29 - ANTHROPOMETRY AND BODY COMPOSITION OF THE SOCCER REFEREE

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INTRODUCTION

The referee, supported by his assistants, has the authority to fulfill the soccer game rules. His decisions on facts related to the game are definitive (FIFA, 1999). His role consists on supervising and judging players actions and to apply suitable penalties according to the rules.

The basic regulation is the official FIFA rules. His performance requires that he is as close as possible to where the play is being held in order to have the best possible angle of sight to guarantee the most impartial assessment possible and also being free of any sort of physical or psychological pressure (RONTOYANNIS, et. al. 1998).

Scientific concern on soccer has been rising significantly during the last decades, almost always focusing on soccer players. Nevertheless, referee's importance is not smaller once that a not well refereed game losses its entire splendor, independently of the players' quality. The little attention that has been given to the referee can be verified by the small amount of research work that deals with physical needs and body composition of soccer referees.

According to Cuchiaro (2000) to establish specific training programs it is necessary to know the anthropometric profile of the athlete in order to find out if it is beyond or not of the adequate profile for this activity, yonder the physical requirements of it. It is also known that a high rate of body fat harms individual's performance besides of being a risk factor for a variety of diseases. Thus it is mandatory to adequately control body fatness.

Hereafter there is an evidence of the needs of research investments in order to improve soccer referees physical performance. By doing so, dubious decisions during a soccer match, as result of physical stress, are to be avoided in order to guarantee that a good soccer match is not dazzled by mistaken decisions of the referee. It is estimated that there are around 76.000 referees working on a variety of championships throughout the world. Aiming to improve referee quality FIFA (Fédération Internationale de Football Association) has reduced the allowed age for referees to 45 years. Although this approach may cause the loss of good, and well experienced, referees. These referees could have their professional careers extended with a good health program of physical training.

This paper aims to establish the anthropometric profile and body composition of referees from the Federação Paranaense de Futebol (Paraná State Soccer Federation) during the 2000 season.

METHODOLOGY

According to Gil (1991), this study is characterized as descriptive cross-sectional. The population for this study where 209 referees from the Federação Paranaense de Futebol (FPF) which have participated in the aptitude evaluation test held by the Comissão da Avaliação da Aptidão Física da FPF (FPF's board that conducts the physical capacity test) for the 2000 season.

Data was gathered from 87 male referees, chosen intentionally as they arrived at the sites where the groups for the physical test were set. The exact number of evaluated elements varied from site to site depending on the total number of candidates in each site and the possibilities from each evaluation team. The total sample corresponded to 41.62% of the population. The evaluations were held between January 20 and February 19 in 2000 in the following cities: Curitiba, Londrina, Maringá and Cascavel.

The measurement was made in 9 skin folds (sub scapular, triceps, biceps, pectoral, medium armpit, abdomen, supra iliac, thigh and calf), 9 perimeters (forearm, contracted arm, relaxed arm, thorax, abdomen, hips, upper thigh, medium thigh, and calf) and 4 bone diameter (bi estilóide, biepicondiliano, bicondiliano e bi maleolar), according to the standard defined by Harrison et. al. (1991), Callaway et. al. and Wilmore et. al. (1991) respectively. Body mass, height and age were also determined according to Ross and Marfell-Jones (1995). Body density was determined through the anthropometric variables according to the equation proposed by Jakson and Pollock (1978) which uses the total of 7 skin folds and two perimeters and the fat percentage through Siri's equation (1961). Fat mass (MG) was obtained multiplying body mass (MC) by the fat percentage fraction (%G): MG = MC.(%G / 100). In order to determine bone mass (MO) and residual mass (MR) equations of Von Döblen and Würch, quoted by De Rose, Pigatto and De Rose (1984) respectively. Muscular mass (MM) was obtained as MM = MC - (MO + MR + MG). Anthropometric evaluation was held always before the physical aptitude tests.

RESULTS AND DISCUSSION

Descriptive characteristics and body composition of the sample studied are presented in Table 1. Average age was 32.9 4.8, a very similar value to that presented by Velho, Petroski and Schwingel (1998) among referees from the Federação Catarinense de Futebol (FCF) with values of 32.59 6.83 years of age in average. Rontoyannis et al. (1998), evaluated 188 referees from the north region in Greece and verified an average age of 36.3 4.5 years. These authors also commented that the average age for referees is 10 years higher than the average of soccer players' ages, this difference is lower in other sports. Silva et al. (1977) evaluated professional soccer players in Paraná State and verified that the average age was 24.18 4.06.

