

**Editor-in-Chief**

Tommy Boone, PhD, MBA

Review Board

Todd Astorino, PhD

Julien Baker, PhD

Steve Brock, PhD

Lance Dalleck, PhD

Eric Goulet, PhD

Robert Gotshall, PhD

Alexander Hutchison, PhD

M. Knight-Maloney, PhD

Len Kravitz, PhD

James Laskin, PhD

Yit Aun Lim, PhD

Lonnie Lowery, PhD

Derek Marks, PhD

Cristine Mermier, PhD

Robert Robergs, PhD

Chantal Vella, PhD

Dale Wagner, PhD

Frank Wyatt, PhD

Ben Zhou, PhD

Official Research Journal of
the American Society of
Exercise Physiologists

ISSN 1097-9751

JEPonline

Body Size and Composition of the Elite Peruvian Soccer Player

Marco Cossio-Bolanos^{1,2}, Daniel Portella⁵, Jefferson E. Hespanhol³,
Nicholas Fraser⁴, Miguel de Arruda¹

¹Faculty of Physical Education, State University of Campinas, São Paulo Brazil, ²Soccer Coaches School, National University San Agustin, Arequipa, Perú, ³Faculty of Physical Education, Catholic University of Campinas, Campinas, Brazil, ⁴Physical Education Department, Ministry of Education – Guyana, ⁵Faculty of Physical Education - School - City University of sao Caetano do Sul / USCS. Professor and researcher GEPEFEX

ABSTRACT

Cossio-Bolanos M, Portella D, Hespanhol JE, Fraser N, Arruda M. Body Size and Composition of the Elite Peruvian Soccer Player. **JEPonline** 2012;15(3):30-38. The assessment of body size and composition is common in estimating relative body fat in footballers. The purpose of this study is to determinate the body size and body composition in soccer players who play in the first league club of Perú. In addition, this study specifies possible differences in the monitored characteristics related to the position each player has in the game. Skinfold and body composition sizes were measured in 68 elite soccer players. The average values were compared between four specific positions in the game (goalkeepers, defenders, midfielders, and attackers). The results indicate that there were no significant differences between playing positions in the variables of body weight, height, age, professional experience, body-fat percentage, and fat mass ($P>0.05$). However midfielders showed lower values of fat-free mass in relation to other playing positions, and they are lower and lighter with regard to the goalkeepers ($P<0.001$). We conclude that the size and body composition are important when analyzing soccer players according to their position, despite the appearance of only minor differences between them.

Key Words: Size, Body Composition, Football, NFL (National Football League)

INTRODUCTION

The assessment of body size and composition is common in disciplines as diverse as nutrition, medicine, anthropology, sport science, and child growth and maturation. Its appraisal in professional football players in the National Football League (NFL) has spanned more than 35 yrs (30). For that reason, several studies have used and continue to use the skinfold method (SKF) in estimating relative body fat in footballers (4,12,21). There are also other assessments of specific anthropometric and fitness characteristics that predispose certain players toward success in soccer (5,22). Clearly, the number of such factors that are relevant to the soccer players' success is a combination of many (22,28).

According to this point of view, the physical composition of the body (i.e., body fat, body mass, and fat-free mass) is relevant in the appraisal and preparation of players for competitive performance (4,22). Physical composition is an important component of fitness because excess adipose tissue acts as dead weight in common game activities such as running and jumping where body mass must be lifted repeatedly against gravity (20).

Consequently, the measurement of body composition in elite soccer players has received widespread attention, especially with regards to playing positions in professional football players in the National Football League (NFL) from several countries. Proof of this is, for example, that research has shown variations in estimated body fat and body mass across playing positions with the highest values generally found in goalkeepers (19,22), although some studies consider that there is generally little difference among the different outfield positions (10,17).

Thus, the purpose of this study was twofold: First, to determinate the body size and composition in soccer players who play in the first league clubs in Perú. Second, to determinate possible differences in the monitored characteristics related to the position in which the footballer plays in the game. Research of this type is important since there is little scientific information about the anthropometric profile of Peruvian soccer players.

METHODS

Experimental Approach to the Problem

The body composition of players from the First Professional Peruvian Soccer League in one season only was evaluated. The assessment took place during the previous competitive period, year 2007/02 and 2008/02. All players at the time of the evaluation performed 8 to 10 training sessions a week with an average of 90 min per day. The number of competitions that took place in the Peruvian Soccer Federation during the evaluation period was 44. All anthropometric assessments were evaluated between 8:00 a.m. and 9:00 a.m. in a laboratory between 20 °C and 24 °C. The evaluation protocol was approved by the ethics committee of the University Sports Institute of the Universidad Nacional de San Agustín. All players were informed about the assessment procedures and signed the consent form.

