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# SOMATOTYPE AND BODY COMPOSITION OF BRAZILIAN FOOTBALL (SOCCER) REFEREES

## *SOMATOTIPO Y COMPOSICIÓN CORPORAL DE ÁRBITROS DE FÚTBOL BRASILEÑOS*

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## SUMMARY

The objective of the present study was determined the somatotype and body composition of official Brazilian football (soccer) referees. Participants consisted of 215 professional referees from the Brazilian Confederation of Soccer (CBF) and the Soccer Federation of Paraná - FPF. The variables of body mass, height, skinfold thicknesses, body girth and bone widths were collected with the purpose of estimating the body composition and determining the somatotype of the referees. We observed that the referees group in general presented mean age of 33.7 years old, relative fatness of 18.5% and somatotype characteristic of mesomorph-endomorph (3.9-4.3-1.9). When analyzed the results separated in national and regional groups, the mean age was 37.9 ± 4.1 and 33.2 ± 5.7 years old; body mass was 79.0 ± 7.9 and 78.5 ±10.7 kg; body fat percentage was 19.3 ± 4.1 and 18.5 ± 4.3; and somatotype was mesomorph-endomorph (3.8-3.9-1.9) and endomorphic mesomorph (3.8-4.4-1.8), respectively. In the classification by age a significant difference was observed for the younger group (20-29 years old), who presented a higher ectomorphy component in relation to the other age groups (p=0,022). In the other components of the somatotype, endomorphy and mesomorphy, no significant differences were observed. Thus, it is possible to state that the dominant characteristic of the somatotype of reference of Brazilian football referees is mesomorph-endomorph, that is, there is a prevalence of musculo-skeletal development and fatness component over linearity. Considering the results of the present study we may conclude that official football referees presented an amount of body fat higher of that observed in football players. Therefore, the nutritional habits must be adapted to their daily physical activities, short training periods and moderate energy intensity physical activity, on average, during match refereeing, to obtain better morphological characteristics and thus minimize the risk of cardiovascular disease.

**Key words:** Referee. Soccer. Football. Anthropometry. Somatotype. Skindfolds.

## RESUMEN

El objetivo del presente estudio fue determinar la composición corporal y somatotipo de árbitros de fútbol brasileños. Se estudiaron 215 árbitros profesionales de la Confederación Brasileña de Fútbol (CBF) y de la Federación de Fútbol de Paraná - FPF. Las variables de masa corporal, estatura, pliegues de grasa, circunferencias corporales y diámetros óseos fueron recogidos con el fin de estimar la composición corporal y determinar el somatotipo de los árbitros. Se observó que el grupo de árbitros, en general, presentan una edad media de 33,7 años, un porcentaje de grasa corporal de 18,5% y un somatotipo mesomorfo-endomorfo (3.9-4.3-1.9). Cuando se analizaron los resultados dividiendo los árbitros en nacionales y regionales, la edad media fue de 37,9 ± 4,1 y 33,2 ± 5,7 años; la masa corporal fue 79,0 ± 7,9 y 78,5 ± 10,7 kg, el porcentaje de grasa corporal fue de 19,3 ± 4,1 y 18,5 ± 4,3 %, y el somatotipo fue mesomorfo-endomorfo (3.8-3.9-1.9) y endomorfico mesomorfo (3.8-4.4-1.8), respectivamente. En la clasificación por edad se observó una diferencia significativa en el grupo más joven (20-29 años), que presentó un componente ectomórfico mayor en relación con los otros grupos de edad (p=0,022). En los otros componentes del somatotipo, endomorfia y mesomorfia, no se observaron diferencias significativas. Por lo tanto, es posible afirmar que la característica dominante del somatotipo de los árbitros de fútbol de Brasil es mesomorfo-endomorfo, es decir, hay una prevalencia de los componentes músculo-esquelético y de la grasa sobre el componente lineal. Teniendo en cuenta los resultados de este estudio podemos concluir que los árbitros oficiales de fútbol presentan un porcentaje de grasa corporal mayor que el observado en los jugadores de fútbol profesionales. Por lo tanto, los hábitos nutricionales deben ser adaptados a sus actividades físicas diarias, a los cortos períodos de entrenamiento y a la actividad física de moderada intensidad energética, en promedio, desarrollada durante el arbitraje, para obtener mejores características morfológicas y así poder minimizar el riesgo de padecer patologías cardiovasculares.