Table 1 - Descriptive characteristics and body composition of soccer referees. (n=87)

Variable	Mean Value	Standard Deviation	Higher Value	Lower Value
Age (year)	32.9	4.8	44.7	23.5
Height (cm)	175.4	6.9	195.0	153.0
Body Mass (kg)	75.5	9.1	97.3	52.7
Fat Percentage (%)	16.3	4.1	26.9	7.2
Fat Mass (kg)	12.5	4.0	23.0	4.0
Bone Mass (kg)	12.6	1.3	16.3	9.1
Residual Mass (kg)	18.2	2.2	23.4	12.7
Muscular Mass (kg)	32.2	3.8	42.8	22.0

The average height found in this research (175.4 6.9 cm) is very similar to those of the referees from FCF (174.4 6.6 cm), it is however 2 centimeters smaller than the height of Greek referees (177.4 5.7 cm) and 3.7 centimeters smaller than that of professional soccer players. Comparing the height of referees with other national population groups, as presented by Petroski in 1995 among individuals aging from 18 to 66 years from south of Brazil, referees are only 0.9 cm taller. Nevertheless, referees are 3.2 cm taller than Santa Maria (RS) soldiers (RODRIGUEZ-AÑEZ, 1997), 2.2 cm taller than Ponta Grossa (PR) soldiers (SCREMIN, 1999), but 3.3 cm shorter than Curitiba (PR) university students (RODRIGUES-AÑEZ and COSTA, 1999).

Body mass of Paraná State referees (75.4 9.1) is lower than Santa Catarina State referees (76.4 10.8) and Greeks (81.6 7.8), but significantly higher than body mass of RS soldiers (10 Kg), PR soldiers (9.8 kg), Paraná stateuniversity students (2.6 Kg) and men from south of Brazil (1.9 Kg).

In relation to the fat percentage, the observed value (16.3 4.1%) is very similar to that found on Greeks (16.7 4.5%) but smaller than that related by Schwingel et al. (1998) in a study held with 57 referees from Santa Catarina State which presented values of 20.7 5.6% for this variable (fat percentage). Fat percentage in referees is very similar to that demonstrated by Petrosky (1995) among south of Brazil male population (16.14%) but higher than that found by Rodriguez-Añez and Costa (1999) among university students (12.47%), and to that found by Rodriguez-Añez (1997) (12.97%) and Scremin (1999) (9.81%) among soldiers. Comparing the percentage of fat in professional soccer players there is a difference of 8.43%.

No data were found in this research regarding body composition of referees such as bone mass, residual mass or muscular mass. However, some comparisons can be made with the average values presented by Petroski (1995) among men in south of Brazil. These average values from Petroski can be found in Table 2.

TABELA 2 - Mean values in south Brazil aging from 18 to 66 years. (n=304)

	Absolute Values (Kg)	Relative Values (%)
Age (years)	30.17±9.78	
Height (cm)	174.5±6.81	
Body Mass	73.6±9.74	
Fat Mass	12.24±6.35	16.14±6.86
Bone Mass	12.09*	16.42*
Residual Mass	17.74*	24.10*
Muscular Mass	31.7*	43.07*

* Estimated values from original data of Petroski (1995).

Bone mass found in this study (12.6 Kg) corresponds to 16.69% of body mass of the evaluated sample population, similar to that found among men in the south region (16.42%). When these two groups are compared to younger men it can be observed that the youngest have higher bone mass. Rodriguez-Añez and Costa (1999) found a 17.23% bone mass among university students with an average age of 20.37 years and Scremin (1999) found this value to be 17.9% among soldiers that joined the army in 1998. Being a constant, residual mass (24.1%) is almost the same in all groups compared. When the muscular mass of the referees in this study (42.65%) is compared to that presented in other studies, it can be observed that it is very similar to the study of Petroski (43.07%) and both of them are lower than that found in a younger population. Rodriguez-Añez and Costa (1999) found a value of 45.75% for muscular mass among university students and Scremin (1999) found 47.96% of muscular mass among soldiers.

In Table 3 perimeter values are presented. There is a lack of work with this information. As this is a work aiming to determine de anthropometric profile of referees, this information is important in order to allow the comparison with results from other studies held by other confederations and even with other groups such as athletes (players) or sedentary individuals.

TABELA 3 - Soccer referees perimeters (n=87).

