distribution of female basketball players.

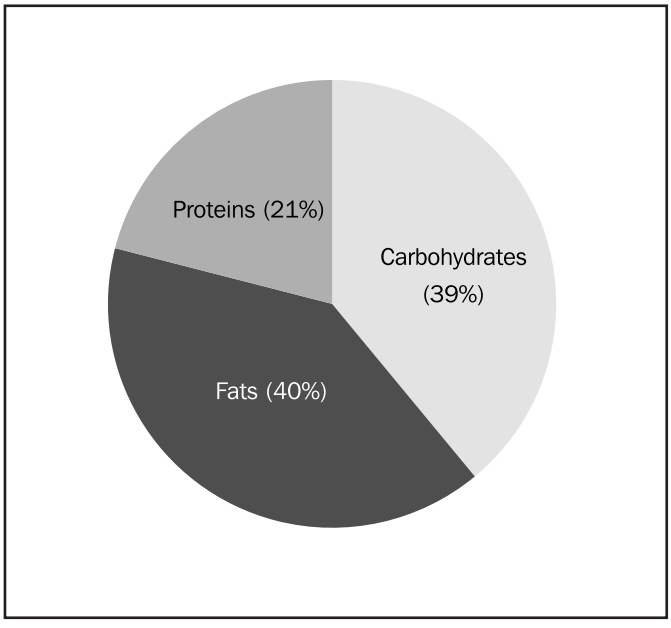

Table 4. Percentage of basketball players who meet the dietary recommended intake.

	% Dietary recommended intake	Male	Female
Energy	<100	82.4	92.9
	≥100	17.6	7.1
Protein	<100	82.4	71.4
	≥100	17.6	28.6
Carbohydrates	<100	100.0	92.9
	≥100	0	7.1
Folic acid	<100	76.5	86.7
	≥100	23.5	13.3
Calcium	<100	82.4	86.7
	≥100	17.6	13.3
Cinc	<100	76.5	80.0
	≥100	23.5	20.0
Fiber	<100	52.9	86.7
	≥100	47.1	13.3
Phosphore	<100	0	6.7
	≥100	100	93.3
Iron	<100	11.8	66.7
	≥100	88.2	33.3
Magnesium	<100	64.7	73.3
	≥100	35.3	26.7
Niacine	<100	5.9	6.7
	≥100	94.1	93.3
Vitamine A	<100	82.4	60.0
	≥100	17.6	40.0
Vitamine B1	<100	11.8	26.7
	≥100	88.2	73.3
Vitamine B12	<100	5.9	20.0
	≥100	94.1	80.0
Vitamine B2	<100	41.2	6.7
	≥100	58.8	93.3
Vitamine B6	<100	5.9	13.3
	≥100	94.1	86.7
Vitamine C	<100	29.4	26.7
	≥100	70.6	73.3
Vitamine D	<100	76.5	100.0
	≥100	23.5	0
Vitamine E	<100	41.2	40.0
	≥100	58.8	60.0

Table 5. Basketball player's liquid intake during training time.

	Male players	Female players
Water	76.5%	93.3%
Sweet drinks	5.9%	0
Isotonic drinks	17.6%	6.7%

Dietary habits

There were found significant statistically ($p<0.05$) differences between trainings session duration and the fluid intake during the training session. Liquid water was consumed by the 83.3% of player, while the 13.3% consume isotonic drinks and 3.3% of them drink sweetened drinks during the training session. The hydration behavior during the training session can be seen in Table 5. Only 5.9% of men and 6.7% of women did not drink any liquid during the training session, which duration was 107.6±15.2 minutes for male players and 114.0±12.4 minutes for female players.

Statistically analysis

Medium and standard deviation were calculated of all quantitative variables and percentages were calculated for qualitative variables.

All anthropometric parameters follow normality and homoscedasticity criteria, so the ANOVA test was used in order to study the significant differences of basketball players by sex and according to their court position

In the analysis of nutrient intake by sex, the percentage of iron consumed not follow the normality criteria so the statistical Mann-Whitney *U* test was used. In the other side, the percentage of fiber follows the normality and homoscedasticity criteria so the Student's *t*-test was used to calculate their signification level. Similarly, the Mann- Whitney *U* test was used to calculate the level of significance between fluid intake and workout time because they did not follow normality and homoscedasticity criteria.