**Palabras clave:** Árbitro. Fútbol. Antropometria. Somatotipo. Pliegues de grasa.

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## INTRODUCTION

**F**ootball (soccer), an endurance sport in which players perform activities of varying intensity over a 90-min match, is one of the most popular pastimes in the world. The referee is so important for this sport that without him there is no match[1]. An official survey by FIFA revealed more than 840,000 registered referees and assistant referees worldwide. Despite his importance, for a long time, the referee was considered a secondary actor in a football match[2-4]. Scientific papers on football referees are very recent and scarce, in comparison with studies involving football players[5-12]. Among the few published studies, most are related to referee's physical performance during the match[3-4]. One of the pioneers in publishing studies on football referees' body shape was Rontoyannis, *et al.*[13]. They developed a study that approached the anthropometric and functional parameters (visual acuity, fitness and mental abilities) of football referees in Greece.

Besides the measurements of body composition (body fat, lean body mass), the somatotype is an excellent indicator of shape, structure and composition of the human body. This method is extremely useful for analyzing the modifications in the shape and in the body structure due to the training, or to the physical demand of the activity itself[14]. In general, the morphologic structure is described by the somatotype which is a rating of three components: endomorphy – the relative adiposity; mesomorphy – the relative muscle skeletal robustness; and ectomorphy – the relative linearity[15].

The technique of the somatotype was originally described by Sheldon[16], who allowed a more objective analysis of morphological characteristics of the body using numerical scales. Ever since, with the technological evolution, mainly in calculations, this technique became easy to understand and apply. The most used method is that proposed by Heath and Carter[17] and Carter and Heath[18], based on anthropometric measurements. After the analysis of the somatotype, many studies intended to verify the relationship between the physical type and the athletic performance among the participants of different sports modalities[15,19-21]. However, in the studies that approach the referee's physical demands during the football match and the anthropometric profile, no one reported this professional's physical classification (somatotype). Knowledge of body profile and morphological characteristics of football referees could be useful for researchers and coaches at the moment of elaborate a specific physical training program and for the official football organization (FIFA) select new official referees. Thus, the objective of the present study was determined the somatotype and body composition of official Brazilian football referees.

## MATERIALS AND METHODS

### Ethical and legal procedures

The procedures adopted in the present study follow the 96/1996 Resolution, from the Conselho Nacional de Saúde do Brasil (National Health Council of Brazil), which deals with the research procedures in human beings. The project was approved by the Ethic committee of the University Hospital of the Federal University of Paraná (UFPR), Curitiba - Brasil.

### Subjects

The sample consisted of 215 official field football referees, 25 from the board of the Brazilian Confederation of football - CBF (national level) and 190 from the board of the Football Federation of Paraná - FPF (regional level). The data were collected in December 2004 together with the annual fitness test for the 2005 season organized by the Refereeing Commission of the Football Federation of Paraná, where all referees of the official board were present. All the measured were realized in the morning. Care was taken to ensure that subjects maintained their normal training and professional routines during the experimental period. All the subjects were well hydrated and they were instructed to consume food and to drink as usual during the breakfast in the day when the measured were realized.

### Anthropometrical variables, somatotype and body composition

The anthropometrical variables of body mass and height were measured in agreement with the description of Gordon, *et al.*[22]. The body mass was verified by means of a digital Plenna scale with an accuracy of 100g and the height was measured with a stadiometer to 0,1 cm. The skinfold thickness (triceps, biceps, subscapular, chest, mid-axilla, supra-iliac, vertical abdominal, mid-thigh and medial leg); the bone widths of the biepicondylar humerus and femur; the calf and the contracted arm girth were obtained in agreement with the standardizations of Wilmore, *et al.*[23], Harrison, *et al.*[24] and Callaway, *et al.*[25], respectively. The skinfold thickness was measured through a Cescorf skinfold callipers (Cescorf LTDA, Brazil) with constant tension, with an accurateness of 0.1 mm. The measurements of body circumferences were collected with a flexible measuring tape, non-elastic and the bone widths were measured with a metal sliding caliper (Mitutoyo Inc, Japan).

