



Relationship of Sport Competitive Level on Dietary Intake, Body Composition and Somatotype between Elite and Amateur Female Volleyballers

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Abstract

The aim of this study was to compare the energy, macronutrients and body composition of Elite (EFVPs) and Amateur (AFVPs) Female Volleyballers and to analyze their dietetic-nutritional intakes and habits with those recommended for athletes. Twelve EFVPs and twelve AFVPs were considered for this study. A protocol from the International Society of Advancement of Kinanthropometry was followed to record anthropometric data. To calculate the nutritional intake and the size of food servings, the participants were asked to keep a daily diet for seven consecutive days. Statistically ($P < 0.05$), the EFVPs were older (26 ± 4 years vs. 21 ± 4 years), taller ($178 \text{ cm} \pm 9 \text{ cm}$ vs. $166 \text{ cm} \pm 4 \text{ cm}$), heavier ($69.4 \text{ kg} \pm 8.7 \text{ kg}$ vs. $57.3 \text{ kg} \pm 6.5 \text{ kg}$) and had a greater muscle mass ($30.0 \text{ kg} \pm 2.5 \text{ kg}$ vs. $25.7 \pm 2.0 \text{ kg}$) than the AFVPs. However, no significant differences between groups were described in somatotype ($P > 0.05$). The EFVPs consumed more ($P < 0.05$) calories ($2,854 \text{ kcal} \pm 279 \text{ kcal}$ vs. $2,173 \text{ kcal} \pm 179 \text{ kcal}$), proteins ($141 \text{ g} \pm 20 \text{ g}$ vs. $106 \text{ g} \pm 16 \text{ g}$), fat ($114 \text{ g} \pm 20 \text{ g}$ vs. $91 \text{ g} \pm 8 \text{ g}$) and carbohydrates ($303 \text{ g} \pm 37 \text{ g}$ vs. $208 \text{ g} \pm 21 \text{ g}$) than the AFVPs. Additionally, the results indicated that all the volleyballers had an inadequate diet and food intake in terms of both quantity and quality. These findings suggest that higher height and muscle mass offers an advantage for professional players than dietary evidences and habits related to a higher intake of energy and macronutrients in case of amateur players. Nevertheless, this contradictory data between the two levels of volleyballers indicates an inadequate diet and food intake in terms of both quantity and quality regarding the nutritional recommendations for athletes.

Keywords: Dietary intake; Body composition; Sports nutrition; Female athletes; Volleyball

Introduction

Volleyball requires players to perform frequent short actions of high intensity followed by periods of low intensity activity [1,2]. In particular, excess of Fat Mass (FM) in Female Volleyball Players (FVPs) is dead weight that the body needs to lift repeatedly against gravity. This reduces performance and increases energy demand [3]. Therefore, Body Composition (BC) of FVPs is key point in volleyball performance [2-5]. In addition, Muscle Mass (MM), an indicator of sports performance, contributes to the production of energy during high intensity activities, and provides strength and resistance [6]. For that, Elite Female Volleyball Players (EFVPs) advance through a strict selection process and have considerable access to professional consulting related to physical training and dietary-nutritional aspects [7]. This access positively influences BC [8] and it is one of the main reasons why EFVPs outperform Amateur Female Volleyball Players (AFVPs). EFVPs are taller, thinner, have a higher MM and a lower FM percentage in comparison to the AFVPs [7-10].

Furthermore, an adequate diet is fundamental for allowing female volleyball players to optimize their athletic performance because the diet can improve energy production during physical exercise, adjust BC and contribute to the prevention of sports-related injuries [11]. Advances in exercise physiology have allowed the development of dietary and nutritional patterns that help athletes to fulfill their needs [12]. However, insufficient data and literature references exist in the field of

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women's volleyball [13], although recent findings indicate that EFVPs improved BC and strength despite an energy and macronutrients intake different from recommendations [5].

Some scientific publications have reported results discussing the anthropometric differences among volleyball teams in different categories [1,7]. For example, in 2002, Papadopoulou et al. [14] reported the dietary intake of teenage Greek VPs in two categories. Additionally, eight years later the same authors reported the comparison of the nutritional status among 14 Greek high-level FVPs; however, none of these studies compared BC, energy and macronutrient intakes among different team categories in women's volleyball [13].

Thus, the primary aim of this study was to know and compare dietary and dietetic-nutritional intakes, BC and somatotype between elite and an amateur team of female volleyballers. The secondary aim was to compare the energy and macronutrient intakes of both teams based on the dietary guidelines recommended for athletes, in terms of intake of carbohydrates [15], proteins [16] and fat [17].

