

# Anthropometric and Body Composition Profile of Young Professional Soccer Players

María F. Bernal-Orozco,<sup>1</sup> Margarita Posada-Falomir,<sup>2</sup> Celia M. Quiñónez-Gastélum,<sup>3</sup> Luisa P. Plascencia-Aguilera,<sup>3</sup> Juan R. Arana-Nuño,<sup>3</sup> Nayeli Badillo-Camacho,<sup>1</sup> Fabiola Márquez-Sandoval,<sup>1</sup> Francis E. Holway,<sup>4</sup> and Barbara Vizmanos-Lamotte<sup>1</sup>

<sup>1</sup>Doctorate in Translational Nutritional Sciences, Center of Health Sciences, University of Guadalajara, Guadalajara, Jalisco, Mexico; <sup>2</sup>Mexican Federation of Sports Nutrition, Miguel Hidalgo Delegation, Mexico City, Mexico; <sup>3</sup>Nutrition Department, Guadalajara Sports Club, Guadalajara, Jalisco, Mexico; and <sup>4</sup>International Society for the Advancement of Kinanthropometry (Level 4 anthropometrist), Buenos Aires, Argentina

## Abstract

Bernal-Orozco, MF, Posada-Falomir, M, Quiñónez-Gastélum, CM, Plascencia-Aguilera, LP, Arana-Nuño, JR, Badillo-Camacho, N, Márquez-Sandoval, F, Holway, FE, and Vizmanos-Lamotte, B. Anthropometric and body composition profile of young professional soccer players. *J Strength Cond Res* 34(7): 1911–1923, 2020—The purpose was to describe the anthropometric and body composition profile of young professional soccer players and to compare the players profiles between different competitive divisions and playing positions. A retrospective cross-sectional study was carried out with anthropometric data obtained from the records of soccer players of *Club Deportivo Guadalajara, S.A. de C.V.* (Mexico) in the under-17, under-20, second, third, and fourth division categories. Body mass, height, sitting-height, skinfolds, girths, and bone breadths were measured by certified anthropometrists from September 2011 to March 2015, following the procedures recommended by the International Society for the Advancement of Kinanthropometry. Body composition was determined using the 5-way fractionation method. Comparisons between playing positions in each division and between divisions were performed using analysis of variance, and Bonferroni's post-hoc analyses (SPSS version 22 for Windows,  $p < 0.05$  considered as significant). Data from 755 subjects were analyzed. The mean age was  $18.1 \pm 1.7$  years old (minimum 14.8, maximum 23.2). The under-20 division registered higher anthropometric and body composition values than all other competitive divisions. In addition, goalkeepers were taller, heavier, and obtained the highest values for adipose mass, whereas forwards presented higher percentages of muscle mass. These tables can be used during nutritional assessment and nutritional monitoring of players to establish body composition goals. In addition, the strength and conditioning practitioner may also use these data to design effective and specific training programs most suitable to the anthropometric and body composition profile of each player, taking into consideration his competitive division and playing position.

**Key Words:** anthropometry, muscle mass, bone mass, adipose mass, skin mass, residual mass

## Introduction

Body composition involves the analysis of the human body based on the fractionation of total body mass. In the field of sports, its assessment is important because body composition is among the factors that can determine athletic potential and likelihood of success in a particular sport, in combination with technical/tactical, physical, functional, and psychosocial factors (17,34).

In the case of soccer, body fat should be monitored, as appropriate fat levels enable players to move more effectively during training and games. Lean mass, in particular muscle mass, should also be monitored, because inappropriate training loads (those which are excessive or insufficient) can lead to undesirable

changes in physique, which could affect performance factors such as speed, strength, power, and risk of injury (13,41).

Different approaches can be used to assess and determine body composition. Among them is the five-way fractionation method, which divides the human body into skin mass, adipose mass, muscle mass, bone mass, and residual mass based on anthropometric measurements of body mass, skinfolds, body perimeters, and body diameters (39). This anthropometric body composition fractionation method has several advantages over other methods, which is why it is increasingly being used in body composition studies of soccer players (2,3,5–7,21,22,24–26,33,37,42,43,45). These studies have been used to describe body composition by competitive division (first division, under-17 or U-17, under-20 or U-20, etc.) or by age or age group (2,3,6,21,22,24–26,33,37,45), but only a few include body composition analyses according to playing position (goalkeeper, forward, central defender, etc.) (2,5,7,22,42). Playing position is important in this regard because differences in the physiological and metabolic demands of each position may suggest the presence of different anthropometric and body composition characteristics distinctive to position (11), a fact that cannot be represented in general descriptions by competitive category or division.

In Mexico, only 3 studies have been carried out on the anthropometric and body composition profiles of Mexican soccer

Address correspondence to María F. Bernal Orozco, [fera\\_18@yahoo.com.mx](mailto:fera_18@yahoo.com.mx).

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**Table 1****Fourth division's anthropometric and body composition profile according to soccer playing position.\***

Variables	Goalkeepers ( <i>n</i> = 12)	Lateral (outside) defenders ( <i>n</i> = 18)	Central defenders ( <i>n</i> = 20)	Offensive midfielders ( <i>n</i> = 20)	Defensive midfielders ( <i>n</i> = 6)	Forwards ( <i>n</i> = 32)	Total ( <i>n</i> = 108)
Age (y)	15.7 ± 0.4 (15.4–16.0)	15.7 ± 0.3 (15.5–15.9)	15.8 ± 0.4 (15.6–16.0)	15.8 ± 0.3 (15.6–16.0)	15.7 ± 0.2 (15.4–15.9)	15.7 ± 0.3 (15.6–15.8)	15.7 ± 0.4 (15.7–15.8)
<b>Basic</b>							
Mass (kg)	73.4 ± 6.6† (69.1–77.6)	66.1 ± 4.8 (63.7–68.5)	68.7 ± 7.4 (65.3–72.2)	64.3 ± 6.2† (61.4–67.1)	65.4 ± 12.4 (52.4–78.4)	67.6 ± 5.5 (65.7–69.6)	67.5 ± 6.9 (66.2–68.8)
Stature (cm)	181.8 ± 4.5‡ (179–184.7)	171.8 ± 4.4 (172.2–177.9)	175.1 ± 6.1 (169.6–174)	170.8 ± 7.0 (61.4–67.1)	173.5 ± 6.1 (52.4–78.4)	173.4 ± 6.1 (65.7–69.6)	173.9 ± 6.5 (66.2–68.8)
Sitting height (cm)	95.3 ± 2.2‡ (93.9–96.8)	90.0 ± 3.1 (90.8–93.5)	92.1 ± 2.9 (88.5–91.6)	90.9 ± 3.8 (89.1–92.6)	91.0 ± 3.7 (87.1–94.9)	92.1 ± 2.5 (91.2–93)	91.8 ± 3.3 (91.2–92.5)
<b>Skinfolds (mm)</b>							
Triceps	8.8 ± 1.7 (7.7–9.9)	7.9 ± 2.1 (6.8–8.9)	8.4 ± 2.6 (7.2–9.6)	8.5 ± 2.4 (7.3–9.6)	7.0 ± 1.5 (5.4–8.6)	7.1 ± 1.5 (6.6–7.7)	7.9 ± 2.1 (7.5–8.3)
Subscapular	9.5 ± 1.5 (8.5–10.5)	8.8 ± 1.6 (8.0–9.6)	7.9 ± 1.2 (7.4–8.5)	8.6 ± 2.1 (7.6–9.6)	9.1 ± 3.9 (5.0–13.2)	8.1 ± 1.4 (7.6–8.6)	8.5 ± 1.8 (8.1–8.8)
Biceps	3.6 ± 0.7 (3.1–4.0)	3.7 ± 0.9 (3.2–4.1)	3.8 ± 0.7 (3.4–4.1)	3.9 ± 0.8 (3.5–4.2)	3.7 ± 0.7 (3.0–4.4)	3.9 ± 1.4 (3.4–4.3)	3.7 ± 1.0 (3.6–4.0)
Iliac crest	13.3 ± 2.7 (11.6–15.0)	12.4 ± 3.4 (10.8–14.1)	11.4 ± 2.7 (10.2–12.7)	10.6 ± 3.4 (9.1–12.2)	13.1 ± 5.0 (7.9–18.4)	10.7 ± 3.0 (9.6–11.7)	11.5 ± 3.3 (10.9–12.1)
Supraspinal	8.1 ± 2.3§ (6.7–9.6)	7.2 ± 1.8 (6.2–8.1)	6.6 ± 1.5 (5.9–7.3)	6.4 ± 2.1 (5.4–7.4)	8.4 ± 3.9 (4.3–12.5)	6.3 ± 3.0 (5.5–7.0)	6.8 ± 2.2 (6.4–7.2)
Abdominal	13.2 ± 3.9 (10.7–15.7)	12.4 ± 3.9 (10.4–14.3)	11.2 ± 3.1 (9.7–12.6)	11.1 ± 4.4 (9.0–13.2)	15.2 ± 8.5 (6.2–24.1)	11.2 ± 3.9 (9.8–12.6)	11.8 ± 4.3 (11.0–12.6)
Front thigh	10.8 ± 3.4 (8.6–12.9)	9.0 ± 3.4 (7.3–10.7)	9.6 ± 3.1 (8.1–11.1)	9.3 ± 3.4 (7.7–10.9)	9.4 ± 2.2 (7.1–11.8)	8.3 ± 1.8 (7.6–8.9)	9.2 ± 2.3 (8.6–9.7)
Medial calf	8.1 ± 3.1 (6.1–10.0)	6.1 ± 1.7 (5.2–6.9)	6.7 ± 2.2 (5.6–7.7)	6.0 ± 1.4 (5.4–6.7)	6.3 ± 1.2 (5.0–7.6)	6.0 ± 2.0 (5.3–6.7)	6.4 ± 2.1 (6.0–6.8)
<b>Girths (cm)</b>							
Head	56.8 ± 0.8‡ (56.3–57.3)	54.8 ± 0.9 (54.4–55.3)	55.5 ± 1.3 (54.9–56.1)	55.2 ± 0.9 (54.7–55.6)	56.2 ± 1.4 (54.8–57.7)	55.7 ± 1.3 (55.2–56.2)	55.6 ± 1.3 (55.3–55.8)
Arm (relaxed)	29.8 ± 1.8 (28.6–30.9)	28.5 ± 1.7 (27.7–29.3)	28.3 ± 2.5 (27.2–29.5)	27.9 ± 2.3 (26.8–28.9)	27.2 ± 2.9 (24.1–30.2)	28.4 ± 1.7 (27.8–29)	28.4 ± 2.1 (28.0–28.8)
Arm (flexed and tensed)	32.1 ± 1.7 (31.1–33.1)	30.9 ± 1.7 (30.0–31.8)	30.6 ± 2.4 (29.5–31.7)	30.3 ± 2.3 (29.3–31.4)	29.4 ± 2.9 (26.3–32.4)	30.8 ± 1.7 (30.1–31.4)	30.7 ± 2.1 (30.3–31.1)
Forearm (maximum)	26.4 ± 0.7 (26.0–26.9)	25.6 ± 1.2 (24.9–26.2)	25.9 ± 1.4 (25.3–26.6)	25.5 ± 1.2 (24.9–26.1)	25.1 ± 1.9 (23.1–27.1)	25.7 ± 1.3 (25.3–26.2)	25.7 ± 1.3 (25.5–26.0)
Wrist (distal styloids)	16.5 ± 0.2† (16.3–16.6)	15.5 ± 0.5 (15.3–15.8)	16.0 ± 0.7 (15.7–16.3)	15.7 ± 0.7 (15.4–16.1)	15.8 ± 1.2 (14.5–17.1)	15.8 ± 0.6 (15.6–16.1)	15.9 ± 0.7 (15.7–16.0)
Chest (mesosternal)	93.0 ± 4.5 (90.1–95.8)	90.8 ± 3.0 (89.3–92.3)	91.4 ± 3.9 (89.6–93.2)	89.6 ± 4.5 (87.5–91.7)	89.8 ± 8.0 (81.4–98.1)	92.3 ± 3.8 (91.0–93.7)	91.3 ± 4.3 (90.5–92.1)
Waist (minimum)	75.7 ± 3.2 (73.6–77.7)	75.0 ± 2.7 (73.6–76.3)	75.6 ± 3.2 (74.1–77.1)	74.6 ± 2.9 (73.3–76.0)	76.2 ± 7.5 (68.3–84.1)	75.2 ± 2.8 (74.2–76.2)	75.2 ± 3.2 (74.6–75.8)
Gluteal (hips)	95.1 ± 4.1 (92.5–97.6)	93.0 ± 2.7 (91.7–94.4)	93.5 ± 4.9 (91.2–95.7)	92.3 ± 3.9 (90.5–94.1)	91.7 ± 7.0 (84.4–99.0)	93.6 ± 2.9 (92.5–94.6)	93.3 ± 3.4 (92.5–94)
Thigh (1 cm gluteal)	56.5 ± 2.6 (54.8–58.2)	54.5 ± 2.0 (53.4–55.5)	55.5 ± 2.8 (54.2–56.9)	54.3 ± 3.0 (52.9–55.7)	53.6 ± 5.1 (48.2–59.0)	55.4 ± 2.4 (54.6–56.3)	55.1 ± 2.8 (54.6–55.6)
Thigh (mid-troch-tib.lat.)	52.4 ± 2.7 (50.7–54.1)	50.2 ± 2.0 (49.2–51.2)	51.4 ± 2.2 (50.4–52.4)	50.3 ± 2.5 (49.2–51.5)	48.3 ± 5.1 (43.0–53.6)	52.4 ± 5.4 (50.4–54.3)	51.2 ± 3.8 (50.5–52.0)
Calf (maximum)	36.5 ± 1.9 (50.5–52.0)	35.2 ± 1.6 (34.8–36.8)	35.8 ± 2.1 (35.3–37.7)	35.1 ± 2.0 (34.4–36.0)	35.3 ± 3.5 (31.6–39.0)	35.8 ± 1.9 (35.1–36.4)	35.6 ± 2.03 (35.2–36.0)
<b>Bone breadths (cm)</b>							
Biacromial	40.7 ± 1.3§ (39.9–41.6)	38.6 ± 1.8 (37.7–39.5)	39.1 ± 1.9 (38.2–40)	38.6 ± 2.2 (37.6–39.6)	38.8 ± 1.8 (36.9–40.8)	39.2 ± 1.5 (38.6–39.8)	39.1 ± 1.8 (38.8–39.5)
Biilocrystal	28.3 ± 0.9§ (27.7–28.8)	26.7 ± 1.1 (26.2–27.3)	27.6 ± 2.0 (26.6–28.5)	27.2 ± 1.6 (26.4–27.9)	26.8 ± 2.2 (24.5–29.1)	26.8 ± 1.2 (26.4–27.2)	27.2 ± 1.5 (26.9–27.4)
Transverse chest	28.7 ± 1.5 (27.8–29.6)	27.4 ± 0.9 (27–27.9)	27.8 ± 1.6 (27.1–28.6)	27.8 ± 1.5 (27.1–28.5)	28.3 ± 2.1 (26.1–30.6)	28.3 ± 1.5 (27.8–28.9)	28.0 ± 1.5 (27.7–28.3)
Anterior-posterior chest depth	20.1 ± 6.0 (16.3–23.9)	18.2 ± 1.4 (17.5–18.8)	19.1 ± 4.4 (17–21.1)	17.8 ± 1.0 (17.3–18.3)	18.7 ± 1.9 (16.7–20.6)	18.4 ± 1.2 (17.9–18.8)	18.6 ± 3.0 (18–19.1)
Humerus	7.2 ± 0.1† (7.2–7.3)	6.9 ± 0.3 (6.8–7.1)	7.2 ± 0.3 (7.0–7.3)	6.9 ± 0.3† (6.8–7.0)	6.9 ± 0.3 (6.6–7.3)	7.0 ± 0.2 (6.9–7.1)	7.0 ± 0.3 (7.0–7.1)
Femur	10.5 ± 0.4‡ (10.2–10.7)	9.8 ± 0.4 (9.7–10.0)	10.1 ± 0.3 (9.9–10.3)	9.9 ± 0.4 (9.7–10.1)	9.7 ± 0.7 (9.0–10.4)	10.0 ± 0.4 (9.9–10.1)	10.0 ± 0.4 (9.9–10.1)
Wrist (bistylloid)	5.9 ± 0.1 (5.8–5.9)	5.6 ± 0.3‡ (5.5–5.7)	5.9 ± 0.2 (5.8–6.0)	5.7 ± 0.2 (5.6–5.7)	5.7 ± 0.4 (5.2–6.1)	5.7 ± 0.2 (5.7–5.8)	5.7 ± 0.2 (5.7–5.8)
Ankle (bimalleolar)	7.8 ± 0.3† (7.7–8.0)	7.3 ± 0.4† (7.2–7.5)	7.6 ± 0.4 (7.5–7.8)	7.5 ± 0.3 (7.4–7.7)	7.5 ± 0.5 (7.0–8.0)	7.6 ± 0.3 (7.5–7.7)	7.6 ± 0.4 (7.5–7.6)
<b>Body composition</b>							
Adipose mass (kg)	18.6 ± 3.1† (16.6–20.6)	15.2 ± 2.0 (14.2–16.2)	15.8 ± 2.6 (14.6–17.0)	14.6 ± 2.2 (13.6–15.7)	16.1 ± 3.1 (12.8–19.4)	14.7 ± 1.7 (14.1–15.3)	15.5 ± 2.5 (15.0–16.0)
Muscle mass (kg)	33.9 ± 3.5§ (31.7–36.1)	31.9 ± 3.0 (30.3–33.4)	32.8 ± 3.7 (31.0–34.5)	30.5 ± 3.5 (28.9–32.1)	29.9 ± 6.9 (22.6–37.2)	33.2 ± 3.3 (32.1–34.4)	32.3 ± 3.8 (31.6–33.0)
Residual mass (kg)	8.1 ± 0.9 (7.5–8.6)	7.5 ± 0.6 (7.2–7.8)	8.0 ± 1.1 (7.4–8.5)	7.4 ± 0.7 (7.1–7.8)	7.7 ± 1.5 (6.2–9.3)	7.8 ± 0.8 (7.5–8.1)	7.7 ± 0.9 (7.6–7.9)
Bone mass (kg)	8.9 ± 0.7§ (8.4–9.3)	7.8 ± 0.5§ (7.6–8.1)	8.4 ± 1.1 (7.9–8.9)	8.0 ± 1.0 (7.5–8.5)	7.9 ± 1.4 (6.5–9.4)	8.1 ± 0.7 (7.9–8.4)	8.2 ± 0.9 (8.0–8.4)
Skin mass (kg)	4.0 ± 0.2† (3.9–4.1)	3.7 ± 0.2 (3.6–3.8)	3.8 ± 0.3 (3.7–4.0)	3.7 ± 0.3† (3.5–3.8)	3.7 ± 0.3 (3.4–4.0)	3.8 ± 0.3 (3.7–3.9)	3.8 ± 0.3 (3.7–3.8)
Adipose mass (%)	25.2 ± 2.5‡ (23.6–26.8)	23.0 ± 2.5 (21.7–24.3)	22.9 ± 2.3 (21.8–24.0)	22.8 ± 2.3 (21.7–23.8)	24.7 ± 2.8 (21.7–27.7)	21.7 ± 1.7 (21.1–22.3)	22.9 ± 2.4 (22.4–23.4)