Subjects

Anthropometric measurements were taken on 68 soccer player during the precompetitive period of 2007/02 and 2008/02. According to the positional roles, the players were categorized as goalkeepers ($n = 8$), defenders ($n = 18$), midfielders ($n = 27$), and attackers ($n = 16$). All the players were members of the Peruvian Football Federation. The Federation comprises 12 football associations. All subjects were in good health (defined as being free from diabetes, heart disease, musculoskeletal dysfunction, cancer, and smoking), and were participating in consistent training at an average of 8 hrs per week.

Procedures

Upon entering the laboratory, the subjects' height was measured using a stadiometer (Holtain) to the nearest 0.1 cm while body mass was obtained to the nearest 0.1 kg using a calibrated balance beam scale (Tanita). Measurements were taken without clothes at the same level of hydration and nourishment as when they were taken in a state of rest. Skinfold thickness at 6 sites was performed using a Harpenden skinfold caliper (British Indicator Ltd, Luton, United Kingdom). The upscale pressure of the caliper was checked according to the manufacturer's specification, and it was constant at 10 g/cm².

Measures were taken at the triceps, subscapula, anterior suprailiac, abdomen, thigh and calf (mm). The landmarks were identified and measured according to Wilmore and Behnke (31) with the median of two measurements used to represent skinfold thickness (intra-observer coefficient of reliability CR=98.5%). The percentage of fat was determined according to the athlete-specific equation of Cossio-Bolaños et al. (6): $\%G = (TR + SE + SI + AB) / (6.0478 * 0.507)$. Fat-free mass and fat-mass values were obtained from the measures of estimated body fat and body mass.

Statistical analysis

All results are reported as means and standard deviations (mean $\pm$ SD) calculated by conventional procedures unless otherwise stated. All calculations were performed using Microsoft Excel and Statistical software SPSS 19 (Chicago, IL, USA). A one-way analysis of variance (ANOVA) was used to examine changes in mean values for each specific position of the players. The Bonferroni adjustment was used for multiple comparisons.

RESULTS

In this study we investigated soccer players of the first division. We evaluated all the anthropometric variables in the summer of 2007-2008. The description of the results for the sample is represented in Table I. The data show the total of players (n=68) indicating the mean, standard deviation, and the range.

Comparisons between playing positions are shown in Table 2. Four specific roles were specified for analysis: goalkeepers, defenders, midfielders, and attackers. Analysis of variance showed no significant differences between the 4 playing positions for the following variables: (a) age; (b) years of professional experience; (c) sum of 6 skinfolds; (d) body fat percentage; and (e) fat mass.

However, significant differences were verified in body mass and height between the goalkeepers versus the midfielders ($P < 0.001$) and fat-free mass between goalkeepers vs. midfielders, midfielders vs. defenders, and midfielders vs. attackers ($P < 0.001$). This shows that the goalkeepers have a higher body mass and height in relation to midfielders. At the same time, according to fat-free mass the goalkeepers, defenders, and attackers had a higher fat-free mass than the midfielders, respectively. Figure 1, 2 and 3 show data comparisons between playing positions.

Table 1. Descriptive Characteristics of the Sample (n = 68).

	Mean	±SD	Range
Age (yr)	27.21	4.99	19.00-36.00
Professional experience (yr)	7.97	4.36	2.00-16.00
Weight (kg)	75.92	7.84	55.70-99.00
Height (m)	1.78	0.06	1.65-1.95
Sum of 6 skinfolds (mm)	57.25	14.75	29.20-99.20
Body fat (%)	11.40	2.94	5.82-19.76
Fat-mass (kg)	8.75	2.78	3.69-15.84
Fat-free mass (kg)	67.17	6.34	50.02-84.37

Table 2. Mean (±SD) for the Body Size and the Body Composition Values by Position.

