Kinanthropometric assessment of a football team over one season

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SUMMARY

We studied the 23 components of the Zamora Football Club team, from the second division B of the Spanish football league, along one season. Seventeen anthropometric variables were studied, together with the percentage of fat according to the Carter formula and body composition (tetracompartmental model). Analysis of variance (ANOVA) was employed for comparisons among groups ($p<0.05$).

In general, the team was found to show a suitable anthropometric development along the season. Both weight and the Body Mass Index decreased along the period studied. With the exception of the suprailiac fold, fat folds decreased as from the first measurement. Fat weight declined, as did its percentage, significant differences being observed between the measurements made at the end of the season and the previous measurements taken. A discrete increase in bone and muscle weight was observed.

Key words: Anthropometry – Body composition – Football

INTRODUCTION

Despite the many studies on anthropometry and its use as a tool, it remains a relatively controversial method for the assessment of body composition. Used in many areas, such as endocrinology, geriatrics, internal medicine or sports medicine, anthropometry it has been both criticised –owing to its lack of reliability– and praised by researchers who, following established protocols and taking the requisite precautions, claim it to be useful (Weiner and Lourie, 1969), fast and cheap, although the results must be interpreted with caution (Pacheco and Canda, 1999). Other more advanced methods for the determination of body composition should not be overlooked but their high costs, the impossibility –in many cases– of performing field studies, their complex management and maintenance, and the difficulty involved in using them in certain groups of individuals mean that it is hard to standardise them in practice.

Within the field of sports medicine, anthropometry has been integrated in the usual medical-health examinations in an attempt to monitor and identify possible variations in different parameters that may affect sportspersons' yields. After years of research and experience it seems that the sportsperson engaged in individual sports (as opposed to team sports) has a morphotype and certain anthropometric characteristics that are ideal for the practice of each sports speciality, thus conforming true ideal anthropometric patterns that are sought by those involved in different athletic specialities (Kohsla, 1983; Casajús and Aragonés, 1991; Villa et al., 1992; Gualdi-Russo and Graziani, 1993; Villa et al., 2000). In team sports, however, although it is difficult to define an ideal morphotype certain functions that theoretically require specific morphologies (pivot, base, etc.) have been classified in sub-specialities. Nevertheless, in football, players with apparently very different physical characteristics have triumphed, such that it would appear that there is no special morpho-

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type for top-ranking football players (Casajús and Aragonés, 1997).
Many studies have addressed the analysis of different parameters (including anthropometric parameters) in football players but few have explored aspects, such as anthropometric development along a season (Boennec and Ginet, 1980; De Rose et al., 1983; Gomes et al., 1989; Casajús and Aragonés, 1997; García et al., 1999; Alburquerque et al., 2002). Here we used the anthropometric technique to asses the body composition of a group of footballers belonging to the first team of the Zamora Football Club, which plays in the 2nd Division B of the Spanish league.

Materials and Methods

We performed an anthropometric study of the 23 footballers of Zamora F.C of the Spanish League. All measurements were taken by the first author of this work, whose error in technical measurement lies within the ranges accepted in the literature The norms and measuring techniques of the International Working Group on Kinanthropometry (Ross et al., 1978; Ross and Marfell-Jones, 1983) were followed; these are reflected in the Olympic Book of Sports Medicine (Ross et al., 1988) and are accepted by the Spanish Anthropometric Group (Spanish acronym, –GREC–) (Esparza, 1993).
A total of 17 anthropometric measurements were taken at three different times (at the beginning of the season, mid-season and end-of-season).
– Weight and height.
– Skin folds (triceps, subscapular, suprailiac, abdominal, anterior thigh and inner fold of the calf at medial level).
– Perimeters (minimum abdomen, maximum gluteus).
– Diameters (biacromial, transverse and anteroposterior of the chest, intercrestal, biepicondylar of the femur, biepicondylar of the humerus and bistoilideal).
These measurements, all taken after marking the corresponding anthropometric points on the right side of the subject, were used to perform both an individual analysis and, later, to the corresponding study of body composition, following the strategy of De Rose and Guimaraes, supported by the GREC (Esparza, 1993). In this sense, we used the formula proposed by Carter to calculate fat weight (Carter, 1982); that of Von Döblen (Von Döblen, 1964) modified by Rocha (Rocha, 1975) for bone weight; that of Würch for residual weight (De Rose and Guimaraes, 1980), and the basic proposal of Matiegka (Matiegka, 1921) to measure muscle weight.
The measuring instruments employed were a digital Medicon® stadiometer with a precision of 0.1 kg; a *Slimguide*® plicometer, a segmometer, *Harpenden* anthropometric tape from *Holtain Ltd*® and a *Berfer* compass and pachymeter.
The statistical study was carried out using analysis of variance (ANOVA), setting a level of significance of $p<0.05$. Differences among groups were detected using the Scheffé contrast test.

