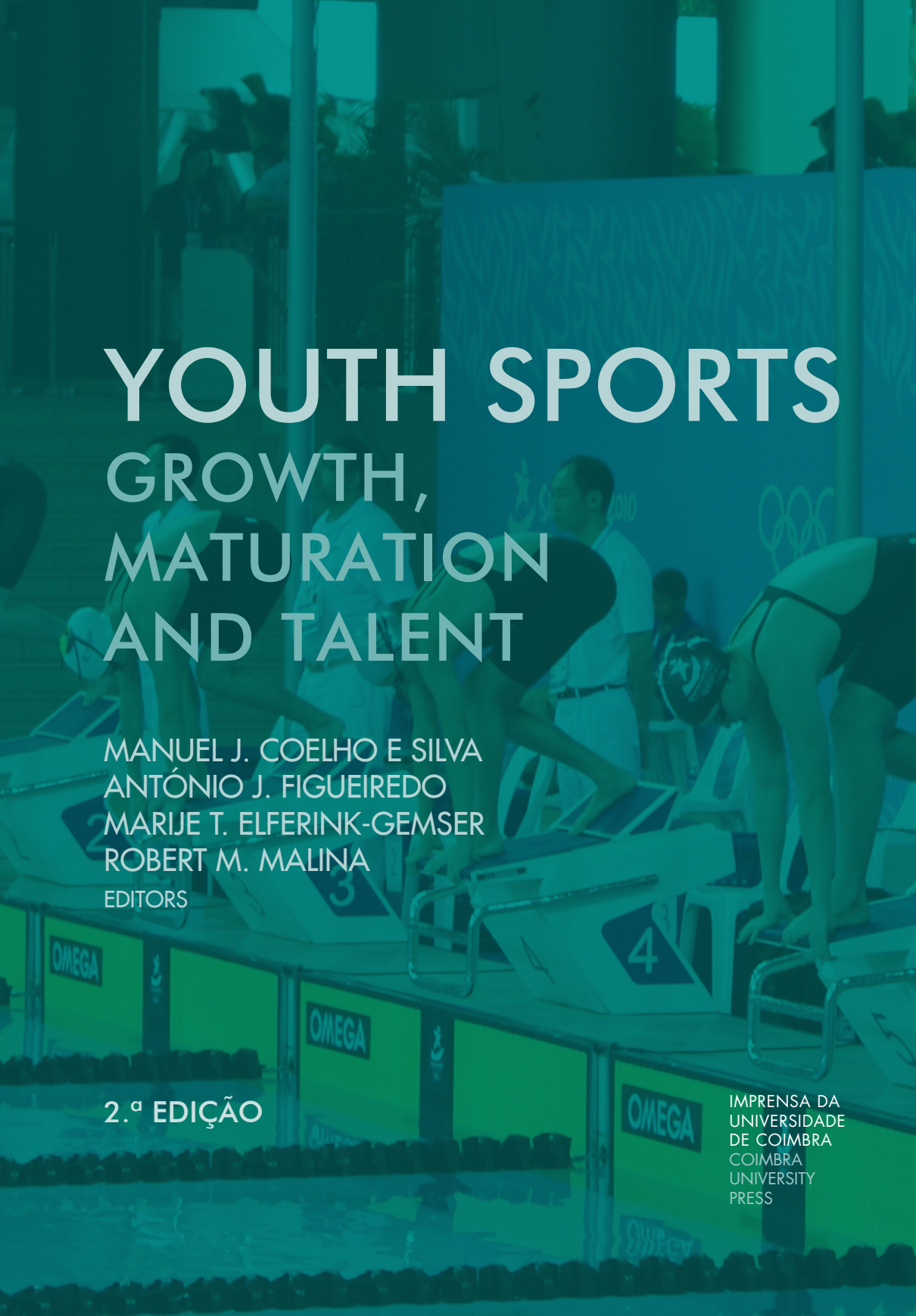

YOUTH SPORTS
GROWTH, MATURATION AND TALENT

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2.ª EDIÇÃO

IMPRENSA DA UNIVERSIDADE DE COIMBRA
COIMBRA UNIVERSITY PRESS

http://dx.doi.org/10.14195/978-989-26-1169-3_4

CHAPTER 4: VARIATION IN SIZE, PHYSIQUE, FUNCTIONAL CAPACITIES AND SOCCER SKILLS IN PLAYERS 11-16 YEARS

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INTRODUCTION

Study of the structural and functional characteristics of athletes has a long tradition in physical education and the sport sciences (Malina, 1997). For example, an extensive battery of anthropometric and functional characteristics was routinely collected on Harvard University students during the latter part of the 19th century (Sargent, 1887). These early observations suggested that the development of athletes was governed, in part, by the constitution of the individual, the specific sport, and the time devoted to practice of the sport. Sargent asked many questions that are still relevant today. For example, can outstanding athletic ability be predicted from body structure?, or does the athlete have a physique that is best suited for a specific sport?

It is also increasingly apparent that elite young athletes often show the physical characteristics associated with successful adult athletes in specific sports (Carter and Heath, 1990). Such observations highlight the need to better understand the growth and maturation of young athletes in the context of the training programs to which they are exposed, often beginning at relatively young ages (Malina, 1998; Malina et al., 2004).

A related question when working with young athletes is long term planning. This is a major feature of talent development programs in modern sport. This is especially relevant because some programs have as their objective the identification of youngsters with potential to attain success in sport at national and international levels. It is suggested that a well-organized and intentional program over a long period encourages a more rational use of training methods (Bompa, 1990).

Individual differences in the timing and tempo of the adolescent growth spurt and sexual maturation have a major impact on the body size and performances of boys. In the context of youth sports, early maturing boys who

are taller, heavier, and stronger than their average and later maturing age peers, are often given preference given the associated strength and power advantages. Although such contrasts in size and performance are often transient, they may contribute to the exclusion of potentially talented youngsters largely because they are smaller and are deficient in muscle mass and muscular strength and power (Malina *et al*., 2004).

