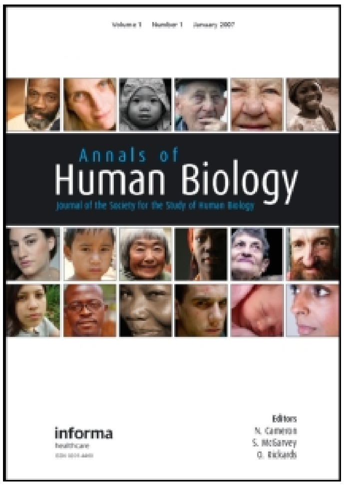

Annals of Human Biology
Publication details, including instructions for authors and subscription information:
http://www.informaworld.com/smpp/title~content=t713723502

Youth soccer players, 11-14 years: Maturity, size, function, skill and goal orientation

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Online Publication Date: 01 January 2009

To cite this Article Figueiredo, António J., Gonçalves, Carlos E., Coelho E Silva, Manuel J. and Malina, Robert M.(2009)'Youth soccer players, 11-14 years: Maturity, size, function, skill and goal orientation',Annals of Human Biology,36:1,60 — 73

To link to this Article: DOI: 10.1080/03014460802570584

URL: http://dx.doi.org/10.1080/03014460802570584

Annals of Human Biology, January–February 2009; 36(1): 60–73

ORIGINAL ARTICLE

Youth soccer players, 11–14 years: Maturity, size, function, skill and goal orientation

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(Received 10 June 2008; revised 15 October 2008; accepted 20 October 2008)

Abstract

Background: Participants in many youth sports are commonly combined into age groups spanning 2 years.

Aim: The study compared variation in size, function, sport-specific skill and goal orientation associated with differences in biological maturity status of youth soccer players within two competitive age groups.

Methods: The sample included 159 male soccer players in two competitive age groups, 11–12 years ($n = 87$) and 13–14 years ($n = 72$). Weight, height, sitting height and four skinfolds, four functional capacities, four soccer skills and goal orientation were measured. Skeletal maturity was assessed using the Fels method. Each player was classified as late, on time or early maturing based on the difference between skeletal and chronological ages. ANOVA was used to compare characteristics of players across maturity groups.

Results: Late, on time and early maturing boys are represented among 11–12-year-olds, but late maturing boys are under-represented among 13–14-year-olds. Players in each age group advanced in maturity are taller and heavier than those on time and late in skeletal maturity, but players of contrasting maturity status do not differ, with few exceptions, in functional capacities, soccer-specific skills and goal orientation.

Conclusion: Variation in body size associated with maturity status in youth soccer players is similar to that for adolescent males in general, but soccer players who vary in maturity status do not differ in functional capacities, soccer-specific skills and goal orientation.

Keywords: *Young athletes, bone age, fitness, sport skill, achievement orientation*

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ISSN 0301-4460 print/ISSN 1464-5033 online
DOI: 10.1080/03014460802570584

Introduction

Participation in youth team sports is based primarily on chronological age groups which often span 2 years. Variation in size, function and skill associated with age *per se* and with maturity status within 2-year age groups can be considerable. Studies of young athletes are often limited to growth and maturity status independent of functional capacities and sport-specific skills; the same is true of studies of function and skill (Malina 1994; Malina et al. 2004). As a result, potential interactions among size, maturity, function and skill are often overlooked as youth progress in a sport.

Behavioural dimensions such as goal orientation, motivation, and perceptions of ability and success have not ordinarily been considered in studies of young athletes that focus on biological and performance characteristics. Interactions between biological and behavioural variables may influence sport performance *per se* and persistence in a sport, and thus merit consideration. Observations of boys in the Adolescent Growth Study of the University of California (Berkeley), for example, indicated variation in behavioural characteristics associated with biological (skeletal age) maturity status (H.E. Jones 1949, M.C. Jones and Bayley 1950; M.C. Jones 1958, 1965, Eichorn 1963). Early maturing boys received greater social recognition from peers, were more at ease in social interactions, were considered more physically attractive and physically efficient, and were treated more favourably by adults compared to late maturing boys. On the other hand, late maturing boys were generally considered more eager, expressive and more attention seeking but lower in social prestige than early maturing boys. Although dated, the results highlight the potential relevance of interactions between biological maturity and behaviours among adolescent boys which are implicit in commonly used models of adaptations to puberty (Petersen and Taylor 1980; Lerner 1985). The identification and quantification of potentially relevant behavioural variables may thus be of interest.