Methods

Participants

Two volleyball teams participated in the study. According to their competitive level, the subjects were divided into two groups: (i) elite female team (EFVPs, n=12) who play in the highest category of the Spanish Super League and (ii) amateur female team (AFVPs, n=12) who play in the second division of the Spanish league. In addition, the EFVP included 4 Spanish international players, 1 from Argentina first team and 1 from the Serbian first team. The EFVP finished at second position in this season and won Spain's cup. All participants had no history or clinical signs of cardiovascular or pulmonary diseases. Players were not currently taking prescribed medications. The study was designed in compliance with the recommendations for clinical research of the Declaration of Helsinki of the World Medical Association (Fortaleza, 2013). The protocol was reviewed and approved by the ethics committee for the University of León.

Procedure

Data were collected during the competition phase of the second macrocycle period, after the athletes had completed 22 weeks of training and prior to the opening of the Spanish Cup (the season ends after 30 weeks). The EFVPs trained on average 18 hours per week, and participated in 1 or 2 tournaments during the regular season. The AFVPs trained 14 hours per week, and competed in weekly games during the regular season.

Anthropometric measurements

All measurements were made by the same technician, trained and assessed to be competent by an ISAK-Level 2 anthropometrist, following The International Society of Advancement of Kinanthropometry (ISAK) protocol [18]. Three series of anthropometric measurements were taken for each site and the mean was recorded. Height (cm) was measured using a SECA[®] stadiometer with 1-mm precision. Body Mass (BM; kg) was measured using a SECA[®] scale with a precision of 0.1 kg. BMI was calculated with the $\text{BM}/\text{height}^2$ (kg/m^2) formula. A Harpenden[®] skinfold calliper with 0.2 mm precision was used to measure the triceps, abdominal, suprailiac, front thigh, subscapular and peroneal skinfolds. A Lufkin[®] metallic woven tape with 1 mm precision was used to measure the perimeters (relaxed arm, thigh and peroneal) in cm. Bone diameters (wrist and

femur, cm) were measured using a Holtain[®] bicondylar calliper with 0.1 cm precision. To calculate FM, MM and Bone Mass, we used the Carter [19], Lee [20] and Rocha [21] equations, respectively. The somatotype components were processed by Carter and Heath [22] formula.

Dietary assessment

The VPs were taught how to accurately assess their food intake by dieticians. First, the participants were requested to complete a validated Food Frequency Questionnaire (FFQ) for the female Spanish population [23], previously used in other studies conducted in FVPs [5,24,25]. This FFQ, which asked the subjects to recall their average consumption over the previous 22 weeks, included 139 different foods and drinks, arranged by food type and meal pattern. In addition, FFQ included some blank items in which VPs indicated if they consumed supplements. Frequency categories were based on the number of times that items were consumed per day, week or month. Daily consumption in grams was determined by dividing the reported intake by the frequency in days.

Second, as a check on the answers to the FFQ, the participants completed a 7-day dietary during 22-week, these questionnaires being distributed on the day the blood samples were taken. The results obtained by the FFQ were found to be highly reproducible regarding the frequency and amount foods consumed compared to the data from the 7-day dietary records. When it was not possible to weigh food, serving sizes consumed were estimated from either product names, the place of food consumption, standard weights of food items or the portion size indicated in a picture booklet of 500 photographs of foods. Food values were converted into intakes of total energy and micronutrients by a validated software package developed by the Spanish Centre for Higher Studies in Nutrition and Dietetics (CESNID), which is based on Spanish tables of food composition [26].

Statistical analysis

The results are expressed as mean \pm standard deviations, frequencies and percentages. We compared the levels of the BC and somatotype parameters, and energy and macronutrients intake between EFVPs and AFVPs by using the Student's t-test or Mann-Whitney U-test, after the determination of the normal parameters by the Shapiro-Wilk test (<30). The differences were considered statistically significant when $P < 0.05$.

The number and percentage of the VPs who meet the distinct nutritional intake criteria for energy, carbohydrates, protein and fat are represented by variables indicating frequency and percentage.

The statistical analysis was performed using the statistical software package SPSS[®] Version 22.0. (SPSS, Inc, Chicago, IL, USA).

Results

Table 1 shows the characteristics, the BC and the somatotypes of the FVPs. Statistically significant differences ($P < 0.05$) were observed between the EFVPs and AFVPs for the values corresponding to age, height, BM and MM. Statistically ($P < 0.05$), the EFVPs were older, taller and heavier. The EFVPs also ($P < 0.05$) had a higher MM, and a higher BM in comparison to the AFVPs. No significant differences ($P > 0.05$) were observed between the EFVPs and AFVPs for the values corresponding to BMI, FM and ratio FM/MM. Table 1 also shows the values for the somatotypes ($P > 0.05$) (EFVPs: 3.7-3.2-3.0; AFVPs: 3.8-3.2-2.9).

Table 1: Age, height, body mass, BMI, body composition and somatotype variables by the female volleyball players.