It is important to have a grasp of variation in physical and functional characteristics associated with age and maturity status in young athletes. The body size and maturity characteristics of young athletes in a variety of sports have been summarized (Malina, 1998; Malina *et al*., 2004). Variation in somatotype among youth in many sports has also been summarized (Carter and Heath, 1990). In contrast, variation in functional characteristics, both general and sport specific, of adolescent athletes associated with maturity has received less attention.

The purpose of the present paper is to present the size, physical and functional profile of adolescent football (soccer) players 11-16 years of age. It specifically considers variation by competition age groups, and then examines variation by stage of puberty within these age groups. In addition, a subsample of the players was subsequently examined after an interval of two years, thus providing an opportunity to examine the stabiity of the physical and functional characeristics of the young football players.

MATERIAL AND METHODS

The participants were 95 football (soccer) players 10.9 to 16.6 years of age in central Portugal. The players were grouped into two-year age categories which reflect the competitive structure of youth soccer in Portugal: 11-12, "infantiles" (n=29); 13-14, "initiates" (n=37); and 15-16, "juveniles" (n=29). The players were evaluated in the 2000/2001 season.

Height, weight, biacromial and bicristal breadths, and the dimensions needed to determine somatotype with the Heath-Carter anthropometric protocol (Carter and Heath, 1990) were taken on each athlete. The androgyny index ([3 X biacromial breadth] - bicristal breadth) was also calculated (Tanner, 1951). It provides information about the degree of masculinity in physique. Stage of sexual maturity was assessed at clinical examination using the criteria for pubic hair described by Tanner (1962). The development of pubic hair (PH) is described in five stages from the prepubertal state (PH 1) to the mature state (PH 5). PH 2 represents the initial appearance of pigmented pubic hair, while PH 3 and PH 4 are intermediate stages (Malina *et al*., 2004).

Several dimensions of performance were assessed: (1) cardiovascular endurance - 20-meter shuttle run (PACER: Progressive Aerobic Cardiovascular Endurance Run) and the 12-minute run, (2) running speed - 25 meter dash, (3) agility - 10 x 5 meter shuttle run, (4) explosive power - standing long jump and vertical jump, (5) abdominal muscular strength and endurance - number of sit-ups completed in 60 seconds, (6) static strength - hand grip strength, and (7) lower back/upper thigh flexibility - sit-and-reach.