Achievement or goal orientation (Nicholls 1984) is a potentially relevant behavioural variable for success in sport. A task-oriented individual views his performance in terms of self-improvement, learning and effort, while an ego-oriented individual views his performance or ability relative to others (Duda 1992; McArdle and Duda 2002). It is generally assumed that a task orientation is more adaptive than an ego orientation specifically from a motivational perspective. This in turn may influence continuation or discontinuation of participation in a sport. A comprehensive evaluation of correlates of goal orientation for physical activity, including sport, however, did not include any biological markers (Biddle et al. 2003).

Given performance advantages associated with early maturation in boys, specifically size, strength, power and speed (Malina et al. 2004), it may be reasonable to assume that advanced maturation is associated with increased ego orientation. Evidence suggests that ego-oriented athletes tend to view ability as a stable concept and are more likely to attribute success to natural ability (Sarrazin et al. 1996). The performance advantages associated with advanced maturity among adolescent boys might be perceived by them as natural ability. They may also be identified as having superior ability by coaches and peers. This in turn may contribute to higher levels of ego orientation. On the other hand, performance limitations of late maturing boys associated with small body size and less muscular strength compared to early maturing peers of the same age may contribute to task orientation, specifically focus on practice and training to improve ability and in turn mastery (Dweck and Leggett 1988).

The purpose of this study is to compare the growth and maturity status, functional capacities, sport-specific skills and goal orientation of youth soccer players in two competitive age groups, 11–12 and 13–14 years. Variation in body size, function, sport-specific skill and goal orientation of youth soccer players associated with differences in biological maturity status is specifically compared.

Methods

Sample

The sample included 159 male soccer players aged 11.0–14.9 years from five clubs in the midlands of Portugal. All players were born in 1989–1992. All except one were of European ancestry; one player was Portuguese of African ancestry. The organization of youth soccer in Portugal uses 2-year age groups. Accordingly, 87 players born in 1991 and 1992 were classified as *infantiles* (11.0–12.9 years) and 72 players born in 1989 and 1990 were classified as *initiates* (13.1–14.9 years). Players were from local clubs. Infantiles had a median of 3 years' experience in the sport with a range from 1 to 6 years, while initiates had a median of 5 years of experience with a range of 2–8 years. Teams participated in a 9-month competitive season (September/May) through the Portuguese Soccer Federation. Players participated in three training sessions per week (each about 90 min) and one game per week, usually on Saturday. The study was approved by the Scientific Committee of the University of Coimbra and each club. Athletes and their parents provided informed consent. Subjects were also informed that participation was voluntary and that they could withdraw from the study at any time.

Protocol

All data were collected within a 2-week period under standard conditions in an indoor facility at the University of Coimbra. Chronological (decimal) age was calculated as the difference between date of birth and date of the hand–wrist radiograph for the assessment of skeletal maturity (see below).

Anthropometry

Weight, height, sitting height and four skinfolds (triceps, subscapular, suprailiac, medial calf) were measured by a single trained observer following the protocol described in Lohman et al. (1988). Players wore shorts and a T-shirt and shoes were removed. Leg (subischial) length was estimated as height minus sitting height. The sitting height/standing height ratio was calculated. The skinfolds were summed to provide an estimate of overall subcutaneous adiposity.

Functional capacities

Aerobic and anaerobic function, agility and muscular power were tested. The yo-yo intermittent endurance test – level 1 (Bangsbo 1994; see also Balson 1994; Reilly 2001; Reilly and Doran 2003) was used as the measure of aerobic performance. Level 1 of the yo-yo intermittent endurance test requires the subject to perform a series of 20 m shuttle runs following a cadence set by an audio metronome with a 5 s rest interval between every 40 m. Speed is increased at intervals, i.e. the time between the signals is shortened. The objective of the test is to perform as many shuttles as possible and the score corresponds to the total amount of metres covered until the athlete is no longer able to maintain the required speed, e.g. if a subject completed 40 shuttles, his score was 1600 m ($40 \times 2 \times 20$).

The relationship between the yo-yo intermittent endurance test and the PACER (progressive aerobic cardiovascular endurance run test, Léger et al. 1988) was examined in 69 male soccer players 13–18 years (Figueiredo et al. 2004). The correlation between tests was 0.78 ($p \leq 0.01$) and the shared variance between the intermittent and continuous tests was 61%. In a study of adult soccer players ($n = 81$, 23.5 ± 4.0 years) at three competitive levels (low, high (amateur) and professional) the intermittent test had higher predictive value in discriminating players by competitive level (Lemmink et al. 2004).