Variable	Mean Value	Std Deviation	Higher Value	Lower Value
Forearm	27.2	1.6	31.2	20.7
Contracted Arm	31.6	2.4	37.6	26.3
Relaxed Arm	29.1	2.3	35.5	23.8
Thorax	95.2	5.4	110.6	82.5
Abdomen	84.1	6.8	98.5	68.9
Hips	96.7	5.2	108.0	83.2
Upper Thigh	58.0	4.2	69.7	44.2
Medium Thigh	53.2	4.2	62.5	43.4
Calf	37.8	2.4	42.8	31.2

Analysing male univeristy students aging in average 20,37 years, Rodriguez-Añez and Costa (1991), observed perimeters smaller that that found in this study: forearm (26,83), contracted arm (31,08), relaxed arm (28,45), thorax (92,34), abdomen (81,24), hips (94,92), upper thigh (56,81), medium thigh (52,27) e calf (37,01). Contracted arm and calf are the two perimeters that are most similar between these two groups.

Scremin (1999) has determined the anthropometric profile of new army soldiers which joined the army in 1998 in Ponta Grossa city (PR), their mean age was 19,44 years. In that case the forearm perimeter is bigger (29,93), and all other perimeters demonstrated to be smaller than those in this study: contracted arm (30,38), relaxed arm (27,72), thorax (90,09), abdomen (76,21), hips (88,22), upper thigh (53,93) e calf (35,58).

Rodriguez-Añez (1997), while evaluating soldiers and privates from the Santa Maria (RS) Army aging in average 19,49 years, has found values for forearm and contracted arm similar to those in this study (27,73 e 31,5 respectively). However, all other perimeters were smaller in soldiers and privates: relaxed arm (27,95), thorax (93,27), abdomen (78,6), gluteus (93,53), thigh (55,25) and calf (36,61).

Groups previously compared presented to be younger than soccer referees. It suggests that higher perimeters found in this study derive from aging once that almost always bigger perimeters are located in the body central region and in the lower extremity; this can suggest higher quantities of body fat.

Petroski (1995) has evaluated 304 individuals aging from 18 to 66 years and found a smaller average for all perimeters but calf and forearm which demonstrated to be similar (37,05 and 26,48). It is, though, an evidence of a relation between body fat and perimeters in soccer referees once that the muscular mass is relatively equals or smaller than that observed in other groups with a smaller percentage of fat, estimated by skin folds. Nevertheless the percentage of fat in referees indicates normal values (16,3%) or

equivalence to non athletes individuals.

Mean values for skin folds are presented in Table 4. These values are used to estimate body fat through many regression equations.

Table 4 - Skin folds in soccer referees (n=87).

Variable	Mean Value	Std Deviation	Higher Value	Lower Value
Sub scapular	14,0	5,0	34,0	6,4
Triceps	9,4	3,6	25,8	3,2
Biceps	5,1	2,0	13,4	2,5
Pectoral	10,6	4,6	22,0	3,6
Medium armpit	11,6	5,2	34,0	4,2
Abdomen	22,2	10,2	56,3	5,4
Supra iliac	11,8	5,0	31,6	4,1
Thigh	14,4	5,9	36,6	4,7
Calf	8,4	3,3	19,0	3,3

Furthermore skin folds values are important because they allow the observation of body fat topography. Even if hypodermic fat deposition is non-symmetric, once that some determined parts such as sub scapular fold, abdomen and thigh tends to present higher values, it is possible to observe through the values of skin folds if an individual has higher accumulation in the body or in the extremities or else the tendency of a higher accumulation in the lower extremity.

Comparing the values of skin folds from this study to those presented by Rodriguez-Añez and Costa (1999), Scremin (1999) and Rodriguez-Añez (1997) they demonstrate lower values. This is reflected by mean values of the fat percentage of those studies: 12.47%, 9.81% and 12. 97% respectively.

Table 5 - Bones diameter in soccer referees (n=87).

Variable	Mean Value	Std Deviation	Higher Value	Lower Value
Biestilóide	5.92	0.29	6.54	5.20
Biepicondiliano	7.18	0.35	8.00	6.26
Bicondiliano	10.15	0.58	11.90	8.99
Bimaleolar	7.25	0.36	8.27	6.60

The main purpose of bones diameter is to determine bone mass. Mean values found in soccer referees can be observed in Table 5. Even though the absolute values found in referees are bigger, the differences among the groups are minimal. The biggest difference was of 0.49 cm in the bicondiliano diameter between referees in this study and soldiers from Ponta Grossa (PR). The second biggest difference as 0.34 cm also in the bicondiliano diameter between referees and soldiers from Rio Grande do Sul (RS). As there was no information about soccer referees to compare bone diameters the data presented are from other groups. Values found by Rodriguez-Añez and Costa (1999), Scremin (1999) and Petroski (1995) in absolute values and in relation to body mass are respectively: 12.56 kg (17.235), 11.76 kg (17.9%) and 12.09 kg (16.43%).