Two soccer-specific skill tests were administered, passing and dribbling. The tests were adapted from Kirkendall *et al*. (1987):

a) Wall pass

A target area 2.44 m long and 1.22 m high from the floor is drawn on a wall. An area 3.65 m by 4.23 m is marked off on the floor in front of the target area. A restraining line is placed 1.83 m between the baseline and the base of the wall. The ball is set on the restraining line and the subject stands back of the ball ready to kick on the command *go*. The subject continues to kick as many times as possible, with either foot, by immediately kicking the ball or blocking and steadying it, soccer style, before re-kicking. Use of the hands at any time is prohibited, and one point is deducted from the subject's score for each infraction. Three 20-second trials are taken, and the subject's score is the best of the three trial scores. The score is determined by the number of times within 20 seconds that the players successfully propels the ball against the wall. The ball must be directed by the foot, knee or leg. The subject must remain behind the restraining line at all times. If the subject kicks in front of the line, falls forward, or steps over the restraining line during the follow through, the kick does not count.

b) Dribble test

The subject starts to dribble the soccer ball with the feet in and out of markers set at a specific distance from each other. The score is the time elapsed (0.1 second) from the starting signal until the athlete returns to the starting line after dribbling the ball in slalom fashion around the markers. The subjects must complete the test with the ball under control. No practice trials are allowed. Three trials are given. The score of the best trial is retained for analyis.

RESULTS

Descriptive statistics for all variables are summarized in Table 1. As expected, size, functional capacities and soccer skills improve with age group with one exception. There is no change in flexibility. In contrast, somatotype does not

change significanty with age group. The adolescent soccer players tend to have, on average, a mesomorphic somatotype, with balanced contributions of endomorphy and mesomorphy.

Table 1. Means and standard deviations for size, physique, function and skill of soccer players by age group. Significance of the differences among age groups is also indicated.

Variable	11-12 yr (n=29)	13-14 yr (n=37)	15-16 yr (n=29)	F	p
Age (years)	12.0±0.5	13.9±0.6	16.1±0.5		
Stature (cm)	145.6±5.3	164.0±9.3	172.5±5.1	110.09	**
Body Weight (kg)	37.8±48	52.5±8.3	63.8±5.8	111.40	**
Androgyny index	75.2±3.6	84.1±5.4	92.9±4.6	102.94	**
Endomorphy	3.09±1.31	3.05±0.96	2.73±0.68	1.13	n.s.
Mesomorhy	4.45±0.93	4.30±0.88	4.46±0.86	0.33	n.s.
Ectomorphy	3.27±0.92	3.59±1.03	3.06±0.70	2.86	n.s.
12-minute run (m)	2451±145	2630±258	2760±252	13.50	**
PACER (#)	66±12	86±12	97±10	52.55	**
25-meter dash (sec.)	4.85±0.26	4.48±0.21	3.97±0.19	115.38	**
Agility: 10x5m (sec.)	20.16±1.53	19.13±1.34	18.93±0.91	7.86	**
Vertical jump (cm)	28.0±5.6	33.8±7.6	43.9±6.4	42.54	**
Standing long jump (cm)	162.0±17.7	185.8±24.6	209.9±18.2	54.87	**
Sit-ups (#)	44±9	47±6	56±7	18.04	**
Hand grip strength (kg)	25.1±3.5	34.7±5.4	42.6±7.3	70.63	**
Sit-and-reach (cm)	15.2±4.9	13.7±6.0	15.5±8.2	0.76	n.s.
Soccer wall pass test (#)	14.1±3.0	16.7±3.5	17.1±2.1	9.55	**
Soccer dribble test (sec.)	11.48±0.96	11.06±0.82	10.68±0.86	9.73	**

n.s. (non-significant), * (p<.05), ** (p<.01).

Table 2. Distribution of stages of pubid hair (PH) in soccer players by single year chronological ages (N=95).