Anaerobic fitness was assessed with the seven-sprint protocol (Bangsbo 1994, see also Reilly 2001; Reilly and Doran 2003). The test includes seven consecutive sprints (about 35 m with a slalom) with a recovery period of 25 s between sprints during which the subject runs/walks from the end line back to the starting line. The time for each sprint was recorded by a digital chronometer connected to photoelectric cells (Globus Ergo Tester Pro). The protocol provides for the following indicators: The faster sprint from the first two trials (measure of speed), the slower sprint from the last two trials, and the mean of all sprints. Prior to the study, the relationship between the seven-sprint test and the Wingate test was examined in 29 male soccer players aged 15.7 ± 0.7 years (Figueiredo et al. 2003). The first and the third sprints had the highest correlation with relative anaerobic peak power. The outcomes of the seven-sprints were more correlated with anaerobic peak than with anaerobic mean power. Correlations were also of higher magnitude when anaerobic peak power was expressed as watts per kilogram of body weight. Note, however, that the correlation between the fastest sprint and relative anaerobic peak power was moderate ($r = 0.44$, $p \leq 0.01$), suggesting that anaerobic outcomes were not independent of test modality (cycling $\times$ running).

Agility was assessed with the 10×5 m shuttle. The test includes running speed and ability to change directions rapidly. Two trials were performed and the better of the two was retained for analysis.

Explosive power was assessed with the vertical jump using the ergo-jump protocol, which includes two components: Squat jump and counter-movement jump (Bosco 1994). Two trials were administered for each test and the better trial was retained for analysis.

Soccer skills

Four tests of soccer skill were administered: Ball control with the body, dribbling speed, shooting accuracy and the wall pass. The test battery was selected on the basis of a principal components analysis of eight tests of soccer skills, six from the Portuguese Soccer Federation – ball control with the body, ball control with the head, dribbling speed, dribbling with a pass, passing accuracy, and shooting accuracy (Federação Portuguesa de Futebol 1986) and two others, a wall pass and slalom dribble test (Kirkendall et al. 1987), administered to 39 youth players (Coelho e Silva et al. 2004). Results of the principal components analysis indicated two factors which accounted for 57% of the variance. Seven of the eight tests loaded on the first factor (40% of the variance) while the test of shooting accuracy loaded very high on the second factor (17% of the variance). The slalom dribble and the test of passing accuracy loaded on the two extracted factors and were thus excluded from the test battery. The test of ball control with the body had higher communality than the test of ball control with the head and was thus retained. The wall pass had higher communality than dribbling with a pass and was retained in the test battery. Thus, the final battery included four tests of soccer skill: Ball control with the body, dribbling speed, shooting accuracy and wall pass.

Maturity status

Posterior–anterior radiographs of the left hand–wrist were taken. The Fels method (Roche et al. 1988) was used to estimate skeletal age (SA). The Fels method utilizes specific criteria for each bone of the hand–wrist and ratios of linear measurements of epiphyseal and metaphyseal widths. Ratings are entered into a program (Felshw 1.0 Software) to calculate SA and its standard error of estimate. All radiographs were assessed by a single observer (AF) who was trained by an experienced assessor (RMM). In addition to SA, stage of pubic hair was assessed at clinical examination by a trained physician. Stages as described by Tanner (1962) were used.

Goal orientation

A Portuguese version (Fonseca and Biddle 1996) of the Task and Ego Orientation in Sport Questionnaire (TEOSQ, Duda 1989; Chi and Duda 1995) was completed by all players. The TEOSQ includes 13 items which are rated on a five-point Likert scale ranging from strongly disagree (1), disagree, neutral, agree and strongly agree (5). Seven items reflect a task orientation while six reflect an ego orientation. Examples of a task focus are: 'I learn a new skill and it makes me want to practice more' and 'I learn something that is fun to do,' while examples of an ego focus are: 'I'm the only one who can do the play or the skill' and 'I can do better than my friends.' Cronbach's alphas (task, 0.76; ego, 0.85) indicate acceptable internal consistency. Confirmatory factor analysis using an independent sample indicated acceptable fit of the data (comparative fit index = 0.91, goodness of fit index = 0.93, standardized root mean square residual = 0.07).

Quality control

A sample of 32 players was measured and tested on a second occasion within 1 week. Intra-observer technical errors of measurement for anthropometric dimensions and coefficients of reliability for the functional capacity and soccer skill tests were calculated. The technical error of measurement is the square root of the squared differences of replicates divided by twice the number of pairs:

$$\sigma_e = \sqrt{\Sigma d^2/2N} \qquad \text{(Malina et al. 1973).}$$

It is also known as the measurement error standard deviation. The coefficient of reliability is based on the ratio of within-subject (*r*) and inter-subject (s) variances:

$$R = 1 - (r^2/s^2) \qquad \text{(Mueller and Martorell 1988).}$$

Higher values indicate greater reliability. Technical errors and reliability coefficients for the present study are summarized in Table I. Technical errors for anthropometric dimensions compare favourably with corresponding intra- and inter-observer errors in several health surveys in the USA and a variety of field surveys, including studies of young athletes (Malina 1995), while reliability coefficients indicate moderate to high reliabilities which are adequate for group comparisons.