	Total (n=24)	Elite (n=12)	Amateur (n=12)	P
Age	23 ± 4	26 ± 4	21 ± 4	0.006
Height (cm)	172 ± 9	178 ± 9	166 ± 4	<0.001
Body mass (kg)	63.4 ± 9.6	69.4 ± 8.7	57.3 ± 6.5	0.001
BMI	21.3 ± 1.5	21.8 ± 0.9	20.8 ± 1.8	0.094
FM (%)	17.4 ± 3.4	17.1 ± 3.8	17.6 ± 3.0	0.743
FM (kg)	11.1 ± 3.3	12.0 ± 3.6	10.2 ± 2.8	0.195
MM (%)	43.4 ± 3.4	44.4 ± 2.5	43.4 ± 4.3	0.977
MM (kg)	27.3 ± 3.5	30.0 ± 2.5	25.7 ± 2.0	<0.001
Ratio FM/MM	0.41 ± 0.10	0.40 ± 0.10	0.41 ± 0.11	0.718
BM (kg)	6.6 ± 1.7	7.7 ± 1.6	5.5 ± 1.0	<0.001
BM (%)	10.2 ± 1.2	11.0 ± 1.2	9.4 ± 0.7	0.001
Endomorphy	3.7 ± 1.0	3.6 ± 1.2	3.8 ± 0.8	0.543
Mesomorphy	3.2 ± 0.6	3.1 ± 0.6	3.2 ± 0.7	0.526
Ectomorphy	3.0 ± 0.6	3.2 ± 0.6	2.9 ± 0.7	0.319

Data expressed in mean ± standard deviation; BMI: Body mass index; FM: Fat mass; MM: Muscle mass; BM: Bone mass; P: Significance between Elite and Amateur female volleyball players.

Table 2: Energy and macronutrients intake per day by the volleyball players.

	Total (n=24)	Elite (n=12)	Amateur (n=12)	P
Energy (kcal)	2514 ± 417	2854 ± 279	2173 ± 179	0
Energy (kcal/kg body mass)	40 ± 6	43 ± 6	38 ± 6	0.103
Proteins (g)	123 ± 25	141 ± 20	105 ± 16	0
Proteins (g/kg body mass)	2.0 ± 0.4	2.1 ± 0.4	1.9 ± 0.4	0.146
Proteins (%)	19.5 ± 2.0	19.8 ± 2.2	19.2 ± 1.9	0.438
Fats (g)	103 ± 19	114 ± 20	91 ± 8	0.003
Fats (g/ kg body mass)	1.7 ± 0.3	1.7 ± 0.4	1.6 ± 0.2	0.497
Fats (%)	36.9 ± 4.0	35.9 ± 4.5	37.9 ± 3.2	0.208
SFA (g)	33 ± 8	35 ± 10	31 ± 4	0.217
MUFA (g)	44 ± 5	47 ± 4	42 ± 5	0.015
PUFA (g)	21 ± 7	22 ± 8	20 ± 6	0.362
Cholesterol (mg)	406 ± 57	447 ± 74	365 ± 49	0.005
Carbohydrates (g)	255 ± 57	303 ± 37	208 ± 21	0
Carbohydrates (g/kg body mass)	4.1 ± 0.8	4.5 ± 0.7	3.7 ± 0.7	0.007
Carbohydrates (%)	40.5 ± 3.6	42.5 ± 3.4	38.4 ± 2.6	0.003

Data expressed in mean ± standard deviation; SFA: Saturated fatty acid; MUFA: Monounsaturated fatty acid; PUFA: Polyunsaturated fatty acid; P: Significance between Elite and Amateur female volleyball players.

Table 2 provides the values corresponding to the daily intake of energy and macronutrients. Statistically significant differences (P<0.05) between both groups were detected regarding energy intake values, proteins, fat and carbohydrates intake. There were also differences (P<0.05) in MUFA and the carbohydrates intake per kg of BM and the percentage of carbohydrates in the total consumed energy.

Table 3 shows the number of FVPs who followed the dietary guidelines and recommendations for energy and macronutrient intake. The table shows that 70.8% of all of the VPs consumed less than the recommended energy intake value (EFVPs: 58.3%; AFVPs: 83.3%); all of the VPs consumed fewer carbohydrates than those recommended according to the right nutritional values for these types of athletes; 62.5% of the FVPs consumed more protein (EFVPs: 83.3%; AFVPs: 50%) and 66.7% of the FVPs consumed more fat than

the recommended doses (EFVP: 50%; AFVP: 83.3%), respectively.

Finally, Table 4 reveals the daily food servings consumed by the EFVPs and AFVPs, and the recommendations for the general population and athletes. Significant differences (P<0.05) in the intake of cereals and potatoes, fruits, vegetables, legumes, dried fruits and eggs were observed. According to the recommended allowances for general population and athletes, the EFVPs consumed low servings of cereals and potatoes and legumes and high serving of pastries and margarine and fatty meat and cold meat.