As can be seen from all comparisons made the anthropometric profile of soccer referees is similar to the average man. It has to be mentioned that the results of this study did not consider the final result of the aptitude test once that the anthropometric evaluation was held before the test and was not conditioned to it. Considering that all individuals were credentialed by FPF this study reveals the profile of this population.

CONCLUSION

The results from this study allow to deduce that soccer referees from Federação Paranaense de Futebol (FPF) present, in average, age of 32.9 4.8 year, height of 175.4 6.9 cm and body mass of 75.4 9.1 kg. When compared to results from other studies with referees, values for body mass and height are very similar. However, when compared to a younger population it can be observed that they tend to present a lower body mass. In relation to body composition data, some few studies demonstrated only body fat percentage information.

The mean fat percentage (16.3 4.1%) found in this study is similar to the value found in Greek referees (16.7 4.5%), but way to lower than those values found in referees from the Federação Catarinense (20.7 5.6%). The results from this study regarding fat percentage are very similar to those expected in non athletes individuals but higher to those found in a younger population such as university students and soldiers.

All other variables from body composition, such as bone and muscular mass, follow the trends and patterns of the average men and distantiate when related to younger individuals. It all allow to conclude that referees from the Federação Paranaense de Futebol have an anthropometric profile typical of the average 30 years old non athlete men.

It is suggested that further studies to identify if the anthropometric profile of better conditioned referees differs from others and yet if there is relation among physical conditioning, anthropometric profile and technical performance during matches.

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ANTHROPOMETRY AND BODY COMPOSITION OF THE SOCCER REFEREE

ABSTRACT

The soccer referee is the authority that makes the game rules to be fulfilled. He supervises, judges and applies the penalties to the players. The performance of his function demands that he has minimal fitness in order to follow the game with a good angle of vision, free of any psychological or physical stress. However, for establishing training programs it is necessary to know the adequate anthropometric profile for this function, beside the physical requirements of this activity. The aim of this study is determine the anthropometric and body composition profiles of the soccer referees of the Federação Paranaense de Futebol (Soccer Federation of Paraná) during the 2000 season. The sample was constituted by 87 referees, which were intentionally choosen. Nine skin folds, 9 perimeters and 4 bone diameters were measured, besides body mass and height. The body density, the fat percent and the masses of fat, bone, residues and muscles were determined using the anthropometric variables. The results of this study lead us to conclude that the soccer referees of the Federação Paranaense de Futebol present a mean age of 32.9 4.8 years, height of 175.4 6.9 cm, and corporal mass of 75.4 9.1 kg. With regard to the body composition data, the mean fat percent was 16.3 4.1%. The results of this study are very similar to the values of the normal population, but higher than the values of younger populations, as university students and soldiers. All other variables of the body composition, as bone and muscular masses, follow this tendency of being closer to the mean normal man and of having a disadvantage regarding younger populations. All these data lead us to conclude that the soccer referee of the Federação Paranaense de Futebol has an anthropometric profile characteristic of the median man with an age of 30 years.

Key-Word: anthropometry, referee, soccer.

ANTHROPOMÉTRIE ET COMPOSITION CORPOREL DE L'ARBITRE DE FOOTBALL

RESUMÈ

L'arbitre de football est l'autorité qui exécute les règles du match. Il supervise, juge et applique les pénalités aux joueurs. L'exécution de sa fonction lui demande au minimum d'aptitude pour accompagner les coups d'um bon angle de vision, libre de pression physique ou psychologique. Toutefois, pour établir des programmes d'entraînement il faut connaître le profil anthropométrique approprié à cette fonction, en plus des exigences physiques de cette activité. Ce travail a comme objectif déterniner le profil anthropométrique et la composition corporalle des arbitres de la Fédération Paranaense de Football pedant la saison 2000. L'échantillon a été constituit par 87 arbitres choisis de manière intentionnelle. On a mesuré 9 plis cutanés, 9 périmètres et 4 diamètres, les osseux, en plus la masse corporalle et la taille. À partir de variables anthropométriques, on a determine la densité corporalle, le pourcentage de graisse et les masses de graisse, les os, les résidus et les muscles. Les résultants de cette étude permettant concluire que les arbitres de football de la Fédération Paranaense de Football présentent une moyenne d'âge de 32,9 ± 4,8, la taille de 175,4 ± 6,9 cm et lê masse corporalle de 75,4 ± 9,1 kg. En ce qui concerne à la composition corporalle, le pourcentage moyen de graisse a été 16,3 ± 4,1%. Les résultants de cette étude ont des valeurs très semblables avec la population normale, mais supérieurs à la valeur trouvée dans des populations plus jeunes, comme les universitaires et le soldants. Toutes les autres variables de la composition corporalle, comme la masse osseuse et musculaire suivent cette tendence de rapprochement avec l'homme à tailler normale et de désavantage si l'on compare avec les populations plus jeunes. Tous ces donnés permettent conclure que l'abitre de la Fédération Paranaense de Football a um profil anthropométrique caractéristique d'um homme dans la trentaine.