Results

The characteristics of age, weight, height and body mass index (BMI) for the beginning of the season are shown in Table 1.
Weight and the BMI of the three measurements are shown in Table 2. It can be noted that as the season advanced, both values decreased progressively.

	ZAMORA F.C. n = 23
Age (years)	24.5±3.5
Weight (Kg)	76.3±7.45
Height (m)	1.765±0.49
BMI	24.45±1.82

Table 1.- General data of the group at the beginning of the season.

	BEGINNING OF THE SEASON	**MID-SEASON**	**END-OF-SEASON**
Weight (Kg)	76,3±7.45	75.8±7.73	74.5±7.62
BMI	24.45±1.82	24.29±1.98	23.88±1.94

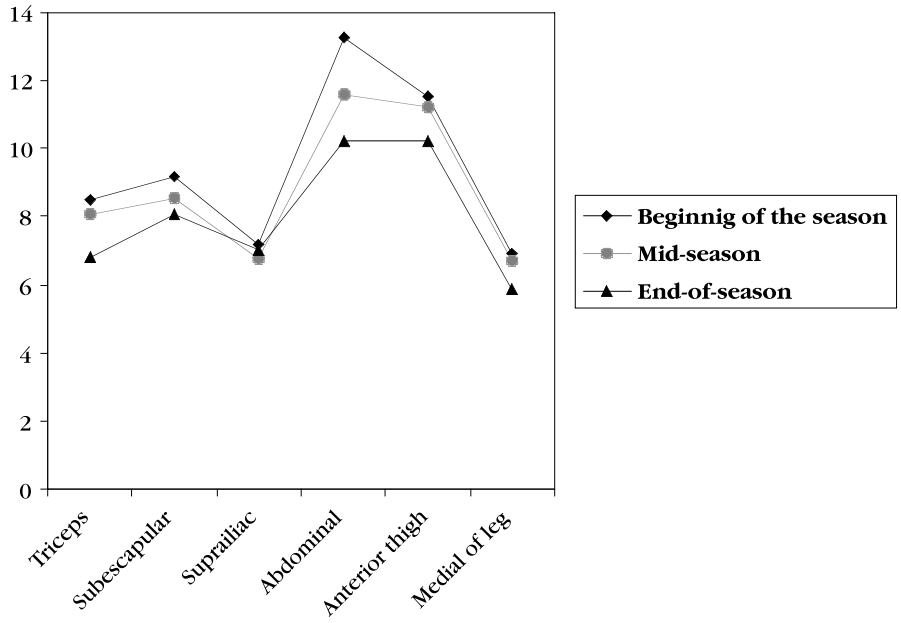
Table 2.- Weight and BMI.

	BEGINNING OF THE SEASON	MID-SEASON	END-OF-SEASON
Triceps *	8.5±1.90	8.1±1.5	6.8±1.52
Subscapular º	9.1±1.53	8.5±1.14	8.1±1.1
Suprailiac	7.2±2.57	6.8±1.98	7±2.08
Abdominal º	13.3±4.42	11.6±4.39	10.3±3.61
Anterior thigh	11.5±2.98	11.2±2.66	10.2±2.16
Medial of leg	6.9±2.10	6.7±1.67	5.8±1.88
Sum six folds º	56.5±10.69	52.9±9.20	48.2±8.9
Fat % (Carter) *	8.6±1.12	8.1±0.97	7.6±0.94

* Significant differences between end-of season and two previous measurements

º Significant differences between beginning and end-of-season

Table 3.- Skin folds (mm), sum of the six folds (mm) and fat % (Carter).