**Table 1** Fourth division's anthropometric and body composition profile according to soccer playing position.\* (Continued)

Variables	Lateral (outside)		Central		Offensive		Defensive		Total (n = 108)
	Goalkeepers (n = 12)	defenders (n = 18)	defenders (n = 20)	midfielders (n = 20)	midfielders (n = 20)	Forwards (n = 32)	midfielders (n = 6)	Forwards (n = 32)	
Muscle mass (%)	46.1 ± 2.0‡ (44.9–47.4)	48.2 ± 2.3 (47.0–49.3)	47.7 ± 2.1 (46.7–48.7)	47.4 ± 2.7 (46.2–48.7)	45.5 ± 2.8 (42.6–48.4)	49.0 ± 1.9‡ (48.4–49.8)	47.8 ± 2.4 (47.4–48.3)	49.0 ± 1.9‡ (48.4–49.8)	47.8 ± 2.4 (47.4–48.3)
Residual mass (%)	11.0 ± 1.4 (10.2–11.9)	11.3 ± 0.6 (11.0–11.6)	11.6 ± 1.1 (11.1–12.1)	11.6 ± 0.7 (11.3–11.9)	11.9 ± 0.3 (11.5–12.2)	11.5 ± 0.5 (11.3–11.7)	11.5 ± 0.8 (11.3–11.6)	11.5 ± 0.5 (11.3–11.7)	11.5 ± 0.8 (11.3–11.6)
Bone mass (%)	12.1 ± 1.1 (11.4–12.9)	11.8 ± 0.6 (11.5–12.2)	12.2 ± 0.9 (11.8–12.6)	12.5 ± 1.0 (12.0–12.9)	12.2 ± 0.7 (11.4–12.9)	12.0 ± 1.0 (11.7–12.4)	12.1 ± 1.0 (12.0–12.3)	12.0 ± 1.0 (11.7–12.4)	12.1 ± 1.0 (12.0–12.3)
Skin mass (%)	5.5 ± 0.3 (5.3–5.7)	5.7 ± 0.3 (5.5–5.8)	5.6 ± 0.4 (5.4–5.8)	5.7 ± 0.4 (5.5–5.9)	5.8 ± 0.8 (4.9–6.6)	5.6 ± 0.3 (5.5–5.7)	5.6 ± 0.4 (5.6–5.7)	5.6 ± 0.3 (5.5–5.7)	5.6 ± 0.4 (5.6–5.7)
Other									
Sum of 6 skinfolds (mm)	58.5 ± 12.7 (50.4–66.6)	51.2 ± 12.2 (45.2–57.3)	50.4 ± 11.8 (44.9–55.9)	49.8 ± 12.9 (43.8–55.9)	55.5 ± 19.0 (35.6–75.4)	47.0 ± 9.9 (43.4–50.5)	50.6 ± 12.3 (48.2–52.9)	47.0 ± 9.9 (43.4–50.5)	50.6 ± 12.3 (48.2–52.9)
Muscle-to-bone ratio	3.8 ± 0.4 (3.6–4.1)	4.1 ± 0.3 (3.9–4.2)	3.9 ± 0.4 (3.7–4.1)	3.8 ± 0.5 (3.6–4.0)	3.7 ± 0.3 (3.4–4.1)	4.1 ± 0.5 (3.9–4.3)	4.0 ± 0.4 (3.9–4.1)	4.1 ± 0.5 (3.9–4.3)	4.0 ± 0.4 (3.9–4.1)

\*Data are presented as mean ± SD (95% confidence interval). In case of statistically significant differences, highest or lowest values, according to Bonferroni's post-hoc analyses, are marked. When 2 values are marked in the same row, it is because the statistical difference was observed in only those 2 values.  
 †Analysis of variance,  $p < 0.01$ .  
 ‡ $p < 0.001$ .  
 § $p < 0.05$ .  
 ||Sum of triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf skinfold thicknesses.

players. One of them was done on 21 university players (36) and used a two-component method for determining body composition. The other 2 used the 5-component model: one was done on 15–20-year-old players ( $n = 72$ ) in the Mexican Soccer League (24), whereas the other was conducted on elite players considering playing position ( $n = 290$ ). The latter study was not published in a scientific journal and is difficult to locate (5).

In view of the above considerations, it is evident that the anthropometric characteristics and body composition of Mexican youth players are not known, according to the 5-component methodology, competitive division, and playing position. This information could be of importance not only to a team's medical and nutritional staff when carrying out comparisons against reference standards and determining nutritional goals (11,26,34), but also in strength and conditioning, because it could influence decisions about how to improve each player's on-field performance and develop effective training regimes that maximize young players' development (11). Likewise, the functional and objective data of a training session may help to identify the most effective body composition for each player (13). Body composition profile may also be significant or decisive in the determination of playing position (9,16,20,22,40) and competitive division (12,25,31,34,35,37).

Therefore, the aim of this study was to describe the anthropometric and body composition profiles (as determined by the 5-component method) of young professional Mexican soccer players in the U-17, U-20, second, third, and fourth competitive divisions (by division and playing position) and to compare the profiles of players between positions and competitive divisions.

**Methods**

**Experimental Approach to the Problem**

A descriptive, comparative, retrospective, and cross-sectional study was conducted based on anthropometric assessment data obtained from all players on the U-17, U-20, second, third, and fourth division teams belonging to *Club Deportivo Guadalajara S.A. de C.V.* (commonly known as "Chivas").

A 5-way fractionation method was selected to obtain a body composition profile. This method represents several advantages over other methods: (a) it was validated using cadavers; (b) it is cost-effective (39); (c) it is reliable (intra-observer measurement error in level II anthropometrists is  $\leq 5\%$  for skinfolds and  $\leq 1\%$  for other variables) (14); (d) it is noninvasive; and (e) because of its portability, it is useful, because it can be implemented as many times as needed and almost anywhere. However, because it is based on the anthropometric method, a disadvantage that should be considered is that errors may arise from the use of more than one evaluator. In addition, the method must be administered before training or physical activity sessions to avoid differences associated with hydration status. To prevent these disadvantages from influencing results, subjects were always measured while fasting and before training, and anthropometrists were certified by the International Society for the Advancement of Kinanthropometry (ISAK) at levels 2 and 3, which implies measurement error rates among multiple observers of  $\leq 7.5\%$  for skinfolds and  $\leq 1\%$  for other variables.

**Subjects**

In Mexican professional soccer, 2 league tournament periods are scheduled per year. The first, called *Apertura* (Opening), runs from July to December. The second, called *Clausura* (Closing),

