López-García, R.; Lagunes-Carrasco, J.O.; Carranza-García, L.E.; Ródenas-Cuenca, L.T.; Morales-Corral, P.G. (201x) Morphological Characteristics in Professional Soccer Referees in Mexico; Anthropometry and Dexa. Revista Internacional de Medicina y Ciencias de la Actividad Física y el Deporte vol. X (X) pp. xx. Http://cdeporte.rediris.es/revista/___*

ORIGINAL

MORPHOLOGICAL CHARACTERISTICS IN PROFESSIONAL SOCCER REFEREES IN MEXICO; ANTHROPOMETRY AND DXA

CARACTERÍSTICAS MORFOLÓGICAS EN ÁRBITROS DE FÚTBOL PROFESIONAL EN MÉXICO; ANTROPOMETRÍA Y DEXA

López-García, R.; Lagunes-Carrasco, J.O.; Carranza-García, L.E.; Ródenas-Cuenca, L.T.; Morales-Corral, P.G.

Doctores en Ciencias de la Actividad Física y Deporte. Docentes e investigadores de la Facultad de Organización Deportiva. Universidad Autónoma de Nuevo León (México). ricardo.lopezgr@uanl.edu.mx, jose.lagunesca@uanl.edu.mx, luis.carranzagr@uanl.edu.mx, luis.rodenascn@uanl.edu.mx, pedro.moralescr@uanl.edu.mx

Spanish-English translator: Sergio Lozano Rodríguez, proyectos.hu@gmail.com
Traductor científico

Código UNESCO / UNESCO code: 2402 Antropología (Física) / Anthropology (Physics)
Clasificación Consejo de Europa / Council of Europe classification: 8. Cinantropometría / Kineanthropometry

Recibido 14 de febrero de 2019 **Received** February 14, 2019
Aceptado 22 de junio de 2019 **Accepted** June 22, 2019

ABSTRACT

The objective of this study was to determine the morphological characteristics of 9 central and 13 assistant soccer referees of the second division of the MX league in Mexico. Anthropometric measurements and evaluations with dual X-ray absorptiometry (DXA) were taken to obtain the fat mass and fat-free mass. In proportionality, the body type method was used to obtain the biotype. The central referees obtained a lower fat percentage (anthropometry and DXA) than the assistant referees, with the latter presenting a body type with greater skeletal muscle robustness. Although the central referees obtained a body condition with less fat than the assistants, by the simple fact that physical demands in a soccer match are two times greater, they were not in agreement with the characteristics of elite referees.

KEYWORDS: referee, soccer, anthropometry, DXA, body fat, somatotype.

RESUMEN

El objetivo de este estudio fue determinar las características morfológicas de 9 árbitros centrales y 13 árbitros asistentes de fútbol de la segunda división de la liga MX en México. Se les tomaron mediciones antropométricas y evaluaciones con la absorciometría dual de rayos X (DEXA) para obtener la masa grasa y la masa libre de grasa. En la proporcionalidad se utilizó en método del somatotipo para poder obtener el biotipo. Los árbitros centrales obtuvieron menor porcentaje graso (antropometría y DEXA) que los árbitros asistentes, presentándose en estos últimos un somatotipo con mayor robustez musculo esquelética. A pesar de que los árbitros centrales obtuvieron un estado corporal con menos grasa que los asistentes, por el simple hecho de que las exigencias físicas en un partido de fútbol son doblemente mayores, no se encontraron acorde a las características que muestran los árbitros de elite.

PALABRAS CLAVES: árbitro, fútbol, antropometría, DEXA, grasa corporal, somatotipo.

