# Anthropometric profile and macronutrient intake in professional Brazilian soccer players according to their field positioning

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## ABSTRACT

The aim of this study was to evaluate the anthropometric profile, total energy value of the diet and macronutrient intake of professional soccer players, as well as verifying the differences among tactical positions: goalkeepers (n = 12), center backs (n = 20), median fields (n = 41), running backs (n = 21) and strikers (n = 24) in the studied variables. The sample was composed by 118 professional players (23 years ± 5 years) of the elite of the São Paulo state. All the evaluations were accomplished during the competitive period. Body composition was determined through skin folds measurement and the dietary data obtained through usual food intake. The goalkeepers and center backs were shown taller, heavier and with larger amount of lean mass than the other athletes, even so without significant differences among body fat percentage. The dietary habits of these athletes indicate a lower carbohydrate ingestion, hyperprotein and tendency to hyperlipidic diet. Thus, we can conclude that there are nutritional inadequacies and anthropometric differences among the players and their tactical positions. The results of the present study suggest that nutritional interventions are accomplished in the soccer elite, seeking to maximize the athletic performance.

## INTRODUCTION

Soccer is the most popular sports all over the world, and it has been practiced by every nation, without exceptions[18], and in the last few years, there is more and more interest by the biological sciences to improve the knowledge related to the soccer game through studies in several areas.

Due to the big dimensions of the game field and the duration of a match, each athlete performs a specific function within the team, as follows: center backs, midfielders, goalkeepers, running backs, and strikers. According to each position and tactical pattern, the total distance ran by a player is different from the remaining, as well as the type and intensity of the actions accomplished[7,19,21].

The assessment and determination of the anthropometric characteristics (height, body mass and composition) is essential to a successful achievement of a soccer team not only during a game, but also along the whole sportive season, and such information can and must be used by the coach to change the player's function or even the tactical formation of the whole team, with the purpose to maximize the performance, once each positioning presents specific features[24].

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Due to its duration, the soccer game can be considered an endurance sports that promotes a high caloric expenditure by its practitioners both in game and in training days. As each specific function of an athlete interferes in the daily energetic needs[11,15], an adequate food ingestion with the aim to supply the correct carbohydrate, fat, protein amounts helps to achieve the optimum energy balance, as well as it propitiates to the athlete to begin playing with optimum muscular glycogen levels, and this is fundamental to improve the athletic performance and to retard the commonly presented fatigue in professional athletes, mainly in the last 45 minutes of a game[7,16].

Thus, the purpose of this study was to assess the anthropometric profile, the total energetic value and each nutrient's (carbohydrate, protein, and lipid) intake habit of professional soccer players, and to verify if there is any difference between their positioning (goalkeepers, center backs, midfielders, running backs, and strikers) among the assessed variables.

## MATERIALS AND METHODS

118 Brazilian professional athletes from the São Paulo's elite players were assessed along the whole competitive period, while they were disputing the 1st and 2nd divisions, divided according to their field positioning: goalkeepers (n = 12), center backs (n = 20), midfielders (n = 41), running backs (n = 21) and strikers (n = 24). Every assessment was performed between 24 and 36 hours after a game; it was excluded from the sampling athletes who had been in the medical department for more than four days. In order to participate in the research, all players signed a consent term that was approved by the Human Research Ethics Committee of the São Carlos Federal University.

### Anthropometric measurements

In order to attain the values related to the body mass and the basal metabolic rate, a TANITA TBF-310[8] body composition analyzer was used able to assess the body mass and composition (fat and lean body mass), as well as the basal metabolic rate (BMR) using bioelectrical impedance principles. The height was measured using a wooden stadiometer[10,12].

The body composition was determined measuring the skin folds assessed through a CESCORF fold compass. The formula used to attain the body fat percentage was proposed by FAULKNER (%G = $\Sigma$ of the skin folds x 0.153 + 5.783) using the tricipital, subscapular, and abdominal folds[12].

### Food intake

In order to attain the nutritional variables, 86 randomized athletes were assessed using the habitual food inquiry that considers only the food consumed more than three times per week, thus

characterizing a habit, regardless whether the athlete was or not on a game day[26,27]. A Virtual Nutri software (USP)[13] was used to make the diet calculations. In order to classify the athletes' diet in above (hyper), normocaloric (normo), or under (hypo) as to what is recommended for each nutrient (carbohydrate, lipidic, and protein), it was used the recommended values by the American Dietetic Association (ADA), and 60 to 70% of the total energetic value (TEV) of the diet are carbohydrates, 10 to 15% are proteins, and less than 30% are lipids[1].

### Statistical analysis

Was performed initially a descriptive analysis (mean, SD, median, maximum and minimum values). The Kruskal-Wallis test and Sperman correlation was performed to non parametrics datas.