Discussion

The success in collective sports depends on numerous external and internal factors, among which the anthropological characteristics of the players are of special interest. In addition, one of the main components of these anthropological characteristics is, without a doubt, the anthropometric characteristics, object of long-term studies by sports scientists[14].

The anthropometric study of athletes is an instrument used for the functional characterization of athletes[15].

In basketball the most common is ecto-mesomorph somatotype. It is a very homogeneous somatotype, and has little tendency to endomorphy[8]. In the study population the results are variables by sex and position. The average somatotype in male guards and centers were endo-mesomorph, in male shooting guards had a mesomorph-endomorph somatotype and male forwards had a mesomorph-ectomorph somatotype so anyone of these group of basketball players. Comparing each position with the somatotype reference values in elite sports[16] there are some differences. Most common somatotype in male guards is 2.4 – 5 – 3 and in this study population were 3.6 – 5.5 – 1.0 so the endomorphic and mesomorphic components are above the mean values while ectomorphic component is under the mean value for guards. The same happens in shooting guards where most common somatotype is 2.1 – 4.4 – 3.5 and the somatotype in this group of basketball players were 3.5 – 3.8 – 2.2 so can be observed again how ectomorphic and mesomorphic component is under recommendation and endomorphic component is above recommendation. In elite forwards basketball players, the most common somatotype are 2.2 – 4.7 - 3.3 and in that study population the somatotype values were 2.4 – 3.5 – 3.6 where endomorphic and ectomorphic component were really similar to elite standards but mesomorphic compound is under recommended values. For elite centers the recommended somatotype values are 2.8 – 3.9 – 3.7

and the values of these study centers were 3.1 - 4.2 – 2.7, so as can be endomorphic and mesomorphic values are really similar to recommendation but again ectomorphic value is under recommendation. These variations could be caused by the fact that the study population are not elite basketball players. In the case of female basketball players, there isn't as much data in elite sport to compare the somatotype by position, but in general terms female basketball players presents great heterogeneity and tendency toward the meso-endomorphy[8]. There is a study which compares female elite basketball players somatotype and the findings of this study show that guards are more mesomorphic than centres and less ectomorphic than both forwards and centers[17]. The same happens in this study population where guards were the most mesomorphic and less ectomorphic comparing every court position which can be generate competitive advantages for this female guards group. In our study population that heterogeneity also can be seen where the most common somatotype in female guards were the meso-endomorphy too but this somatotype changed in the other positions, shooting guards and centers had an ecto-endomorph somatotype and female forwards had a balanced-endomorph somatotype.

Height affects both men and women, but more decisive in females. There are variables that provide competitive advantages. Some of the most significant differences in men are: femur biepicondylar diameter and mesomorphy; and women: height, percentage of fat, endomorphy and mesomorphy[8]. Based on this, in the guards male players studied there are a smaller femur diameter than the other positions, but mesomorphy is bigger than any other player position. Meanwhile female centers studies had more height than any other player position however were female guards who had more fat percentage, endomorphy and mesomorphy than any other court position.

Fat mass index could be a competitive advantage in female basketball players[8]. However, there are studies that recommend an optimal fat percentage in basketball players of about 6-12% in men and 10-16% in women[18]. According to this information all basketball players in this study had more fat than the recommendation, so that excess fat wouldn't be a competitive advantage in women. Only male forwards with a 12.2% of fat are closer to the upper interval of the recommendation, so a smaller percentage of fat could improve the player performance.

The recommended amount of macronutrient intakes varies between some authors. Carbohydrates are important to restore glycogen levels and improve physical performance, according to Burke the recommended amount is between 5-7g·kg^{-1}·day (Burke). In the study population the average amount of carbohydrates intake was 2.8±0.8 g•kg•day in men and 2.8±1.g•kg•day in women. This means that almost the whole population had an intake below the recommendations which can affect in their glycogen recover after exercise and might not be sufficient for a rapid recovery from training and competition, high intensity, intermittent activity typical for team sports can deplete muscle glycogen stores by up to 72% in less than 10 minutes[19]. The fact that the 92.1% of these players didn't meet the carbohydrates requirement means that they should increase their carbohydrates intake until meeting the requirement using low glycemic index foods rich in fiber before exercise and high glycemic index foods poor in fiber after exercise for a quickly glycogen recover[20].