INTRODUCTION

Professional soccer referees can cover a distance of up to 14 kilometers during a game (Castagna, & D´Ottavio, 2001; D´Ottavio, & Castagna, 2001; Krustrup, & Bangsbo, 2001) reaching a cardiovascular resistance of 85-95 % of maximal heart rate (Castagna, & D´Ottavio, 2001; Krustrup, & Bangsbo, 2001; Weston, & Brewer, 2002); therefore, their morphological characteristics must be ideal for good performance on the playing field. There is evidence that having a low fat percentage and an adequate body mass index (BMI) correlate with lower times in a sprint test (Sporis, Jukic, Ostojic, & Milanovic, 2009; Wong, & Wong, 2009), with this positively affecting strength and providing grater agility to the athelete (Grigoryan, 2011). Referees are required to perform a large number of high-speed runs, sprints, and changes of directions; thus, the physical requirement during a game is of high demand and having a good health routine can preserve morphology according to physical needs (Weston, Castagna, Impellizzeri, Bizzini, Williams, & Gregson, 2012; Mallo, Navarro, Aranda, & Helsen, 2009).

It is important to remember that the physical demands of central referees and assistant referees are moderately different; assistant referees tend to have a lower physical activity demand because of low sprint requirements and a high activity time walking and trotting during a game (Krustrup, & Bangsbo, 2001). The competitive period of soccer referees in a season is approximately one year, judging a large number of games, with stages of high competition at the end of this period, in which an efficient body condition is necessary to be able to obtain a good physical performance and prevent some injuries during the season (Gabrilo, Ostojic, Idrizovic, Novosel, & Sekulic, 2013; Kemper, Van der Sluis, Brink, Visscher, Frenchken, & Elferink-Gemser, 2015).

Several studies of soccer referees have been carried out; one of the first was in 1994, in which physical performance was evaluated using physical tests (Weston, Drust, Atkinson, & Gregson, 2011; Wang, Haskell, Farrell, LaMonte, Blair, Curtin, & Burt, 2010). Despite this, a detailed assessment of body morphology was not available, especially of body fat and muscle mass, components that should be evaluated because of their direct link with performance. Most of the literature on the assessment of soccer referee morphology only evaluates measurements such as body weight, height, and BMI. Others assess somatotype and many others evaluate body fat through anthropometry and bioelectrical impedance, but morphological studies of referees with another type of measurement method such as DXA, has not been found. In Mexico, there have been few studies on the morphology of professional referees (Díaz, 2016). In this regard, it is essential to carry out research on body assessment using different measurement methods such as anthropometry and DXA. Therefore, the objective of this study was to determine the morphological characteristics in central and assistant professional soccer referees from the second division of the MX league in Mexico.

MATERIAL AND METHOD

This was a descriptive study with the participation of 9 central referees (24.28 ± 3.52 years of age) and 13 assistant referees (25.71 ± 3.53 years of age) from the second division of the MX league in Mexico. All of the referees received an informed consent form that described the project protocol and which they had to accept and sign to participate in the research.

Anthropometric Measures

Anthropometric measurements were made by a level 3 anthropometrist certified by the International Society for the Advancement of Kinanthropometry (ISAK) (Marfell-Jones, Stewart, & De Ridder, 2012). To carry out the measurements, a restricted profile was used (2 basic measurements, 8 skinfolds, 5 girth measurements and 2 bone breadths). In basic measurements, height in centimeters (cm) was obtained with a Seca 213 stadiometer (20 – 205 cm ± 5 mm) and body weight in kilograms (kg) with a Tanita scale (TBF – 300). Later, with the weight and height values, the body mass index (BMI) was obtained with the formula: weight (kg)/height (meters)^2. Skinfolds were measured in millimeters (mm), the triceps, subscapular, biceps, iliac crest, supraspinal, abdominal, anterior thigh, and medial leg, with the Harpenden skinfold caliper (precision: 0.20 mm), later obtaining the sum of the 6 and 8 folds. Girth measurements (cm) were made in the relaxed arm, the contracted arm, the waist, gluteus, and leg, with a Lufkin anthropometric tape. Bone breadths (cm) of the humerus bicondyle and the femoral biepicondyle were made with the Tommy Rosscraft small bone caliper. Following the ISAK protocol, measurements were made in duplicate and the mean was taken as the final value.