## RESULTS

Table 1 presents the results related to the anthropometric and body composition data. The results are expressed in median, maximum values (Vmax), and minimum values (Vmin). The mean age of the professional athletes was 23 years ± 7 months. It was observed that goalkeepers and center backs were significantly taller and had a higher body mass than the remaining athletes. As to the fat percentage, it was found no significant differences, but goal-keepers presented a higher fat mass than midfielders and running backs. The lean body mass has shown to be higher in center backs, compared to midfielders and running backs, and goalkeepers presented a higher slim mass than the remaining athletes in every position, except for the center backs.

Table 2 presents the values of the basal metabolic rate (BMR), the total energetic value of the diet, and the fraction ingested of each macronutrient. It was observed that the BMR has been shown to be higher in goalkeepers and center backs compared to midfielders and running backs. It was found no differences related to the total energetic value, and the same behavior was observed in the fractions of macronutrients.

Table 3 expresses the results related to the percentage of athletes in each positioning, according to the consumed type of diet ingested for each nutrient, classified according to ADA[1]. As to the food pattern, it was verified that every positioning has presented a low carbohydrates intake. Also, it was observed on table 3 a high protein intake in every positioning, trending to a high lipid intake by midfielders, goalkeepers and strikers.

## DISCUSSION

The anthropometric profile in soccer professional players can be characterized by its heterogeneity, and this may be partially explained by the ethnic and racial differences of its practitioners[17,24].

**TABLE 1**
**Anthropometric data and body composition in Brazilian professional soccer players**

| Positioning | Height (cm) | | Body mass (kg) | | % fat | | Fat mass (kg) | | Lean mass (kg) | |
|---|---|---|---|---|---|---|---|---|---|---|
| Center backs (n = 20) | 183.75 | 191.5 178 | 83.9 | 89.6 78 | 11.59 | 13.5 5.8 | 8.38 | 12.45 4.44 | 69.07 | 79.54 62.78 |
| Midfielders (n = 41) | 176[a,b] | 193 165 | 70.8[a,b] | 91.4 60,8 | 11.53 | 15.02 8.72 | 8.05[b] | 11.83 5.3 | 62.41[a,b] | 79.71 55.49 |
| Goalkeepers (n = 12) | 188.75 | 201 183 | 83.9 | 89.6 78 | 12.47 | 14.01 9.54 | 10.60 | 12.19 7.65 | 74.18 | 77.5 69.89 |
| Strikers (n = 24) | 177.25[a,b] | 193 165 | 72.05[a,b] | 91.4 64 | 11.41 | 15.02 8.72 | 8.14 | 13.14 5.96 | 64.01[b] | 79.93 57.88 |
| Running backs (n = 21) | 175[a,b] | 181 165 | 69.7[a,b] | 78.8 62.2 | 11.19 | 13.28 9.16 | 8.26[b] | 10.6 8.05 | 62.41[a,b] | 68.33 56.15 |
| Mean | Vmax Vmin | | | | | | | | | |

a  p ≤ 0,05 comparing center backs to the remaining groups.
b  p ≤ 0.05 comparing goalkeepers to the remaining groups.

**TABLE 2**
**Basal metabolic rate (BMR), total energetic value of the diet and percentage of macronutrient intake (CHO, Lip, and AA) inf professional soccer players**

| Positioning | BMR (Kcal/day) | | TEV (Kcal/day) | | % CHO | | % Lip | | % AA | |
|---|---|---|---|---|---|---|---|---|---|---|
| Center backs (n = 15) | 1,912.5 | 2,003 1,696 | 2,961 | 2,846.5 2,741.9 | 58.6 | 58.78 44.8 | 26.45 | 31.1 21.7 | 19.7 | 24 14.77 |
| Midfielders (n = 28) | 1,767[a,b] | 2,151 1,545 | 2,989.01 | 5,121.2 1,479.8 | 52.18 | 62.66 35.18 | 33.59 | 47.72 19.24 | 19.17 | 25.3 10.63 |
| Goalkeepers (n = 8) | 2,000.5 | 2,159 1,936 | 3,902.58 | 4,752.8 2,451 | 56.98 | 65.32 41.29 | 30.02 | 40.51 22.64 | 12.76 | 18.94 10.75 |
| Strikers (n = 18) | 1,785 | 2,151 1,545 | 3,641.46 | 5,380.8 1,773 | 53.84 | 65.6 35.18 | 29.65 | 45.15 18.3 | 17.51 | 26.5 10.63 |
| Running backs (n = 17) | 1,745[a,b] | 1,884 1,630 | 3,361.1 | 5,054.2 2,286.1 | 52.36 | 72.04 47.84 | 26.29 | 36.18 17.45 | 19.4 | 23.1 10.51 |
| Mean | Vmax Vmin | | | | | | | | | |

a  p ≤ 0,05 comparing center backs to the remaining groups.
b  p ≤ 0.05 comparing goalkeepers to the remaining groups.