	Goalkeepers	Defenders	Midfielders	Attackers
	(n = 8)	(n = 18)	(n = 27)	(n = 15)
Age (yr)	27.705±5.27	27.67±4.77	26.41±4.93	27.93±5.65
Professional experience (yr)	9.50±4.21	8.11±3.98	7.19±4.44	8.40±4.84
Weight (kg)	82.57±7.46	76.51±7.65	72.50±7.88	77.83±5.26
Height (m)	1.85±0.03	1.79±0.06	1.74±0.05	1.79±0.06
Sum of 6 skinfolds (mm)	59.45±10.31	56.61±13.52	59.06±16.97	53.59±14.42
Body fat (%)	11.84±2.50	11.28±2.69	11.76±3.38	10.68±2.87
Fat-mass (kg)	9.86±2.41	8.74±2.74	8.66±3.11	8.34±2.49
Fat-free mass (kg)	72.72±5.65	67.77±5.76	63.84±6.10	69.48±4.69

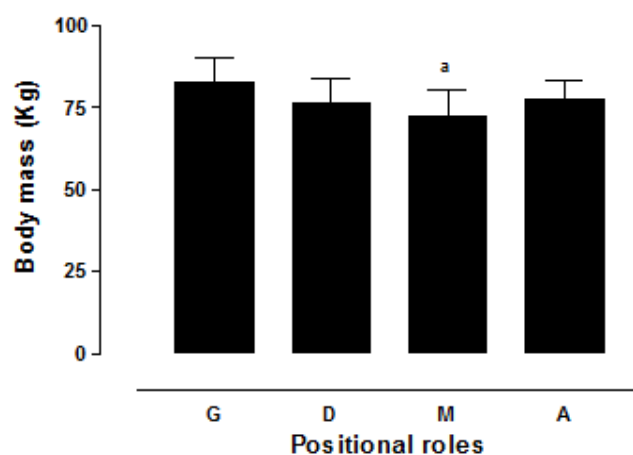


Figure 1. Comparison of the mean estimated body mass across 4 positions in soccer players (n = 68). **G**oalkeepers, **D**efenders, **M**idfielders, and **A**ttackers. ^aSignificant difference between the Goalkeepers and the Midfielders.

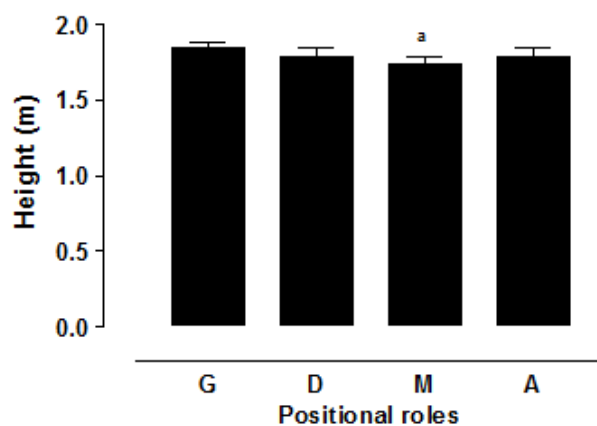


Figure 2. Comparison of the mean estimated height across 4 positions in soccer players (n = 68). **G**oalkeepers, **D**efenders, **M**idfielders, and **A**ttackers. ^aSignificant difference between the Goalkeepers and the Midfielders.

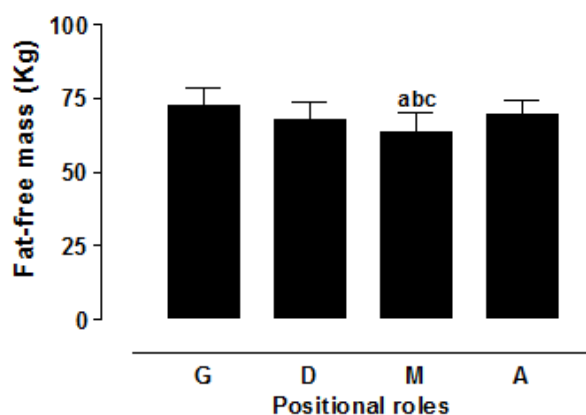


Figure 3. Comparison of the mean estimated fat-free mass across 4 positions in the soccer players (n = 68). **G**Goalkeepers, **D**Defenders, **M**Midfielders, and **A**Attackers. ^aSignificant difference between the Goalkeepers and the Midfielders. ^bSignificant difference between the Defenders and the Midfielders. ^cSignificant difference between the Attackers and the Midfielders.

DISCUSSION

The players of the First Professional Peruvian Soccer League were studied to better understand the differences that may exist between the different positions of soccer players. Interestingly, this study found similar values in terms of age (14,23,25), experience (11,13), body weight and body height (1,14,23,24,25), body fat percentage (4,23,25), fat mass, and fat-free mass (4,10). Yet, while it is well known that there are ethnic factors that may influence a player's average body size (8), the results confirm that the high-level soccer players of Peru are homogeneous in their morphological characteristics (3). There is very little difference between the positions of these professional players (26).