	Stages of Pubic Hair					
Age group	1	2	3	4	5	Total
11.0-11.9	8	6	-	-	-	14
12.0-12.9	1	9	5	-	-	15
13.0-13.0	-	5	8	5	-	18
14.0-14.9	-	-	4	15	-	19
15.0-15.9	-	-	-	6	1	7
16.0-16.9	-	-	-	11	11	22
Total	9	20	17	37	12	95

The distribution of stages of pubic hair within single year age groups is summarized in Table 2. The youngest players (11 years) are prepubertal (PH 1) and early pubertal (PH 2). With one exception, all players 12 years and older are pubertal, and one-half of the 16 year old players are classified as mature. Descriptive statistics for size, physique, functional capacities and soccer skill of soccer players by stage of pubic hair within each age group are summarized in Table 3. Within each age-group players advanced in pubertal status are chronologically older, taller, heavier and more androgynous, although the differences in body weight and the androgyny index are not

significant except among 13-14 year old players. In contrasts, somatotypes of players by stage of pubic hair overlap considerably (Figures 1-3). Larger body body size and tend to be more androgynous. Functional capacities and the two soccer skills do not consistently differ among players of contrasting maturity status within each age group, with the exception of cardiovascular endurance (Pacer test), running speed, power (the two jumps) and static strength among 13-14 year old players. Note, however, that sample sizes are rather small, which encourages caution in interpreting the trends.

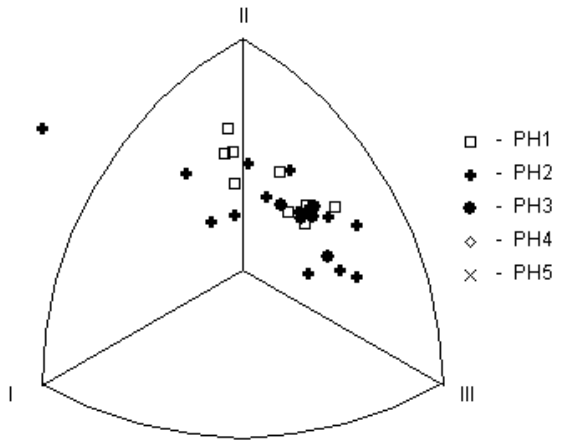

Figure 1. Distributions of somatotypes of soccer players within infantiles (11-12 yr).

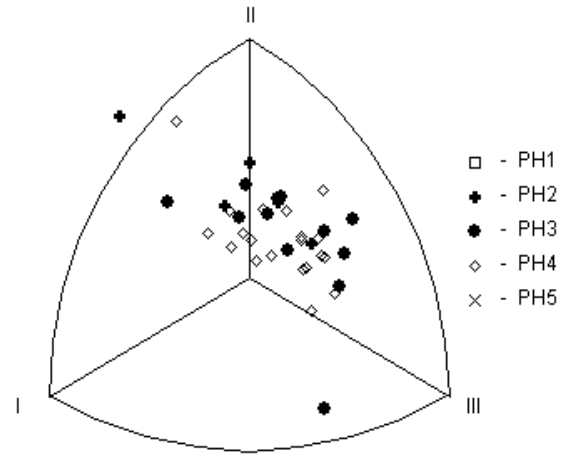

Figure 2. Distributions of somatotypes of soccer players within initiates (13-14 yr).

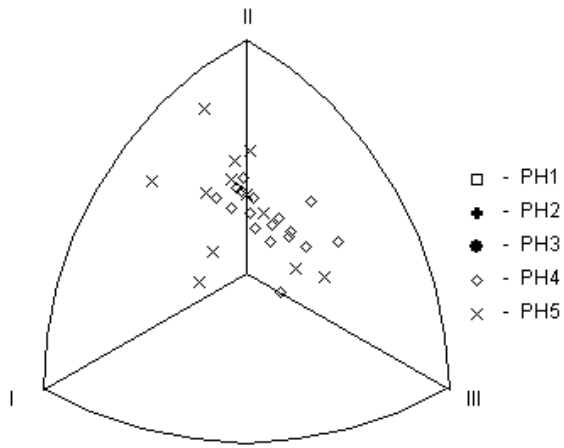

Figure 3. Distributions of somatotypes of soccer players within juveniles (15-16 yr).

