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Original Article

Body Composition of Professional Football (Soccer) Players Determined by Dual X-Ray Absorptiometry

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Abstract

A three-compartment body composition analysis of 42 professional football (soccer) players and 33 age- and body mass index–matched control subjects was determined by dual X-ray absorptiometry (DXA). The equipment provided a direct measurement of fat, lean, and bone mass. Fat mass was significantly higher in the controls subjects whereas lean mass and bone mass were markedly higher in the players. The percentage of body weight fat varied from 6.1 to 19.5% in the football players and from 9.1 to 29.9% in the control subjects. The respective averages were 12.0 ± 3.1 and 19.2 ± 5.6% ($p < 0.001$). The midfielders had a significantly higher percentage of fat (13.6 ± 3.3%) than backs or forwards (11.1 ± 2.8 and 11.0 ± 2.3%, $p < 0.05$ and $p < 0.06$, respectively). In the football players, the correlation between age and fat mass was significant ($r = 0.53$, $p < 0.001$), whereas there was no correlation between fat and age in the control subjects ($r = 0.13$, $p > 0.1$). This article provides, for the first time, DXA analysis of body composition of football players in relation to their age and function. The results should be of interest to coaches because they will help improve athletes' performance.

Key Words: Body composition; dual X-ray absorptiometry; fat mass; lean mass; football.

Introduction

It is assumed that one of the hallmarks of good training status in most competitive sports is an increment in muscle mass with a concomitant reduction in fat mass. Football (soccer), one of the most widely played sports in the world, is, from a physical point of view, characterized by the rapid, explosive running and jumping required to get access to the ball. We are not aware of previous studies regarding the body composition of professional male football players, although there are some reports on female football players.

Dual X-ray absorptiometry (DXA) has become the "gold standard" to determine a three-compartment body composition: bone, fat, and lean tissue *(1)*. The method has good reproducibility and is easily performed *(2)*.

In the present study, a large group of professional football players (PFP) and age- and body size-matched control subjects were studied. The results were analyzed regarding other variables such as function and age.

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Table 1
Anthropometric and Body Composition Values for Control Subjects and PFP (average ± 1 SD)

	PFP ($n = 42$)	Control Subjects ($n = 33$)	p Value[a]
Age (yr)	23.2 ± 3.5	24.9 ± 4.4	NS
Weight (kg)	76.2 ± 5.4	75.5 ± 8.4	NS
Height (cm)	176.5 ± 4.5	176.5 ± 5.1	NS
BMI	24.4 ± 1.3	24.2 ± 2.2	NS
Fat mass (kg)	9.2 ± 2.8	14.8 ± 5.7	0.001
Body weight (%)	12.2 ± 3.1	19.2 ± 5.6	0.001
Lean mass (kg)	63.1 ± 3.9	57.3 ± 4.2	0.01
Body weight (%)	82.9 ± 3.1	76.3 ± 5.4	0.01
Bone mass (kg)	3.8 ± 0.3	3.4 ± 0.5	0.001
Body weight (%)	5.1 ± 0.3	4.5 ± 0.4	0.001

[a] NS, not significant.

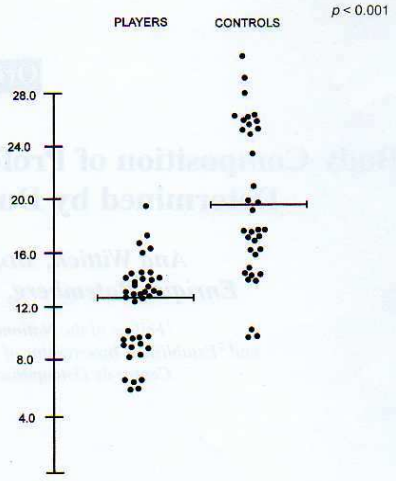

Fig. 1. Individual values of percentage of fat on control subjects and PFP.