In short, the results show that the goalkeepers have similar values of body mass and height with the defenders and attackers. The goalkeepers were taller only in regards to the midfielders. This finding has been observed in studies along with the defenders (7,26) being the tallest and heaviest players. Although it could have been expected that the defenders would have had similar height values as the goalkeepers, given that body height plays an important role in playing the position, this was not the case. Similar results were found in players from the English Premier League (26), from professional players of Croatia (10), and from professional players of Brazil (15), where the goalkeepers were taller and heavier and the midfielders were the shortest and lightest, respectively.

As to the fat-free mass variable, it was observed that the goalkeepers, defenders, and attackers have higher values than midfielders. Similar results were reported by other studies (4,15), which confirms that the least amount of MLG is associated with a better resistance (16) and higher values of force production (9). Previous studies have shown that midfielders travel greater distances in relation to other positions in the game (27,29). In general, the midfielders are shorter, faster, more agile, and have better resistance than the taller players engaged in defensive positions (16). Therefore, due to

different physiological demands developed during the game (2), the position of play is very important in the interpretation of the morphology of the players.

On the other hand, as to the age of the players, professional experience, sum of skinfolds, and fat mass, the results showed similar averages in all playing positions. However, the studies describe a higher percentage of fat in the goalkeepers and lower values of fat in the midfielders (18,19,25), and older age and professional experience in the goalkeepers (10). In fact, in our study the lack of differences between these variables is probably due to the similarity of the type of specific resistance training developed by all the players, and/or the body type of this specific population or, perhaps, the same level of experience training between playing positions.

Players with the lowest percentage of body fat often have a better performance. Because body fat is a direct reflection of the intensity of training (20), the body composition of soccer players is likely to change during the course of the competitive season as a result of training, competition, and diet (13). In general, the results showed that the size and body composition in the soccer elite players of Peru are similar in relation to international studies. As to the playing positions, there were no significant differences, except that the players who serve as midfielders are those who have only low values of MLG with relation to the other playing positions and they are lower and lighter with regard to the goalkeepers.

CONCLUSION

It is in the interest of the multidisciplinary teams of professional clubs of football to monitor the body composition of players in a constant manner before, during, and after the competitive season, especially as a function of their general position in a game. This means evaluating residual mass, bone mass, muscle mass, and sum of skinfolds in order to verify and support differences between playing positions. Therefore, the main concern of physical conditioning programs throughout a season is to maintain appropriate levels of physiological responses and body composition.

Address for correspondence: Miguel de Arruda. Av. Erico Verissimo 701. Ciudad Universitaria CEP. 13083-851. Campinas, S.P. Brasil. Fone: 0055-19-35216600, E-mail: mcossio1972@hotmail.com

REFERENCES

1. Arruda M, Cossio-Bolaños MA, Portella D. Los pliegues cutáneos como predictores del porcentaje graso en futbolistas profesionales. **Biomecánica**. 2009;17(2):7-14.
2. Bangsbo JL, Norregaard L, Thorso, F. Activity profile of competition soccer. **Can J Sport Sci**. 1991;16:110-116.
3. Bell W, Rhodes G. The morphological characteristics of the association football player. **Br J Sports Med**. 1975;9:196-200.
4. Carling C, Orhant E. Variation in body composition in professional soccer players: interseasonal and intraseasonal changes and the effects of exposure time and player position. **J Strength Cond Res**. 2010;24(5):1332-1339.