In the last years basketball is evolving to a game faster and more physique than before. Regarding the proteins, an adequate intake is essential to maintain the lean mass promoting the protein synthesis. The amount recommended varies by the nature of the effort, so in a physique game like basketball the protein intake should be 1.8g·kg^{-1}·day[21]. Proteins don't have an important energetic function during the physical activity but have a main role to have an optimal physical performance. In the sample size of the present study male and female basketball players protein intake were 1.4g•kg^{-1}•day which is less than recommendation for both groups and this is lower than that observed in Spanish elite basketball players (2.3g•kg^{-1}•day)[22]. In these training levels a protein deficit might produce a decreased capacity to generate the maximum strength power which can be traduced in less physical performance in the court[21].

In respect of fats, it is important to know what the main sources of the diet is. Recommendations about saturated fatty acids, polyunsaturated fatty acids and monounsaturated fatty acids are 7-8% for SFA, 10% for PUFA and more than 10-15% for MUFA maintaining total fats in a 20%-35% interval[23]. The male basketball players in this study had a fat intake of 35%, meanwhile female basketball players had a fat intake of 40% being above the recommended interval, having both groups an increased intake of saturated fatty acids instead of polyunsaturated fatty acids which are under the recommended percentage.

Related to micronutrient intake, in the assessment of vitamins intake it can be seen that vitamin A and D are below the recommended requirements for male and female basketball players according to Spanish recommendations[24]. On the other hand, the mineral intake assessment shows that minerals such as folic acid, calcium, cinc and magnesium are below recommendations for both groups and female players have a specific deficit in iron.

Almost any of these players met the carbohydrates recommendations, in terms of improving their performance male and female basketball players should meet the recommendation eating sources of non-processed carbohydrates like whole grains, fruits and vegetables in order to meet the fiber recommendation especially in female players who presents a bigger deficit. In order to meet the protein requirements for basketball male and female player should eat more lean meats, sea food and eggs which are sources with a high protein and low saturated fat contain. Saturated fats which can be found in fatty meats, full fat dairies and processed foods that contain these fats should be reduced instead polyunsaturated fats sources like fatty fishes, seed oils and nuts.

Micronutrients as vitamins and minerals play an important role in some metabolic pathways (energy production, hemoglobin synthesis, maintenance of healthy bones, immunology function, protection against oxidative stress, etc.)[23]. Liposoluble vitamins like vitamin A and D can be stored in the adipose tissue. Vitamin A has an important role in the immune function maintaining the epithelial cell functions. In this study population it is observed a deficit for male and female players. In the scientific literature there are only a small percentage of athletes with an inadequate intake of vitamin A and there is no evidence that these athletes have biochemical deficiencies. In terms of performance, whether β-carotene provide any ergogenic effect is yet to be determi-

ned[11]. An inadequate intake of vitamin D is observed for both groups. When cutaneous endogenous production is limited like happens in indoor sport like basketball, diet is the main source of vitamin D. Fatty fish is the main source of dietary vitamin D, so if the basketball player dislikes fatty fish or consume only a limited amount of it, vitamin D supplementation could be required to avoid deficits. The consumption in male players of this study were 3.4±3.0 µg which is similar to the results of Bescós and Guisado in a study with Spanish professional basketball players were the dietary vitamin D intake were 3.5±1.9 µg[25]. In the other hand, water-soluble vitamins cannot be stored so there is necessary to intake them daily. In our study population, Folic acid is the only one water-soluble vitamin under recommendations. A deficiency of folate causes abnormal cell replication in the erythropoietic system which could cause megaloblastic anemia. There are limited data about physiological benefits of folate supplementation in order to improve physical performance[11].

Calcium is involved in a several number of physiological processes of the energy metabolism and muscular contraction. It also enhances the absorption of vitamin D[25] and magnesium. That magnesium could have an important role in strength performance specially when there is an inadequate intake[26] however these effects in performance does not happen when magnesium status is normal. In our sample size male and female player had an intake under recommendations of calcium and magnesium with coincide with other studies in team sports athletes[25]. In addition, there is observed a zinc deficit for male and female players. Physical activity reduces the levels of serum zinc which can produce a lower physical performance[27]. Some studies have found iron depletion and anemia in elite basketball players[28]. Female players in this study had a low iron intake with a 84.9% of the DRI's and this deficit could be greater when these female players have the iron menstruation losses[29]. Iron deficiency without anemia impairs work performance promoting skeletal muscle fatigue[11] so iron repletion will decrease fatigue improving overall vitality and performance[28].