Table 3. Means for size, functional capacities and soccer-specific slkills by sexual maturational stages (11-12 yr, n=29).

Variable	PH1 n=9	PH2 n=15	PH3 n=5	F	p
Stature (cm)	142.7	145.2	152.0	7.25	**
Body Weight (kg)	36.6	37.6	40.4	1.01	ns
Androgyny index	74.5	74.9	77.7	0.88	ns
12-minute run (m)	2451	2443	2447	0.09	ns
PACER (#)	61	67	73	1.06	ns
25-meter dash (sec.)	4.89	4.85	4.76	0.37	ns
Agility: 10x5m (sec.)	19.00	17.93	17.55	1.74	ns
Vertical jump (cm)	28.0	28.7	25.8	0.50	ns
Standing long jump (cm)	152.3	166.5	166.0	2.10	ns
Sit-ups (#)	39.9	44.7	48.8	1.78	ns
Hand grip strength (kg)	25.3	24.2	27.4	1.70	ns
Sit-and-reach (cm)	16.8	15.3	12.2	1.60	ns
Soccer wall pass test (#)	14.8	13.9	13.6	0.29	ns
Soccer dribble test (sec.)	11.63	11.41	11.42	0.15	ns

* ($p<.05$). ** ($p<.01$).

Table 4. Means for size, functional capacities and soccer-specific slkills by sexual maturational stages (13-14 yr, n=37).

Variable	PH2 n=5	PH3 n=12	PH4 n=20	F	p
Stature (cm)	149.5	161.4	169.3	20.03	**
Body Weight (kg)	43.2	48.7	57.0	11.74	**
Androgyny index	79.3	82.7	86.1	4.71	*
12-minute run (m)	2910	2553	2606	4.20	*
PACER (#)	80	85	88	1.90	ns
25-meter dash (sec.)	4.74	4.55	4.37	12.35	**
Agility: 10x5m (sec.)	17.31	17.09	17.02	0.17	ns
Vertical jump (cm)	26.8	32.0	36.6	4.48	*
Standing long jump (cm)	162.8	176.6	192.5	6.71	**
Sit-ups (#)	44.8	46.1	48.4	1.01	ns
Hand grip strength (kg)	28.1	32.5	37.6	12.63	**
Sit-and-reach (cm)	13.4	12.8	14.4	0.27	ns
Soccer wall pass test (#)	13.8	18.1	16.6	2.91	ns
Soccer dribble test (sec.)	11.73	11.03	10.91	2.19	ns

* (p<.05). ** (p<.01)

Table 5. Means for size, physique, function and skill of soccer players by age group and maturational status (15-16 yr, n=29).

Variable	PH4 (n=17)	PH5 (n=12)	F	p
Stature (cm)	170.8	175.0	5.52	*
Body Weight (kg)	60.7	68.2	19.62	**
Androgyny index	92.0	94.1	1.50	ns
12-minute run (m)	2708	2835	1.85	ns
PACER (#)	94	100	2.95	ns
25-meter dash (sec.)	4.00	3.93	0.91	ns
Agility: 10x5m (sec.)	16.90	16.96	0.03	ns
Vertical jump (cm)	44.9	42.5	1.03	ns
Standing long jump (cm)	207.8	212.8	0.68	ns
Sit-ups (#)	56.3	54.7	0.26	ns
Hand grip strength (kg)	40.9	44.9	2.16	ns
Sit-and-reach (cm)	15.1	16.1	0.09	ns
Soccer wall pass test (#)	17.2	17.0	0.09	ns
Soccer dribble test (sec.)	10.80	10.55	3.11	ns

* (p<.05). ** (p<.01).

IMPLICATIONS AND RECOMMENDATIONS

Results of this descriptive analysis of body size and maturity status are consistent with other observations on adolescent soccer players (Malina, 2003). On average, somatotypes are generally mesomorphic with equal development of endomorphy and mesomorphy, which is consistent with other data for adolescent and adult soccer players (Carter and Heath, 1990). Nevertheless, there is considerable variation in the distribution of somatotypes, especially when pubertal status is considered. The role of

selection for physique among young soccer players needs further consideration. Individual factors (self) and coach and/or sport related factors are probably involved in this process.