Twenty radiographs were independently assessed by AF and RMM to estimate inter-observer variability. The mean difference between SA assessments of the two assessors and the inter-observer technical error of measurement were small, 0.03 ± 0.04 years and 0.12 years, respectively. The inter-observer intra-class correlation was 0.99. The total number of indicators (stages, grades and linear widths of epiphyses and diaphyses) involved

Table I. Intra-observer technical errors of measurement (σ_e) for anthropometric dimensions, and reliability coefficients (R) for functional capacity and soccer skill tests.

Anthropometry	σ_e	Functional capacity and skill	R
Weight, kg	0.47	Squat jump	0.83
Height, cm	0.27	Counter-movement jump	0.87
Sitting height, cm	0.31	Agility shuttle run	0.84
Skinfolds, mm		Intermittent endurance run	0.88
Triceps	0.52	Best sprint	0.81
Subscapular	0.53	Mean sprint	0.88
Suprailiac	0.72	Ball control	0.77
Medial calf	0.47	Dribbling speed	0.74
		Wall pass	0.83
		Shooting accuracy	0.71

in the assessment of the 20 films was 988. Disagreement between assessors occurred on 48 occasions ($<5\%$); all differences were by one stage/grade or by 0.5 mm for metaphyseal and epiphyseal widths. Replicate assessments of pubertal stage were not possible.

Maturity classification

The difference between SA and CA (SA minus CA) provides an estimate of relative skeletal age (RSA). The difference between SA and CA was used to classify players as follows:

- late (delayed), SA younger than CA by >1.0 years;
- average (on time), SA ± 1.0 years CA;
- early (advanced), SA older than CA by >1.0 years;
- mature, skeletally mature.

The classification criteria are similar to previous studies that used the difference between SA and CA to classify youth athletes in several sports into contrasting maturity categories (Krogman 1959; Rochelle et al. 1961; Peña Reyes et al. 1994; Malina et al. 2004, 2007a,b). The band of ± 1.0 year approximates standard deviations for SA within half-year CA groups in the Fels sample of boys 12–16 years, 0.94–1.26 years (Roche et al. 1988). Using a band of 1 year also allows for the error associated with the assessment of SA and provides a broad range of youth who are classified as on time in maturity status. A narrow range, e.g. a band of ± 3 months to define early and late maturity (e.g. Kemper et al. 1986), is well within the range of the error of SA assessment. The median standard error of estimate for SA assessments of the total sample ($n = 159$) was 0.30 year with a range from 0.27 to 0.42 year.

Analysis

Descriptive statistics were calculated by competitive age group for all variables except stage of pubic hair (PH); for the latter, the distribution of stages was noted. ANOVA was used to compare CA, body size and proportions, functional capacities, soccer skills and goal orientation by competitive age group and among late, average (on time) and early maturing players within competitive age group. An alpha level of 5% was accepted. Effect size was estimated with partial eta squared (η^2). If a comparison was significant among maturity groups, pairwise comparisons with a Bonferroni adjustment were used to identify which groups differed.

Results

Descriptive statistics for CA, SA, body size and proportions, subcutaneous adiposity, functional capacities, soccer-specific skills and goal orientation for players in the two competitive age groups are summarized in Table II. Older youth players are significantly taller and heavier and have proportionally longer legs than younger players, but the groups do not differ in subcutaneous adiposity. Older players perform significantly better in all functional capacity and soccer-skill tests. Players in the two age groups do not differ in task orientation, but older players are significantly lower in ego orientation ($F = 4.91$, $p < 0.05$).

SA approximates CA in 11–12-year-old players, but is, on average, in advance of CA by about one-half year in 13–14-year-old players. Pubic hair stages 1–3 are represented among 11–12-year-old players with the majority in PH1 ($n = 47$, 54%), about one-third in PH2 ($n = 30$, 34%) and few in PH3 ($n = 10$, 11%). Pubic hair stages 2–5 are represented among 13–14-year-old players with most in PH4 ($n = 32$, 44%) and PH3 ($n = 25$, 35%), several in PH1 ($n = 13$, 18%) and PH5 ($n = 2$, 3%).

The classification of players by skeletal maturity status within each competitive age group is summarized in Table III. Players classified as late maturing are disproportionately represented in the two age groups; there are relatively few older players classified as late maturing. Among 11–12-year-old players, 17 are late (20%), 45 are on time (52%) and 25 are early (29%) in skeletal maturation, while among 13–14-year-old players, only four are late (6%), 45 are on time (63%) and 23 are early (31%) in skeletal maturation. Distributions of stages of pubic hair development are also summarized by skeletal maturity classification in Table III. In the younger age group, 15 of 17 late maturing players are in

Table II. Descriptive statistics for players in each competitive age group and results of comparisons between groups and estimated effect size (η^2).