**Table 2****Third division's anthropometric and body composition profile according to soccer playing position.\***

Variables	Third division's anthropometric and body composition profile according to soccer playing position.*						
	Goalkeepers (n = 10)	Lateral (outside) defenders (n = 9)	Central defenders (n = 21)	Offensive midfielders (n = 23)	Defensive midfielders (n = 18)	Forwards (n = 50)	Total (n = 131)
Age (y)	17.0 ± 0.8 (16.4–17.5)	16.7 ± 0.4 (16.4–16.9)	16.6 ± 0.5 (16.3–16.8)	16.9 ± 0.6 (16.7–17.2)	16.9 ± 0.5 (16.6–17.1)	16.6 ± 0.7 (16.4–16.8)	16.7 ± 0.3 (16.6–16.8)
Basic							
Mass (kg)	78.1 ± 6.7† (73.3–83.0)	67.1 ± 5.0 (63.2–70.9)	69.3 ± 5.8 (66.7–71.9)	64.2 ± 3.5 (62.7–65.7)	65.9 ± 5.7 (63.1–68.7)	68.5 ± 5.2 (67.1–70.0)	68.2 ± 6.1 (67.1–69.2)
Stature (cm)	186.7 ± 6.0† (182.4–191.0)	177.7 ± 6.0 (173.2–182.3)	178.2 ± 5.5 (175.7–180.7)	172.0 ± 4.4 (170.1–173.9)	172.7 ± 6.1 (169.7–175.7)	175.3 ± 4.5 (174.0–176.6)	175.9 ± 6.3 (174.8–177.0)
Sitting height (cm)	97.5 ± 2.1† (96.0–99.0)	93.1 ± 2.8 (90.9–95.3)	93.6 ± 2.9 (92.3 to 94.9)	92.0 ± 2.3 (91.0–92.9)	92.3 ± 3.6 (90.4–94.1)	93.3 ± 3.3 (92.4–94.2)	93.3 ± 3.2 (92.7–93.8)
Skinfolds (mm)							
Triceps	9.3 ± 2.9‡ (7.3–11.4)	6.5 ± 1.2 (5.6–7.4)	8.4 ± 3.1 (6.9–9.8)	7.9 ± 2.3 (7.0–8.9)	6.7 ± 1.7 (5.9–7.6)	7.7 ± 1.9 (7.2–8.2)	7.8 ± 2.2 (7.4–8.1)
Subscapular	10.0 ± 2.8 (8.0–12.0)	7.8 ± 1.5 (6.7–8.9)	8.0 ± 1.8 (7.2–8.8)	8.4 ± 2.3 (7.4–9.4)	8.3 ± 2.3 (7.2–9.4)	8.2 ± 1.3 (7.8–8.6)	8.3 ± 1.9 (8.0–8.7)
Biceps	3.7 ± 0.9 (3.1–4.4)	2.9 ± 0.5 (2.6–3.3)	3.6 ± 0.8 (3.2–3.9)	3.6 ± 0.5 (3.4–3.9)	3.5 ± 0.6 (3.2–3.8)	3.8 ± 1.0 (3.5–4.0)	3.6 ± 0.8 (3.5–3.8)
Iliac crest	13.8 ± 6.1 (9.4–18.2)	10.6 ± 3.1 (8.2–13.1)	10.0 ± 2.8 (8.7–11.3)	11.4 ± 3.8 (9.7–13.1)	11.0 ± 4.4 (8.8–13.2)	10.7 ± 3.7 (9.8–11.8)	11.0 ± 3.9 (10.3–11.7)
Supraspinal	8.9 ± 4.5 (5.7–12.1)	6.3 ± 1.6 (5.1–7.5)	6.2 ± 1.8 (5.4–7.1)	6.5 ± 2.6 (5.4–7.7)	6.9 ± 2.9 (5.5–8.3)	6.4 ± 2.1 (5.8–7.0)	6.7 ± 2.5 (6.2–7.1)
Abdominal	14.7 ± 6.5 (10.1–19.3)	11.3 ± 5.2 (7.3–15.3)	11.3 ± 3.8 (9.6–13.1)	11.7 ± 5.1 (9.5–13.9)	11.4 ± 5.1 (8.8–13.9)	11.0 ± 3.6 (10.0–12.0)	11.5 ± 4.5 (10.7–12.3)
Front thigh	9.5 ± 1.8 (8.3–10.8)	7.6 ± 2.1 (6.0–9.2)	9.0 ± 4.0 (7.2–10.9)	8.6 ± 2.1 (7.7–9.5)	8.4 ± 2.2 (7.3–9.5)	8.5 ± 2.1 (7.9–9.1)	8.6 ± 2.5 (8.2–9.0)
Medial calf	7.0 ± 2.3 (5.3–8.6)	4.7 ± 1.4 (3.6–5.7)	5.7 ± 2.0 (4.8–6.7)	6.1 ± 1.5 (5.4–6.7)	5.7 ± 1.5 (4.9–6.5)	5.6 ± 1.6 (5.1–6.0)	5.8 ± 1.7 (5.5–6.1)
Girths (cm)							
Head	56.7 ± 1.0‡ (56.0–57.4)	55.0 ± 0.7 (54.5–55.6)	56.1 ± 1.4 (56.0–57.4)	55.0 ± 1.2 (54.5–55.5)	55.5 ± 1.1 (54.9–56.0)	55.6 ± 1.3 (55.2–56.0)	55.6 ± 1.3 (55.4–55.8)
Arm (relaxed)	30.2 ± 2.5† (28.4–32.0)	28.2 ± 1.4 (27.1–29.3)	27.7 ± 1.6 (26.9–28.4)	27.5 ± 1.9 (26.7–28.3)	28.0 ± 1.8 (27.1–28.9)	28.8 ± 1.2 (28.4–29.1)	28.3 ± 1.8 (28.0–28.6)
Arm (flexed and tensed)	32.9 ± 2.5§ (31.1–34.6)	30.9 ± 1.5 (29.7–32.0)	30.4 ± 1.6 (29.7–31.2)	30.0 ± 2.1 (29.1–30.9)	30.7 ± 1.6 (29.9–31.5)	31.3 ± 1.3 (30.9–31.7)	30.9 ± 1.8 (30.6–31.2)
Forearm (maximum)	27.2 ± 1.0† (26.5–28.0)	25.3 ± 1.1 (24.4–26.1)	25.7 ± 1.3 (25.2–26.3)	25.1 ± 1.1 (24.6–25.6)	25.4 ± 1.0 (24.9–25.9)	25.9 ± 1.0 (25.6–26.1)	25.7 ± 1.2 (25.5–25.9)
Wrist (distal styloids)	16.7 ± 0.5† (16.3–17.1)	15.7 ± 0.7 (15.2–16.3)	16.0 ± 0.5 (15.7–16.2)	15.3 ± 0.6 (15.1–15.6)	15.6 ± 0.7 (15.2–15.9)	15.9 ± 0.7 (15.7–16.1)	15.8 ± 0.7 (15.7–15.9)
Chest (mesosternale)	95.6 ± 4.2‡ (92.6–98.6)	91.4 ± 1.6 (90.1–92.6)	91.5 ± 3.7 (89.9–93.2)	90.5 ± 2.4 (89.4–91.5)	90.7 ± 3.7 (88.9–92.6)	92.1 ± 3.4 (91.1–93.1)	91.8 ± 3.5 (91.1–92.4)
Waist (minimum)	76.8 ± 4.3 (73.7–79.9)	74.3 ± 3.6 (71.6–77.0)	74.8 ± 2.7 (73.5–76.0)	74.4 ± 3.0 (73.1–75.6)	74.4 ± 4.1 (72.3–76.4)	75.2 ± 3.3 (74.2–76.1)	74.9 ± 3.4 (74.3–75.5)
Gluteal (hips)	97.6 ± 4.2‡ (94.6–100.6)	92.8 ± 3.0 (90.5–95.1)	93.9 ± 4.0 (92.0–95.7)	92.5 ± 2.8 (91.3–93.7)	91.9 ± 4.2 (89.7–94.0)	94.3 ± 3.7 (93.2–95.3)	93.7 ± 3.9 (93.0–94.4)
Thigh (1 cm gluteal)	57.5 ± 3.5 (55.0–60.0)	54.2 ± 2.4 (52.4–56.1)	55.4 ± 2.5 (54.3–56.5)	54.8 ± 1.7 (54.0–55.5)	54.9 ± 3.1 (53.3–56.4)	55.7 ± 2.8 (54.9–56.5)	55.4 ± 2.7 (55.0–55.9)
Thigh (mid-troch-tib.lat.)	52.8 ± 3.2 (50.5–55.1)	50.5 ± 2.4 (48.6–52.4)	50.7 ± 1.9 (49.9–51.6)	50.9 ± 1.2 (50.4–51.4)	51.2 ± 3.2 (49.6–52.8)	52.0 ± 2.7 (51.2–52.7)	51.4 ± 2.5 (51.0–51.9)
Calf (maximum)	36.4 ± 2.0 (35.0–37.8)	34.9 ± 3.0 (32.6–37.3)	36.1 ± 2.2 (35.1–37.1)	35.0 ± 1.3 (34.4–35.6)	35.6 ± 2.1 (34.5–36.6)	36.0 ± 1.7 (35.5–36.5)	35.7 ± 1.9 (35.4–36.1)
Bone breadths (cm)							
Biacromial	42.0 ± 0.6† (41.5–42.5)	38.6 ± 1.4 (37.9–41.0)	40.2 ± 1.7 (39.4–41.0)	38.6 ± 1.3 (38.1–39.2)	39.0 ± 1.2 (38.4–39.6)	39.7 ± 1.7 (39.2–40.2)	39.6 ± 1.7 (39.3–39.9)
Biilocrystal	28.3 ± 0.7 (27.8–28.8)	27.4 ± 1.1 (26.6–28.2)	28.0 ± 1.8 (27.2–28.9)	26.8 ± 1.2§ (26.2–27.3)	27.2 ± 1.4 (26.4–27.9)	27.1 ± 1.1 (26.7–27.4)	27.3 ± 1.3 (27.1–27.5)
Transverse chest	28.9 ± 1.4 (27.9–29.9)	27.4 ± 1.2 (26.5–28.3)	27.8 ± 1.4 (27.1–28.4)	27.8 ± 1.2 (27.3–28.3)	28.1 ± 1.9 (27.2–29.1)	27.9 ± 1.6 (27.5–28.4)	27.9 ± 1.5 (27.7–28.2)
Anterior-posterior chest depth	18.5 ± 1.6 (17.4–19.6)	18.2 ± 0.7 (17.7–18.7)	18.7 ± 1.0 (18.3–19.2)	19.2 ± 4.1 (17.5–21.0)	20.6 ± 6.3 (17.5–23.8)	18.4 ± 1.4 (18.0–18.8)	18.9 ± 3.1 (18.4–19.5)
Humerus	7.4 ± 0.3† (7.2–7.7)	7.0 ± 0.5 (6.6–7.3)	7.1 ± 0.3 (7.0–7.2)	6.7 ± 0.3 (6.6–6.9)	7.0 ± 0.3 (6.8–7.1)	7.0 ± 0.3 (6.9–7.1)	7.0 ± 0.4 (6.9–7.1)
Femur	10.7 ± 0.4† (10.4–11.0)	9.9 ± 0.3 (9.7–10.2)	10.1 ± 0.4 (10.0–10.3)	9.8 ± 0.3 (9.7–9.9)	10.0 ± 0.5 (9.7–10.2)	10.1 ± 0.4 (10.0–10.2)	10.1 ± 0.4 (10.0–10.1)
Wrist (bistylloid)	6.0 ± 0.2§ (5.9–6.2)	5.7 ± 0.3 (5.4–5.9)	5.9 ± 0.2 (5.8–6.0)	5.7 ± 0.3 (5.5–5.8)	5.7 ± 0.2 (5.6–5.8)	5.8 ± 0.3 (5.7–5.8)	5.8 ± 0.3 (5.7–5.8)
Ankle (bimalleolar)	7.9 ± 0.3§ (7.7–8.1)	7.6 ± 0.5 (7.2–7.9)	7.8 ± 0.4 (7.7–8.0)	7.5 ± 0.2 (7.4–7.6)	7.4 ± 0.4 (7.2–7.6)	7.6 ± 0.3 (7.5–7.7)	7.6 ± 0.3 (7.5–7.7)
Body composition							
Adipose mass (kg)	20.1 ± 3.4† (17.6–22.5)	15.3 ± 1.4 (14.2–16.3)	16.1 ± 2.5 (15.0–17.2)	14.7 ± 1.8 (13.9–15.4)	14.5 ± 1.6 (13.7–15.2)	15.1 ± 1.9 (14.6–15.7)	15.5 ± 2.5 (15.1–15.9)
Muscle mass (kg)	36.3 ± 3.1† (34.1–38.6)	32.5 ± 3.5 (29.8–35.2)	32.7 ± 3.2 (31.3–34.2)	30.7 ± 1.6 (30.0–31.4)	31.7 ± 3.2 (30.1–33.3)	33.5 ± 2.8 (32.7–34.3)	32.8 ± 3.1 (32.2–33.3)
Residual mass (kg)	8.0 ± 0.8 (7.4–8.6)	7.5 ± 0.6 (7.0–8.0)	7.7 ± 0.6 (7.5–8.0)	7.6 ± 0.8 (7.2–7.9)	7.9 ± 1.3 (7.3–8.6)	7.7 ± 0.8 (7.5–7.9)	7.7 ± 0.8 (7.6–7.9)
Bone mass (kg)	9.6 ± 0.4† (9.3–9.8)	7.9 ± 0.4 (7.6–8.2)	8.8 ± 1.0 (8.3–9.3)	7.6 ± 0.7 (7.3–8.0)	8.1 ± 0.8 (7.7–8.4)	8.4 ± 0.8 (8.1–8.6)	8.3 ± 0.9 (8.2–8.5)
Skin mass (kg)	4.2 ± 0.2† (4.1–4.4)	3.9 ± 0.2 (3.7–4.0)	3.9 ± 0.2 (3.8–4.0)	3.6 ± 0.2 (3.6–3.7)	3.7 ± 0.3 (3.6–3.8)	3.8 ± 0.2 (3.8–3.9)	3.8 ± 0.3 (3.8–3.9)
Adipose mass (%)	25.5 ± 2.4† (23.8–27.2)	22.8 ± 1.6 (21.6–24.0)	23.2 ± 2.6 (22.0–24.4)	22.8 ± 2.0 (21.9–23.6)	22.0 ± 1.6 (21.1–22.8)	22.1 ± 1.9 (21.5–22.6)	22.7 ± 2.2 (22.3–23.1)

**Table 2**

**Third division's anthropometric and body composition profile according to soccer playing position.\* (Continued)**

Variables	Lateral (outside)		Central		Offensive		Defensive		Total (n = 131)
	Goalkeepers (n = 10)	defenders (n = 9)	defenders (n = 21)	midfielders (n = 23)	midfielders (n = 18)	Forwards (n = 50)	midfielders (n = 18)		
Muscle mass (%)	46.5 ± 1.0 (45.7–47.2)	48.4 ± 2.1 (46.8–50.0)	47.3 ± 2.8 (46.0–48.6)	47.9 ± 1.8 (47.1–48.6)	48.2 ± 1.8 (47.3–49.0)	48.8 ± 1.6§ (48.4–49.3)	48.1 ± 2.0 (47.8–48.5)	48.1 ± 2.0 (47.8–48.5)	
Residual mass (%)	10.3 ± 1.2‡ (9.4–11.2)	11.2 ± 0.6 (10.7–11.7)	11.2 ± 0.6 (10.9–11.5)	11.8 ± 1.1 (11.3–12.3)	12.0 ± 1.5 (11.3–12.7)	11.3 ± 0.8 (11.0–11.5)	11.4 ± 1.1 (11.2–11.6)	11.4 ± 1.1 (11.2–11.6)	
Bone mass (%)	12.3 ± 0.7 (11.8–12.8)	11.8 ± 0.5 (11.4–12.2)	12.7 ± 0.8 (12.3–13.0)	11.9 ± 0.9 (11.5–12.3)	12.3 ± 0.9 (11.8–12.7)	12.2 ± 0.9 (12.0–12.5)	12.2 ± 0.9 (12.1–12.4)	12.2 ± 0.9 (12.1–12.4)	
Skin mass (%)	5.4 ± 0.5 (5.1–5.8)	5.8 ± 0.3 (5.6–6.0)	5.7 ± 0.4 (5.5–5.9)	5.7 ± 0.3 (5.5–5.7)	5.6 ± 0.4 (5.4–5.8)	5.6 ± 0.3 (5.5–5.7)	5.6 ± 0.4 (5.6–5.7)	5.6 ± 0.4 (5.6–5.7)	
Other									
Sum of 6 skinfolds (mm)	59.4 ± 19.8 (45.3–73.6)	44.2 ± 9.0 (37.3–51.0)	48.7 ± 15.2 (41.8–55.6)	49.3 ± 12.9 (43.7–54.9)	47.4 ± 13.5 (40.7–54.1)	47.3 ± 10.5 (44.4–50.3)	48.6 ± 13.1 (46.3–50.9)	48.6 ± 13.1 (46.3–50.9)	
Muscle-to-bone ratio	3.8 ± 0.2 (3.6–4.0)	4.1 ± 0.3 (3.9–4.4)	3.8 ± 0.4‡ (3.6–3.9)	4.0 ± 0.3 (3.9–4.2)	4.0 ± 0.4 (3.8–4.1)	4.0 ± 0.3 (3.9–4.1)	4.0 ± 0.3 (3.9–4.0)	4.0 ± 0.3 (3.9–4.0)	

\*Data are presented as mean ± SD (95% confidence interval). In case of statistically significant differences, highest or lowest values, according to Bonferroni's post-hoc analyses, are marked.