To calculate the relative body fat percentage (BF %) was utilized the equation described by Siri[26]; with the regression model that uses the thickness of seven skinfolds[27]. The somatotype was determined in agreement with the procedures described by De Rose, *et al.*[28], following the anthropometric method proposed by Heath and Carter[17]. The somatotype was also plotted in a graph (somatochart), developed by Carter and Heath[18] and Carter[15], where the values of the coordinates X and Y were calculated:

X = ectomorphy - endomorphy

Y = 2 x mesomorphy - (endomorphy + ectomorphy)

### Statistical analysis

Descriptive statistics and normality by the Kolmogorov-Smirnov test were calculated. All variables followed the Gaussian distribution. The variance analysis (ANOVA) followed by Tukey post-hoc test was used with the purpose of comparing the variables of body composition and somatotypes between different age groups. Referees were divided firstly in three age groups: 1) 20 – 29.9 years; 2) 30 – 39.9 years and 3) equal or over 40 years. The "t" test was used for independent samples in order to compare the referees classified as National (CBF) and Regional (FPF). The data were analyzed with the SPSS program version 10.0, adopting 5% as significant level. The somatotype attitudinal distance (SAD) was also calculated to compare the national and regional referees. We assumed that a SAD ≥ 2 is a distance statistically different between two somatotype means[18].

## RESULTS

The data regarding the anthropometrical characteristics of both groups of referees are presented in Table 1. The national referees presented a higher mean age (37.9 years) in relation to regional referees (33.2 years), and this difference was considered statistically significant (p= 0.001). However, the other anthropometrical variables did not present significant differences.

**TABLE 1.** Anthropometric characteristics of football referees according to their refereeing category

| Variables | National (n=25) | Regional (n=190) |
|---|---|---|
| Age (years) | 37.9 ± 4.1 | 33.2 ± 5.7* |
| Body Mass (kg) | 79.0 ± 7.9 | 78.5 ±10.7 |
| Height (cm) | 178.6 ± 4.4 | 177.3 ± 6.2 |
| BMI (kg.m$^2$) | 24.7 ± 2.4 | 24.9 ± 2.9 |
| Relative Fat (%) | 19.3 ± 4.1 | 18.5 ± 4.3 |
| LBM (kg) | 63.5 ± 5.5 | 63.6 ± 7.1 |

*The values represent the mean ± standard deviation.*

** p< 0.05 vs national referees. LBM: Lean Body Mass; BMI: Body Mass Index.*

The anthropometric characteristics of football referees according to their age are described in Table 2. We observed that the group of referees in general presented mean age of 33.7 years old and a relative adiposity of 18.5%. Body mass presented statistical difference when the younger group (20-29.9 years) was compared with the 30-39.9 year old group, (p=0,009), but not when compared to the group over 40 years. In relation to body fat we observed that younger referees

| Variables | 20-29.9 years (n=55) | 30-39.9 years (n=127) | ≥ 40 years (n=33) | Total (n=215) |
|---|---|---|---|---|
| Age (years) | 25.8 ± 2.2 | 35.0 ± 2.6 | 42.0 ± 1.5 | 33.7 ± 5.7 |
| Body Mass (kg) | 75.0 ± 9.3* | 80.0 ± 10.8 | 78.1 ± 8.8 | 78.5 ± 10.3 |
| Height (cm) | 177.3 ± 6.8 | 177.9 ± 6.0 | 176.0 ± 4.8 | 177.5 ± 6.1 |
| BMI (kg.m$^2$) | 22.8 ± 2.5 | 25.2 ± 2.9 | 25.2 ± 2.4 | 24.8 ± 2.8 |
| Body Fat % | 16.9 ± 4.3** | 19.0 ± 4.3 | 19.5 ± 3.4 | 18.5 ± 4.3 |
| Fat Mass (kg) | 12.9 ± 4.4** | 15.5 ± 5.0 | 15.4 ± 4.1 | 14.8 ± 4.8 |
| LBM (kg) | 62.1 ± 6.4 | 64.5 ± 7.1 | 62.6 ± 5.6 | 63.6 ± 6.8 |