Discussion

These main findings suggest that higher height and muscle mass offers an advantage to be professional players than dietary evidences and habits related to a higher intake of energy and macronutrients in case of AFVPs. Nevertheless, this contradictory data between the

Table 3: Frequency and percentage by volleyball female players who meet criteria in intake of energy, carbohydrates, proteins and fats.

	Total (n=24)	Elite (n=12)	Amateur (n=12)
Energy (Kcal/kg body mass/day)			
<45	17 (70.8%)	7 (58.3%)	10 (83.3%)
45-50*	6 (25%)	4 (33.3%)	2 (16.7%)
>50	1 (4.2%)	1 (8.3%)	0 (0%)
Carbohydrates (g/kg body mass/day)			
<7	24 (100%)	12 (100%)	12 (100%)
7-10*	0 (0%)	0 (0%)	0 (0%)
>10	0 (0%)	0 (0%)	0 (0%)
Proteins (g/kg body mass/day)			
<1.6	5 (20.8%)	2 (16.7%)	3 (25%)
1.6-1.8**	3 (12.5%)	0 (10%)	3 (25%)
>1.8	16 (62.5%)	10 (83.3%)	6 (50%)
Fats (%)			
<20	0 (0%)	0 (0%)	0 (0%)
25-35***	8 (33.3%)	6 (50%)	2 (16.7%)
>35	16 (66.7%)	6 (50%)	10 (83.3%)

Data expressed in frequency (percentage of cases); *Recommended energy and carbohydrate intakes [15]; **Recommended protein intake in sports [16]; ***Recommended fat intake [17].

two levels of volleyball players indicates an inadequate diet and food intake in terms of both quantity and quality regarding to nutritional recommendations for athletes.

In relation to the daily caloric intake, the EFVPs consumed 2,854 kcal/day ± 279 kcal/day (43 kcal/kg ± 6 kcal/kg BM/day), and the AFVPs consumed 2,173 kcal/day ± 179 kcal/day (38 kcal/kg ± 6 kcal/kg BM/day). Gonzalez-Gross et al. [15] have recommended 45 kcal/kg to 50 kcal/kg BM/day for athletes who exercised more than 75-90 minutes/day like current recommendations [12]. The 33.3% by EFVPs and 16.7% by AFVPs met the requirement imposed by the recommend value. Papadopoulou et al. [14] showed lower caloric intake for a group of 65 teenage VPs (1,648 kcal/day ± 780 kcal/day)

and for a group of 14 Greek EFVPs (<17% MG (1,397 kcal ± 379 kcal) and >17% MG (1,696 kcal ± 578 kcal)). These intakes were lower than the recommended energy guideline value proposed by Beals [27] in a study that included 23 high-level FVPs (2,815 kcal/day ± 306 kcal/day). Anderson [28] recommended 2,888.9 Kcal/day for 15 EFVPs at their peak performance during the season and before the start of a nutrition intervention. These intake values were similar to the 2,854 kcal/day intake consumed by the EFVPs in our study. In comparison, Ahmadi et al. [29] reported 2,266 kcal/day ± 835.9 kcal/day among semi-professional players, same to the 2,173 kcal/day for the AFVPs.

The proteins consumption by the EFVPs was 2.0 g/kg/day ± 0.4 g/kg/day, and by the AFVPs were 1.9 g/kg/day ± 0.4 g/kg/day. This quantity is above the recommended guidelines proposed by Phillips and Van Loon [16] (1.2 g/kg/day to 1.6 g/kg/day and 1.6 g/kg/day to 1.8 g/kg/day to maintain and increase MM respectively). This recommendation was followed by none of the EFVPs and by 25% of the AFVPs. Other authors have reported lower protein intakes among FVPs [13,14,28], in a range similar to the discussed recommendations [16]. In this regard, the FVPs have an adequate daily consumption for general population [30] and athletes [12,15,31] of all protein-rich foods (dairy products, fish, meat and eggs). In 2011, Gacek [32] reported an insufficient consumption frequency of these products in 210 VPs of both sexes, because consumed more sweets, soft drinks and fast food than dairy products. Although some researchers claimed that a protein intake 3 or 4 times higher than the recommended value has no adverse effects [33], excessive protein intake on the part of the FVPs, together with a depleted glycogen store, could increase urea levels [34] and ketone concentrations. In turn, this could result in early dehydration and a decreased physical performance, among other detrimental effects [35].