Distributions of birth dates of soccer players indicate an over-representation of youth born in the first quarter of the selection year. This is labeled as the relative age effect. It has been suggested that the success of adolescent athletes born early in the selection year can be largely explained by physical precocity, especially the body size advantage compared to those born late in the selection year (Helsen *et al*., 2000). Accordingly, players born in the latest quarter of the soccer year (October-December) are smaller and less likely to be noticed by coaches and perhaps not identified as talented. The same has been shown for ice hockey, which has a different calendar year. There is a strong linear relationship between month of birth (January to December) and the proportion of players in the Canadian *National Hockey League* for "Junior A" (Barnsley *et al*., 1985).

Unfortunately, these analyses do not consider individual differences in the timing and tempo of the adolescent spurt and sexual maturation, and their potential role in the selection process for a specific sport. Size in itself is only one factor which is confounded by maturity status in adolescent boys. A player born late in the selection year but who is an early maturer may be as large as a boys born early in the selection year but who is a late maturer. In the present study, maturity-associated variation in size, function and skill was greatest among 13-14 year old players (Table 3). This is the age range when most boys progress through the adolescent growth spurt and sexual maturation and also the age range when performance is quite variable since strength and power have their own growth spurts (Malina *et al*., 2004). Research dealing with the relative age effect needs to extend beyond the distributions of birth dates to other factors that may contribute to successful soccer performance during adolescence (see, for example, Malina et al., 2007).

Research that considers the expectations of coaches for young athletes of contrasting in physical status, maturity and strength is lacking. It also would be of interest to assess the satisfaction or dissatisfaction associated with participationt in sports of young athletes were are early and late in biological maturation.

In summary, the data presented for adolescent soccer players provide a general profile of their growth, maturity, functional and skill characteristics. Coaches need to be aware of such data, especially inter-individual variation. There is a need for studies focused on the perceptions and expectations of coaches on athletes who differ in size, maturity status and skill. Preliminary data suggested considerable variation in playing time associated with functional

capacity and skill. The coaches promoted players (more playing time) on the basis of motor fitness and soccer specific skills, whereas somatotype and body size did not seem to be relevant predictors for playing time in this age group of 15-16 year old players (Coelho e Silva *et al*., 2005). Corresponding data are needed for younger age groups when variation in size and maturity is much more apparent. Taking into account the information provided by the present study, the following recommendations should be of interest to coaches and sport authorities:

- *It might be more practical to group athletes into more homogenous age-groups, especially during early phases of sport participation.* During the transition into puberty and during puberty, age groups of one year (12 months) may provide better opportunities for all players.

- *The potential value of matching yound soccer players by maturity status should be systematically evaluated.* Sport authorities already permit the moving up of younger, advanced players into older competitive age-groups. Hence, it may be worthwhile to consider maturity status in this process, especially among players 11-12 and 13-14 years. This may also necessitate less mature older players competing against younger athletes of similar maturity status which may not be viewed as acceptable by adolescent athletes. Though potentially interesting, it is important to examine the implications of such matching for behavior and peer relationships. Asking a 14 year old, slow maturing player to compete with 11-12 year olds may have negative behavioral implications. Similarly, asking a more mature 12 year old to compete with 14 year olds may also have negative behavioral implications (see Malina and Beunen, 1996).

- *The identification of potentially talented individuals should not place too much reliance of size, strength and power advantages associated with early biological maturation in early and mid-adolescent players to the neglect of skill mastery and game sense.* Talent identification is a complicated process (Malina, 1997). Many factors are involved. Selection is the first phase, and all too often initial selections are based on limited data. Coaches need to be aware of changes in size, function and skill associated with adolescence, and their behavioral implications. Size and performance advantages and disadvantages associated with variation in maturity status are often transient. It is important to recognize that adolescent athletes are first adolescents and then athletes.

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Partially supported by *Fundação para a Ciência e a Tecnologia*