†Analysis of variance,  $p < 0.001$ .

‡ $p < 0.05$ .

§ $p < 0.01$ .

||Sum of triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf skinfold thicknesses.

runs from January to May. This study is based on all soccer players' assessment records (from fourth, third, second, U-17, and U-20 competitive divisions), carried out at the mid-point of each tournament period from *Apertura* 2011 (September 2011) to *Clausura* 2015 (March, 2015). Hence, the study covered a total of 8 tournament periods. A total of 755 individual player records were analyzed: 14.3% were from fourth division, 17.4% from third, 22.5% from U-17, 22.4% from second division, and 23.4% from U-20. The average age was  $18.1 \pm 1.7$  (the lowest was 14.8 and the highest was 23.2). Subjects were free from injuries and health problems that could have affected the study's results.

The study was approved by the Ethics and Research Committee of the University of Guadalajara's Center of Health Sciences and was carried out in accordance with the Declaration of Helsinki guidelines, which call for the dignity and integrity of the individuals from whose records study data are collected to be respected.

All soccer players sign a club's informed consent when they are accepted in the club. Parental or guardian signed consent is obtained in the case of players under 18 years of age. This consent includes information about the benefits and risks of recurrent anthropometric measurements. Consequently, all soccer players voluntarily participate in anthropometric measurements with the consent of their parents (when needed).

To safeguard the privacy of the study subjects and the confidentiality of their personal data, and in accordance with article 3 of the Federal Data Protection Law of Mexico, a disassociation procedure was used from records. This procedure ensures that personal data cannot be associated with the holder of the data or enables—because of the data's structure, content, or disaggregation level—the holder to identify the subject.

**Procedures**

The soccer team's anthropometrists created a Microsoft Excel database containing player anthropometric and body composition data from 8 tournaments played between September 2011 and March 2015. Players were only identified by a registration number and pseudonym, thus preventing their data from being associated with their personal identity. This database was adjusted as needed for subsequent analysis.

The methodology for the anthropometric evaluation is described as follows: Anthropometric assessments were performed at Club Deportivo Guadalajara's Department of Nutrition during the early morning hours. Evaluation sessions were scheduled on a specific day for each category at a time midway through the tournament period. Subjects were assessed before training sessions while fasting and following urination. During the procedure, they wore only Lycra shorts. Anthropometric assessments were performed by 4 anthropometrists, 3 of whom had ISAK certification at level 2 and one at level 3 in accordance with ISAK's international standards (14). It is important to note that subjects were generally evaluated by the same anthropometrists, although this was not always the case.

Each subject was assessed for body mass or mass using a Tanita model HD-313 scale (Tanita Corporation, Tokyo, Japan) with a 150-kg capacity and accuracy to the nearest 0.1 kg. Height was measured with a Seca model HR-222 stadiometer (SECA GMBH & Co., Hamburg, Germany) with a measuring range up to 230 cm and accuracy to 0.1 cm. Sitting height was measured with the same SECA model HR-222 stadiometer and a wooden box measuring 40 cm in height, 50 cm in length, and 30 cm in width. Eight skinfold measurements were taken with a Harpenden caliper (Baty International, RH15 9LB, England, width of 80 mm and accuracy to 0.2 mm) from the following defined ISAK sites:

**Table 3****Under-17 category's anthropometric and body composition profile according to soccer playing position.\***

Variables	Lateral (outside)							Central		Offensive		Defensive		Forwards (n = 38)		Total (n = 170)	
	Goalkeepers (n = 17)	defenders (n = 22)	defenders (n = 24)	midfielders (n = 40)	midfielders (n = 29)	midfielders (n = 29)	Forwards (n = 38)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	Total (n = 170)	
Age (y)	17.5 ± 0.4 (17.3–17.7)	17.7 ± 0.4† (17.5–17.9)	17.7 ± 0.4† (17.5–17.8)	17.5 ± 0.6 (17.3–17.7)	17.6 ± 0.5 (17.5–17.8)	17.3 ± 0.6 (17.1–17.5)	17.5 ± 0.5 (17.4–17.6)										
Basic																	
Mass (kg)	78.2 ± 4.2‡ (76.0–80.4)	68.5 ± 4.4 (66.5–70.4)	72.6 ± 4.7 (70.6–74.6)	64.5 ± 5.5 (62.8–66.3)	68.2 ± 6.0 (65.9–70.4)	70.1 ± 7.3 (67.7–72.5)	69.4 ± 6.8 (68.4–70.5)										
Stature (cm)	187.1 ± 3.9‡ (185.1–189.1)	175.3 ± 5.2 (173.0–177.6)	181.4 ± 4.1 (179.7–183.2)	171.4 ± 4.2 (170.0–172.7)	175.1 ± 5.0 (173.2–177.0)	174.9 ± 6.4 (172.8–177.0)	176.3 ± 6.8 (175.3–177.3)										
Sitting height (cm)	97.5 ± 1.6‡ (96.7–98.3)	91.5 ± 3.5 (89.9–93.0)	94.2 ± 1.8 (93.4–95.0)	91.5 ± 3.2 (90.4–92.5)	93.0 ± 2.7 (92.0–94.0)	92.8 ± 2.9 (91.9–93.8)	93.0 ± 3.3 (92.5–93.5)										
Skinfolds (mm)																	
Triceps	8.8 ± 1.5† (8.1–9.6)	7.0 ± 1.5 (6.3–7.6)	7.8 ± 2.1 (6.9–8.6)	7.0 ± 2.5 (6.2–7.8)	7.1 ± 1.3 (6.6–7.6)	7.5 ± 1.8 (6.9–8.0)	7.4 ± 1.9 (7.1–7.7)										
Subscapular	9.1 ± 1.6 (8.3–9.9)	8.1 ± 1.1 (7.6–8.5)	8.8 ± 2.0 (7.9–9.6)	8.2 ± 1.5 (7.7–8.7)	7.9 ± 1.3 (7.4–8.4)	8.5 ± 1.7 (8.0–9.1)	8.4 ± 1.6 (8.1–8.6)										
Biceps	3.3 ± 0.7 (2.9–3.6)	3.2 ± 0.8 (2.9–3.6)	3.2 ± 0.7 (2.9–3.5)	3.5 ± 1.0 (3.2–3.8)	3.2 ± 0.7 (3.0–3.5)	3.6 ± 0.9 (3.3–3.9)	3.4 ± 0.8 (3.2–3.5)										
Iliac crest	13.9 ± 4.5§ (11.6–16.3)	10.2 ± 3.4 (8.7–11.7)	11.8 ± 2.7 (10.7–13.0)	10.2 ± 3.3 (9.1–11.3)	10.8 ± 3.3 (9.5–12.0)	12.2 ± 3.9 (10.9–13.5)	11.3 ± 3.7 (10.8–11.9)										
Supraspinal	8.0 ± 2.0 (6.9–9.0)	6.4 ± 2.1 (5.4–7.3)	7.4 ± 2.5 (6.4–8.5)	6.5 ± 2.2 (5.8–7.2)	6.6 ± 2.3 (5.7–7.5)	6.8 ± 1.8 (6.2–7.3)	6.8 ± 2.2 (6.5–7.2)										
Abdominal	14.0 ± 3.8† (12.0–15.9)	10.6 ± 2.5 (9.5–11.7)	11.7 ± 3.7 (10.2–13.3)	10.5 ± 3.5 (9.3–11.6)	10.6 ± 3.7 (9.1–12.0)	11.7 ± 4.0 (10.4–13)	11.3 ± 3.7 (10.7–11.9)										
Front thigh	10.2 ± 3.0 (8.7–11.8)	8.7 ± 3.2 (7.3–10.1)	9.6 ± 3.0 (8.3–10.9)	8.3 ± 3.2 (7.3–9.3)	8.5 ± 2.0 (7.8–9.3)	8.9 ± 2.2 (8.1–9.6)	8.9 ± 2.8 (8.5–9.3)										
Medial calf	7.1 ± 2.3‡ (5.9–8.3)	5.2 ± 1.5 (4.6–5.8)	6.4 ± 1.9 (5.7–7.2)	5.3 ± 1.6 (4.7–5.8)	5.3 ± 0.9 (4.9–5.6)	5.4 ± 1.3 (5.0–5.8)	5.6 ± 1.7 (5.4–5.9)										
Girths (cm)																	
Head	56.6 ± 1.5 (55.8–57.3)	55.6 ± 1.0 (55.1–56.0)	56.5 ± 1.4 (55.9–57.1)	55.3 ± 1.7§ (54.7–55.8)	56.3 ± 1.3 (55.8–56.8)	56.1 ± 1.1 (55.8–56.5)	56.0 ± 1.4 (55.8–56.2)										
Arm (relaxed)	30.4 ± 1.8§ (29.4–31.3)	29.2 ± 1.3 (28.6–29.7)	28.7 ± 1.5 (28.1–29.4)	28.4 ± 1.6 (27.9–28.9)	28.7 ± 1.7 (28.1–29.4)	29.4 ± 1.4 (29.0–29.9)	29.0 ± 1.6 (28.8–29.3)										
Arm (flexed and tensed)	32.9 ± 1.7‡ (32.0–33.8)	32.1 ± 1.5 (31.5–32.8)	31.8 ± 1.4 (31.2–32.4)	30.9 ± 1.4 (30.5–31.4)	31.4 ± 1.7 (30.7–32.0)	31.9 ± 1.5 (31.4–32.4)	31.7 ± 1.6 (31.4–31.9)										
Forearm (maximum)	27.4 ± 1.0‡ (26.9–27.9)	26.2 ± 1.2 (25.7–26.7)	26.1 ± 1.2 (25.6–26.6)	25.7 ± 1.2 (25.3–26.1)	25.8 ± 1.2 (25.3–26.2)	26.3 ± 1.3 (25.9–26.8)	26.1 ± 1.3 (26.0–26.3)										
Wrist (distal styloids)	16.5 ± 0.5‡ (16.2–16.8)	15.5 ± 0.7 (15.3–15.8)	15.9 ± 0.7 (15.6–16.2)	15.7 ± 0.6 (15.5–15.9)	15.7 ± 0.6 (15.5–15.9)	15.7 ± 0.7 (15.7–15.9)	15.8 ± 0.7 (15.7–15.9)										
Chest (mesosternale)	96.4 ± 3.2‡ (94.7–98)	93.5 ± 2.7 (92.3–94.7)	93.3 ± 4.1 (91.5–95.0)	90.8 ± 2.9 (89.9–91.8)	91.9 ± 3.2 (90.7–93.1)	94.1 ± 4.5 (92.7–95.6)	93.0 ± 3.9 (92.4–93.6)										
Waist (minimum)	77.1 ± 3.3 (75.4–78.8)	75.1 ± 2.5 (74.0–76.2)	76.4 ± 2.6 (75.3–77.5)	74.1 ± 2.9§ (73.2–75.0)	75.1 ± 2.9 (74.0–76.2)	76.3 ± 3.5 (75.2–77.5)	75.5 ± 3.1 (75.1–76.0)										
Gluteal (hips)	97.4 ± 2.8‡ (96–98.8)	93.8 ± 3.3 (92.4–95.3)	96.5 ± 2.7 (95.4–97.7)	91.7 ± 3.8 (90.4–92.9)	93.7 ± 3.5 (92.3–95.0)	94.5 ± 4.4 (93.1–95.9)	94.2 ± 4.0 (93.6–94.8)										
Thigh (1 cm gluteal)	58.3 ± 2.9‡ (56.7–59.8)	55.9 ± 2.4 (54.8–57.0)	56.5 ± 2.6 (55.4–57.6)	54.5 ± 2.6 (53.7–55.3)	55.2 ± 2.5 (54.2–56.1)	56.4 ± 4.0 (55.4–57.4)	55.9 ± 2.9 (55.5–56.3)										
Thigh (mid-troch-tib.lat.)	53.5 ± 2.7† (52.2–54.9)	52.1 ± 2.8 (50.9–53.3)	51.6 ± 1.8 (50.8–52.4)	51.3 ± 2.4† (50.5–52.0)	51.6 ± 2.4 (50.7–52.5)	52.6 ± 3.2 (51.5–53.6)	52.0 ± 2.7 (51.6–52.4)										
Calf (maximum)	36.6 ± 1.4 (35.9–37.3)	35.7 ± 1.5 (35.0–36.3)	36.2 ± 1.7 (35.5–36.9)	35.5 ± 1.9 (34.9–36.1)	35.8 ± 1.9 (35.1–36.6)	36.5 ± 1.8 (35.9–37.1)	36.0 ± 1.8 (35.7–36.3)										
Bone breadths (cm)																	
Biacromial	42.2 ± 1.3‡ (41.5–42.9)	40.4 ± 1.6 (39.7–41.1)	40.2 ± 0.8 (39.8–40.5)	39.2 ± 1.1 (38.8–39.5)	39.7 ± 1.7 (39.0–40.4)	39.6 ± 1.9 (39.0–40.3)	40.0 ± 1.7 (39.7–40.2)										
Biilocrystal	28.5 ± 1.2‡ (27.9–29.1)	26.7 ± 1.2 (26.2–27.3)	28.1 ± 1.1 (27.6–28.5)	26.1 ± 1.3 (25.7–26.5)	27.2 ± 1.3 (26.7–27.7)	26.7 ± 1.1 (26.3–27.0)	27.0 ± 1.4 (26.8–27.2)										
Transverse chest	29.1 ± 1.7 (28.2–30.0)	27.8 ± 1.6 (27.1–28.5)	29.0 ± 1.4 (28.4–29.6)	27.9 ± 0.9§ (27.6–28.1)	27.9 ± 0.9 (27.6–28.2)	28.5 ± 2.0 (27.8–29.1)	28.3 ± 1.5 (28.1–28.5)										
Anterior-posterior chest depth	18.8 ± 1.6 (18.0–19.6)	18.9 ± 1.0 (18.5–19.3)	18.6 ± 1.3 (18.0–19.1)	19.0 ± 1.0 (18.7–19.3)	18.5 ± 1.2 (18.1–19.0)	19.2 ± 1.4 (18.7–19.6)	18.9 ± 1.2 (18.7–19.0)										
Humerus	7.3 ± 0.2‡ (7.1–7.4)	6.9 ± 0.4 (6.7–7.1)	7.0 ± 0.4 (6.9–7.2)	6.8 ± 0.3 (6.7–6.9)	6.9 ± 0.3 (6.8–7.0)	7.0 ± 0.3 (6.9–7.1)	7.0 ± 0.3 (6.9–7.0)										
Femur	10.4 ± 0.3‡ (10.3–10.6)	9.9 ± 0.4 (9.7–10.1)	10.1 ± 0.3 (10.0–10.3)	9.8 ± 0.4 (9.7–10.0)	9.9 ± 0.5 (9.8–10.1)	9.9 ± 0.4 (9.8–10.1)	10.0 ± 0.4 (9.9–10.1)										
Wrist (bistylloid)	6.0 ± 0.2‡ (5.9–6.1)	5.7 ± 0.3 (5.5–5.8)	5.8 ± 0.3 (5.7–5.9)	5.7 ± 0.2 (5.6–5.7)	5.7 ± 0.3 (5.6–5.8)	5.7 ± 0.2 (5.6–5.8)	5.7 ± 0.3 (5.7–5.8)										
Ankle (bimalleolar)	8.0 ± 0.3‡ (7.8–8.1)	7.4 ± 0.2 (7.3–7.5)	7.7 ± 0.3 (7.6–7.9)	7.4 ± 0.3 (7.3–7.5)	7.6 ± 0.3 (7.5–7.7)	7.5 ± 0.3 (7.4–7.6)	7.6 ± 0.3 (7.5–7.6)										
Body composition																	
Adipose mass (kg)	19.5 ± 2.2‡ (18.4–20.7)	14.8 ± 1.9 (13.9–15.6)	17.4 ± 2.2 (16.5–18.4)	13.9 ± 2.2 (13.2–14.6)	14.9 ± 1.3 (14.4–15.4)	15.2 ± 2.2 (14.5–15.9)	15.5 ± 2.6 (15.1–15.9)										
Muscle mass (kg)	37.0 ± 2.3‡ (35.8–38.2)	34.1 ± 2.7 (32.9–35.3)	34.4 ± 3.4 (32.9–35.8)	31.8 ± 2.9 (30.8–32.7)	33.4 ± 3.7 (32.0–34.8)	35.0 ± 4.4 (33.5–36.4)	34.0 ± 3.7 (33.4–34.5)										
Residual mass (kg)	8.1 ± 0.7 (7.8–8.5)	7.7 ± 0.7 (7.4–8.0)	8.2 ± 0.6§ (7.9–8.5)	7.5 ± 0.7 (7.3–7.8)	7.8 ± 0.8 (7.5–8.1)	8.1 ± 1.0 (7.8–8.4)	7.9 ± 0.8 (7.8–8.0)										
Bone mass (kg)	9.3 ± 0.8‡ (8.9–9.8)	8.2 ± 0.8 (7.8–8.5)	8.6 ± 0.5 (8.4–8.8)	7.7 ± 0.8 (7.5–7.9)	8.3 ± 0.9 (7.9–8.6)	8.1 ± 0.7 (7.8–8.3)	8.2 ± 0.9 (8.1–8.4)										
Skin mass (kg)	4.2 ± 0.2‡ (4.1–4.3)	3.8 ± 0.2 (3.7–3.9)	4.0 ± 0.2 (4.0–4.1)	3.6 ± 0.2 (3.5–3.7)	3.8 ± 0.3 (3.7–3.9)	3.8 ± 0.3 (3.7–3.9)	3.8 ± 0.3 (3.8–3.9)										
Adipose mass (%)	24.9 ± 1.9‡ (23.9–25.9)	21.5 ± 2.5 (20.4–22.7)	24.0 ± 2.8 (22.8–25.2)	21.5 ± 2.3 (20.8–22.2)	21.9 ± 1.7 (21.3–22.6)	21.6 ± 2.3 (20.9–22.4)	22.3 ± 2.5 (21.9–22.7)										