After obtaining the anthropometric measurements, the Durnin & Womersley (1974) formula was used to obtain body density: BD = 1.1765 – 0.0744 *[Log(skinfold tríceps + bíceps skinfold + subscapular skinfold + iliac crest skinfold)]; later, the Siri equation (1961) was used to obtain percent body fat (fat = [495/body density] – 450), kilograms of fat (fat = [body weight x percent fat] / 100), and fat-free mass (FFM = body weight – kilograms of fat). For proportionality, the somatype method was used (Carter, Carter, & Heath, 1990) to obtain three biotypes: endomorph, mesomorph, and ectomorph.

Dual-energy X-ray absorptiometry (DXA)

DXA equipment ([GE Healthcare Lunar Technology bone radiodensitometry] was used for body assessment with the enCORE software platform Model LU43616ES). The protocol included full body assessment in the supine position with a minimum of clothing, scanning the entire body in 10 minutes to provide the complete body components of percent fat and kilograms of lean mass.

Statistical analysis

Results of analyses are presented as means and standard deviation. The Kolmogorov-Smirnov test showed a normal distribution of study variables. Student's t-test for independent samples determined the means of the variables of the anthropometric measures, of body components, and the somatotype of the 2 study groups (central and assistant referee). All statistical analyses considered a $p \leq .05$ significant. The statistical analysis was carried out with SPSS IBM statistical software versión 21.0.

RESULTS

Table 1 shows the results of the anthropometric measures. In these, the basic measures of the central referees were a body weight of 71.33 ± 8.63 kg and a height of 175.45 ± 5.61 cm; assistant referees had a body weight of 74.07 ± 7.17

kg and a height of 172.64 ± 6.07 cm; BMI (central referees 23.20 ± 2.88 kg/m^2 and assistant referees, 23.20 ± 2.88 kg/m^2) was within normal range (18.5 kg/m^2 – 24.9 kg/m^2) (WHO, 1999). Regarding skinfolds, bone breadths, and girth measurments, and the sum of the six and eight skinfolds, the assistant referees reached higher values than the central referees, less in the anterior thigh skinfold and the humeral bone breadth ($p > .05$).

Table 1. Results of anthropometric measures (basic measurements, skinfolds, bone breadths, and girth measurements) of central and assistant referees.

Measurements	Central referees	Assistant referees
Basic measurements		
Weight (kg)	71.33 ± 8.63	74.07 ± 7.17
Height (cm)	175.45 ± 5.61	172.64 ± 6.07
BMI (kg/m^2)	23.20 ± 2.88	24.89 ± 2.60
Skinfolds (mm)		
Tríceps	11.09 ± 2.92	11.69 ± 3.68
Subscapular	13.91 ± 3.68	17.22 ± 5.66
Bíceps	4.60 ± 1.02	4.89 ± 1.54
Iliac crest	21.38 ± 6.73	23.46 ± 7.84
Supraspinal	13.03 ± 3.50	13.87 ± 6.25
Abdominal	21.72 ± 7.67	24.21 ± 8.32
Anterior thigh	11.23 ± 2.55	10.65 ± 2.34
Medial leg	6.75 ± 1.73	7.24 ± 2.21
Σ 6 skinfolds	77.77 ± 17.23	84.84 ± 22.91
Σ 8 skinfolds	103.77 ± 23.16	113.30 ± 31.49
Bone breadths (cm)		
Relaxed arm	28.40 ± 2.61	31.05 ± 2.11
Contracted arm	30.05 ± 2.48	32.40 ± 1.93
Waist	78.50 ± 4.87	81.48 ± 5.58
Gluteus	91.07 ± 5.47	95.94 ± 4.53
Leg	35.57 ± 2.87	36.90 ± 2.09
Bone breadths (cm)		
Humerus	6.74 ± 0.23	6.73 ± .039
Femur	9.65 ± .043	9.76 ± 0.73

Σ 6 skinfolds: sum of 6 skinfolds; Σ 8 skinfolds: sum of 8 skinfolds. * $p \leq .05$.