Graphic 1.- Profile of fat folds.

Regarding fat folds (Table 3 and Graphic 1), a decrease in these values was observed between the measurement taken prior to the football season and that performed at the end-of-season. The triceps value taken at the end of the season was significantly lower than those found in the previous two measurements. The subscapular and abdominal values showed significant differences between the pre-season measurement and that made at the end of the season; this was identical to what was found for the sum of the six folds studied.

The minimum abdomen and maximum gluteus perimeters decreased slightly along the season (Table 4).

Analysis of body composition revealed a progressive decrease in fat weight, with significant differences among the three measurements and a discrete (percentage) increase in bone and muscle weight. The latter showed significant differences between the mid-season measurements and those taken at the end of the football season (Table 5 and Graphic 2).

DISCUSSION

Before starting this section, we stress again that few authors have carried out detailed anthropometric studies of professional football teams and

	BEGINNING OF THE SEASON	MID-SEASON	END-OF-SEASON
PERIMETERS			
Minimum abdomen	78.2±4.1	77.6±6.24	75.9±4.05
Maximum gluteus	93.3±4.05	92.4±6.12	91.8±4.09

Table 4.- Perimeters (cm).

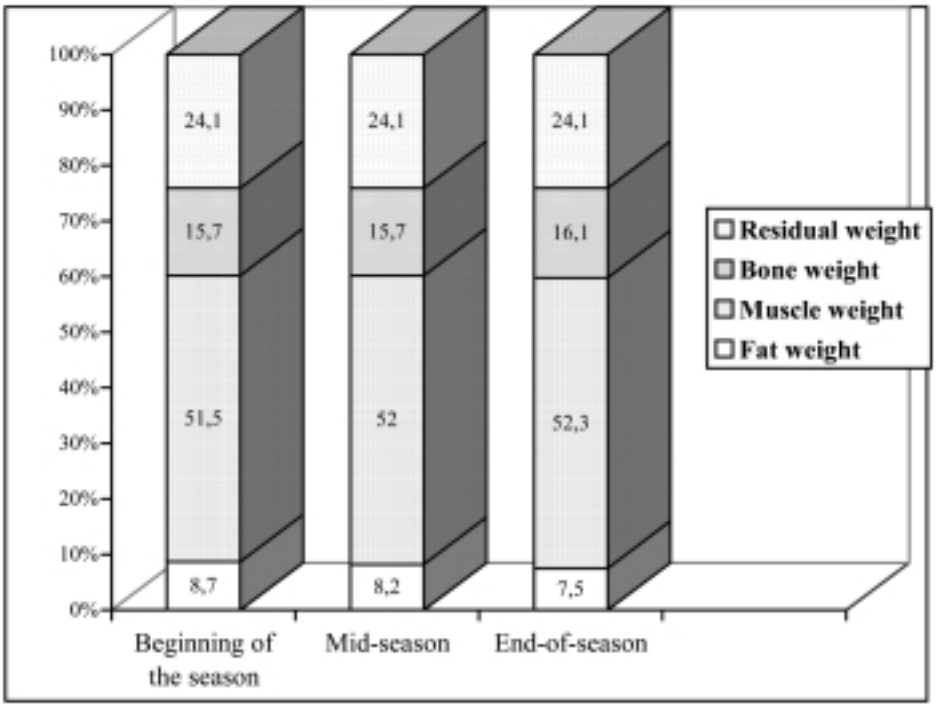
	BEGINNING OF THE SEASON	MID-SEASON	END-OF-SEASON
Fat weight *	6.6±1.32	6.2±1.17	5.7±1.05
Bone weight	12±0.85	11.9±0.85	12±0.85
Residual weight º	18.4±1.8	18.3±1.86	17.9±1.84
Muscle weight+	39.3±4.05	39.4±4.33	39±4.23

* Significant differences between beginning of the season and the other ones and between second and third measurements

º Significant differences between end-of-season and the other ones

+ Significant differences between end-of-season and mid-season

Table 5.- Body composition (Kg).