**Table 3** Under-17 category's anthropometric and body composition profile according to soccer playing position.\* (Continued)

Variables	Lateral (outside)		Central		Offensive		Defensive		Total (n = 170)
	Goalkeepers (n = 17)	defenders (n = 22)	defenders (n = 24)	midfielders (n = 40)	midfielders (n = 29)	Forwards (n = 38)			
Muscle mass (%)	47.3 ± 1.6 (46.5-48.2)	49.8 ± 2.3 (48.8-50.8)	47.3 ± 2.7† (46.1-48.4)	49.2 ± 1.9 (48.6-49.8)	48.9 ± 1.8 (48.2-49.6)	49.8 ± 2.3 (49.1-50.6)	48.9 ± 2.3 (48.6-49.3)		
Residual mass (%)	10.4 ± 0.7‡ (10.0-10.8)	11.2 ± 0.6 (11.0-11.5)	11.3 ± 0.4 (11.1-11.5)	11.7 ± 0.8 (11.5-12.0)	11.4 ± 0.6 (11.2-11.7)	11.5 ± 0.7 (11.3-11.8)	11.4 ± 0.8 (11.3-11.5)		
Bone mass (%)	12.0 ± 1.2 (11.3-12.6)	11.9 ± 0.8 (11.6-12.2)	11.9 ± 0.8 (11.6-12.2)	12.0 ± 1.0 (11.6-12.3)	12.1 ± 0.7 (11.8-12.4)	11.5 ± 0.7 (11.3-11.8)	11.9 ± 0.9 (11.7-12.0)		
Skin mass (%)	5.4 ± 0.4 (5.2-5.6)	5.5 ± 0.2 (5.4-5.6)	5.6 ± 0.4 (5.4-5.7)	5.6 ± 0.3† (5.5-5.7)	5.6 ± 0.3† (5.5-5.7)	5.5 ± 0.3 (5.4-5.6)	5.5 ± 0.3 (5.5-5.6)		
Other									
Sum of 6 skinfolds (mm)	57.2 ± 11.5§ (51.3-63.1)	45.9 ± 9.8 (41.6-50.3)	51.7 ± 13.3 (46.1-57.4)	45.8 ± 12.1 (41.9-49.6)	45.9 ± 7.9 (42.9-48.9)	48.7 ± 10.9 (45.1-52.3)	48.5 ± 11.5 (46.7-50.2)		
Muscle-to-bone ratio	4.0 ± 0.5 (3.8-4.2)	4.2 ± 0.4 (4.0-4.4)	4.0 ± 0.4 (3.8-4.2)	4.1 ± 0.4 (4.0-4.3)	4.1 ± 0.3 (3.9-4.2)	4.3 ± 0.4§ (4.2-4.5)	4.1 ± 0.4 (4.1-4.2)		

\*Data are presented as mean ± SD (95% confidence interval). In case of statistically significant differences, highest or lowest values, according to Bonferroni's post-hoc analyses, are marked. When 2 values are marked in the same row, it is because the statistical difference was observed in only those 2 values (except for age and skin mass in percentage, where both values are the highest ones and no additional differences were observed between groups).

†Analysis of variance,  $p < 0.05$ .

‡ $p < 0.001$ .

§ $p < 0.01$ .

||Sum of triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf skinfold thicknesses.

triceps, subscapular, biceps, iliac crest, supraspinal, abdominal, frontal thigh, and medial calf (14). Eleven girth measurements were taken with a Rosscraft steel tape (Rosscraft Innovations, Vancouver, Canada; measurement range of up to 200 cm and accuracy to 0.1 cm) from the following sites: head, arm (relaxed), arm (flexed and tensed), forearm (maximum), wrist (distal styloids), chest (mesoesternal) waist (minimum), gluteal (hips), thigh (1 cm gluteal), thigh (mid-troch-tib. lat.), and calf (maximum). Eight bone breadths were measured from the following sites: biacromial, biocristal, transverse chest, anteroposterior chest depth, humerus, femur, wrist (bistyloid), and ankle (bimalleolar). Rosscraft Campbell 20 anthropometers for large bones with a measurement range of 54 cm and accuracy to 0.1 cm were used, as was a Rosscraft Campbell 10 anthropometer for small bones with a measurement range of 15 cm and accuracy to 0.1 cm (Rosscraft Innovations, Vancouver, Canada).

Based on these measurements, the analysis of body composition was carried out using the 5-component fractionation method (39), with consideration for the following tissue types (in kg and percentages): muscle, adipose, bone, skin, and residual. The analysis was performed in a form created in Microsoft Excel by Francis Holway. The sum of 6 skinfold measurements (triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf) was also calculated, as well as the muscle/bone index.

**Statistical Analyses**

Anthropometric and body composition profiles were grouped by competitive division and individual playing position (goalkeeper, outside defender, central defender, attacking midfielder, defensive midfielder, and center forward) and presented in tables as a mean ± SD (95% confidence interval). In addition, although it was not the aim of the study, comparisons of the differences in anthropometric and body composition profiles across playing positions and within each competitive division were made using an analysis of variance, or analysis of variance, and Bonferroni's post-hoc analysis. Data were analyzed using the SPSS program for Windows version 22, and  $p < 0.05$  was considered as significant.

**Results**

The anthropometric and body composition profiles are shown for each competitive division and playing position in Tables 1-5 (fourth division, third division, U-17, second division, and U-20, respectively). Within each division, it was found that average body mass (kg), height (cm), sitting height (cm), skinfold sum (mm), and body adipose mass (in kg and %) tended to be higher in goalkeepers, whereas higher average percentages of muscle mass were found among forwards. In addition, differences across playing positions were more evident in older categories, such as under-20 and second division.

The analysis by playing position across competitive divisions (data not shown) showed that average body mass (kg), sitting height (cm), some girths (like relaxed arm and waist in cm), muscle mass (in kg and %), and bone/muscle index were higher in older categories (second division and under 20), whereas height (cm) was lower in younger categories (fourth and third divisions). However, defensive midfielders and lateral defenders presented more variables without significant differences across categories (30 and 22 variables, respectively).

Specifically, the U-20 division obtained values for muscle mass (36.4 ± 3.7 kg), percentage of adipose mass (21.8 ± 2.9), percentage of muscle mass (49.7 ± 2.7%), percentage of bone mass