With regard to body components with the anthropometric method and DXA (Table 2), the assistant referees had a higher percent fat value and kilograms of fat than the central referees but there were no significant differences. In relation to kilograms of FFM, the assistant referees had greater values than the central referees ($p > .05$).

Tabla 2. Results of body components (anthropometric and DXA) and somatotype of central and assistant referees.

Measurements	Central referees	Assistant referees
Age	24.28 ± 3.52	25.71 ± 3.53
Anthropometry		
Percent fat	21.32 ± 3.49	22.66 ± 5.13
Kilograms of fat	15.44 ± 3.97	16.93 ± 4.71
Percent FFM	78.67 ± 3.49	77.33 ± 5.13
Kilograms of FFM	55.89 ± 5.06	57.14 ± 5.20
DXA		
Percent fat	20.93 ± 3.02	21.48 ± 4.23
Kilograms of fat	14.80 ± 3.79	14.99 ± 4.26
Kilograms of FFM	53.60 ± 4.97	55.83 ± 5.78
Somatotype		
Endomorph	3.75 ± 1.02	4.22 ± 1.41
Mesomorph	4.15 ± 1.13	5.22 ± 1.01
Ectomorph	2.51 ± 1.58	1.71 ± 1.00

FFM: free fat mass. * $p \leq .05$.

In somatotype, of the nine central referees (Figure 1), 7 had a combination of biotypes between mesomorph and endomorph (4 = meso-endomorphic; 1 = endo-mesomorphic; 2 = mesomorph-endomorph); the other 2 had a balanced ectomorphic biotype. Regarding the 13 assistant referees (figure 2), one presented a balanced biotype, which was mesomorphic, 9 presented a combined biotype between mesomorph and endomorph (5 = meso-endomorphic; 4 = endo-mesomorphic) and 3 had a combined biotype between mesomorph and ectomorph (2 = meso-ectomorphic; 1 = mesomorph-ectomorph). Mean somatotype values of the central referees were 3.75 ± 1.02 in endomorph, 4.15 ± 1.13 in mesomorph and 2.51 ± 1.58 in ectomorph with a mesomorph-endomorph biotype (Table 2). Mean somatotype values of the assistant referees were 4.22 ± 1.41 in endomorph, 5.22 ± 1.01 in mesomorph and 1.71 ± 1.00 in ectomorph with a meso-endomorph biotype (Table 2).