The EFVPs consumed 4.5 g/kg/day ± 0.7 g/kg/day in carbohydrates, and the AFVPs consumed 3.7 g/kg/day ± 0.7 g/kg/day. Anderson [28] reported intakes similar to those of our EFVPs in a group of 15 VPs. However, in different studies, Holway and Spriet [36] reported results that were similar to those of our AFVPs (3.3 g/kg to 4.1 g/kg). Gonzalez-Gross et al. [15] suggested a 7 g/kg/day to 10 g/kg/day of consumption, a value that is close to what other institutions

Table 4: Number of servings daily consumed by EFVPs and AFVPs and the dietary recommendations of reference.

Food groups	Daily servings consumed by EFVP	Daily servings consumed by AFVP	Recommended servings pyramid SENC ¹	Recommended servings ATHLETES ²
Cereals and potatoes	3.4 ± 1.0	2.0 ± 0.5**	4-6/day	6-11/day
Dairy products	2.8 ± 1.4	2.0 ± 0.4	2-4/day	3-4/day
Fruits	3.0 ± 1.3	1.7 ± 0.8*	≥ 3/day	2-4/day
Vegetables	4.8 ± 1.4	2.4 ± 1.4*	≥ 2/day	3-5/day
Olive oil	1.5 ± 0.8	2.0 ± 1.1	3-6/day	2-4/day
Other oils	0.3 ± 0.4	0.5 ± 0.5	Not available	Not available
Legumes	0.5 ± 0.4	0.4 ± 0.2*	2-4/week	2-3/week or Frequent (1/day)
Dried fruits	0.4 ± 0.4	0.1 ± 0.1*	3-7/week	2-3/week or Frequent (1/day)
Fish	0.9 ± 0.2	0.7 ± 0.2	3-4/week	2-3/day Alternating between these food groups
Lean meat and poultry	1.8 ± 0.7	1.4 ± 0.5	3-4/week	
Eggs	0.5 ± 0.1	0.3 ± 0.1**	3-4/week	
Fatty meat and sausages	0.3 ± 0.2	0.5 ± 0.4	Occasional and moderate	Few times per month
Pastries and margarines	1.7 ± 1.2	1.8 ± 0.7	Occasional and moderate	Few times per month
Wine and beer	0.4 ± 0.6	0.7 ± 0.5	Occasional and moderate	Not available

Based on the number of servings consumed for each food group per person per day; ¹Healthy Nutrition Pyramid of the Spanish Society of Community Nutrition (Sociedad Española de Nutrición Comunitaria [SENC]) [15]; ²Proposal for the adaptation of the food pyramid to an athlete's diet [15]; *Significance between Elite and Amateur female volleyball players P<0.05; **Significance between Elite and Amateur female volleyball players P<0.001.

have proposed [12]. In this regard, all the FVPs in our study (100%) had carbohydrate consumption lower than the recommended value. We found that the EFVPs consumed 3.4 ± 1.0 daily servings of cereals and potatoes and 0.5 ± 0.4 servings per day of legumes. The AFVPs consumed 2.0 ± 0.5 and 0.4 ± 0.2 daily servings of these carbohydrate-rich foods, respectively [15,31]. These servings should be increased to 6-11 daily servings of cereals and potatoes and to 2-3 servings per week of legumes for recommended serving for athletes [15,31]. The low consumption of carbohydrates corresponded with the increase in protein intake in all FVPs. This was a particular threat for EFVPs because of the inability to replenish glycogen stores because of continuous physical activity [12].

Fat accounted for $35.9\% \pm 4.5\%$ of the EFVPs' total energy and $37.9\% \pm 3.2\%$ of the AFVPs' total energy. These data were in agreement with previous results from other studies [1,13,14,28,37]. The reported values were higher than those showed by Beals [27] and to the 20% to 35% of the energy total recommended in adult population [17]. The 50% of the EFVPs and 83.3% of the AFVPs consumed more fat than the maximum recommended [17]. This quantity was difficult to justify in team sports, an increase of more than 30% of fat ingested suggested a decrease in carbohydrates, which could help in muscular recovery [38]. These data could have resulted from a high consumption of fat from meat and sausages (EFVPs: 0.3 ± 0.2 ; AFVPs: 0.5 ± 0.4 servings/day) and from pastries and margarines (EFVPs: 1.7 ± 1.2 ; AFVPs: 1.8 ± 0.7 servings/day), which are foods with a high fat content [17]. All of the FVPs consumed these products on a daily basis, although the recommended consumption for athletes is a few times per month for athletes [15,31].

The current nutritional recommendations for athletes were developed regardless gender differentiation. It has been observed that female athletes may have lower energy and nutritional needs than men [39]. Possibly for this reason, the data obtained were lower than the current recommendations, in accordance to other similar studies [5,36].