	11–12 years ($n = 87$)		13–14 years ($n = 72$)				
Variable	Mean	SD	Mean	SD	F	p	η^2
Chronological age (CA), years	11.80	0.53	14.14	0.56	732.58	<0.01	0.82
Skeletal age (SA), years	11.96	1.44	14.65	1.16	163.14	<0.01	0.51
SA minus CA, years	0.17	1.44	0.51	1.07	2.81		0.18
Weight, kg	38.1	6.2	54.1	10.1	149.96	<0.01	0.49
Height, cm	144.6	6.7	163.5	9.3	217.95	<0.01	0.58
Sitting height, cm	73.0	3.1	81.7	4.9	189.14	<0.01	0.55
Estimated leg length, cm	71.7	4.5	81.8	5.2	173.79	<0.01	0.53
Sitting height ratio,%	50.5	1.3	50.0	1.2	6.76	<0.01	0.04
Sum of skinfolds, mm	32.4	14.5	36.3	16.1	2.63		0.02
Fastest sprint, s	8.37	0.50	7.80	0.39	63.86	<0.01	0.29
Mean sprint, s	8.79	0.60	8.06	0.43	76.22	<0.01	0.33
Agility shuttle run, s	20.55	1.32	18.69	0.92	102.41	<0.01	0.40
Intermittent endurance run, m	1371	731	2556	912	82.75	<0.01	0.35
Squat jump, cm	23.8	4.3	28.8	4.0	57.94	<0.01	0.27
Counter-movement jump, cm	26.2	4.5	31.9	4.9	59.06	<0.01	0.27
Ball control, no. hits	23.9*	22.1	68.4*	82.3	23.54	<0.01	0.13
Dribbling speed, s	15.77	1.81	13.36	0.88	107.55	<0.01	0.41
Wall pass, points	18.0	3.2	21.2	3.2	39.51	<0.01	0.20
Shooting accuracy, points	6.5	2.5	8.1	3.1	12.10	<0.01	0.07
Task orientation	4.3	0.4	4.2	0.6	2.92		0.02
Ego orientation	2.0	0.7	1.8	0.6	4.91	<0.01	0.03

*Medians for ball control were 17.0 and 40.5, respectively.

Table III. Distribution of players by maturity status (SA minus CA) and distribution of stages of pubic hair by skeletal maturity status within each age group.

	Skeletal maturity classification		
	Late	On time	Early
11–12 years	**17**	**45**	**25**
PH1	15	24	8
PH2	2	17	11
PH3	0	4	6
13–14 years	**4**	**45**	**23**
PH2	3	9	1
PH3	1	18	6
PH4	0	18	14
PH5	0	0	2

PH1 (88%); 41 of 45 players classified as on time are in PH1 (53%) and PH2 (38%); while stages PH1 (32%), PH2 (44%) and PH3 (24%) are represented in players classified as early maturing. In the older age group, three of the four late maturing players are in PH2; 36 of 45 players classified as on time are in stages PH3 (40%) and PH4 (40%) with the remainder (20%) in PH2; the majority of players classified as early maturing are in PH4 (61%), with several in PH3 (26%), two in PH5 (9%) and one in PH2 (4%).

Characteristics of players of contrasting maturity status within each competitive age group are summarized in Tables IV and V. Skeletal age is included in the tables to illustrate the maturity contrasts of the groups. Within each age group, chronological ages of players of contrasting skeletal maturity status do not differ, but early maturing boys are significantly heavier and taller with longer segment lengths than average (on time) and late maturing boys. The gradient is early > on time > late maturing. The gradient is significant for subcutaneous adiposity in 11–12-year-old players (Table IV) but not in 13–14-year-old players (Table V). Among younger players, the sitting height ratio does not differ among maturity groups, while among older players, boys on time in maturity status have a significantly lower sitting height ratio indicating proportionally longer legs (Table V).

Functional capacities and soccer-specific skills, with few exceptions, do not differ among boys of contrasting maturity status within each age group. Among 11–12-year-old players, only aerobic endurance differs among maturity groups. Late maturing boys have greater endurance capacity than on time and early maturing boys who do not differ (Table IV). The difference persists when height and weight are statistically controlled with ANCOVA (not shown). Among 13–14-year-old players, vertical jumping performances (squat and counter-movement jumps) differ significantly among maturity groups in a gradient identical to that for body size, i.e. early > on time > late (Table V). Only the difference in the counter-movement jump is of borderline significance ($p = 0.06$) when height and weight are statistically controlled with ANCOVA (not shown). Consistent with the observation in young players, the small sample of late maturing 13–14-year-old players ($n = 4$) performs better, on average, than on time and early maturing players, but the differences are not statistically significant. Task and ego goal orientations also do not differ among players of contrasting maturity status within each competitive age group and no gradient in means across maturity groups is suggested.