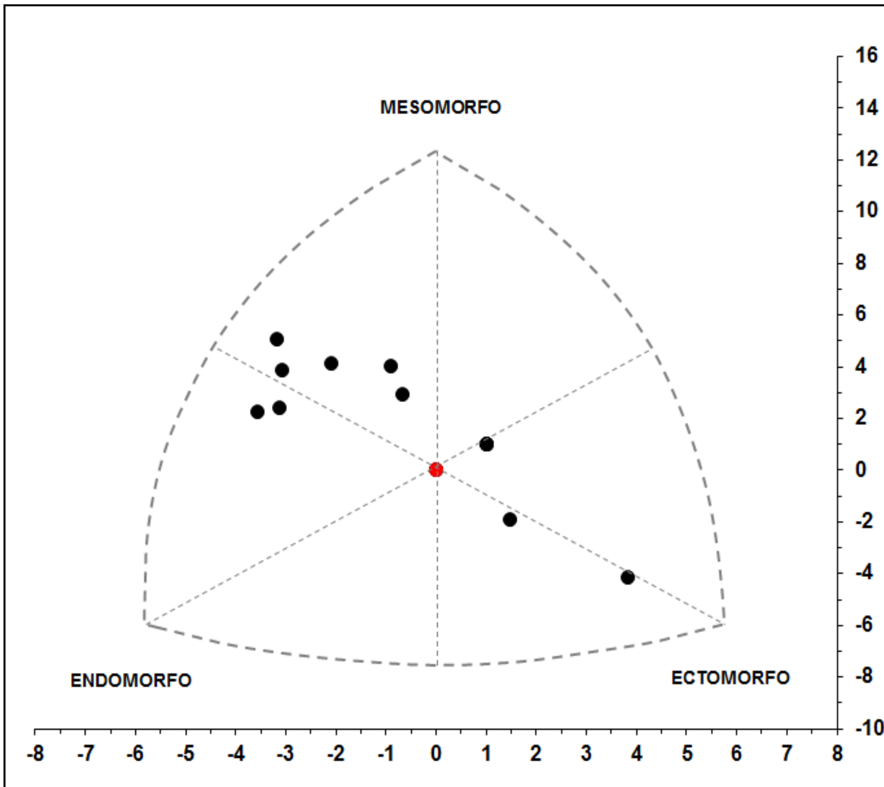

Figure 1. Somatotype distribution of central referees on the somatograph.

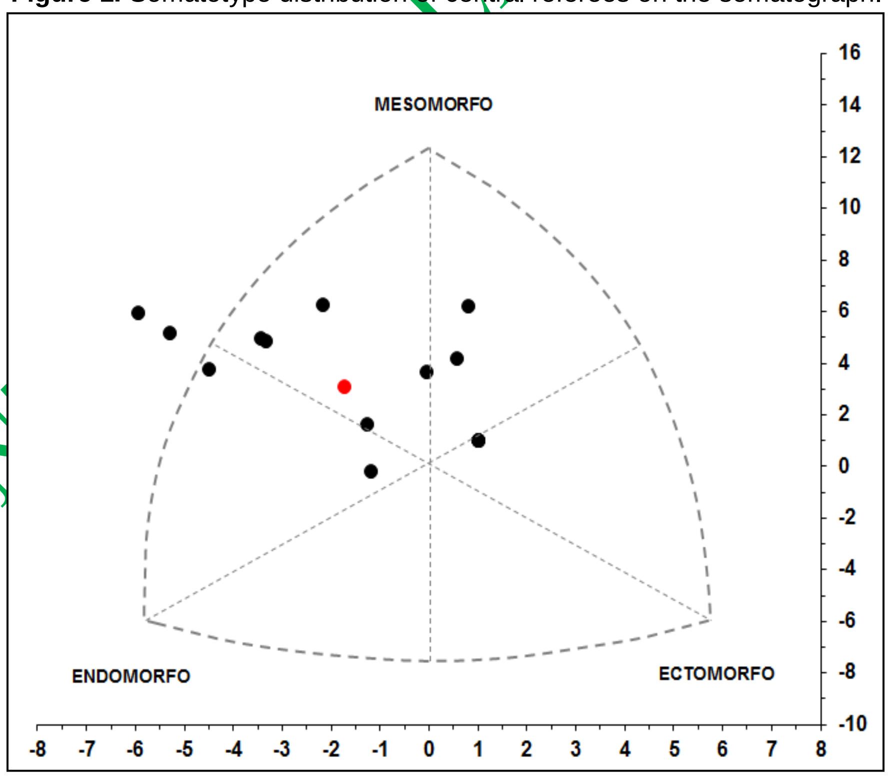

Figure 2. Somatotype distribution of assistant referees on the somatograph.

DISCUSSION

Body assessment of referees goes hand-in-hand with physical preparation. Nowadays, referees should have optimal performance to evaluate and judge, in a timely manner, all plays that occur during a soccer game. Therefore, the objective of this study was to determine the morphological characteristics in central and assistant professional soccer referees. A large number of studies regarding body status of professional soccer referees from different categories have been found in the literature. Our referees belong to the second division of their professional MX league in Mexico, which compares with studies from the same category and even with those from a higher level such as the first division.