Concerning to the anthropometric data, it is important to remark that BMI calculation does not distinguish between MM and FM. Therefore, it is usual to find healthy athletes with an increased BMI because of an increased MM. For this reason, BMI should not be used to quantify FM in athletes. In this respect, no significant differences ($P > 0.05$) were shown in this variable among the VPs (EFVPs: 21.8 ± 0.9 vs. AFVPs: $20.8 \text{ kg/m}^2 \pm 1.8 \text{ kg/m}^2$). However, a significant difference in MM ($P = 0.000$) was observed between EFVPs ($30.0 \text{ kg} \pm 2.5 \text{ kg}$) and AFVPs ($25.7 \text{ kg} \pm 2.0 \text{ kg}$), but not for the variable corresponding to FM ($P = 0.195$) (EFVPs: $12.0 \text{ kg} \pm 3.6 \text{ kg}$; AFVPs: $10.2 \text{ kg} \pm 2.8 \text{ kg}$). Some authors, such as Gonzalez-Rave et al. [2], have shown the need to evaluate BC changes during the season because of its influence on physical performance. They reported an increase in MM and a decrease in FM; however, in this case, the BC was performed *via* electrical bio-impedance, a system that requires a strict validated protocol. In sports, anthropometric techniques are highly practical for measuring BC because they allow data evaluation and comparison with other reference data [40].

Furthermore, Granados et al. [41] reported similar FM percentages in both groups in a study conducted with elite and amateur handball players. However, elite players exhibited higher values of BM and fat-free mass, as we found in the case of EVFPs and another study in volleyball has described [42]. Moreover, Granados et al. [41] observed that an increase of fat-free mass in elite players

supposed a performance advantage in terms of greater power and muscular potential compared with amateur players.

Regarding height, EFVPs measured on average $178 \text{ cm} \pm 9 \text{ cm}$ tall, while AFVPs averaged $166 \text{ cm} \pm 4 \text{ cm}$. During the Montreal Olympic Games, Japanese athletes won championships in volleyball competitions; it is noteworthy that the Japanese athletes were on average 169 cm tall, while their competitors averaged 178 cm in height [43]. These facts showed that the height variable did not influence the team's success. However, in women's volleyball, the net dividing the court is 224 cm high; therefore, the recruitment of taller VPs with a greater vertical jump is the best way to dominate the net and win the game [3,8].

Bayios et al. [44] analyzed the somatotypes, anthropometric profiles and BC of elite Greek female athletes including volleyball players and showed that these variables differed among the different sports. In the same way, other authors compared the first 2 divisions (competitive levels) of every league and concluded that players in the highest division were taller and exhibited greater homogeneity in somatotype [45]. Other authors have studied women's morphology and its importance in performance in other team sports, such as handball [41,46,47]. Those researchers claimed that BC and morphology were potentially an important criterion for evaluating the sporting performance of athletes [8]. Their studies reported functional differences that depended on the position that each athlete occupies in the game field, thus supporting anthropometric control checks aimed at distributing the players in the field based on their characteristics and identifying new sports talents [41,47]. This research line could determine the morphological characteristics and ideal BC of female volleyball players, thus offering a new alternative for selection criteria based on anthropometric profile, competitive level and position occupied on the game field [47].

For the best our knowledge, studies of the anthropometric and nutritional characteristics in female volleyball have been scarce [48]. This imposes the need to open new lines of research to improve dietary and nutritional strategies for athletes. Moreover, data obtained from such studies will help sports practitioners to acquire a deeper knowledge of the physical fitness of female VPs [49] and design adequate nutrition education to improve FVPs' daily food and nutritional intake [5]. This will advance sports performance and help athletes maintain optimum levels of health. Also, the authors suggest the need for energy and nutritional needs differentiated by gender, for later comparison with other studies. Further studies concerning to the energy and nutritional needs considering the gender differentiation in order to be comparable with other previous reports.

The limiting factor of this study is the small size of the sample. However, we have studied all the members of two groups; furthermore, the amateur group was the second team of it League and elite group was the winning team of the Spanish Cup and second of the Spanish Female Premier League in the year in which the study was conducted, which we consider remarkable and very difficult to reach in a more numerous groups.

On the other hand, future researches should include vitamins and minerals intake because they play important roles in general health and sport performance. In the same way, future researches should include the position of the players to individualize nutrition.

Conclusions

These findings suggest that higher height and muscle mass

offers an advantage to be professional volleyball players than dietary evidences and habits related to a higher intake of energy and macronutrients in case of amateur players. Nevertheless, the results of this study showed that both elite and amateur players followed inappropriate diets in both quality and quantity and included too few servings of carbohydrates, leading to greater consumption of fat and proteins regarding recommendations for athletes, despite, the elite players consume more energy, protein, fat and carbohydrates than amateurs caused by their higher frequency and intensity of physical exercise.