An adequate hydration status is fundamental in order to do a physical activity which guarantees an optimal health and physical performance. An exogenous amount of glucose can decrease the consumption of muscular glycogen during the physical activity and the addition of sodium and potassium amounts can maintain an adequate hydration status avoiding the hyponatremia. In general terms, during a high intensity physical activity it is recommended an isotonic drink consuming 150-200 ml every 15-20 minutes[30]. In this study population the most consumed drink during exercise was water in a 76.5% of male players and 93.3% of female players. Categorizing basketball as a high intensity physical activity and viewing that the exercise duration is near 120 minutes an isotonic drink it is necessary to better maintain skill and sprint performance than when ingesting water alone[31].

In summary, anthropometric measurement of a group of male and female basketball players of the National Spanish Basketball League was characterized by an excess of fat mass in both groups except for male forwards, so that high percentage could cause worse physical performance. The average somatotype in male guards and centers were endo-mesomorph, in male shooting guards were mesomorph-endomorph and male forwards were mesomorph-ectomorph which differs of the homogenous ecto-mesomorph somatotype for male players described previously. In the case of female players, the heterogeneity of their somatotype was shown in the present study.

Dietary intake was characterized by a high fat consumption. Saturated fat intakes were higher than recommended for a healthy diet and polyunsaturated were above recommendations. Hypovitaminosis and hypomineralosis were found in almost all micronutrients studied, moreover the main fluid intake during the long high intensity training comes to water instead of isotonic drinks, which can result in a worse performance. These results indicate that a more professional advice, ideally by sport nutritionists, would be necessary to improve dietary habits and drinking patterns of male and female basketball players.

Conflict of interest

The authors do not declare a conflict of interest.

Bibliography

1. Paredes CA, Pérez-Rodríguez M. Estrategia para la selección de talentos en el baloncesto, categoría liga cantonal de milagro. *Revista Científica Olimpia.* 2019;16:1-12.
2. Alacid F, Mayor JM, López-Miñarro PA. Perfil antropométrico del canoísta joven de aguas tranquilas. *Int J Morphol*. 2011;29:835-40.
3. Guillén L, Ayuso J, Norte-Navarro A, Cejuela R, Cabañas MD, Martínez-Sanz JM. Composición corporal y somatotipo en triatletas universitarios. *Nutr Hosp.* 2015;32:799-807.
4. Chena M, Pérez-López A, Álvarez I, Bores A, Ramos-Campo DJ, Rubio-Arias JA. Influencia de la composición corporal sobre el rendimiento en salto vertical dependiendo de la categoría de la formación y la demarcación en futbolistas. *Nutr Hosp.* 2015;32:299-307.
5. Mangine GT, Hoffman JR, Frafala MS, Vazquez J, Krause MC, Gillett J. Effect of age on anthropometric and physical performance measures in professional baseball players. *Journal Strenght Cond. Research*. 2015;27:375-81.
6. Amador M, Mermelo M. Métodos para evaluar la composición corporal en humanos. Coordinación Académica Faces. Caracas: UCV; 2013.
7. Garcia-Gil M, Torres-Unda J, Esain I, Duñabeitia I, Gil SM, Gil J, Irazusta J. Anthropometric parameters, age, and agility as performance predictors in elite female basketball players. *J. Strength Cond. Res*. 2018;32:172-330.
8. Herrero de Lucas A, Esparza-Ros F, Cabañas-Armesilla MD. Características antropométricas de los deportes olímpicos de verano. En: Cabañas MD, Esparza F. Editores. *Compendio de Cineantropometría*. Madrid: CTO; 2009; 295-8.
9. Holway FE, Spriet LL. Sport-specific nutrition: practical strategies for team sports. *J. Sports Sci.* 2011;29:115-25.
10. Antonio J, Kalman D, Stout J, Greenwood M, Willoughby D, Haff G. *Essentials of sports nutrition and supplements.* New Jersey. Humana Press; 2008;38.
11. Lukaski HC. Vitamin and mineral status: effects on physical performance. *Nutrition.* 2004;20:632-44.
12. Kreider RB, Wilborn CD, Taylor L, Campbell B, Almada AL, Collins R, Cooke M, Earnest CP, Greenwood M, Kalman DS, Kerksick CM, Kleiner SM, Leutholtz B, Lopez H, Lowery LM, Mendel R, Smith A, Spano M, Wildman R, Willoughby DS, Ziegenfuss TN, Antonio J. ISSN exercise & sport nutrition review: research & recommendations. *J Int Soc Sports Nutr.* 2010;7:7.
13. Mujika I, Burke LM. Nutrition in team sports. *Ann Nutr Metab.* 2010;57:26-35.
14. Pireva A. Anthropometric and body composition differences among elite kosovo basketball, handball and soccer players. *International Journal of Morphology.* 2019;37:1067-72.
15. Gajardo-Burgos R, Barría-Vargas C, Flández-Valderrama J, Avendaño-Chipón R, Barría-Pailaquilén RM, Monrroy-Uarac M. Perfil antropométrico de basquetbolistas sub-14 chilenos. *International Journal of Morphology*. 2018;36:943-7.
16. Sociedad Internacional para el Avance de la Kineantropometría (ISAK). *Estándares internacionales para la valoración antropométrica*. Australia. 2001.
17. Carter JEL, Ackland TR, Kerr DA, Stapff AB. Somatotype and size of elite female basketball players. *J Sports Sci.* 2005;23:1057-63.
18. Wilmore JH, Costill DL. *Fisiología del esfuerzo y del deporte.* Barcelona. Editorial Paidotribo; 2004.
19. MacDougall JD, Ward G, Sale D, Sutton J. Muscle glycogen repletion after highintensity, intermittent exercise. *J Appl Physiol.* 1977;42:129-32.