Subjects and Methods

Subjects

All male PFP ($n = 42$) of one of the teams (Ferro Carril Oeste) of the First Division Professional League of Argentina were studied during preseason training during 1997 and 1999. The study was approved by the ethical committee of the institution. The results were analyzed as a single group. The study was performed as part of an assessment of body composition to optimize performance. All players were free of any illness, were not taking any medications, and denied the use of anabolic agents. Training is conducted for 48 wk/yr, for an approximate total of 20–22 h/wk, including football practice, running, and exercise training.

Age of onset of the playing career was 14 yr (amateur careers start at the age of 14). The length of the competitive career before the study was ~8 yr: ~4 yr amateur and ~4 yr professional. Training during the amateur period usually is 40% shorter, with an average of 12–14 h of practice per week.

The control subjects were university students (and a few instructors) participating in a study designed to determine peak bone mass values. From the total population of 65 normal men between ages 20 and 35, 33 were drawn to match the PFP in age and body mass index (BMI). The control subjects were also free of any illness and were not taking any medications. They were only engaged in recreational sport activities such as swimming or football (in all cases <3 h/wk) and had not been engaged before in any competitive sport training. Weight and height of all subjects were determined and BMI was calculated.

Methods

Body composition including lean, fat, and bone mass was determined with a DXA densitometer (Lunar DPX-L, software version 1.33). The results were provided by the standard software. The coefficients of variation for lean and fat mass were 0.8 and 4.8%, respectively. The results of the bone mass of a group of the PFP and control subjects has been previously published *(3)*.

Statistical Analyses

Results from PFP and control subjects were compared using the unpaired t-test. Correlation was assessed by linear regression.

Results

Table 1 gives the age, weight, height, BMI, as well as the results of the body composition of 42

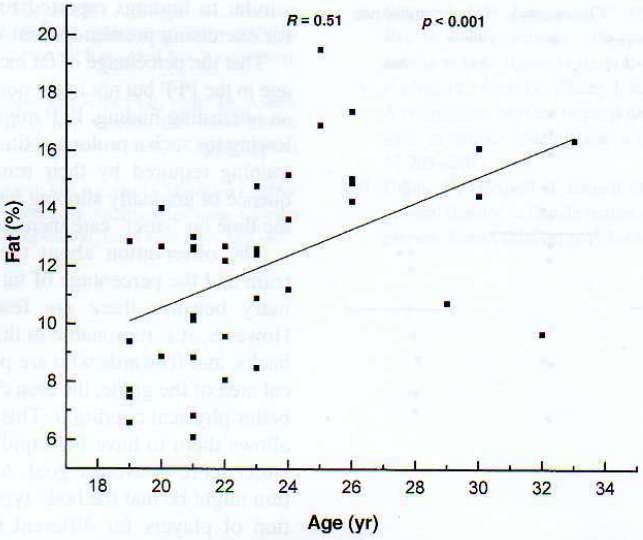

Fig. 2. Correlation between percentage of fat mass and age in PFP.

Table 2
Anthropometric and Body Composition Values for PFP with Different Functions (average ± 1 SD)

	Backs (n = 14)	Midfielders (n = 14)	Forwards (n = 9)
Age (yr)	22 ± 2.9	24 ± 3.6	22 ± 1.7
Height (cm)	176 ± 0.04	176 ± 0.03	176 ± 0.05
Weight (kg)	75.3 ± 4.7	75.4 ± 5.3	75.5 ± 5.4
Fat mass (%)	11.2 ± 2.8	13.6 ± 3.3[a]	11.0 ± 2.3

[a] $p < 0.05$ compared with backs and $p < 0.06$ compared with forwards.

PFP and 33 age- and BMI-matched control subjects. Fat mass was significantly higher in the control subjects whereas lean mass and bone mass were markedly higher in the PFPF.

The percentage of fat varied from 6.1 to 19.5% in the PFP and from 9.1 to 29.9% in the control subjects. The respectives averages were 12.0 ± 3.1 and 19.2 ± 5.6% ($p < 0.001$). Figure 1 depicts the individual values.