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References

- Gabbett T, Georgieff B. Physiological and anthropometric characteristics of australian junior national, state, and novice volleyball players. *J Strength Cond Res.* 2007;21(3):902-8.
- Gonzalez-Rave JM, Arija A, Clemente-Suarez V. Seasonal changes in jump performance and body composition in women volleyball players. *J Strength Cond Res.* 2011;25(6):1492-501.
- Mielgo-Ayuso J, Calleja-González J, Clemente-Suárez VJ, Zourdos MC. Influence of anthropometric profile on physical performance in elite female volleyballers in relation to playing position. *Nutr Hosp.* 2014;31(2):849-57.
- Melchiorri G, Viero V, Triossi T, Annino G, Padua E, Tancredi V. Anthropometric and performance measures to study talent detection in youth volleyball. *J Sports Med Phys Fitness.* 2017.
- Mielgo-Ayuso J, Zourdos MC, Calleja-González J, Urdampilleta A, Ostojic S. Dietary intake habits and controlled training on body composition and strength in elite female volleyball players during the season. *Appl Physiol Nutr Metab.* 2015;40(8):827-34.
- Andreoli A, Melchiorri G, Brozzi M, Di Marco A, Volpe SL, Garofano P, et al. Effect of different sports on body cell mass in highly trained athletes. *Acta Diabetol.* 2003;40(1):122-5.
- Malousaris GG, Bergeles NK, Barzouka KG, Bayios IA, Nassis GP, Koskolou MD. Somatotype, size and body composition of competitive female volleyball players. *J Sci Med Sport.* 2008;11(3):337-44.
- Lidor R, Ziv G. Physical and physiological attributes of female volleyball players--a review. *J Strength Cond Res.* 2010;24(7):1963-73.
- Giannopoulos N, Vagenas G, Noutsos K, Barzouka K, Bergeles N. Somatotype, Level of Competition, and Performance in Attack in Elite Male Volleyball. *J Hum Kinet.* 2017;58:131-40.
- Nikolaidis PT. Body mass index and body fat percentage are associated with decreased physical fitness in adolescent and adult female volleyball players. *J Res Med Sci.* 2013;18(1):22-6.
- Eichner ER. Overtraining: consequences and prevention. *J Sports Sci.* 1995;13:41-8.
- Thomas DT, Erdman KA, Burke LM. Position of the academy of nutrition and dietetics, dietitians of canada, and the american college of sports medicine: Nutrition and athletic performance. *J Acad Nutr Diet.* 2016;116(3):501-28.
- Papadopoulou SK, Papadopoulou SD. Nutritional status of top team-sport athletes according to body fat. *Nutrition & Food Science.* 2010;40(1):64-73.
- Papadopoulou SK, Papadopoulou SD, Gallos GK. Macro- and micro-nutrient intake of adolescent greek female volleyball players. *Int J Sport Nutr Exerc Metab.* 2002;12(1):73-80.
- Gonzalez-Gross M, Gutierrez A, Mesa JL, Ruiz-Ruiz J, Castillo MJ. Nutrition in the sport practice: Adaptation of the food guide pyramid to the characteristics of athletes diet. *Arch Latinoam Nutr.* 2001;51(4):321-31.
- Phillips SM, Van Loon LJ. Dietary protein for athletes: from requirements to optimum adaptation. *J Sports Sci.* 2011;29(1):29-38.
- Rodriguez NR, Di Marco NM, Langley S. American college of sports medicine position stand. Nutrition and athletic performance. *Med Sci Sports Exerc.* 2009;41(3):709-31.
- <http://www.ceap.br/material/MAT17032011184632.pdf>.
- Carter JEL. Body composition of montreal olympic athletes. In: *Physical structure of olympic athletes part I: the montreal olympic games anthropological project.* Switzerland: Basel; 1982. p. 107-16.
- Lee RC, Wang Z, Heo M, Ross R, Janssen I, Heymsfield SB. Total-body skeletal muscle mass: Development and cross-validation of anthropometric prediction models. *Am J Clin Nutr.* 2000;72(3):796-803.
- Rocha M. Bone weight of the Brazilian of both sexes from 17 to 25 years old. *Arq Anat Antropol.* 1975;1:445-51.
- Carter JEL, Heath BH. *Somatotyping: Development and applications.* Cambridge: Cambridge University Press, USA; 1990.
- Martin-Moreno JM, Boyle P, Gorgojo L, Maisonneuve P, Fernandez-Rodriguez JC, Salvini S, et al. Development and validation of a food frequency questionnaire in spain. *Int J Epidemiol.* 1993;22(3):512-9.
- Mielgo-Ayuso J, Urdampilleta A, Martinez-Sanz JM, Seco J. Nutritional analysis of dietary intake performed by professional volleyball players during the competitive phase of the regular league. *Rev Esp Nutr Hum Diet.* 2013;17(1):10-16.
- Mielgo-Ayuso J, Zourdos MC, Calleja-González J, Urdampilleta A, Ostojic S. Iron supplementation prevents a decline in iron stores and enhances strength performance in elite female volleyball players during the competitive season. *Appl Physiol Nutr Metab.* 2015;40(6):615-22.
- Farrán A, Zamora R, Cervera P. Food composition tables. In: McGraw-Hill. *Centre d'ensenyament superior de nutrició i dietètica (CESNID).* Barcelona: Universitat de Barcelona; 2004.
- Beals KA. Eating behaviors, nutritional status, and menstrual function in elite female adolescent volleyball players. *J Am Diet Assoc.* 2002;102(9):1293-6.
- Anderson DE. The impact of feedback on dietary intake and body composition of college women volleyball players over a competitive season. *J Strength Cond Res.* 2010;24(8):2220-6.
- Ahmadi A, Enayatzadeh N, Akbarzadeh M, Asadi S, Tabatabaee SH. Iron status in female athletes participating in team ball-sports. *Pak J Biol Sci.* 2010;13(2):93-6.
- Dapcich V, Castell GS, Barba LR, Rodrigo CP, Bartrina JA, Majem LS. *Healthy Eating Guide.* Lérida: Spanish Society of Community Nutrition; 2004.
- Mettler S, Mannhart C, Colombani PC. Development and validation of a food pyramid for Swiss athletes. *Int J Sport Nutr Exerc Metab.* 2009;19(5):504-18.
- Gacek M. Eating habits of a group of professional volleyball players. *Rocz Panstw Zakl Hig.* 2011;62(1):77-82.
- Michaelsen KF. Are there negative effects of an excessive protein intake? *Pediatrics.* 2000;106(4):1293.
- Kim H, Lee S, Choue R. Metabolic responses to high protein diet in korean elite bodybuilders with high-intensity resistance exercise. *J Int Soc Sports Nutr.* 2011;8:10.
- Sawka MN, Burke LM, Eichner ER, Maughan RJ, Montain SJ, Stachenfeld NS. American college of sports medicine position stand. Exercise and fluid replacement. *Med Sci Sports Exerc.* 2007;39(2):377-390.

