Anthropometric measurements and body composition of English and Malaysian footballers

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ABSTRACT

This comparative study was conducted to determine the anthropometric measurements and body composition of football teams in the UK and Malaysia. A total of 32 footballers from two teams were studied. The teams were the St Mary's University team (UK) and the Selangor Reserved League team. The height and body weight of the subjects were measured using SECA digital balance with height attachment. Skinfold thickness measurements were taken using Harpenden skinfold callipers at four sites (biceps, triceps, subscapular and suprailiac) and the VO_2 max of the subjects was estimated by participation in a multi-stage 20m shuttle-run test. The UK team were significantly heavier ($p<0.05$), taller ($p<0.05$) and had a higher body fat content ($p<0.05$) than their Malaysian counterpart. There was no significant difference in VO_2 max between the two teams, with the Malaysians recording a slightly higher VO_2 max. With regard to playing position, the defenders were found to be the most physically robust and yet had the highest VO_2 max, whilst the midfielders had the lightest body weights. More data on the body composition and nutritional status of Malaysian footballers would allow adjustments to be made to dietary intakes and training levels in order to obtain maximum performance throughout the football season.

INTRODUCTION

Football is probably the world's most popular sport, played in practically every nation at varying levels of competence. Football may be played competitively or for fun, as a career, a means of keeping fit or simply a recreational pursuit (Reilly, 1996). Most sports, including football, require certain physical characteristics and body

composition, and whilst there is an increased interest in football judging by the popularity of events such as the World Cup, few standards for male teams world-wide exist. In particular, although Nudri, Ismail & Zawiah (1996) had presented data on Malaysian athletes, there is a scarcity of data on the body composition and anthropometric measurements of Malaysian footballers.

At competitive, organised levels, football is an endurance sports that incorporates periods of intense exercise interspersed with lower levels of activity over a 90-minute period (Reilly, 1996). Therefore, a large amount of aerobic power is essential to a footballer. Aerobic ability may be assessed by measuring maximal aerobic power (VO_2 max). This is the maximum rate at which energy can be released from the oxidative process exclusively (Bouchard, Shephard & Stephens, 1994). For this reason VO_2 max is an essential measurement in the study of footballers.

Since the physiological as well as physical characteristics are important considerations in player performance (Bell & Rhodes, 1980), it may therefore be assumed that anthropometric and VO_2 max measurements may differ between footballers of various playing positions, for instance striker, goalkeeper, defender and midfielder. Consequently, differences in the physical characteristics of footballers in different playing positions within teams are also worth investigating.

The purpose of this study was to collect anthropometric, body composition and VO_2 max measurements on an English football team and make comparisons with a Malaysian team. Additionally, the effect of playing position upon physique was also considered.

METHODOLOGY

Subjects

Thirty-two footballers with an average age of 22 years were recruited from two teams. The first team studied was a collegiate team from St Mary's University College while the second team was the Selangor Reserved League team, a semi-professional team based in the state of Selangor. Both teams were of a high standard and included players who played semi-professionally for other teams in their respective football leagues. Consequently, it would be expected that these two teams would be of a similar standard. The Selangor team were known to train everyday except weekends and match days. The St Mary's University team trained twice a week and also played matches twice a week.

Anthropometry

Anthropometric measurements were carried out according to the technique of Norgan & Jones (1990). Body weight was measured with SECA digital balance to the nearest 0.1 kg. The balance was calibrated for accuracy with the use of a known

weight. Height measurements were read to the nearest 0.5 cm from a scale marked in centimetres up to a height of two meters and fixed to the beam balance.

Skinfold thickness measurements were taken with Harpenden skinfold callipers (British Indicators, UK) to the nearest 0.1 mm. Total body fat was estimated from the sum of four skinfold values taken at the biceps, triceps, subscapular and suprailiac as recommended by Durnin & Rahaman (1967) and calculated using the Durnin & Womersley equations (1974).

VO$_2$ max measurements

As a guide to overall fitness, the subjects participated in a multi-stage 20m shuttle-run test to estimate their VO$_2$ max (Leger & Lambert, 1982). After familiarisation, the tests were performed in groups to ensure maximal effort by stimulating competition. Also, non-participants were encouraged to offer support and motivation.