20. Burke L. *Nutrición en el deporte: un enfoque práctico.* Madrid. Médica panamericana; 2009.
21. Urdampilleta A, Vicente-Salar N, Martinez Sanz JM. Necesidades proteicas de los deportistas y pautas dietético-nutricionales para la ganancia de masa muscular. *Rev Esp Nutr Hum Diet.* 2012;16:25-35.
22. Schröder H, Navarro E, Mora J, Seco J, Torregrosa JM, Tramullas A. Dietary habits and fluid intake of a group of elite spanish basketball players: a need for professional advice?. *Eur J Sport Sci.* 2004;4:1-15.
23. Position of the American Dietetic Association, Dietitians of Canada, and the American College of Sport Medicine: nutrition and athletic performance. *J Am Diet Assoc.* 2009;109:509-27.
24. Ortega RM, Requejo AM, Navia B, López Sobaler AM. *Ingestas diarias recomendadas de energía y nutrientes para la población española.* Madrid. Universidad Complutense de Madrid; 2004.
25. Bescós R, Rodríguez Guisado FA. Low levels of vitamin D in professional basketball players after wintime: relationship with dietary intake of vitamin D and calcium. *Nutr Hosp.* 2011;26:945-51.
26. Santos DA, Matias CN, Monteiro CP, Silva AM, Rocha PM, Minderico CS, Bettencourt Sardinha L, Laires MJ. Magnesium intake is associated with strength performance in elite basketball, handball and volleyball players. *Magnes Res.* 2011;24:215-9.
27. Rico JI, Pérez-López M. La actividad física y el zinc: Una revisión. *Arch Med Deporte.* 2011;141:36-44.
28. Dubnov G, Constantini NW. Prevalence of iron depletion and anemia in top- level basketball players. *Int J Sport Nutr Exerc Metab.* 2004;14:30-7.
29. Martínez-Sanz JM, Urdampilleta A, Mierlgo-Ayuso J. Necesidades energéticas, hídricas y nutricionales en el deporte. *Eur J Hum Mov.* 2013;30:37-52.
30. Urdampilleta A, Martínez-Sanz JM, Julia-Sánchez S, Álvarez-Herms, J. Protocolo de hidratación antes, durante y después de la actividad físico- deportiva. *Eur J Hum Mov.* 2013;31:57-76.
31. Ali A, Williams C, Nicholas CW, Foskett A. The influence of carbohydrate- electrolyte ingestion on soccer skill performance. *Med Sci Sports Exerc.* 2007;39:1969-76.