**Table 4**  
**Second division's anthropometric and body composition profile according to soccer playing position.\***

Variables	Lateral (outside)						
	Goalkeepers (n = 12)	defenders (n = 20)	Central defenders (n = 21)	Offensive midfielders (n = 46)	Defensive midfielders (n = 17)	Forwards (n = 53)	Total (n = 169)
Age (y)	21.0 ± 1.4† (20.1–21.9)	19.6 ± 0.8 (19.2–20.0)	20.5 ± 1.5 (19.9–21.2)	19.9 ± 1.1 (19.6–20.2)	19.1 ± 0.6 (18.8–19.4)	19.4 ± 1.3 (19.0–19.7)	19.8 ± 1.3 (19.6–20.0)
Basic							
Mass (kg)	79.2 ± 4.6† (76.2–82.1)	70.0 ± 4.4 (67.9–72.0)	76.6 ± 6.2 (73.8–79.5)	67.6 ± 5.0 (66.1–69.1)	70.7 ± 5.3 (68.0–73.4)	72.7 ± 7.9 (70.5–74.9)	71.7 ± 7.0 (70.7–72.8)
Stature (cm)	184.9 ± 3.6† (182.6–187.2)	175.1 ± 3.9 (173.3–177.0)	182.7 ± 2.4 (181.7–183.8)	172.7 ± 4.8 (171.3–174.1)	175.9 ± 5.6 (173.0–178.8)	176.6 ± 6.0 (174.9–178.2)	176.6 ± 6.1 (175.7–177.6)
Sitting height (cm)	95.1 ± 2.9 (93.3–96.9)	92.1 ± 1.9 (91.2–93.0)	95.2 ± 2.6 (94.1–96.4)	91.6 ± 2.7† (90.9–92.4)	92.7 ± 2.8 (91.3–94.1)	93.7 ± 3.0 (92.9–94.6)	93.2 ± 3.0 (92.7–93.6)
Skinfolds (mm)							
Triceps	8.4 ± 2.1 (7.1–9.7)	7.3 ± 1.2 (6.7–7.8)	7.5 ± 1.8 (6.7–8.3)	7.0 ± 1.9 (6.4–7.6)	7.9 ± 2.3 (6.8–9.1)	7.6 ± 1.8 (7.1–8.1)	7.5 ± 1.9 (7.2–7.8)
Subscapular	10.2 ± 1.1† (9.5–10.9)	9.0 ± 1.2 (8.4–9.6)	8.5 ± 1.6 (7.8–9.2)	8.7 ± 1.8 (8.1–9.2)	8.3 ± 1.1 (7.7–8.8)	8.8 ± 1.6 (8.4–9.3)	8.8 ± 1.6 (8.6–9.0)
Biceps	3.4 ± 0.9 (2.9–4.0)	3.1 ± 0.4 (2.9–3.2)	3.5 ± 0.9 (3.1–4.0)	3.3 ± 0.7 (3.1–3.5)	3.4 ± 0.7 (3.1–3.7)	3.6 ± 0.8 (3.4–3.8)	3.4 ± 0.7 (3.3–3.5)
Iliac crest	15.5 ± 4.4 (12.7–18.2)	12.7 ± 3.5 (11.1–14.4)	12.8 ± 3.8 (11.0–14.5)	11.4 ± 3.4 (10.4–12.4)	11.9 ± 3.2 (10.3–13.6)	12.5 ± 4.9 (11.1–13.8)	12.4 ± 4.1 (11.8–13.0)
Supraspinal	8.4 ± 2.0 (7.1–9.6)	7.3 ± 1.8 (6.5–8.2)	7.3 ± 1.7 (6.5–8.0)	6.6 ± 1.7 (6.1–7.1)	7.8 ± 2.4 (6.5–9.0)	7.0 ± 2.4 (6.3–7.7)	7.1 ± 2.1 (6.8–7.5)
Abdominal	15.4 ± 3.4 (13.3–17.5)	13.4 ± 3.5 (11.7–15.0)	11.6 ± 3.7 (9.9–13.2)	11.5 ± 3.8 (10.4–12.6)	11.9 ± 3.9 (9.9–13.9)	12.2 ± 4.8 (10.9–13.5)	12.3 ± 4.2 (11.6–12.9)
Front thigh	11.5 ± 2.5† (9.9–13.0)	7.7 ± 2.1 (6.8–8.7)	7.7 ± 2.7 (6.5–8.9)	8.4 ± 2.4 (7.6–9.1)	9.1 ± 2.5 (7.8–10.4)	9.3 ± 2.3 (8.7–9.9)	8.8 ± 2.5 (8.4–9.2)
Medial calf	6.2 ± 1.2 (5.4–6.9)	5.1 ± 1.4 (4.5–5.8)	5.0 ± 1.6 (4.2–5.7)	4.9 ± 1.3 (4.5–5.3)	5.8 ± 2.5 (4.5–7.0)	5.4 ± 1.4 (5.0–5.8)	5.3 ± 1.5 (5.0–5.5)
Girths (cm)							
Head	56.7 ± 0.3 (56.4–56.9)	54.7 ± 0.8† (54.3–55.1)	57.0 ± 1.6 (56.3–57.7)	55.9 ± 1.4 (55.5–56.3)	56.0 ± 1.4 (55.5–56.3)	55.8 ± 1.1 (55.2–56.7)	55.9 ± 1.4 (55.7–56.1)
Arm (relaxed)	31.6 ± 1.2§ (30.8–32.4)	29.9 ± 2.0 (29.0–30.8)	30.4 ± 2.0 (29.5–31.3)	29.3 ± 1.7 (28.8–29.8)	29.4 ± 1.4 (28.7–30.2)	30.1 ± 1.7 (29.6–30.5)	29.9 ± 1.8 (29.7–30.2)
Arm (flexed and tensed)	34.1 ± 1.4 (33.3–35.0)	32.9 ± 2.3 (31.8–34.0)	33.2 ± 2.0 (32.3–34.1)	31.6 ± 1.8† (31.1–32.1)	32.3 ± 1.5 (31.5–33.0)	32.6 ± 1.8 (32.1–33.1)	32.5 ± 2.0 (32.2–32.8)
Forearm (maximum)	27.9 ± 0.6† (27.5–28.3)	26.2 ± 1.4 (25.6–26.9)	27.2 ± 1.3 (26.6–27.7)	26.3 ± 1.3 (26.0–26.7)	26.1 ± 0.9 (25.6–26.6)	26.7 ± 1.2 (26.3–27.0)	26.6 ± 1.3 (26.4–26.8)
Wrist (distal styloids)	17.0 ± 0.3† (16.8–17.2)	15.7 ± 0.6 (15.4–16.0)	16.2 ± 0.6 (15.9–16.5)	15.8 ± 0.5 (15.6–15.9)	15.7 ± 0.5 (15.5–16.0)	15.8 ± 0.7 (15.6–16.0)	15.9 ± 0.7 (15.8–16.0)
Chest (mesosternale)	97.4 ± 1.4 (96.5–98.3)	94.4 ± 4.6 (92.2–96.5)	97.0 ± 4.0 (95.2–98.8)	93.3 ± 3.7§ (92.2–94.4)	93.9 ± 2.4 (92.7–95.1)	94.9 ± 4.2 (93.8–96.1)	94.7 ± 4.0 (94.1–95.4)
Waist (minimum)	80.9 ± 1.5† (79.9–81.8)	77.4 ± 3.6 (75.8–79.1)	78.7 ± 3.0 (77.4–80.0)	75.7 ± 3.3 (74.7–76.6)	77.0 ± 2.1 (76.0–78.1)	77.5 ± 4.4 (76.3–78.7)	77.3 ± 3.7 (76.8–77.9)
Gluteal (hips)	97.9 ± 1.3 (97.1–98.7)	94.2 ± 3.7 (92.4–95.9)	97.0 ± 3.3 (95.5–98.5)	93.3 ± 3.4† (92.3–94.3)	95.7 ± 3.7 (93.8–97.6)	96.0 ± 5.0 (94.6–97.4)	95.3 ± 4.2 (94.6–95.9)
Thigh (1 cm gluteal)	58.1 ± 2.0 (56.8–59.3)	56.4 ± 2.8 (55.1–57.7)	58.4 ± 3.2§ (56.9–56.8)	55.7 ± 2.6§ (54.9–56.4)	56.8 ± 1.8 (55.9–57.7)	57.2 ± 3.4 (56.3–58.2)	56.9 ± 3.0 (56.4–57.3)
Thigh (mid-troch-tib.lat.)	53.5 ± 2.0 (52.3–54.8)	52.2 ± 2.2 (51.1–53.2)	53.7 ± 3.0† (52.3–55.1)	51.9 ± 2.5 (51.2–52.6)	52.0 ± 1.5 (51.2–52.3)	53.3 ± 3.5 (52.4–54.3)	52.7 ± 2.8 (52.3–53.2)
Calf (maximum)	35.9 ± 0.8 (35.3–36.4)	35.6 ± 1.2 (35.0–36.1)	37.2 ± 1.8§ (36.4–38.0)	35.6 ± 1.2§ (35.2–35.9)	35.9 ± 1.5 (35.1–36.6)	36.4 ± 2.4 (35.7–37.0)	36.1 ± 1.8 (35.8–36.4)
Bone breadths (cm)							
Biacromial	41.6 ± 0.5 (41.3–41.9)	40.1 ± 1.3 (39.5–40.7)	41.1 ± 1.1 (40.6–41.6)	39.7 ± 1.3† (39.3–40.1)	40.5 ± 1.0 (40.0–41.0)	40.6 ± 1.8 (40.1–41.19)	40.4 ± 1.5 (40.2–40.6)
Biilocrystal	28.3 ± 0.7 (27.9–28.7)	26.3 ± 1.2 (25.8–26.9)	28.6 ± 0.7† (28.3–28.9)	26.7 ± 1.1 (26.3–27.0)	26.9 ± 1.2 (27.2–28.0)	26.7 ± 1.2 (26.6–27.2)	27.1 ± 1.3 (27.0–27.3)
Transverse chest	29.2 ± 0.3 (29.1–29.4)	28.0 ± 1.5 (27.3–28.8)	29.4 ± 1.2† (28.8–29.9)	27.7 ± 1.1 (27.3–28.0)	28.2 ± 0.9 (27.8–28.7)	28.4 ± 1.8 (27.9–28.9)	28.3 ± 1.5 (28.1–28.5)
Anterior-posterior chest depth	18.9 ± 1.2 (18.1–19.7)	19.1 ± 0.8 (18.7–19.5)	19.6 ± 1.7 (18.9–20.4)	19.3 ± 1.0 (19.0–19.6)	18.9 ± 1.3 (18.3–19.6)	19.4 ± 1.0 (19.1–19.7)	19.3 ± 1.1 (19.1–19.5)
Humerus	7.2 ± 0.2 (7.1–7.3)	7.0 ± 0.2 (6.9–7.1)	7.1 ± 0.3 (7.0–7.3)	7.0 ± 0.3 (6.9–7.1)	7.0 ± 0.3 (6.8–7.1)	7.0 ± 0.3 (6.9–7.1)	7.0 ± 0.3 (7.0–7.1)
Femur	10.2 ± 0.1 (10.1–10.2)	10.1 ± 0.3 (9.9–10.2)	10.3 ± 0.4 (10.1–10.4)	10.0 ± 0.3 (9.9–10.1)	10.0 ± 0.3 (9.8–10.2)	10.0 ± 0.4 (9.9–10.1)	10.1 ± 0.4 (10.0–10.1)
Wrist (bistylloid)	6.1 ± 0.1† (6.0–6.2)	5.7 ± 0.2 (5.6–5.8)	5.9 ± 0.2 (5.8–6.0)	5.7 ± 0.2 (5.7–5.8)	5.8 ± 0.3 (5.6–5.9)	5.8 ± 0.3 (5.7–5.9)	5.8 ± 0.3 (5.7–5.8)
Ankle (bimalleolar)	7.5 ± 0.2 (7.4–7.7)	7.7 ± 0.4 (7.5–7.9)	7.7 ± 0.3 (7.5–7.8)	7.6 ± 0.3 (7.5–7.7)	7.6 ± 0.3 (7.5–7.8)	7.5 ± 0.3 (7.4–7.6)	7.6 ± 0.3 (7.5–7.6)
Body composition							
Adipose mass (kg)	19.6 ± 3.0† (17.6–21.5)	15.4 ± 1.2 (14.8–15.9)	16.5 ± 2.2 (15.5–17.5)	14.3 ± 1.9 (13.8–14.9)	15.7 ± 1.9 (14.8–16.7)	15.9 ± 2.5 (15.2–16.6)	15.7 ± 2.5 (15.4–16.1)
Muscle mass (kg)	37.8 ± 1.8 (36.6–39.0)	34.8 ± 3.2 (33.3–36.3)	38.3 ± 3.7 (36.6–40.0)	33.7 ± 2.9† (32.8–34.5)	34.6 ± 2.9 (33.1–36.1)	36.1 ± 4.6 (34.9–37.4)	35.5 ± 3.9 (35.0–36.1)
Residual mass (kg)	8.8 ± 0.3 (8.6–9.0)	8.0 ± 0.7 (7.7–8.4)	8.8 ± 0.7 (8.4–9.1)	7.7 ± 0.6† (7.6–7.9)	8.1 ± 0.7 (7.8–8.5)	8.4 ± 1.0 (8.1–8.6)	8.2 ± 0.8 (8.1–8.3)
Bone mass (kg)	8.8 ± 0.3 (8.7–9.0)	7.9 ± 0.7 (7.6–8.2)	9.0 ± 0.7† (8.7–9.3)	8.1 ± 0.6 (8.0–8.3)	8.4 ± 0.8 (8.0–8.9)	8.4 ± 0.9 (8.2–8.6)	8.4 ± 0.8 (8.3–8.5)
Skin mass (kg)	4.2 ± 0.2† (4.0–4.3)	3.8 ± 0.1 (3.7–3.9)	4.1 ± 0.2 (4.0–4.1)	3.7 ± 0.2 (3.6–3.7)	3.9 ± 0.3 (3.7–4.0)	3.9 ± 0.3 (3.8–4.0)	3.9 ± 0.3 (3.8–3.9)
Adipose mass (%)	24.6 ± 2.4† (23.1–26.2)	22.0 ± 1.7 (21.2–22.8)	21.5 ± 2.0 (20.6–22.4)	21.2 ± 1.9 (20.6–21.7)	22.3 ± 2.2 (21.1–23.4)	21.9 ± 2.4 (21.2–22.6)	21.9 ± 2.3 (21.5–22.2)



**Table 4** Second division's anthropometric and body composition profile according to soccer playing position.\* (Continued)

Variables	Lateral (outside)		Central		Offensive		Defensive		Total (n = 169)
	Goalkeepers (n = 12)	defenders (n = 20)	defenders (n = 21)	midfielders (n = 46)	midfielders (n = 17)	Forwards (n = 53)	Defenders (n = 17)		
Muscle mass (%)	47.8 ± 1.2‡ (47.0–48.5)	49.7 ± 2.0 (48.8–50.6)	49.9 ± 1.8 (49.1–50.8)	49.8 ± 1.7 (49.3–50.3)	48.9 ± 1.9 (47.9–49.9)	49.6 ± 2.3 (49.0–50.3)	49.5 ± 2.0 (49.2–49.8)	49.5 ± 2.0 (49.2–49.8)	
Residual mass (%)	11.1 ± 0.6 (10.7–11.5)	11.5 ± 0.8 (11.1–11.9)	11.4 ± 0.4 (11.2–11.6)	11.5 ± 0.8 (11.2–11.7)	11.5 ± 0.4 (11.3–11.7)	11.5 ± 0.6 (11.3–11.7)	11.4 ± 0.7 (11.3–11.5)	11.4 ± 0.7 (11.3–11.5)	
Bone mass (%)	11.2 ± 0.9 (10.6–11.8)	11.4 ± 0.8 (11.0–11.7)	11.8 ± 0.8 (11.4–12.2)	12.1 ± 0.7§ (11.9–12.3)	11.9 ± 0.5 (11.6–12.2)	11.6 ± 0.9 (11.4–11.8)	11.7 ± 0.8 (11.6–11.9)	11.7 ± 0.8 (11.6–11.9)	
Skin mass (%)	5.3 ± 0.1 (5.2–5.3)	5.5 ± 0.4 (5.3–5.6)	5.3 ± 0.4 (5.1–5.5)	5.5 ± 0.3 (5.4–5.6)	5.5 ± 0.3 (5.3–5.6)	5.4 ± 0.3 (5.5–4.7)	5.4 ± 0.3 (5.4–5.5)	5.4 ± 0.3 (5.4–5.5)	
Other									
Sum of 6 skinfolds (mm)¶	60.1 ± 10.4‡ (53.4–66.7)	49.8 ± 7.7 (46.2–53.4)	47.4 ± 11.1 (42.4–52.5)	47.1 ± 10.3 (44.0–50.1)	50.7 ± 11.0 (45.0–56.3)	50.3 ± 12.2 (47.0–53.7)	49.8 ± 11.2 (48.1–51.4)	49.8 ± 11.2 (48.1–51.4)	
Muscle-to-bone ratio	4.3 ± 0.3 (4.1–4.5)	4.4 ± 0.4 (4.2–4.6)	4.2 ± 0.3 (4.1–4.4)	4.1 ± 0.3 (4.0–4.2)	4.1 ± 0.2 (4.0–4.2)	4.3 ± 0.4 (4.2–4.4)	4.2 ± 0.4 (4.2–4.3)	4.2 ± 0.4 (4.2–4.3)	

\*Data are presented as mean ± SD (95% confidence interval). In case of statistically significant differences, highest or lowest values, according to Bonferroni's post-hoc analyses, are marked. When 2 values are marked in the same row, it is because the statistical difference was observed in only those 2 values.