Following personal warm up routines, the test commenced with a four second countdown after which the tape emitted a single beep at regular intervals. The subjects had to reach the end of the 20m course by the time the next beep sounded. They then proceeded to run back and forth along the 20m reaching either end of the course every time a beep was emitted from the cassette recorder. After each minute, the span between the beeps decreased leading to a proportional increase in running speed of 0.14 m/second.

Every minute spent running was termed "another level".

Each subject ran for as long as was possible before voluntarily withdrawing when they could no longer keep up with the pace set by the tape. Subjects failing to reach the end of the 20m run twice before the beep sounded were withdrawn. The number of levels and shuttle runs completed were noted at the time the subject retired. Maximal oxygen uptake values were then predicted using the tables of Leger & Lambert (1982) based on the relationship between VO$_2$ max and the maximum speed achieved in the multi-stage shuttle run.

Statistical analysis

Values are presented as mean values ± SD. The results were compared between the teams using analysis of variance (ANOVA). Data was analysed using Excel 97 (Microsoft Corporation) software. A significance level of $p < 0.05$ was considered significantly different.

RESULTS AND DISCUSSION

Table 1 shows the physical characteristics of the football teams studied. The Selangor and St Mary's teams both have mean age of 19 years. The team from St Mary's were significantly heavier and taller ($p < 0.05$) than the Malaysian team. There are well-established ethnic differences between UK and Malaysian subjects. UK males were

Table 1. Mean physical characteristics of the football players

Team	n	Age (yrs)	Height (cm)	Weight (kg)	BMI (kg/m^2)	Body Fat (%)
Selangor	14	19.1 ± 1.0	170.1 ± 5.0	64.8 ± 7.2	22.0 ± 1.9	14.6 ± 2.1*
St Mary's	18	19.4 ± 1.8	179.2 ± 5.4*	74.0 ± 10.9*	23.1 ± 3.5	17.3 ± 3.9*

* $p < 0.05$

Table 2. Results of VO$_2$ max measurements

Team	n	Level	VO$_2$ max (ml/kg)
Selangor	14	11.3 ± 1.7	50.13 ± 5.83
St Mary's	18	10.9 ± 1.8	49.61 ± 11.28

Statistical analysis shows no significance between the groups.

on average taller and heavier than their Malaysian counterparts. Chee *et al.* (1997) found the mean height of Malaysian males to be 1.62 m and mean weight 58.3 kg, whilst the Department for Health and Social Security in the UK (1986) found the average UK male to be 1.76 m and weigh 70 kg. The results of the subjects in this study showed a similar trend, the UK footballers being notably taller in height and heavier in weight than the Malaysian footballers.

The St Mary's male team were found to have significantly more body fat ($p < 0.05$) than the Malaysian team. Forbes (1987) and Malina (1996) have also compared the body composition of different ethnic groups and found that these differences may be a direct result of lifestyle factors, most notably diet as well as differences in activity and training levels.

Table 2 shows the results of the maximal multi-stage 20 m shuttle run test. Both the level that was achieved by the footballers and the VO$_2$ max this equates to, are presented. Although there were no significant differences between the results of this test, it is evident that the Selangor team on average attained a higher level than the UK teams and consequently had a higher VO$_2$ max (a high VO$_2$ max being more beneficial to a footballer).

The differences in VO$_2$ max may be partially attributed to differences in lean body mass, since it had been found that athletes with lower body fat have higher maximum oxygen uptakes and excess fat may deter athletic performance (Heck, 1980). Climate may also have played a part in the VO$_2$ max results, since in Malaysia temperature and humidity

average 30° and 90% respectively whilst in the UK temperature at the time of measurement was 18° and humidity averaged 50% (Ward & Robinson, 1990). However, since all subjects performed these tests in their country of birth, acclimatisation was not considered to have been a problem.

Table 3 compares the anthropometric characteristics of footballers from previous studies with the results obtained in this study.