Table IV. Age, body size, functional capacities, sport-specific skills and goal orientation of 11–12-year-old players classified as late, on time and early in skeletal maturation and results of ANOVAs and estimated effect size (η^2).

	Late (n =17)		On time (n =45)		Early (n =25)				
	Mean	SD	Mean	SD	Mean	SD	F	p	η^2
Chronological age (CA), years	11.9	0.6	11.8	0.5	11.7	0.6	0.63	–	0.15
Skeletal age (SA), years	10.1	0.8	11.8	0.8	13.6	0.6			
Weight, kg	33.6	3.6	37.5	5.1	42.1	7.1	12.55	<0.01	0.23
Height, cm	139.4	4.5	144.6	5.9	148.4	7.3	11.12	<0.01	0.21
Sitting height, cm	70.6	2.5	72.7	2.7	75.0	2.7	14.12	<0.01	0.25
Estimated leg length, cm	68.7	3.5	71.9	3.9	73.3	5.2	6.09	<0.01	0.13
Sitting height ratio,%	50.7	1.5	50.3	1.1	50.6	1.4	0.86	–	0.02
Sum of skinfolds, mm	23.2	7.0	32.4	12.3	38.5	18.5	6.33	<0.01	0.13
Fastest sprint, s	8.28	0.43	8.38	0.52	8.41	0.52	0.37	–	0.10
Mean sprint, s	8.63	0.46	8.82	0.63	8.85	0.63	0.75	–	0.02
Agility shuttle run, s	20.24	1.23	20.61	1.29	20.67	1.45	0.60	–	0.01
Intermittent endurance run, m	1774	725	1308	657	1208	788	3.57	<0.05	0.08
Squat jump, cm	23.3	6.3	24.7	5.1	24.9	5.6	0.92	–	0.02
Counter-movement jump, cm	22.7	5.4	25.8	5.5	26.3	5.2	1.22	–	0.03
Ball control, no. hits	23.6	21.1	26.3	25.7	19.6	14.6	0.75	–	0.02
Dribbling speed, s	15.56	1.51	15.76	1.93	15.93	1.82	0.21	–	0.01
Wall pass, points	19.2	2.1	17.5	3.1	17.5	3.1	1.59	–	0.04
Shooting accuracy, points	6.9	2.1	6.8	2.4	6.8	2.4	0.47	–	0.01
Task orientation	4.4	0.4	4.3	0.5	4.3	0.4	0.25	–	0.01
Ego orientation	2.1	0.6	2.1	0.7	2.0	0.7	0.00	–	0.00

Discussion

Variation in body size associated with contrasting maturity status in youth soccer players was similar to that for adolescent males in general, among whom boys advanced in skeletal maturity are taller and heavier than those on time and late in skeletal maturity (Malina et al. 2004). On the other hand, soccer players who vary in maturity status did not differ consistently in functional capacities and soccer-specific skills (Tables IV and V), which contrasts with observations of adolescent males in general, among whom there is a maturity gradient of early > on time > late in tests of strength, speed, power and agility (Jones 1949; Lefevre et al. 1988, 1990). The differences among boys of contrasting maturity status also tend to persist when maturity-related variation in height and weight are statistically controlled (Beunen et al. 1981). Performance differences among maturity groups are apparent by 13 years of age and tend to be greatest at 14 and 15 years (Jones 1949; Lefevre et al. 1988, 1990; Malina et al. 2004). Among the sample of soccer players only the two vertical jumping tests show a significant gradient of early > on time > late among 13–14-year-olds (Table V) but not among 11–12-year-olds (Table IV). The lack of consistent differences in functional capacities and skills among soccer players of contrasting maturity status thus contrasts with that noted in adolescent boys in general. The lack of functional and skill differences among adolescent soccer players likely reflects selective practices and/or positive influences of regular fitness and skill training associated with the sport. A related factor for which data are not currently available may be selective drop out or persistence in the sport.

In contrast to other functional capacities tested, later maturing 11–12-year-old soccer players performed significantly better on the endurance shuttle run; the same trend was suggested among 13–14-year-old players, but the sample included only four late maturing boys. Comparative data for the yo-yo intermittent shuttle run test of aerobic endurance in

Table V. Age, body size, functional capacities, sport-specific skills and goal orientation of 13–14-year-old players classified as late, on time and early in skeletal maturation and results of ANOVAs and estimated effect size (η^2).