**TABLE 3**
**Percentage of Brazilian soccer players according to type of the ingested diet**

| Positioning | Carbohydrates | | | Lipids | | | Proteins | | |
|---|---|---|---|---|---|---|---|---|---|
| | Hyper | Normo | Hypo | Hyper | Normo | Hypo | Hyper | Normo | Hypo |
| Center backs (n = 15) | 0 | 6.7 | 93.3 | 33.3 | 40 | 26.7 | 60 | 40 | 0 |
| Midfielders (n = 28) | 0 | 3.6 | 96.4 | 57.2 | 21.4 | 21.4 | 78.6 | 21.4 | 0 |
| Goalkeepers (n = 8) | 0 | 37.5 | 62.5 | 50 | 37.5 | 12.5 | 25 | 75 | 0 |
| Strikers (n = 18) | 0 | 5.6 | 94.4 | 50 | 16.7 | 33.3 | 83.3 | 16.7 | 0 |
| Running backs (n = 17) | 5.8 | 0 | 94.2 | 29.41 | 41.2 | 29.4 | 82.3 | 17.7 | 0 |

ADA's reference value: CHO = 60-70%/Aas = 15%/Lipid < 30%[1].

In this study, it was verified that goalkeepers and center backs are taller compared to other analyzed athletes, and such data was also found in several studies evidencing such trend[17,19,20].

In order to a team to be successful, it is essential that both its center backs and the goalkeepers have a privileged height, as they perform a higher amount of vertical jumping, and thus, they are willing to be successful in their movements. Opposite to this, running backs, midfielders and strikers are lower and rather run with the ball, and they are quicker, and this fact grants to them an additional advantage against the center backs[2,3].

As to the body mass, goalkeepers and center backs have shown to be heavier than the other assessed positions. These results are similar to the ones found by several authors from several countries, who also attained the same answers. The behavior of this variable seems to partially explain the lower distance they run, besides of their specific role during a game[2,20,21,22].

In this sense, the researches have shown that goalkeepers run an average of 4 km, and the center backs run approximately 8 km per game, a mean lower value than other athletes, who run between 9 and 12 km per game. This occurs among other factors because heavier athletes must move a greater mass against the gravity action, and this has been widely known to be power consuming, besides of making difficult to change actions and directions, an action that occurs about one hundred times during a professional game[16].

The body composition is a very important aspect to the physical ability level of the professional athletes in any modality, as the fat surplus can substantially decrease the human performance[17]. The results found in the literature ranged from 6 to 12%. Such great discrepancy may be partially due to the different methods used to attain these values[2,17,19,20].

The results found in the present study are in accordance to others found in the literature, but previously mentioned researches have shown that defenders, mainly goalkeepers, trend to present a higher percentage of body fat justified by a lower metabolic overload both in gaming days and along training sessions[19,20].

It was observed in the present study no percentual differences in the fat among the assessed positions, but the higher adiposity found in goalkeepers in the above mentioned studies may be partially explained by different methodologies. It is worthy to mention that the measurement of the cutaneous fold is one of the most used techniques due to several factors in order to assess professional soccer players[16].

When the body composition was divided in two compartments, the data related to the slim mass in which defenders presented higher values was attained, and this is highly positive for them, as within the specificity of their technical and tactic attributions both positioning present much more anaerobic strength and power than running backs and midfielders with an excellent aerobic ability level. Such high amount of slim mass is essential to develop the strength in the lower limbs mainly demanded in aerial interventions, as previously mentioned[15,24].

It can be verified on table 2 that as it could be expected, the Basal Metabolic Rate (BMR) in athletes presented higher values in goalkeepers and center backs, and this fact is due to the higher amount of slim mass found in those athletes, as the slim mass is the main component of such variable.

Among the upmost questions related to the athletic performance in soccer players, it can be pointed out the following: "Which the minimum necessary amount of food to be consumed, and which types must be ingested in order to achieve an optimization of the performance and keeping the health?"[11].

In this sense, related to the Total Energetic Value (VET) of the diet, it was observed no differences between the five groups assessed in the present study. Nevertheless, the values presented here are in accordance to other data found in the literature. A study accomplished in 33 Italian professional athletes found a mean caloric ingestion of 3066 Kcal[22], while English athletes presented 3127 Kcal[15]. On the other hand, Swiss soccer players presented values up to 4930 Kcal[3]. Such wide variation between studies can be attributed to the technique employed, to the macronutrient quantification software, to weather factors, and mainly to the preparation phase when the study was performed[13].