36. Holway FE, Spriet LL. Sport-specific nutrition: Practical strategies for team sports. *J Sports Sci.* 2011;29(1):115-25.
37. Hassapidou MN, Manstrantoni A. Dietary intakes of elite female athletes in greece. *J Hum Nutr Diet.* 2001;14(5):391-6.
38. Hausswirth C, Le Meur Y. Physiological and nutritional aspects of post-exercise recovery: specific recommendations for female athletes. *Sports Med.* 2011;41(10):861-82.
39. Loucks AB, Kiens B, Wright HH. Energy availability in athletes. *J Sports Sci.* 2011;29(1):7-15.
40. Milic M, Grgantov Z, Chamari K, Ardigo LP, Bianco A, Padulo J. Anthropometric and physical characteristics allow differentiation of young female volleyball players according to playing position and level of expertise. *Biol Sport.* 2017;34(1):19-26.
41. Granados C, Izquierdo M, Ibanez J, Bonnbau H, Gorostiaga EM. Differences in physical fitness and throwing velocity among elite and amateur female handball players. *Int J Sports Med.* 2007;28(10):860-7.
42. Martín-Matillas M, Valadés D, Hernández-Hernández E, Olea-Serrano F, Sjöström M, Delgado-Fernández M, et al. Anthropometric, body composition and somatotype characteristics of elite female volleyball players from the highest spanish league. *J Sports Sci.* 2014;32(2):137-48.
43. Norton K, Olds T. *Anthropometrica: A textbook of body measurement for sports and health courses.* Sidney: University of New South Wales, Australia; 2004.
44. Bayios IA, Bergeles NK, Apostolidis NG, Noutsos KS, Koskolou MD. Anthropometric, body composition and somatotype differences of greek elite female basketball, volleyball and handball players. *J Sports Med Phys Fitness.* 2006;46(2):271-80.
45. Nikolaidis PT, Afonso J, Busko K. Differences in anthropometry, somatotype, body composition and physiological characteristics of female volleyball players by competition level. *Sport Sci Health.* 2015;11(1):29-35.
46. Milanese C, Piscitelli F, Lampis C, Zancanaro C. Anthropometry and body composition of female handball players according to competitive level or the playing position. *J Sports Sci.* 2011;29(12):1301-9.
47. Srhoj V, Rogulj N, Zagorac N, Katić R. A new model of selection in women's handball. *Coll Antropol.* 2006;30(3):601-5.
48. Zapolska J, Witzczak K, Manczuk A, Ostrowska L. Assessment of nutrition, supplementation and body composition parameters on the example of professional volleyball players. *Rocz Panstw Zakl Hig.* 2014;65(3):235-42.
49. Paz GA, Gabbett TJ, Maia MF, Santana H, Miranda H, Lima V. Physical performance and positional differences among young female volleyball players. *J Sports Med Phys Fitness.* 2017;57(10):1282-9.