Some of the variables of body composition that mainly affect performance are the BMI and fat mass. It has been shown that an increased BMI and a higher fat percentage harm some physical abilities (Reilly, Bangsbo & Franks 2000). In this study, our central referees had a BMI of 23.2 kg/m^2 and a fat percentage of 21.32% with anthropometry, and of 20.93% with DXA. Assistant referees had a BMI of 24.89 kg/m^2 and a fat percentage of 22.66 with anthropometry and of 21.48% with DXA.

Compared to other studies, our central and assistant referees had higher fat percentages, such as the studies performed in elite Brazilian referees (Da Silva, De los Santos, & Cabrera, 2012; Da Silva, Perez, & Fernandez, 2007; Da Silva, & Rodríguez-Añez, 2003), referees from different categories in Spain (Casajús, Matute-Llorente, Herrero, Vicente-Rodríguez, & González-Agüero, 2016; Casajús, & Castagna, 2007; Castillo, Yenci, Casajús, & Cámara, 2016; Irigoyen, Vaíllo, Domínguez, Martín, & Larumbe, 2014), referees from the Premier League of Bosnia and Herzegovina (Talović, Alić, Lakota, Jelešković, Nurković, Tabaković, & Čaušević), referees from the first divison of Chile (Fernández Vargas, Inácio da Silva, & Arruda, 2008), and referees from the first divison of México (Díaz, 2016).

It is important to point out that the mean age of these studies was over 30 years, while our referees had a mean age between 24 and 25 years; in other words, they had less time in the profession, a factor that could have caused the high fat percentage. Although there are studies, such as that by Casajús et al. (2016), which showed that older referees had a greater fat percentage than younger referees. Another important factor to consider in these results is that several studies used different measuring methods such as bioelectric impedance and anthropometry. In anthropometry, there are different equations to obtain the fat percentage; the majority uses the Jackson and Pollock formula (1978) which considers the pectoral skinfold, a measurement that we did not apply in our protocol since we used the equation of Durnin and Womersley which does not consider the pectoral skinfold.

The sum of 6 and 8 skinfolds, which is an indicator to determine body fat, was also used. With this our central and assistant referees obtained a high number in comparison with a longitudinal study of soccer referees of Spain from different national categories during a competitive period (Castillo, Cámara, & Yenci, 2019). Although our work was not a longitudinal study, the evaluation was during a competitive period. Most of our skinfold values agree with those obtained by Castillo et al. (2019), except for the abdominal skinfolds, which are the abdomen and iliac crest, in which we obtained twice the value, concluding that our referees store a large amount of fat mainly in the abdominal area.

Central referees usually cover a mean distance of 11 km per game, almost twice that of an assistant referee who covers a distance of 6.5 km (Weston, Drust, Atkinson, & Gregson 2011, Di Salvo, Carmont, & Maffulli, 2011); this demonstrates a high physical and metabolic demand in central referees, which is why the need to have an adequate body composition according to the requirements of a soccer match is greater. In our results, central referees had a lower percentage of fat than the assistants; this coincides with the study by Casajús et al. (2016) that included a sample of referees from both categories (first and second division), and with the study of Díaz (2016) with a sample of first division referees. In contrast, the studies by Da Silva et al. (2007) and Da Silva & Rodríguez-Añez (2003) showed that assistants with less age than the centrals had a lower fat percentage.

In the somatotype, a difference was found between the two groups of referees: a mesomorph-endomorph biotype in central referees, in which there was a slight predominance of skeletal muscle robustness over adiposity, classifying them, according to the Carter scale, with a moderate level of muscle development and adiposity. Assistant referees showed a meso-endomorphic biotype, in which there was a superiority of skeletal muscle robustness over adiposity, classifying them, according to the Carter scale, with a moderate level of adiposity and a high level of muscle development. Most studies have reported a biotype in which skeletal muscle predominates over adiposity (Da Silva et al., 2007; Fernández Vargas et al., 2008), with younger referees having more mesomorphy (musculoskeletal) than the older referees.