Analyzing the carbohydrate percentage ingested by athletes, it was found no differences between groups, and the values have shown to be similar to those found in other researches[13,20,23], but these data can be discussed, because upon the analysis of table 3, a low carbohydrate ingestion is found among soccer players, and these responses are once again shared by other studies, and as to the athletes' CHO consumption, it is recommended 60 to 70% of the TEV[1]. This is certainly damaging to the performance of professional soccer players, once 60% of the total energetic expenditure during a soccer game come from that energetic source[19].

It is verified in the literature that there is a positive relationship between the TEV and the amount of carbohydrate ingested, indicating that athletes with low CHO ingestion indexes would have also a deficient total energetic value (TEV)[23].

Another very important factor is the muscular glycogen stock, that together with the blood glucose levels are the main responsible by maintaining the strength intensity or retard the fatigue while performing intense and prolonged physical activities.

It is observed an accentuated decrease in the muscular glycogen levels in professional and official soccer games, mainly along the second half of the match, thus raising the amount of wrong passes, decreasing the distance ran, and even increasing the incidence of injuries in the locomotor system[16,18].

While practicing exercises, the endocrine system among others, has to play the role to keep the glycemia within its normal values, and that function is performed by the glycoregulator hormones (adrenalin, cortisol, insulin, glucagon, and growth hormone) which are released or inhibited by nervous impulses ascending from the motor plaque. These hormonal changes are activated according to the intensity and duration of the activity, and the carbohydrates availability[5].

As previously mentioned, it was verified that there is a decrease in the available sugar along soccer games; such important change stimulates the action of some glycoregulator hormones (adrenalin, cortisol, glugacon, and GH), at the same time it inhibits the insulin's action in order to propitiatte the extra mobilization of the nutrient destined to attend the demand of the exercise[29].

Nevertheless, it is also possible that the fatigue mechanism present a central component that is directly connected to the peripheral mechanism[4,6], as with the decreasing availability of the carbohydrate, the lipids and proteins oxidation is accentuated, thus increasing the circulating concentrations of the free fatty acids (FFA) and ammonia.

When the FFA concentration increases, the concentrations of tryptophan (a precursor of the 5-HT – serotonin – which is an inhibitor neurotransmitter and the main promoter of the central fatigue), also increases[5].

By its turn, the ammonia is a highly toxic substance to the brain, and its surplus modifies the metabolic muscular functions.

Thus, the appropriate CHO ingestion as well as the adequate training prescription are essential to a successful team, as they propitiate to the athlete to start the game with optimum stocks of muscular glycogen, delaying the undesirable fatigue in athletes.

It is worthy to point out that the major part of the studies investigating the CHO ingestion, including this one, have found lower values than ADA did[1].

Opposite to this, we have found proteins in our study, where it was verified that athletes presented a high protean intake above the preconized 15%[1]. These data are similar to those observed by Guerra and co-workers (2001)[7] in professional Brazilian athletes, as well as in European soccer players[11,13,20,23].

It is known that is "fashion" to be on a hyperprotean diet, but they have no scientific support. According to the literature up to this moment, the above recommended intake does not promote any improvement in the protein synthesis, and it may even cause a kidney overloading, as every Nitrogen surplus resulting from the protean degradation must be excreted[13].

On the other hand, considering the low CHO intake by players assessed in the present study, it can be suggested that there may be an early depletion of the muscular glycogen stocks. Nevertheless, the athlete shall keep his activity in the highest intensity possible up to the end of a game. That additional power can be supplied by the protean metabolism, thus increasing the need of aminoacids available to the proteolysis.

Another factor to be mentioned is that in high intensity physical activities, it occurs an increase in the protean turnover, and an accentuated aminoacids loss through the sweat[9,28], and up to a certain point, this would justify such exacerbated intake; but it must be pointed out that the adequate glycid intake would be the most correct practice both to improve the performance and to promote the athlete's health.

As to the lipid intake, it was observed a trend to the hyper ingestion of that nutrient, but that factor was not reflected in a significant or negative way on the athletes' body composition profile. Probably, these results occurred due to the fact that soccer is an endurance sports that alternates low and high intensity moments, and such relationship is kept at the 7/1 ratio, respectively[16]. Thus, up to 40% of the power used in a soccer game can be due to the fat oxidation[23].

## CONCLUSION

The results obtained in this study suggest that there are anthropometric differences between athletes, according to their assessed positions, and the correct use of these individual differences in behalf of the team can contribute to the sportive success. According to the data related to the macronutrient intake, it is believed that it demands better nutritional interventions to professional Brazilian soccer players, in view that the results found in this study are different from what is preconized to optimize the athletic performance. Thus, it demands further studies mainly aiming to determine the total energetic intake in these athletes to enable the nutritional and training adjustments.

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