	Late ($n=4$)		On time ($n=45$)		Early ($n=23$)				
	Mean	SD	Mean	SD	Mean	SD	F	p	η^2
Chronological age (CA), years	14.0	0.2	14.2	0.6	14.1	0.6	0.71	–	0.02
Skeletal age (SA), years	12.4	0.5	14.3	0.6	15.8	1.0			
Weight, kg	38.3	3.8	52.3	9.0	60.2	8.7	13.11	<0.01	0.28
Height, cm	146.6	4.1	162.2	8.8	169.1	6.0	15.68	<0.01	0.31
Sitting height, cm	74.5	1.8	80.3	4.2	85.5	3.6	20.51	<0.01	0.37
Estimated leg length, cm	72.2	2.8	81.8	5.3	83.6	3.3	10.15	<0.01	0.23
Sitting height ratio, %	50.8	0.8	49.6	1.1	50.6	1.0	8.11	<0.01	0.19
Sum of skinfolds, mm	32.7	15.5	35.9	17.6	37.7	13.1	0.19	–	0.01
Fastest sprint, s	7.94	0.20	7.83	0.41	7.70	0.36	1.20	–	0.03
Mean sprint, s	8.22	0.25	8.09	0.44	7.95	0.42	1.17	–	0.03
Agility shuttle run, s	19.13	0.41	18.82	0.85	18.36	1.04	2.49	–	0.07
Intermittent endurance run, m	3070	643	2478	935	2617	902	0.85	–	0.02
Squat jump, cm	23.8	0.7	28.4	3.7	30.6	4.0	6.63	<0.01	0.16
Counter-movement jump, cm	25.5	2.0	31.5	4.9	33.9	3.9	6.63	<0.01	0.16
Ball control, no. hits	42.5	12.8	80.2	97.1	50.0	46.9	1.24	–	0.04
Dribbling speed, s	13.31	0.18	13.28	0.83	13.51	1.03	0.49	–	0.02
Wall pass, points	20.0	2.2	21.5	3.2	20.7	3.6	0.71	–	0.02
Shooting accuracy, points	9.3	3.8	7.9	3.0	8.2	3.2	0.34	–	0.01
Task orientation	4.3	0.2	4.2	0.6	4.1	0.6	0.16	–	0.01
Ego orientation	1.8	0.4	1.9	0.6	1.7	0.6	1.34	–	0.04

boys of contrasting maturity status are not available. Among Polish boys of 11–14 years enrolled in a sports school, absolute peak oxygen uptake ($L\,min^{-1}$) differed significantly among early, on time and late maturing boys, while relative peak oxygen uptake ($ml\,kg^{-1}\,min^{-1}$) did not (Malina et al. 1997). Absolute peak oxygen uptake was lower in later maturing boys across all ages. Although the overall comparison was not significant, relative peak oxygen uptake was higher, on average, in late maturing compared to on time and early maturing boys 11–13 years, but the difference among maturity groups was negligible among 14-year-old boys of contrasting maturity status (Malina et al. 1997). The results suggest an important role for lower body mass in endurance performance of adolescent boys, including soccer players. Among adolescent male athletes, including a subsample of soccer players, pubertal status had an effect on aerobic power in addition to that of age and body size (Baxter-Jones et al. 1993).

Among players aged 11–12 years (early adolescence), athletes spanning the skeletal maturity spectrum from late (delayed) to early (advanced) were represented, but among players aged 13–14 years, which is the age interval encompassing peak height velocity, late maturing players were noticeably under-represented (Table III). The height, weight and maturity of boys in the present study were consistent with other observations for youth soccer players (Malina 1994, 2003), and also with the hypothesis that late maturing boys are excluded from soccer either voluntarily as in dropping out or systematically as in cutting and/or early maturing boys are preferentially selected as age and sport specialization increase (Malina 2003). The trends were also consistent for estimates of skeletal maturity based on both the Fels (Roche et al. 1988) and Tanner–Whitehouse (Tanner et al. 1983) methods in Mexican (Peña et al. 1994), Portuguese (Malina et al. 2000) and Spanish (Malina et al. 2007a) youth players.

Stages of pubic hair were consistent with skeletal maturity of the youth soccer players (Table III), although there was more variation in the former. The variation is due, in part, to method as the scales for pubic hair and skeletal age differ. Further, stage of pubic hair indicates pubertal status at the time of examination and does not provide information on when a player entered the stage or how long he has been in the stage (Malina et al. 2004). Among players 11–12 years, stages PH1 through PH3 were represented (Table III), but most (88%) late maturing boys were prepubertal (PH1). Among players 13–14 years, stages PH2 through PH5 were represented, but the majority of boys (79%) were in PH3 and PH4.

