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The Jumping Parameters of Children According to Maturity Coefficient

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ABSTRACT The purpose of the research is to explore the level of influence of children's early maturation on some jumping parameters. Research groups consisted of (n_{girl}=205 n_{boy}=210) child players from 4 years old to 10 years old with different academy of the junior sports hall. The research groups were measured for mass, standing and sitting height. Leg length was calculated by subtracting the participant's sitting height from their standing height. To assess jumping parameters, counter-movement jump was achieved. The participants completed counter movement jumps by arm swing recorded with an OptoJump device. The Test continued for 15 seconds and contact time, flight time, jumping height, pace and percentage of sole area used during jumping were attained from children. As a result, when examining girls and boys' maturation coefficients according to jumping parameters who had an early maturation coefficiency, show those superiorities during different ages for both sexes.

INTRODUCTION

Maturation of children under the determination of the stage of development of sports skills plays an important role. Children's jumping ability is affected by parameters such as coordinating skills and strength. It is thought that the jumping height, contact time and flight time vary during the developmental period.

It was discussed that early maturing boys and girls would have lower mean levels of physical activity compared with their average and late maturing counterparts. This hypothesis was based on the evidence that early maturing boys and girls have an increased risk for being classified as overweight or obese, and body mass index (BMI) is inversely related to physical activity in many cross-sectional designs among youth.

It was further hypothesized that gender and age-related differences in physical activity would occur when participants were ranged according to chronological age. But, this hypothesis is not taken into consideration when they were aligned according to biological age.

The chosen date of birth is used in order to group children into age-specific teams. This particular date of birth is generally the 1st of January in most European countries. In these countries, the large part of sports teams are formed of participants born between the 1st January and 31st December of the same year. So, a child born at the beginning of a given year will be almost 12 months older than another one born at the end of the same year. Nonetheless, they will play sports together (Welk et al. 2007).

It is evaluated that players who were born in the beginning of the year would have some physical advantages and better performances than their younger peers, by comparing anthropometric and maturity-related variables and physical test performance amongst players of different relative ages born in the same year (Carling et al. 2009; Brewer et al. 1992; Musch and Grondin 2001).

Maturity offset and chronological age during the time of measurement can lead an estimate of age at PHH. This approach has been handled for swimmers, gymnasts and a combined sample of figure skaters and ballet dancers (Simmons et al. 2004; Monsma et al. 2005).

It is seen that biological maturation is considered in terms of status and timing. Maturity status indicates the maturation of the individual at a specific point in time. Meanwhile, some indicators of maturity status are discussed as invasive. For example, the skeletal maturity assessment requires radiographs; pubertal status, which are evaluated by clinical examination signifying direct examination of secondary sex characteristics (Malina et al. 2004; Marubini and Milani 1986).

The difficulties in getting a measure of maturity status and timing, lots of non-invasive estimates have been submitted. An estimate of mature height is required in order to express current height as a percentage of the predicted mature height. On the other hand, during the adolescent growth spurt, estimates of skeletal maturity are required in order to obtain more accurate predictions (Tanner et al. 2001; Mirwald et al. 2002). By the way, non-invasive estimates can be alternatives in case of having the logistical difficulties in getting measures of maturation. The self-assessment of pubertal status has been used for some time, although protocols differ in detail and application, and could be personally invasive to youth (Malina et al. 2004).

According to two recent studies, the physical activity's specific gender differences became non-significant when boys and girls were ranged in accordance with biological age (that is, years from peak height velocity, PHV) in place of chronological age. These results show that biological age is a crucial factor, when comparing physical activity among genders (Torres-Unda et al. 2013; Sherar et al. 2007).

It is clear that there are different properties leading athletes to be successful. Duncan et al. (2006) explained that anthropometric profiles are the most important pre-requisite in any sports in order to have better performance. Landolsia et al. (2014) also stated that sprinting; throwing, weightlifting and jumping are important abilities for being good at in athletes' branches. It is also expressed that vertical jumping is one of the most important ability for many sports such as volleyball, basketball and football (Ibrahim 2010).

The relation between anthropometric parameters and vertical jump is demonstrated in many tests. Zhang (2010) examined anthropometric properties and their relationships with physical features and found no relationships. Besides, Davis et al. (2003) didn't find any significant relationship between the physical parameters such as fat, lower extremity length, weight with vertical jumping and endurance, in their study. However, past research has showed that anthropometric measures and jump height have strong correlation (Kraska et al. 2009).

The vertical jump is a fundamental skill acquired during childhood and its mastery underpins performance in many sports and activities (Van Praagh and Dore 2002). Lots of studies have observed gradual increases in jump height from childhood to adulthood. This increase is related to changes in anthropometry, muscle strength, and in the movement pattern (Jenson et al. 1994).