5. Carling C, Le Gall F, Reilly T, Williams AM. Do anthropometric and fitness characteristics vary according to birth date distribution in elite youth academy soccer players? **Scand J Med Sci Sports**. 2009;7:3-9.
6. Cossio Bolaños MA, Valdez F, Condori R. Estimación del porcentaje graso a través del método del área superficial en futbolistas. In: Memorias VIII, Congreso Panamericano de Educación Física. Caracas, Venezuela, 2001.
7. Hazir T. Physical characteristics and somatotype of soccer players according to playing level and position. **J Hum Kinetics**. 2010;26:83-95.
8. Hirata R. Physique and age of Tokio Olympic Champions. **J Sport Med Phys Fit**. 1966;6:207-222.
9. Karlsson KM, Karlsson C, Ahlborg HG, Valdimarsson O, Ljunghall S, Obrant KJ. Bone turnover responses to changed physical activity. **Calcified Tissue International**. 2003;72:675-680.
10. Matkovic BR, Misigoj-Durakovic M, Matkovic B, Jankovic S, Ruzic L, Leko G, Kondric M. Morphological differences of elite croatian soccer players according to the team position. **Coll Antropol**. 2003;27(1):167-174.
11. Mirkov DM, Nedeljkovic A, Kukolj M, Ugarkovic D, Jaric S. Evaluation of reliability of soccer-specific field tests. **J Strength Cond Res**. 2008;22:1046-1050.
12. Ostojic SM. Estimation of body fat in athletes: Skinfold vs. bioelectrical impedance. **J Sports Med Phys Fitness**. 2006;46:442-446.
13. Ostojic SJ. Seasonal alterations in body composition and sprint performance of elite soccer players. **JEPonline**. 2003;6(3):11-14.
14. Poulmedis P. Isokinetics maximal torque power of Greek elite soccer players. **JOSPT**. 1985;6(5):293-295.
15. Prado WL, Botero JP, Fernandes Guerra RL, Rodrigues CP, Cuvello LC, e Damaso AR. Perfil antropométrico e ingestão de macronutrientes em atletas profissionais brasileiros de futebol, de acordo com suas posições. **Rev Bras Med Esporte**. 2006;12(2):61-65.
16. Pynea DB, Gardner AS, Sheehanc K, Hopkinsd WG. Positional differences in fitness and anthropometric characteristics in Australian football. **J Sci Med Sport**. 2006;9:143-150.
17. Ramadan J, Byrd R. Physical characteristics of elite soccer players. **J Sports Med Phys Fitness**. 1987;27:424-428.
18. Raven RB, Gettman LR, Pollock, ML. A physiological evaluation of professional soccer players. **Brit J Sports Med**. 1976;10:209-216.
19. Reilly T. **The Science of Training—Soccer**. London, UK: Routledge, 2008.

20. Reilly T. Fitness assessment. In **Science and Soccer**. (Editor). Reilly, T. London: E & FN Spon. Pp. 25-49, 1996.
21. Reilly T, Doran, D. Kinanthropometric and performance profiles of elite Gaelic Footballer. **J Sport Sci**. 1999;17:922.
22. Reilly T, Bangsbo J, Franks A. Anthropometric and physiological predispositions for elite soccer. **J Sports Sci**. 2000;18:669–683.
23. Rienzi E, Drust B, Reilly T, Carter JE, Martin A. Investigation of anthropometric and work-rate profiles of elite South American international soccer players. **J Sports Med Phys Fitness**. 2000;40(2):162-169.
24. Silvestre R, Kraemer WJ, West C, Jedelson DA, Spiering BA, Vingren JL, Hatfield DL, Anderson JM, Maresh CM. Body composition and physical performance during a National Collegiate Athletic Association Division I men's soccer season. **J Strength Cond Res**. 2006;20(4):962-970.
25. Sporis G, Jukic I, Ostojic SM, Milanovic D. Fitness profiling in soccer: physical and physiologic characteristics of elite players. **J Strength Cond Res**. 2009;23(7):1947-1953.
26. Sutton L, Scott M, Wallace J, Reilly T. Body composition of English Premier League soccer players: Influence of playing position, international status, and ethnicity. **J Sports Sci**. 2009;27(10):1019-1026.
27. Tumilty D. Physiological characteristics of elite soccer players. **Sports Med**. 1993;16:80-96.
28. Vaeyens R, Malina RM, Janssens M, Van Renterghem B, Bourgois J, Vrijens J, et al. A multidisciplinary selection model for youth soccer: The Ghent Youth Soccer Project. **Br J Sports Med** 2006;40:928-34.
29. White JE, Emery TM, Kane JE, Groves R, Risman AB. Pre-season fitness profiles of professional soccer players. In **Science and Football** by Reilly T, Lees A, Davids, K, Murphy, WJ. (Editors). London: E. & F.N. Spon. 1988;164-171.
30. Wilmore JH, Haskell WL. Body composition and endurance capacity of professional football player. **J Appl Physiol**. 1972;5:564-567.
31. Wilmore JH, Behnke AR. An anthropometric estimation of body density and lean body weight in young men. **J Appl Physiol**. 1969;27:25-31.

Disclaimer

The opinions expressed in **JEPonline** are those of the authors and are not attributable to **JEPonline**, the editorial staff or the ASEP organization.