The present study is limited to youth soccer players in Portugal and a question of potential interest is the growth and maturity status of the players relative to the general population of Portuguese youth. The younger age group of soccer players tended to be, on average, slightly shorter and lighter than Portuguese boys of the same age from Madeira (Freitas et al. 2002) and the Azores (Maia and Lopes 2007). In contrast, the older players tended to be, on average, similar in height and weight to boys from Madeira; they were also similar in height to boys from the Azores but were lighter in weight. The comparisons of body weight need to be tempered; youth soccer players in each age group had, on average, consistently thinner skinfold thicknesses than boys from Madeira and the Azores, which would suggest proportionally more lean mass. It was not possible to compare the skeletal maturity status of the youth soccer players with the general population as data utilizing the Fels method are not presently available. Of relevance, Portuguese boys from Madeira tended to be advanced, on average, in skeletal maturity (Tanner–Whitehouse 2, radius–ulna–short bone scores) compared to age-matched boys from Belgium (Freitas et al. 2004).

Players in the two competitive age groups did not differ in task orientation, but older players had a significantly lower ego orientation than younger players (Table II). This may reflect increased emphasis on individual and team improvement associated with experience in the sport. For the combined sample of players in the present study ($n=159$), task and ego orientation scores were 4.24 ± 0.50 and 1.95 ± 0.65, respectively. In an independent sample of club soccer players 13–16 years of age ($n=40$) in Portugal (Gonçalves et al. 2005), task orientation (4.23 ± 0.74) was similar while ego orientation was considerably higher (2.80 ± 0.91) than in the present study. Corresponding data for an older sample elite Dutch youth soccer players (16.4 ± 2.0 years) indicated, on average, a slightly lower task score (3.90 ± 0.64) but a higher ego score (3.64 ± 0.73) compared to younger players in the present study (Van-Yperen and Duda 1999). In the Dutch sample, improvement in skilled performance during a season, as assessed by coaches, was associated with higher task orientation. On the other hand, an ego orientation, described as 'a dysfunctional motivational pattern', was associated with negative peer acceptance among Norwegian youth soccer players 12–19 years of age (Ommundsen et al. 2005). Although this study utilized a different scale for the assessment of task and ego orientation compared to that used in the present study, the results suggest than goal orientation may influence peer relationships among adolescent male soccer players.

Although behavioural differences associated with variation in maturity status among adolescent boys have been documented historically (H.E. Jones 1949, M.C. Jones 1965, M.C. Jones and Bayley 1950), the earlier studies were not set in the context of a specific sport which has its unique demands. In the present study, youth soccer players of contrasting maturity status did not differ in task or ego orientation. This contrasted with expectations that advanced maturation would be associated with increased ego orientation and late maturation would be associated with increased task orientation. Ego-oriented athletes are more likely to attribute success to natural ability (Sarrazin et al. 1996) and performance advantages associated with advanced maturity (Malina et al. 2004) might be perceived by adolescent boys as natural ability. Success in sport at early adolescent ages, which may be due in part to maturity mismatches, may lead to boys advanced in maturity status to be labelled as having superior ability by coaches and peers. These factors may in turn contribute to higher ego orientation in early maturing athletes. On the other hand, performance limitations of late maturing boys associated with small body size and less muscular strength and power compared to early maturing peers may lead them to focus on practice and training to improve ability and mastery of sport skills and in turn higher task orientation.

The present study noted no association between maturity status and goal orientation in youth soccer players, but older players had a significantly lower ego orientation than younger players. Unfortunately, other behavioural variables were not considered in this study. Other dimensions of adolescent behaviour, either general or sport-specific, relative to variation in the growth and biological maturity status of young athletes need further systematic study. Such an approach would have the potential to improve the understanding of interactions among growth, maturation and behavioural development during adolescence, of factors that influence behaviours, and perhaps of decision making by players, parents, coaches and the sport system.

Models of adaptations to puberty include the underlying biological changes and their overt manifestations. Petersen and Taylor (1980), for example, offered a model that focuses on exogenous and endogenous factors that may mediate between biological changes during puberty and psychological outcomes. Lerner (1985), on the other hand, proposed a contextual model that emphasizes the 'goodness of fit' between physical and psychological changes during puberty and the context within which they occur. Both models deal with adolescents in general, and have not been often applied to a sport context with its specific demands (Monsma and Malina 2004; Monsma et al. 2006). The models noted have their roots in developmental psychology but each has commonalities with the biocultural framework in studies of human variability and adaptation to the environment (Baker 1966; Lasker 1969). The biocultural approach applied to youth implies that biological growth and maturation do not proceed in isolation of the behavioural realm, which is largely rooted in culture.

Acknowledgements

We gratefully appreciate the patience and cooperation of the young athletes, coaches and parents. We also thank Professor Sean P. Cumming of the University of Bath for sharing his insights on goal orientation in young athletes.

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