Previous research has shown that the coordination of a jump is relatively stable from childhood, so differences in the patterns of movement could be due to differences in the amplitude and velocity of motion. During the motor development and learning process, the child tunes the magnitude and velocity of movement to improve the jump performance, thereby increasing variability (Floria et al. 2014).

There are lots of studies that examined the variability of the vertical jump up to today. In general, these studies have observed that the variation in jump height decreases with increasing age and is higher in boys under 5 years. Other parameters related to vertical jump performance, such as the contribution of the stretch-shortening cycle to increased jump height, show a similar trend toward a gradual reduction of variability with age and development. These studies are consistent with the notion that motor development and learning are characterized by reductions in the variability of skilled performance with respect to age (Focke et al. 2013).

These findings contrast with the variability in force-related measures (for example, Peak force during the eccentric phase) was similar across children between 9 and 16 years irrespective of their maturity status (Meylan et al. 2012).

Objective

The purpose of the research is to explore the level of influence of children's early maturation on some jumping parameters.

MATERIAL AND METHODS

Research groups consisting of the child players (n_{girl}=205 n_{boy}=210) whose ages changes from 4 to 10 years from different academies of the junior sports hall. They were instructed to give their maximal efforts during all tests. The measurements were applied in accordance with the ethical standards of the Helsinki Declaration. All children trained three days a week (1-1.5 h of training day). Chronological age was calculated by subtracting the participant's date of birth from the observation date transformed into decimal age (in years) and maturity offsets were calculated. One-year age groups were formed based on the participant's chronological age, where a 9 year old would include participants between 9.0 and 9.99 years (Markovic and Jaric 2007).

Biological Maturity Status; Maturity offset was estimated by using an established, non-invasive equation. The equation predicts the number of years, each participant was from Peak Height Velocity (PHV) using anthropometric variables and age. A negative maturity offset indicates the number of years the participant is away from PHV, while a positive maturity offset represents the number of years the participant is beyond PHV. The gender-specific equations for boys and girls are as follows: CA, mass, stature, sitting height and estimated leg length (stature minus sitting height) at each serial observation were used in order to predict maturity offset (time before or after PHV) as follows:

Boys

Maturity offset (years)=-9.236+ (0.0002708 x (Leg length x Sitting height)) +
(-0.001663 x (Age x Leg length)) + (0.007216 x (Age x Sitting height)) + (0.02292 x (Mass by stature ratio x100)).

Girls

Maturity offset=-9.376+ 0.0001882 (leg length x sitting height) + 0.0022 (age x leg length) + 0.005841 (age x sitting height) - 0.002658 (age x weight) + 0.07693 (Mass by stature ratio x 100) (Malina et al. 2004).

The need to multiply the mass by a stature ratio of 100 was disregarded in the original publication. The original validation study reported a correlation coefficient of r=. 83 between skeletal age and maturity offset. The maturity-offset equation has also been cross-validated with 121 boys and 88 girls. The mean difference between the actual and predicted maturity offset were 0.24 years and 0.001 years in boys and girls, respectively, Given the methodological and practical limitations of evaluating maturation with skeletal, somatic, and sexual indicators, the maturity offset equation gives a reasonably accurate estimate of years away from PHV for field-based research (Harrison 1988).

A written informed consent was taken from all parents after verbal and written explanation of the experimental design of the study. The external conditions were the same when the measurements were taken; for the anthropometric measurements, players only wore shorts and for the performance tests they wore shorts, T-shirt and soccer boots, except for the jump test during which they wore running shoes. Standard procedures were followed to measure standing height, sitting height, and body mass. A portable stadiometer (Seca Road Rod, Seca Corporation, Hanover, MD) was used to measure standing height and sitting height. Leg length was calculated by subtracting the participant's sitting height from their standing height. Body mass was measured using a strain gauge scale (Lifesource. A&D Maker. Milpitas, CA) and BMI was calculated by dividing the participant's body mass (kg) by their height (m^2) (Markovic and Jaric 2007).

The following tests were achieved on all players in the same sports hall at the same time of the day and in the same order: For vertical jump, tests were performed by using the jump platform on which flight and ground contact time were measured. The height (cm) of each jump was measured by using an optical measurement system (Newtest, Finland).

In order to evaluate jumping parameters, counter-movement jump were taken into place. The participants performed counter movement jumps with arm swing recorded with an OptoJump device (MicroGate, Italy). The Test continued for 15 seconds and contact time, flight time, jumping height, pace and percentage of sole area used during jumping are attained from children.