Unfortunately, there is little research on the anthropometric profiles of Asian football players. For this reason, the Selangor team could only be compared to Chin *et al.*'s (1992) study of elite players from Hong Kong. It may be said that the Hong Kong players were on average both taller and heavier than the team from Selangor, but in addition had less body fat. Consequently, the Hong Kong players also to have a higher

Table 3. Comparison of anthropometric characteristics of footballers from similar studies

Team	Reference	Height (cm)	Weight (kg)	Body fat[1] (%)
Asian				
Hong Kong	Chin *et al.* (1992)	173	67.7	7.3
Selangor	Present Study	171	64.8	14.6
UK				
Tottenham	Reilly (1979)	179	77.5	n.a.
First Division team	White *et al.* (1988)	180	76.7	n.a.
League team	Davis *et al.* (1992)	n.a.	77.1	10.5
St Mary's University	Present Study	179	74.0	17.3

[1] Body fat reported in previous studies were ascertained from four skinfold sites according to Durnin & Wormersley (1974).
n.a. – not available

Table 4. Comparison of VO₂ max data of footballers from previous studies

Team	Reference	VO₂ max
Asian		
Hong Kong	Chin *et al.* (1992)	59.1
Selangor	Present Study	50.1
UK		
England	Reilly (1996)	50.0
St Mary's	Present Study	49.6

Table 5.   Physical characteristics of footballers in different playing positions

	Defender	*Midfielder*	*Striker*	*Goal Keeper*
n	12	10	7	2
Height (cm)	176.9 ± 7.9	172.8 ± 6.0	175.9 ± 5.5	176.5 ± 2.1
Weight (kg)	70.5 ± 7.3	65.6 ± 9.5	70.6 ± 5.1	90.0 ± 2.0
Body fat (%)	15.4 ± 3.0	15.8 ± 3.6	17.1 ± 2.2	20.6 ± 8.0
VO_2 max (ml/kg)	54.4 ± 5.2	42.8 ± 14.2	50.7 ± 6.4	n.a.

n.a. – not available

VO_2 max (Table 4).

With respect to the teams from the UK, St Mary's appeared to be of comparable height, lower body weight and had a greater percentage fat than the English League teams. Likewise they also had a lower VO_2 max (Table 4).

Table 5 compares the physical characteristics of football players that play in different positions. The data of both the St Mary's University team and the Selangor team were combined for analysis. Although there were trends between the different positions, these findings were not significant. As in the study undertaken by Bell & Rhodes (1980), the defenders tended to be taller, heavier and have less body fat than either the midfielders or the strikers, hence they were more robust. VO_2 max was also higher in the defenders.

The midfielders had the lightest body weights. This characteristic suits their role enabling them to cover greater distances and act as links between defence and attack. Consequently, they expend the most energy during matches (Reilly, 1996). It would also then be expected that the midfielders would have the highest VO_2 max, but this does not appear to be the case.

It was very difficult to make observations and comparisons regarding the goalkeepers, since there were only 2 subjects. The goalkeepers of both the men's teams were not significantly different from the rest of their teams. In the past it had been suggested that goalkeepers have a tendency to be taller than other team members (Bell & Rhodes, 1980). This was not evident in the goalkeepers of this study. The abilities to jump and reach are useful for goalkeepers particularly if the goalkeeper in question is of average height. However, the advantages of being tall are obvious and professional goalkeepers are frequently taller than players of other positions (Reilly, 1996).

CONCLUSION

Generally, there were differences between the two teams studied. The Malaysian team was found to have significantly less ($p < 0.05$) body fat

than the UK team. The St Mary's team was significantly taller (p<0.05) and heavier (p<0.05) than the Selangor team. There are many factors that may account for these differences, notably ethnicity, climate and differences in aerobic and football specific training sessions.

It was also found that there were differences, although not statistically significant, in the anthropometric characteristics and body composition associated with playing position. The defenders were found to be the most physically robust and yet had the highest VO_2 max, whilst the midfielders were shortest and had the lightest body weight.

More information on footballers of all nationalities, including Malaysians is required. In particular, data regarding body composition and nutritional status during the football season and out of season. This could then, allow adjustments to be made to dietary intakes and training levels in order to obtain maximum performance throughout the football season.

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