Palavras-chave: anthropométrie, arbitre, football.

ANTROPOMETRIA Y COMPOSICIÓN CORPORAL DE ÁRBITROS DE FUTBOL

RESUMEN

El árbitro de fútbol es la autoridad que hace cumplir las reglas del juego. Él supervisa, juzga y aplica las penalidades a los

jugadores. El desempeño de su función exige que posea el mínimo de aptitud para acompañar las jugadas con un buen ángulo de visión, libre de cualquier presión física o sicológica. Sin embargo, para establecer programas de entrenamiento es necesario conocer el perfil antropométrico adecuado para esta función, además de las exigencias físicas de esta actividad. Este trabajo tuvo por objetivo determinar el perfil antropométrico y el de la composición corporal de los árbitros de la Federación Paranaense de Fútbol durante la temporada 2000. La muestra fue constituida por 87 árbitros elegidos de forma intencional. Fueron mensuradas 9 doblas cutáneas, 9 perímetros y 4 diámetros óseos, además de la masa corporal y la estatura. A partir de las variables antropométricas, se determinó la densidad corporal, el porcentual de gordura y las masas de gordura, huesos, residuos y músculos. Los resultados de este estudio permiten concluir que los árbitros de fútbol de la Federación Paranaense de Fútbol presentan una edad media de 32,9 4,8 años, estatura 175,4 6,9 cm, y masa corporal 75,4 9,1 kg. Con respecto a los datos de la composición corporal, el porcentual de gordura mediano fue de 16,3 4,1%. Los resultados de este estudio son muy semejantes a los valores de la población normal, sin embargo superiores a los valores encontrados en poblaciones más jóvenes, como universitarios y soldados. Todas las otras variables de la composición corporal, como masas ósea y muscular, siguen esta tendencia de aproximación con el hombre normal mediano y de desventaja con respecto a las poblaciones más jóvenes. Todos estos datos permiten concluir que el árbitro de la Federación Paranaense de Fútbol posee un perfil antropométrico característico del hombre mediano de 30 años de edad.

Palabras-llave: antropometria, árbitros, futbol.

ANTROPOMETRIA E COMPOSIÇÃO CORPORAL DO ÁRBITRO DE FUTEBOL

RESUMO

O árbitro de futebol é a autoridade que faz cumprir as regras do jogo. Ele supervisiona, julga e aplica as penalidades aos jogadores. O desempenho da sua função exige que possua um mínimo de aptidão para acompanhar as jogadas com um bom ângulo de visão, livre de qualquer pressão física ou psicológica. Contudo, para estabelecer programas de treinamento é necessário conhecer o perfil antropométrico adequado para esta função, além das exigências físicas desta atividade. Este trabalho teve por objetivo determinar o perfil antropométrico e o da composição corporal dos árbitros da Federação Paranaense de Futebol durante a temporada 2000. A amostra foi constituída por 87 árbitros escolhidos de forma intencional. Foram mensuradas 9 dobras cutâneas, 9 perímetros e 4 diâmetros ósseos, além da massa corporal e a estatura. A partir das variáveis antropométricas, determinou-se a densidade corporal, o percentual de gordura e as massas de gordura, ossos, resíduos e músculos. Os resultados deste estudo permitem concluir que os árbitros de futebol da Federação Paranaense de Futebol apresentam uma idade média de 32,9 4,8 anos, estatura 175,4 6,9 cm, e massa corporal 75,4 9,1 kg. Com relação aos dados da composição corporal, o percentual de gordura médio foi de 16,3 4,1%. Os resultados deste estudo são muito semelhantes aos valores da população normal, porém superiores aos valores encontrados em populações mais jovens, como universitários e soldados. Todas as outras variáveis da composição corporal, como massas óssea e muscular, seguem esta tendência de aproximação com o homem normal médio e de desvantagem com relação às populações mais jovens. Todos estes dados permitem concluir que o árbitro da Federação Paranaense de Futebol possui um perfil antropométrico característico do homem médio de 30 anos de idade.

Palavras-chave: antropometria, árbitros, futebol.