†Analysis of variance,  $p < 0.001$ .

‡ $p < 0.05$ .

§ $p < 0.01$ .

¶Sum of triceps, subscapular, suprascapular, abdominal, front thigh, and medial calf skinfold thicknesses.

(11.8 ± 0.9), and percentage of skin mass (5.3 ± 0.3), which were significantly higher than all other competitive divisions. This group also had the highest average for anthropometric variables (body mass, sitting height, and most girths) (comparison not shown).

**Discussion**

This study presents for the first time anthropometric and body composition profiles from several youth divisions of Mexican soccer players (U-17, U-20, second, third, and fourth) and different playing positions (goalkeepers, lateral/outside defenders, central defenders, offensive midfielders, defensive midfielders, and forwards). Several divisions were included, because in Mexico, no data are available for any of these categories. These data were necessary, because in soccer, assessments are used alongside fitness measurements to determine physical preparedness for competition and to monitor the effects of training and dietary interventions on body composition status (41) and vice versa.

Soccer players are generally classified into 4 position categories: goalkeepers, defenders, midfielders, and forwards. Nevertheless, additional subdivisions, such as central defenders or fullbacks (lateral defenders), may be identified when players have specific functions (17). Our study's selection of playing positions was based on that found in Francis Holway's form for body composition analysis, because it was designed to be implemented internationally for soccer positions as well as those in other sports.

In our study, the U-20 division obtained values which were higher than all other competitive divisions, and the youngest category—the fourth division—obtained the lowest values for most body composition masses and the average of anthropometric variables and the highest percentages of adipose mass and skin mass. This was expected, because fourth division subjects were younger and had not fully matured to the point where adipose mass decreases and muscle mass increases.

Irrespective of age group, our study's main results showed that goalkeepers present, in most cases, the highest values for average body mass, height, sitting height, skinfold sum, and adipose mass (in kg and %), whereas forwards were only found to have higher percentages of muscle mass. This latter finding is consistent with previously reported values (5,17,22). This outcome can be attributed to the fact that goalkeepers are subject to a lower metabolic load than other players during games and training (44). For example, goalkeepers run about 4 km during a game, whereas midfielders run between 11 and 11.5 km (17). In addition, the tactical maneuvers performed by forwards that require quickness, acceleration, kicking, jumping, etc., result in high levels of energy expenditure (33,34). Moreover, goalkeepers must have a greater complexion to better protect the goal.

Most body composition studies in soccer players separate the human body into 2 components: fat mass and lean/fat-free mass (1,4,8–10,12,15,16,23,27–31,34,35). In this study, a 5-component model was used to determine body composition (39). However, it is important to note that in this methodology for determining body composition, adipose mass is not the same as fat mass determined by the bi-compartmental method. Adipose mass is tissue which is separable by dissection and includes most subcutaneous adipose tissue, and that which surrounds the organs and visceral structures, in addition to a small quantity of intramuscular adipose tissue. In addition, adipose tissue is composed of lipids, water, proteins, and electrolytes. In contrast, the fat mass that we are most familiar with is comprised solely of triglycerides (39). Because of this, adipose mass values are higher than fat mass values (around 20–25% vs. <10%), so comparisons with other studies with different approaches for determining body composition should be made with caution.

**Table 5**  
**Under-20 category anthropometric and body composition profile according to soccer playing position.\***

Variables	Goalkeepers (n = 20)	Lateral (outside) defenders (n = 26)	Central defenders (n = 27)	Offensive midfielders (n = 44)	Defensive midfielders (n = 18)	Forwards (n = 42)	Total (n = 177)
Age (y)	18.9 ± 0.7 (18.5–19.2)	19.5 ± 0.7 (19.2–19.7)	19.6 ± 0.9 (19.2–19.9)	19.2 ± 0.9 (19.0–19.5)	19.3 ± 1.1 (18.8–19.8)	19.3 ± 0.8 (19.0–19.5)	19.3 ± 0.9 (19.2–19.4)
<b>Basic</b>							
Mass (kg)	83.2 ± 4.5† (81.1–85.3)	70.3 ± 4.7 (68.4–72.2)	78.7 ± 4.8 (76.8–80.6)	68.8 ± 6.3 (66.9–70.7)	71.2 ± 5.1 (68.7–73.7)	72.5 ± 5.8 (71.0–74.0)	73.3 ± 7.0 (72.2–74.3)
Stature (cm)	187.6 ± 4.9† (185.3–189.9)	174.2 ± 4.9 (172.2–176.2)	182.5 ± 3.0 (181.4–183.7)	173.3 ± 4.3 (172.0–174.6)	175.6 ± 5.9 (172.7–178.6)	177.4 ± 5.4 (175.7–179.0)	177.6 ± 6.6 (93.9–94.8)
Sitting height (cm)	97.8 ± 2.3 (96.7–98.8)	93.2 ± 1.8 (92.5–93.9)	96.3 ± 2.0 (95.6–97.1)	92.1 ± 2.4 (91.4–92.8)	93.7 ± 2.7† (92.4–95.0)	94.7 ± 2.9 (93.8–95.6)	94.3 ± 3.0 (93.9–94.8)
<b>Skinfolds (mm)</b>							
Triceps	10.2 ± 1.8† (9.3–11.0)	6.8 ± 2.2 (5.9–7.7)	7.7 ± 1.5 (7.1–8.3)	7.5 ± 2.1 (6.9–8.2)	7.0 ± 1.2 (6.4–7.6)	6.9 ± 1.9 (6.3–7.5)	7.6 ± 2.1 (7.2–7.9)
Subscapular	10.8 ± 2.0† (9.9–11.8)	8.6 ± 1.3 (8.1–9.2)	9.3 ± 1.6 (8.6–9.9)	9.3 ± 2.1 (8.7–9.9)	8.4 ± 2.5 (7.2–9.7)	8.3 ± 1.6 (7.8–8.8)	9.1 ± 2.0 (8.8–9.4)
Biceps	4.0 ± 1.0 (3.5–4.4)	3.4 ± 0.8 (3.1–3.7)	3.4 ± 0.9 (3.1–3.8)	3.4 ± 0.8 (3.2–3.6)	3.3 ± 0.7 (2.9–3.6)	3.3 ± 0.8 (3.1–3.6)	3.4 ± 0.8 (3.3–3.6)
Iliac crest	18.4 ± 6.2† (15.4–21.3)	11.1 ± 4.3 (9.3–12.8)	13.4 ± 3.9 (11.9–14.9)	12.3 ± 3.1 (11.3–13.3)	12.8 ± 5.5 (10.0–15.5)	11.0 ± 3.2 (10.0–12.0)	12.7 ± 4.6 (12.0–13.4)
Supraspinal	10.5 ± 3.3† (8.9–12.0)	6.7 ± 2.3 (5.8–7.6)	7.2 ± 1.4 (6.6–7.8)	7.4 ± 2.2 (6.7–8.0)	7.2 ± 3.3 (5.6–8.8)	6.3 ± 1.6 (5.8–6.8)	7.3 ± 2.6 (6.9–7.7)
Abdominal	18.3 ± 5.0† (16.0–20.7)	11.9 ± 4.0 (10.2–13.5)	13.1 ± 2.9 (12.0–14.2)	12.3 ± 4.2 (11.0–13.6)	11.6 ± 4.9 (9.1–14.0)	10.8 ± 3.4 (9.8–11.9)	12.6 ± 4.5 (11.9–13.3)
Front thigh	11.3 ± 4.8† (9.0–13.5)	8.0 ± 2.4 (7.0–9)	8.9 ± 2.3 (8.0–9.8)	8.6 ± 2.2 (8.0–9.3)	8.8 ± 3.0 (7.3–10.3)	8.1 ± 2.4 (7.4–8.8)	8.8 ± 2.9 (8.3–9.2)
Medial calf	8.5 ± 3.7† (6.8–10.2)	4.7 ± 1.5 (4.1–5.3)	5.8 ± 1.7 (5.1–6.4)	4.7 ± 1.0 (4.4–5.0)	5.0 ± 0.9 (4.6–5.5)	4.9 ± 1.3 (4.5–5.3)	5.4 ± 2.1 (4.5–5.3)
<b>Girths (cm)</b>							
Head	57.2 ± 1.4 (56.5–57.9)	55.2 ± 1.0† (54.8–55.6)	57.5 ± 1.4 (57.0–58.1)	55.9 ± 1.4 (55.5–56.4)	56.3 ± 1.1 (55.8–56.9)	56.2 ± 1.2 (55.9–56.6)	56.3 ± 1.5 (56.1–56.5)
Arm (relaxed)	31.6 ± 1.1† (31.1–32.1)	30.5 ± 1.3 (30.0–31.1)	31.0 ± 2.0 (30.3–31.8)	29.4 ± 1.6 (28.9–29.9)	29.5 ± 1.7 (28.7–30.4)	29.9 ± 1.8 (29.4–30.5)	30.2 ± 1.8 (29.9–30.5)
Arm (flexed and tensed)	33.7 ± 1.1 (33.2–34.3)	33.6 ± 1.9 (32.9–34.4)	33.8 ± 1.8 (33.1–34.6)	31.5 ± 3.0† (30.6–32.5)	32.4 ± 1.7 (31.6–33.3)	32.7 ± 1.9 (32.1–33.3)	32.8 ± 2.3 (32.5–33.2)
Forearm (maximum)	27.6 ± 0.8† (27.2–28)	26.7 ± 0.9 (26.3–27.0)	27.1 ± 1.0 (26.7–27.5)	26.3 ± 1.3 (25.9–26.7)	26.5 ± 1.3 (25.9–27.1)	26.8 ± 1.0 (26.5–27.2)	26.8 ± 1.1 (26.6–26.9)
Wrist (distal styloids)	16.7 ± 0.4† (16.4–16.9)	15.5 ± 0.5 (15.3–15.7)	16.0 ± 0.5 (15.8–16.2)	15.7 ± 0.5 (15.6–15.9)	15.9 ± 0.4 (15.6–16.1)	16.1 ± 0.8 (15.8–16.3)	15.9 ± 0.7 (15.8–16.0)
Chest (mesosternale)	98.7 ± 2.2† (97.7–99.7)	94.7 ± 2.9 (93.5–95.9)	97.7 ± 2.5 (96.7–98.7)	94.4 ± 3.9 (93.2–95.6)	94.4 ± 4.0 (92.4–96.4)	95.9 ± 3.6 (94.8–97.0)	95.8 ± 3.6 (95.3–96.3)
Waist (minimum)	81.2 ± 3.0† (79.8–82.6)	75.2 ± 3.8 (73.7–76.7)	79.0 ± 3.0 (77.8–80.2)	76.8 ± 3.5 (75.7–77.9)	76.5 ± 3.1 (74.9–78.0)	76.9 ± 3.1 (75.9–77.9)	77.4 ± 3.7 (76.8–77.9)
Gluteal (hips)	100.6 ± 2.3† (99.5–101.7)	93.5 ± 4.6 (91.7–95.4)	98.7 ± 2.7 (97.7–99.8)	93.9 ± 3.7 (92.8–95.0)	94.1 ± 3.7 (92.2–95.9)	95.8 ± 3.7 (94.6–96.9)	95.8 ± 4.3 (95.2–96.4)
Thigh (1 cm gluteal)	60.3 ± 2.3† (59.2–61.3)	57.2 ± 2.2 (56.3–58.1)	59.6 ± 2.6 (58.6–60.7)	55.9 ± 3.0 (55.0–56.8)	57.0 ± 2.0 (56.0–58.0)	56.9 ± 2.5 (56.1–57.6)	57.5 ± 2.9 (57.1–57.9)
Thigh (mid-troch-tib.lat.)	55.1 ± 2.2† (54.0–56.1)	53.2 ± 1.8 (52.5–54.0)	54.9 ± 2.7 (53.8–56.0)	52.4 ± 3.0 (51.4–53.3)	53.5 ± 1.8 (52.6–54.4)	52.8 ± 2.4 (52.0–53.5)	53.4 ± 2.7 (53.0–53.8)
Calf (maximum)	37.5 ± 1.7 (36.7–38.2)	36.4 ± 1.5 (35.7–37.0)	37.7 ± 1.4 (37.1–38.3)	35.9 ± 2.0† (35.3–36.5)	36.6 ± 2.0 (35.5–37.6)	36.5 ± 1.8 (36.0–37.1)	36.6 ± 1.8 (36.4–36.9)
<b>Bone breadths (cm)</b>							
Biacromial	42.1 ± 1.4 (41.4–42.8)	40.4 ± 1.6 (39.8–41.1)	41.6 ± 1.0 (41.2–42.0)	40.8 ± 0.9† (40.5–41.1)	40.5 ± 1.0 (40.0–41.0)	40.7 ± 1.4 (40.2–41.1)	40.9 ± 1.3 (40.7–41.1)
Biilocrystal	29.2 ± 0.7 (28.9–29.5)	26.8 ± 2.0† (26.0–27.6)	27.9 ± 1.0 (27.5–28.3)	27.0 ± 1.0 (26.7–27.3)	27.0 ± 1.2 (26.4–27.5)	27.2 ± 1.5 (26.8–27.7)	27.4 ± 1.5 (27.2–27.6)
Transverse chest	30.0 ± 1.1 (29.4–30.5)	28.0 ± 1.5 (27.4–28.6)	29.3 ± 1.3 (28.8–29.8)	28.5 ± 0.9† (28.2–28.8)	28.2 ± 0.8 (27.8–28.6)	28.9 ± 1.4 (28.5–29.4)	28.8 ± 1.3 (28.6–29.0)
Anterior-posterior chest depth	20.5 ± 1.6 (19.8–21.3)	18.9 ± 0.8 (18.5–19.2)	19.5 ± 1.2 (19.1–20.0)	20.0 ± 4.1 (18.8–21.3)	19.2 ± 1.1 (18.7–19.8)	19.4 ± 1.2 (19.1–19.8)	19.6 ± 2.3 (19.3–20.0)
Humerus	7.4 ± 0.3† (7.3–7.6)	6.9 ± 0.3 (6.8–7.1)	7.0 ± 0.3 (6.9–7.1)	7.0 ± 0.3 (6.9–7.1)	6.9 ± 0.3 (6.8–7.1)	7.1 ± 0.3 (7.0–7.2)	7.0 ± 0.3 (7.0–7.1)
Femur	10.5 ± 0.3† (10.3–10.6)	9.7 ± 0.5 (9.5–9.9)	10.3 ± 0.2 (10.2–10.4)	10.1 ± 0.3 (10.0–10.1)	10.1 ± 0.3 (10.0–10.3)	10.1 ± 0.3 (10.0–10.3)	10.1 ± 0.4 (10.1–10.2)
Wrist (bistylloid)	6.0 ± 0.2† (5.9–6.1)	5.7 ± 0.2 (5.6–5.8)	5.8 ± 0.2 (5.7–5.9)	5.7 ± 0.2 (5.7–5.8)	5.9 ± 0.2 (5.7–6.0)	5.8 ± 0.3 (5.8–5.9)	5.8 ± 0.2 (5.8–5.8)
Ankle (bimalleolar)	7.8 ± 0.2† (7.7–7.9)	7.4 ± 0.3 (7.3–7.6)	7.7 ± 0.3 (7.6–7.8)	7.5 ± 0.3 (7.4–7.6)	7.5 ± 0.4 (7.3–7.7)	7.7 ± 0.2 (7.6–7.8)	7.6 ± 0.3 (7.6–7.7)
<b>Body composition</b>							
Adipose mass (kg)	21.8 ± 4.2† (19.9–23.8)	14.7 ± 2.5 (13.7–15.7)	17.4 ± 1.7 (16.7–18.1)	14.7 ± 2.0 (14.1–15.3)	15.1 ± 1.4 (14.4–15.8)	15.1 ± 1.9 (14.5–15.6)	16.0 ± 3.2 (15.6–16.5)
Muscle mass (kg)	38.7 ± 1.4 (38.0–39.3)	36.1 ± 2.9 (34.9–37.2)	39.4 ± 3.4† (38.1–40.8)	33.9 ± 3.9 (32.7–35.0)	35.7 ± 4.0 (33.7–37.7)	36.6 ± 2.7 (35.7–37.4)	36.4 ± 3.7 (35.9–37.0)
Residual mass (kg)	9.0 ± 0.6 (8.7–9.3)	7.7 ± 0.8† (7.3–8.0)	8.7 ± 0.7 (8.5–9.0)	8.1 ± 1.0 (7.8–8.4)	8.1 ± 0.9 (7.6–8.5)	8.4 ± 0.7 (8.1–8.6)	8.3 ± 0.9 (8.2–8.5)
Bone mass (kg)	9.5 ± 0.7† (9.2–9.8)	8.1 ± 1.1 (7.6–8.5)	9.0 ± 0.6 (8.8–9.2)	8.4 ± 0.6 (8.2–8.6)	8.5 ± 0.5 (8.2–8.7)	8.6 ± 0.7 (8.4–8.8)	8.6 ± 0.8 (8.5–8.7)
Skin mass (kg)	4.2 ± 0.2† (4.1–4.3)	3.8 ± 0.2 (3.7–3.9)	4.1 ± 0.2 (4.1–4.2)	3.7 ± 0.2 (3.6–3.8)	3.9 ± 0.3 (3.7–4.0)	3.9 ± 0.2 (3.8–4.0)	3.9 ± 0.3 (3.9–3.9)
Adipose mass (%)	26.1 ± 3.7† (24.3–27.8)	20.8 ± 3.2 (19.5–22.1)	22.2 ± 2.3 (21.3–23.0)	21.4 ± 2.1 (20.7–22.0)	21.4 ± 2.6 (20.1–22.6)	20.7 ± 1.8 (20.2–21.3)	21.8 ± 2.9 (21.3–22.2)
Muscle mass (%)	46.6 ± 2.9† (45.2–47.9)	51.4 ± 3.7 (49.9–52.9)	50.0 ± 1.9 (49.3–50.8)	49.1 ± 2.1 (48.5–49.8)	49.9 ± 2.5 (48.7–51.2)	50.4 ± 1.8 (49.9–51.0)	49.7 ± 2.7 (49.3–50.1)
Residual mass (%)	10.9 ± 0.8 (10.5–11.3)	10.9 ± 0.6 (10.6–11.2)	11.1 ± 0.6 (10.9–11.4)	11.8 ± 1.2† (11.5–12.2)	11.4 ± 0.7 (11.0–11.7)	11.6 ± 0.7 (11.3–11.8)	11.4 ± 0.9 (11.2–11.5)