*The values represent the mean ± standard deviation. BMI: Body Mass Index; FW: fat mass (kg); LBM: Lean Body Mass. * p<0.05 vs group 30-39.9 years old. ** p<0.05 vs groups 30-39.9 years old and ≥ 40 years old.*

**TABLE 2.** Anthropometric characteristics of football referees according to their age

presented smaller values of adiposity, and this difference was statistically significant (p=0.008).

In the analysis of the general somatotype of the referees it was observed that they presented a mean somatotype of 3.9-4.3-1.9 (Figure 1A) showing a dominant mesomorph-endomorph pattern (Figure 1B). A percentage of 44% of the national referees and 26.9% of regional referees present endomorphic mesomorph dominant characteristic. In other words, there is a predominance of the muscle-skeletal components and adiposity in relation to the linear height component.

Figure 2A presents a comparison of the somatotype between national and regional referees. We observed that there were no statistical difference (p>0.05) between these groups. The group of national referees presented a mean mesomorph-endomorph somatotype (3.8-3.9-1.9). Meanwhile, the group of regional referees presented a mean endomorphic mesomorph somatotype (3.8-4.4-1.8). Another dominant component in the analyzed sample was that 28% of national referees and 47.5% of the regional presented a endomorphic mesomorph somatotype, in which the muscle-skeletal development prevails over the other components (adiposity and linearity) (Figure 2B).

In the classification by age a significant difference was observed for the younger group (20-29.9 years old), who presented a higher ectomorphy component in relation to the other age groups

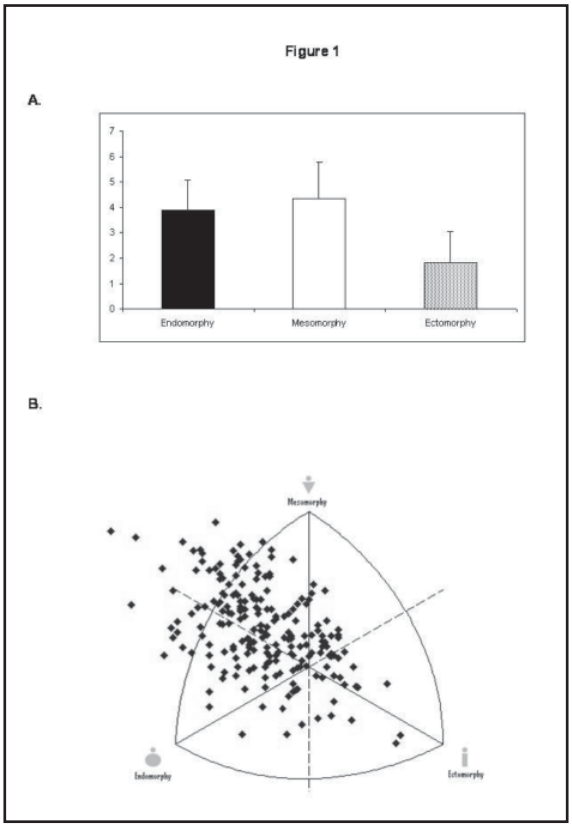


**FIGURE 1.** A. Somatotype of field football referees. It was observed that they presented a mean somatotype of 3.9-4.3-1.9. B. Somatotype distributions (somatochart) of field football referees showing a dominant meso-endomorphic pattern

(p=0,022). In the other components of the somatotype, endomorphy and mesomorphy, no significant differences were observed (Figure 3).