Muscle mass development is related to the performance of high-speed runs and sprints, as our results and those of Díaz (2016), demonstrate. It was observed that the assistant referees who usually do these types of activities have a high mesomorphy value, considering this a greater musculoskeletal development than that of the central referees who present moderate musculoskeletal development. It is important to remember that to obtain a mesomorphy value, some muscle perimeters and bone diameters need to be taken into account; *i.e.*, a high value in this biotype depends on the amount of bone mass of the subject.

CONCLUSIONS

Our results and scientific studies indicate, regarding fat storage, that assistant referees, because they have fewer demands in physical resistance, tend to accumulate more body fat than central referees. Even so, the fat percentage of our central and assistant referees are too high compared to first category or elite referees, although when comparing the adiposity value in the somatotype, we found the same levels in endomorphy (moderate adiposity) as the elite referees. This could be due to the use of different measurement methods or the use of different anthropometric formulas, which yield a variety of fat percentage results in these studies. Monitoring the referee's body condition can be beneficial to obtain good physical preparation, with the aim of having good performance as a field judge.

REFERENCES

Carter, J. L., Carter, J. L., & Heath, B. H. (1990). *Somatotyping: development and applications* (Vol. 5). Cambridge university press.

Casajús, J. A., Matute-Llorente, Á., Herrero, H., Vicente-Rodríguez, G., & González-Agüero, A. (2016). Grasa corporal en los árbitros y árbitros asistentes españoles de fútbol de élite: estudio de seguimiento durante un año. *Apunts: Medicina de l'esport*, *51*(189), 21-26.

Casajus, J. A., & Castagna, C. (2007). Aerobic fitness and field test performance in elite Spanish soccer referees of different ages. *Journal of science and medicine in sport*, *10*(6), 382-389.

Castagna, C., & D'Ottavio, S. (2001). Physiological load imposed on elite soccer referees during actual match play. *Journal of Sports Medicine and Physical Fitness*, *41*(1), 27-32.

Castillo, D., Yanci, J., Casajús, J. A., & Cámara, J. (2016). Physical fitness and physiological characteristics of soccer referees. *Science & Sports*, *31*(1), 27-35.

Castillo, D., Cámara, J., & Yanci, J. (2019). Efecto de un periodo competitivo sobre el perfil antropométrico de árbitros de fútbol. *Revista Internacional de Medicina y Ciencias de la Actividad Física y del Deporte*.

Da Silva, A. I., & Rodriguez-Añez, C. R. (2003). Níveis de aptidão física e perfil antropométrico dos árbitros de elite do Paraná credenciados pela Confederação Brasileira de Futebol (CBF). *Revista Portuguesa de Ciências do Desporto*, *3*(3), 18-26.

Da Silva, A. I., Perez, R. F., & Fernandes, L. C. (2007). Indice de massa corporal e perimetro da cintura de arbitros de futebol da CBF. *Journal of Physical Education*, *18*(1), 41-47.

Da Silva, A. I., de los Santos, H., & Cabrera, C. (2012). Análisis comparativo de la composición corporal de árbitros de fútbol de Brasil y Uruguay. *International Journal of Morphology*, *30*(3), 877-882.

Díaz, L. F. A. (2016). Perfil antropométrico y rendimiento en competencia en árbitros y árbitros asistentes de fútbol soccer profesional mexicano. *Revista Mexicana de Investigación en Cultura Física y Deporte*, *1*(1), 114-131.

Di Salvo, V., Carmont, M. R., & Maffulli, N. (2011). Football officials activities during matches: a comparison of activity of referees and linesmen in European, Premiership and Championship matches. *Muscles, ligaments and tendons journal*, *1*(3), 106.

D'ottavio, S., & Castagna, C. (2001). Analysis of match activities in elite soccer referees during actual match play. *The Journal of Strength & Conditioning Research*, *15*(2), 167-171.

Durnin, J. V., & Womersley, J. V. G. A. (1974). Body fat assessed from total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *British journal of nutrition*, *32*(1), 77-97.

Fernández Vargas, G. E., Inácio da Silva, A., & Arruda, M. (2008). Perfil antropométrico y aptitud física de árbitros del fútbol profesional chileno. *International Journal of Morphology*, *26*(4), 897-904.