In the PFP the correlation between age and fat mass was significant ($r = 0.53$, $p < 0.001$) as well as the correlation between age and percentage of fat ($r = 0.51$, $p < 0.001$) (Fig. 2). On the other hand, there was no correlation between fat or percentage of fat and age in the control subjects ($r = 0.13$, $p > 0.1$).

As far as the position in the team, three groups of players (backs, midfielders, and forwards) had the same height and weight (Table 2). However, the midfielders had a significantly higher percentage of fat (13.6 ± 3.3%) than backs or forwards (11.1 ± 2.8 and 11.0 ± 2.3%; $p < 0.05$ and $p < 0.06$, respectively). Figure 3 shows the individual values. Only four goalkeepers were studied, and because of the small number, the results of this group were not compared with these of the other groups.

Discussion

The results obtained in this study provided information about a very relevant datum for physical fitness: the percentage of fat within the total body weight. We have obtained results in young normal males who are not in competitive sports but who, at the same time, do not have a totally sedentary life style. The average percentage of fat of the present study (~19%) is similar to the results obtained in

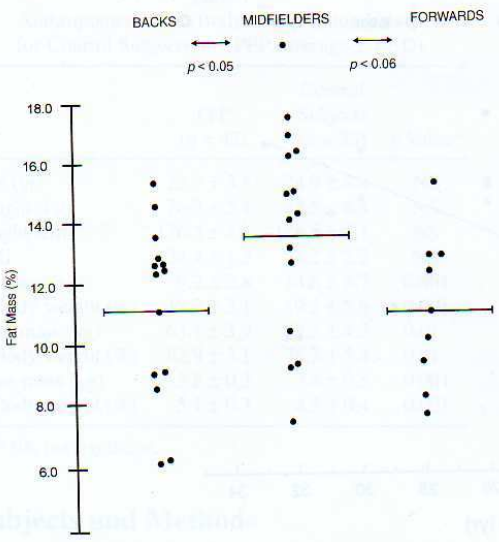

Fig. 3. Individual values of percentage of fat mass according to the function in the team.

other studies in young control subjects studied by DXA. Average percentage of fat varied in those studies from 17 to 21% *(4–7)*. Therefore, in the present study the value of average percentage of fat in the control subjects (19.2%) is in good agreement with values reported in the literature.

The minimum percentage of fat of a normal young male was determined by Friedl et al. *(6)*, who followed for 8 wk a group of rangers during exhaustive training with a low food intake. This group started training with 14% fat mass. Six weeks later, the fat had diminished to 6.9% and at 8 wk only a small additional diminution of 5.8% was registered. This observation led the investigators to calculate that the fat mass should never diminish below 5 to 6% of body weight. Below this limit, probably what begins to be lost is the remaining fat inside tissues, and that should not be affected by training or low food ingestion. In fact, the lower percentage of fat observed in one of the PFP was 6.1%.

The study of the body composition revealed, as expected, that the male PFP had significantly lower fat mass and a significantly higher lean mass compared with age-matched control subjects. This is similar to findings reported for female athletes and for exercising premenopausal women *(8–10)*.

That the percentage of fat increased with increasing age in the PFP but not in the normal control subjects is an interesting finding. PFP might become tired of following for such a prolonged time the rigorous exercise training required by their trainers, with the consequence of gradually slipping into higher fat masses as the time on "strict" care increases.

The observation about the function within the team and the percentage of fat of the PFP is preliminary because there are few such observations. However, it is reasonable to think that those players, backs, and forwards who are performing in the critical area of the game, the area close to the goal, are in better physical condition. This better physical status allows them to have the rapid reflexes necessary to either score or avoid a goal. An alternative explanation might be that the body type influences the selection of players for different positions in the team probably at an early stage of their sport career.

In conclusion, this study gives, for the first time, the body composition related to function and age of PFP compared with control subjects. The reported values should be of interest to coaches in charge of professional football teams.

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