We observed a heterogenic distribution of somatotype data for the groups of national and regional referees analyzed (Figure 3). However, when the somatotype attitudinal distance (SAD) was calculated we obtained a value of 1.11. A value

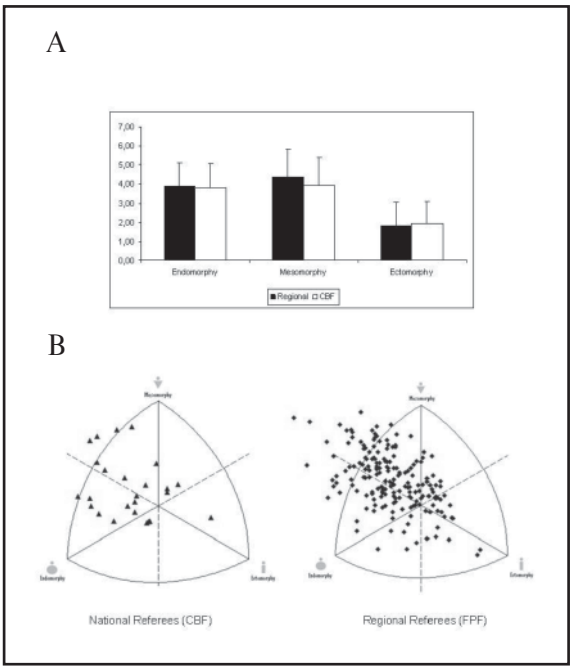


**FIGURE 2.**
A. Comparison of the somatotype of regional and national field football referees showing that there was no statistical difference. B. Somatotype distribution of field football referees according to refereeing category. Somatochart 1 shows that Regional Referees (FPF) presented a mean mesomorph-endomorphic somatotype (3.8-4.4-1.8), meanwhile the somatochart 2 show that National Referees (CBF) presented a mean endomorph-mesomorphic somatotype (3.8-3.9-1.9).

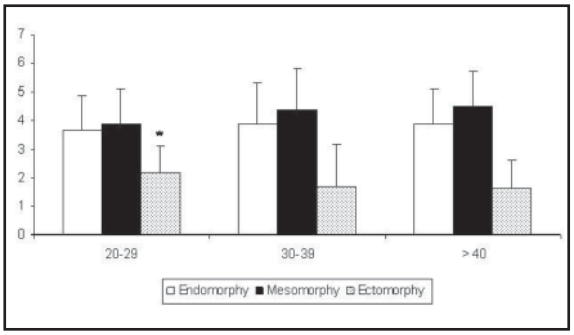


**FIGURE 3.**
Comparison between the components of the somatotype of field football referees according to the age

for SDD bellow 2 was considered not significant. The value of 1.11 observed in the present study confirms that, independent of the individual variability, the national and regional groups of referees not differentiates by their somatotypes.

## DISCUSSION

In the present study was observed that official football referees presented an amount of body fat higher of that observed in football players[4,29], and the somatotype present an average characteristic of mesomorph-endomorph (3.9-4.3-1.9), i.e., with prevalence of the muscle-skeletal component over adiposity and linearity. The mean body fat percentage was 18.5%, a value above the mean for men in the South of Brazil (16.14%), the geographical area where this study was developed[30]. Considering the fact that is expected of football referees have a physical performance above the average population, it would be convenient to them start a nutritional and training program to reduce their fat percentage.

The body mass, height and mainly the age of football referees is very similar to several other studies made in different countries[7,11,13,31]. Therefore, it would be interesting to determine the body composition of football referees, this way it would be possible to determine with more accuracy this professional's anthropometrical profile. The age group that involves most of the referees according to the literature and to this study is between 30 – 39.9 years. From the 215 referees evaluated here, 127 are in this age group, i.e., 59% of the sample.

We noticed that the youngest age group presents the lowest fat percentage (Table 2). The increasing amount of fat it is one of the main effects of ageing, which tend to cause alterations on body morphology. Furthermore, national referees have a higher BF % if compared to regional referees, a result that could be explained by the significant different mean age of these groups (Table 1). A recent longitudinal study with Brazilian football referees found that their mean body fat percentage increase from 13.2+2.9% to 17.3+3.9 in a period of ten years, moved from a balanced mesomorph pattern to a mesomorph-endomorph pattern[32]. Lohman, *et al*.[33] report that accumulation of fat might be due also to alterations in the diet, low practice of physical activities, or hormonal regulation.