Gabrilo, G., Ostojic, M., Idrizovic, K., Novosel, B., & Sekulic, D. (2013). A retrospective survey on injuries in Croatian football/soccer referees. *BMC musculoskeletal disorders*, *14*(1), 88.

Grigoryan, S. (2011). Concept of optimal body composition of professional football players. *Georgian medical news*, (198), 23-28.

Irigoyen, J. Y., Vaíllo, R. R., Domínguez, C. G., Martín, J. J. S., & Larumbe, A. L. A. (2014). Valoración y relación de las características antropométricas y la condición física en árbitros de fútbol. *Revista Española de Educación Física y Deportes*, (406), 15-27.

Jackson, A. S., & Pollock, M. L. (1978). Generalized equations for predicting body density of men. *British journal of nutrition*, *40*(3), 497-504.

Kemper, G. L. J., Van der Sluis, A., Brink, M. S., Visscher, C., Frencken, W. G. P., & Elferink-Gemser, M. T. (2015). Anthropometric injury risk factors in elite-standard youth soccer. *International journal of sports medicine*, *36*(13), 1112-1117.

Krustrup, P., & Bangsbo, J. (2001). Physiological demands of top-class soccer refereeing in relation to physical capacity: effect of intense intermittent exercise training. *Journal of sports sciences*, *19*(11), 881-891.

Mallo, J., Navarro, E., Aranda, J. M. G., & Helsen, W. F. (2009). Activity profile of top-class association football referees in relation to fitness-test performance and match standard. *Journal of sports sciences*, *27*(1), 9-17.

Marfell-Jones, M. J., Stewart, A. D., & De Ridder, J. H. (2012). *International standards for anthropometric assessment*.

Reilly, T., Bangsbo, J., & Franks, A. (2000). Anthropometric and physiological predispositions for elite soccer. *Journal of sports sciences*, *18*(9), 669-683.

Siri, W. (1961). Body composition from fluid spaces and desity. *Techniques for Mensuring Body Composition. Washington, DC: National Academia of Science and National Research Council*.

Sporis, G., Jukic, I., Ostojic, S. M., & Milanovic, D. (2009). Fitness profiling in soccer: physical and physiologic characteristics of elite players. *The Journal of Strength & Conditioning Research*, *23*(7), 1947-1953.

Talović, M., Alić, H., Lakota, R., Jelešković, E., Nurković, N., Tabaković, M., & Čaušević, D. Body composition profile of elite football referees in Bosnia and Herzegovina. *Editors-in-Chief: Dario Škegro*.

Wang, C. Y., Haskell, W. L., Farrell, S. W., LaMonte, M. J., Blair, S. N., Curtin, L. R., & Burt, V. L. (2010). Cardiorespiratory fitness levels among US adults 20–49 years of age: findings from the 1999–2004 National Health and Nutrition Examination Survey. *American journal of epidemiology*, *171*(4), 426-435.

Weston, M., & Brewer, J. (2002). A study of the physiological demands of soccer refereeing. *Journal of Sports Sciences*.

Weston, M., Drust, B., Atkinson, G., & Gregson, W. (2011). Variability of soccer referees' match performances. *International Journal of Sports Medicine*.

Weston, M., Castagna, C., Impellizzeri, F. M., Bizzini, M., Williams, A. M., & Gregson, W. (2012). Science and medicine applied to soccer refereeing. *Sports medicine*, *42*(7), 615-631.

Wong, D. P., & Wong, S. H. (2009). Physiological profile of Asian elite youth soccer players. *The Journal of Strength & Conditioning Research*, *23*(5), 1383-1390.

World Health Organization. (1999). Obesity: preventing and managing the global epidemic: report of a WHO consultation. *WHO Technical Report*, *894*.

Número de citas totales / Total references: 32 (100%)
Número de citas propias de la revista / Journal´s own references: 1 (3.12%)