**Table 5**  
Under-20 category anthropometric and body composition profile according to soccer playing position.\* (Continued)

Variables	Goalkeepers (n = 20)		Lateral (outside) defenders (n = 26)		Central defenders (n = 27)		Offensive midfielders (n = 44)		Defensive midfielders (n = 18)		Forwards (n = 42)		Total (n = 177)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Bone mass (%)	11.4 ± 0.9	(11.0–11.8)	11.5 ± 1.1	(11.0–11.9)	11.5 ± 0.7	(11.2–11.7)	12.3 ± 0.9†	(12.0–12.5)	11.9 ± 0.8	(11.5–12.3)	11.9 ± 0.8	(11.6–12.1)	11.8 ± 0.9	(11.7–11.9)
Skin mass (%)	5.1 ± 0.2†	(5.0–5.2)	5.4 ± 0.2	(5.3–5.5)	5.2 ± 0.2	(5.1–5.3)	5.4 ± 0.3	(5.3–5.5)	5.4 ± 0.3	(5.3–5.6)	5.4 ± 0.3	(5.3–5.5)	5.3 ± 0.3	(5.3–5.4)
Other	69.6 ± 17.9†	(61.2–78.0)	46.8 ± 11.9	(42.0–51.5)	52.0 ± 8.0	(48.8–55.2)	49.8 ± 11.3	(46.3–53.2)	48.0 ± 13.1	(41.5–54.5)	45.4 ± 10.7	(42.1–48.7)	50.7 ± 13.7	(48.7–52.7)
Muscle-to-bone ratio	4.1 ± 0.4	(3.9–4.3)	4.5 ± 0.7†	(4.3–4.8)	4.4 ± 0.3	(4.3–4.5)	4.0 ± 0.4	(3.9–4.1)	4.2 ± 0.4	(4.0–4.4)	4.3 ± 0.4	(4.1–4.4)	4.2 ± 0.5	(4.2–4.3)

\*Data are presented as mean ± SD (95% confidence interval). In case of statistically significant differences, highest or lowest values, according to Bonferroni's post-hoc analyses, are marked (except for diacromial and transverse chest's breadths, where more differences were observed in offensive midfielders).

†Analysis of variance, *p* < 0.001.

‡*p* < 0.01.

§Sum of triceps, subscapular, supraspinal, abdominal, front thigh, and medial calf skinfold thicknesses.

In comparison with body composition studies with bi-compartmental fractionation, few studies in the scientific literature have assessed the body composition of soccer players using the 5-component method (2,3,5–7,21,22,24–26,33,37,42,43,45). Most of these studies do not include analyses by playing position, but only report body composition profiles in accordance with assessed divisions (3,6,21,24–26,33,37,43,45). More specifically, 7 of these studies examined a population with an average age similar to that of the players in this study: 4 of them assessed Argentine soccer players (25,42,43,45), 2 assessed Chilean players (21,26), and yet another was carried out on Mexican players (24).

Subjects assessed in these studies seem to be similar to those in our study, although in one study (45), Argentine players seemed to have greater muscle mass values and lower adipose mass in all categories. In addition, the differences in body composition were more pronounced among U-17 players. In the case of adipose mass, although most teams were found to have values of approximately 15 kg, 3 Chilean teams (Universidad de Chile, O'Higgins and Everton) (26) and one Argentine team (45) presented values less than 15 kg. In the case of subjects aged 19 years or older (U-20 and second division), the study performed on Mexican soccer players (24) reported the highest values of adipose mass (24.9%) and muscle mass (47.6%) and the lowest values of bone mass (10.8%). Although other studies that assessed body composition using the 5-component model were found, they were on subjects over the age of 20 (3,6,7,22,37) (older than our study subjects). The most important difference is that percentage of muscle mass in these categories is close to 50%. For more details, Supplemental Digital Content 1 (see Table, <http://links.lww.com/JSCR/A170>), about other studies using the 5-way fractionation method on soccer players without considering playing position.

Only a few studies present body composition profile according to category and playing position (2,5,7,22,42), and taking playing position into consideration makes it more difficult to compare results across studies, because there is not a specific way to classify soccer playing positions. The positions described vary from one study to the next (4–7 differences with respect to positions), and studies were mainly conducted on higher competitive divisions (for example, first division) than those assessed in our study. Only one study has a population group similar to our fourth division (42), because the remaining groups are in either professional or first division categories. In this regard, our soccer players seemed to have a better body composition profile, with adipose mass between 22 and 24% and muscle mass between 45.5 and 49% (Table 1). In the other study (42), adipose mass was 24–25% and muscle mass was about 46%. For more details, Supplemental Digital Content 2 (see Table, <http://links.lww.com/JSCR/A171>), about body composition profile in soccer players considering playing position.

In the case of the anthropometric profile of soccer players, several studies can be found in the scientific literature. However, even though studies that use the full profile stipulated by ISAK protocols do exist, as in the case of our study, some do not report complete anthropometric profiles (1,17–19,32). Other studies include anthropometric descriptions of subjects, but use different assessment methodologies (10,23,27,36).

Only a few studies presented a complete anthropometric profile using ISAK standards. Of these, 5 offer an anthropometric description of an entire competitive division without any differentiation by playing position (6,21,22,37,38) and only one of them, which had been carried out on first division players, included analyses by playing position (5). However, only one study (21) includes players from a division (U-18) that could be considered as comparable to our U-17. In this regard, our Mexican players had a higher average height, and generally higher averages

for skinfolds, girths, and bone breadths, which in turn resulted in higher adipose, muscle, and bone mass values than the players of this Chilean study (see the Supplemental Digital Content 3 table for data on other studies reporting the complete ISAK anthropometric profile; <http://links.lww.com/JSCR/A172>).

One of the strengths of our study is that it is among the few that include both anthropometric profiles and body composition. Moreover, although several studies that present the 5-component body composition profile were found, one of them (which had been posted on a website) is no longer available (5), 4 are not found in indexed journals (33,42,43,45), and 3 do not have complete body composition data (33,43,45). This attests to the value to our study. Another strength of our study is the high number of subjects and competitive divisions assessed, which means that it offers a broad overview of the anthropometric characteristics of adolescent players.

Conversely, one of our study's weaknesses is the fact that, because all assessments in each division were conducted on a semiannual basis, many subjects were assessed twice. This factor increased the sample size. However, it should be taken into account that because the physical changes that a teenage soccer player may undergo over the course of a season can be significant, it was considered valuable to include all assessments that had been conducted as if they had been done on different subjects. Another weakness of the project is not having considered the degree of pubertal maturation of the younger players (fourth, third, and U-17 divisions). However, it is known that coaches tend to look for early pubertal maturing players, who show their skills related to their earliest maturation time.

### Practical Applications

In conclusion, the U-20 division obtained higher anthropometric and body composition values than all other competitive divisions, and the youngest category obtained the lowest values for most variables and the highest percentages of adipose mass. In addition, goalkeepers, in most cases, are taller and heavier and obtained the highest values for adipose mass, whereas forwards presented higher percentages of muscle mass.

These anthropometric and body composition profiles provide objective and specific information that allows professionals in the medical, nutritional, physical, and technical body to develop strategies to improve the individual performance of the players through exercise and diet plans that optimize body composition. Specifically, this information can help during nutritional assessment and during subsequent nutritional monitoring of players from the youngest ages to adulthood, to establish body composition goals. In addition, these data may be useful to the strength and conditioning practitioner to design effective and specific training programs according to the most suitable anthropometric and body composition profile of each player and taking into consideration his competitive division and playing position.

Future studies may consider the anthropometric and body composition of players, in a longitudinal way, including variables of particular interest in adolescence such as pubertal maturation (which allows to identify the height peak velocity). It will also be possible to conduct studies that include functional tests and make comparisons based on anthropometric characteristics.

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