Most of the studies with European football referees obtained similar values for mean age, stature and body mass to that observed in the national group of our study[7,11,31]. A tendency observed in the present study was also evident in the studies

of Rontoyannis, *et al.*[13] and Reilly and Gregson[4], referees reach a level of national representativeness in the board of referees between 35-40 years of age. With that, this group tends to present higher values of body fat than the regional referees who are starting their career, and they are younger.

In fact, the amount of body adiposity is considered a limiting factor for the performance, so most of elite level athletes present low values of body fat. Reilly and Gregson[4] in the analysis of 13 football athletes observed, using the technique of the Dual-energy x-ray Absorptiometry, an average BF % of 13%. This represents a value of high performance, considering that most of the body constitution consists on muscular mass. Recent studies with European professional football players found also values of body fat lower than 11%[34,35]. Other investigations made with Brazilian football athletes observed, by means of the anthropometrical method, values of adiposity lower than 11%[29,36]. This value is lower than the one presented by the referees in the present study. It shows that as far as the accumulation of fat is concerned, the evaluated referees are in lower conditions when compared to professional athletes of the same sport modality.

Regarding the general somatotype of the referees (Figure 1B), we observed that the general group was characterized as mesomorph-endomorph (3.9-4.3-1.9). This category shows the dominance of the mesomorphy (muscle-skeletal) component, followed by endomorphy (adiposity) and the small contribution of ectomorphy (linearity). A similar profile was also found with eleven football referees of Chilean championship, an average somatotype endomorphic mesomorph: 3.8-5.6-1.5[37]. Rahmawati, *et al.*[21], analyzed a group of athletes of different types of sports, and football was one of them. They found a medium somatotype balanced mesomorph (2.7-4.9-2.9), i.e., a clear characteristic of prevalence of the muscular development over the fat and linear (stature) component. This biotype is very different from the one presented by the volleyball athletes, in the same study. In the group of referees it seems logical that the stature does not have a direct influence in their performance; however, the muscular and fat components are directly related to their performance during the match. A clear balanced mesomorph profile (2.0-5.3-2.2) was also observed in a group of south-American international football players[38].

When we compared the national and regional groups we have not observed statistical differences in their somatotype. However, the national referee's group presented a smaller muscle-skeletal component than the one presented by the regional referees. This result becomes clearer when the somatochart (Figure 2B) is analyzed. It was observed that the national referees present a mean somatotype characterized as mesomorph-endomorph (3.8-3.9-1.9), meanwhile the regional referees showed a somatotype that was predominantly endomorphic mesomorph (3.8-4.4-1.8). This tendency might be due to the different mean age of the groups. When the somatype was compared by the somatotype attitudinal distance the differences between the groups were also not statistically different (SDD: 1,11). Because of the variability observed between the groups, the mean somatotype did not differ significantly.

According to the data collected in the literature, the age at which the referee reaches the highest level in his career is between 35-40 years of age, 10 to 15 years older than the elite football players[6,8,39-40]. However, in the same period the athletic (morphologic) condition is reduced when compared to younger referees and football players. This would have a negative effect on their physical performance. Somatotype is an excellent tool to study morphologic structure of elite groups in different sports[15]. So, considering that the national referees are officiating at high level championships, this group should be studied with more detail in the future.

## CONCLUSIONS

**C**onsidering the results of the present study we may conclude that official football referees presented an amount of body fat higher of that observed in football players. The referees`

somatotype present an average characteristic of mesomorph-endomorph (3.9-4.3-1.9), i.e., with the prevalence of mesomorphy (musculoskeletal) component over the endomorphy (adiposity) and minimum ectomorphy (linearity) components. When the referees were classified in refereeing categories we noticed that the national referees are older, and possess larger amounts of body fat than the regional group. The national referees present a mean somatotype characterized as mesomorph-endomorph (3.8-3.9-1.9). Meanwhile, the regional referees showed a somatotype that was predominantly endomorphic mesomorph (3.8-4.4-1.8). Therefore, the nutritional habits of football referees must be adapted to their daily physical activities, short training periods and moderate energy intensity physical activity, on average, during match refereeing to obtain better morphological characteristics and thus minimize the risk of cardiovascular disease.

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