Graphic 2.- Body composition %.

there are even fewer studies that have addressed the same formulas as those applied here. It is therefore difficult to make valid comparisons. In this sense, we refer readers to a recent work by Wittich et al. (2002), who studied professional footballers using absorptiometry with dual-energy X-rays. These authors estimated a mean fat value of 12% in their players; this is considerably higher than the values obtained with any of the formulas commonly used to assess body composition by the anthropometric method.

In the first part of our study we evaluated the body composition of the Zamora F.C players at the beginning of the season: that is, immediately after the summer vacation. The age and the weight and height values of the players were within the range of values reported by other authors (Casajús and Aragonés, 1991; Graganta et al., 1992; Bangsbo, 1994; Casajús and Aragonés, 1994; Castellano et al., 1996; González and Andrés, 1996; Reilly, 1996; Casajús and Aragonés, 1997). However, all the fat folds, the sum of six folds, and the fat percentages obtained according to the formula of Carter had higher values than those published in different studies of teams from the same category. This was not surprising since we performed our initial measurements at the beginning of the season and hence before our players had begun regular training, whereas other published studies provide data for the mid-season; i.e., when the desired physical fitness is assumed to have been reached. Nevertheless, stress should be placed on the differences with the data reported in an earlier study by Villa et al. (2000) for players from the *Unión Deportiva Salamanca*. These authors observed much smaller folds that those seen in our players at the beginning of the season and their values are even lower than those reported in 1997 by Casajús and Aragonés for players of the Spanish National team. Logically, the trend of the sum of six folds in our players again showed differences with respect to the values reported by Villa et al. (2000).

Upon performing the corresponding study of body composition, fat weight was higher in our players whereas muscle weight had values that were very similar to those obtained in the study referred to above.

As commented previously, one of the main aims of the present study was to determine the evolution of the professional team along a season. To do so, we set three moments for the collection of anthropometric measurements: pre-season, mid-season and end-of-season. Considering the team overall, both weight and BMI were seen to decrease progressively along the season. On analysing fat folds, we observed that as the season advanced the values of these decreased, which is why the sum of six folds and the percentage of fat followed the same trend. The latter parameter (fat percentage) showed significant differences between the end-of-season values and those recorded on the two previous occasions. This suggested that the physical training of the team induced a decrease in subcutaneous fat in our players. However, we were interested in knowing whether muscle mass was increased and indeed we found this to be the case when we performed the corresponding study of body composition, where we observed that although this compartment remained similar as regards the absolute values of the three measurements, in percentage terms it increased as from the pre-season value, passing from 51.5 to 52.3%. As is logical, these changes observed in all the team members were judged to be very positive by the medical and technical staff of the team. Additionally, on comparing the data collected mid- and end-of-season with studies of teams of similar characteristics and in the same category (Casajús and Aragonés, 1997), we observed that the values for the fat folds and body composition were very similar to and even closer to those of players from higher categories.

Conclusions

1. The anthropometric study performed on the players after the summer vacation suggests that physical inactivity alters body composition, this departing from the optimum fitness required for playing football.
2. We observed an intimate relationship between physical exercise, training level and body composition. Thus, overall the team showed an improvement in the anthropometric variables studied: in particular a decrease in fat weight and a discreet increase in muscle weight as the football season advanced.
3. The most appropriate body composition from the anthropometric point of view is obtained from measurement at mid-season. We believe that this is so because it is at this time that optimum physical fitness has been achieved and the players are not subject to the “game-overload” currently demanded in football.
4. In light of our results, the anthropometric method can be envisaged as an economical and easy-to- apply technique that permits the monitoring and assessment of footballers with a view to planning individual training.

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