All statistical analyses were handled by using SPSS for Windows 17.0. Descriptive statistics were calculated. Data was expressed as means and standard deviations for each variable. Normality assumption was controlled using the Kolmogorov-Smirnov test and from visual inspection of the normality plot. Anthropometric measurements and data from the performance tests were analysed. Data was displayed as mean ± SD the results of each maturity offset were altered into z-scores. The maturity status of each child was classified on the basis of his z-score for percentage of mature offset: z-score between -1.0 and + 1.0 = average or "on time"; z-score below - 1.0 = late or delayed; z-score greater than +1.0 = early or advanced. This procedure has similarities with the previous studies using differences between skeletal and chronological ages to classify youth into maturity categories (Malina et al. 2004). In order to identify significant differences in all the variables among the child who was born in different parts analysis of Kruskall Wallis H- tests and Mann Whitney U-tests were applied.

RESULTS

The research groups' mean and standard deviation (SD) descriptive statistics for the boy sample of mass, height, sitting length, leg length and BMI parameters are given in the Table 1.

The variables are observed according to ages of the boy players (Table 1).

Descriptive statistics for the girls' sample of mass, height, sitting length, leg length and BMI parametres are given in the Table 2.

The variables are observed according to the ages of the girl player (Table 2).

The statistical analysis results belonging to some parameters obtained from the players in the research group are given as tables.

The mean, SD and significant difference values belonging to some parameters are given in the Table 3.

When examining Table 3, it is seen that Contact Time and Flight Time parameters of men consisting the research group are different in terms of maturation coefficient of 7 age and under 7 age. But, it is determined that the boys mature during 8 and above ages have lower contact time and higher flight time values than the boys mature on time and late ($p<0.05$).

The mean, SD and significant differences values belonging to some parameters are given in the Table 4.

When examining Table 4, it is seen that the maturation coefficients are different for 6 ages and above 6 ages in Jumping Height parameters ($p<0.05$). Especially, it is determined that the children mature at early ages have higher values than the children mature late and on time during the ages specified. For pace parameter as another parameter, the children 7 years old and above have differences in terms of maturation ($p<0.05$). It is stated that the children who mature at early ages have faster, jumping frequency than the children who mature late and on time. For the

Table 1: Descriptive statistics for the boys sample of mass, height, sitting length, leg length and BMI

Age group		*Age (year)*	*Mass (kg)*	*Height (cm)*	*Sitting length (cm)*	*Leg length (cm)*	*BMI kg/m²*
Age 10	Mean	9.58	29.48	130.47	68.68	60.79	16.61
	SD	0.03	0.52	0.52	0.35	0.39	0.25
Age 9	Mean	8.60	25.11	122.97	65.78	56.19	15.91
	SD	0.02	0.55	0.64	0.37	0.55	0.26
Age 8	Mean	7.60	24.23	118.85	63.86	54.00	16.47
	SD	0.02	0.53	0.66	0.36	0.47	0.26
Age 7	Mean	6.55	21.02	113.47	61.25	51.21	15.73
	SD	0.03	0.45	0.57	0.36	0.44	0.23
Age 6	Mean	5.51	18.20	107.78	57.70	49.08	15.29
	SD	0.03	0.28	0.68	0.45	0.51	0.16
Age 5	Mean	4.47	14.10	101.50	52.40	48.50	13.69
	SD	0.02	0.29	0.52	0.32	0.23	0.25
Age 4	Mean	3.45	12.5	98.47	45.25	43.22	12.89
	SD	0.02	0.47	0.42	0.34	0.35	0.27

Table 2: Descriptive statistics for the girl sample of mass, height, sitting length, leg length and BMI

Age group		*Age (year)*	*Mass (kg)*	*Height (cm)*	*Sitting length (cm)*	*Leg length (cm)*	*BMI kg/m²*
Age 10	Mean	7.60	24.01	122.72	64.78	55.19	14.91
	SD	0.03	0.65	0.05	0.49	0.63	0.34
Age 9	Mean	6.60	23.13	118.60	62.86	53.00	15.47
	SD	0.03	0.62	0.06	0.48	0.54	0.34
Age 8	Mean	5.55	19.92	113.22	60.25	50.21	14.73
	SD	0.04	0.53	0.05	0.48	0.51	0.30
Age 7	Mean	4.51	17.10	107.53	56.70	48.08	14.29
	SD	0.04	0.33	0.06	0.60	0.59	0.21
Age 6	Mean	3.47	13.00	101.25	51.40	47.50	12.69
	SD	0.03	0.34	0.04	0.43	0.26	0.32
Age 5	Mean	2.45	11.40	98.22	44.25	42.22	11.89
	SD	0.03	0.55	0.04	0.45	0.40	0.35
Age 4	Mean	6.60	22.91	122.47	63.78	54.19	13.91
	SD	0.03	0.76	0.01	0.66	0.73	0.44

Table 3: The mean, SD and significant difference values of contact and flight time of boys

Age groups	*Maturity category*	*Mean*	*SD*	*p*	*Groups comparison*	*Mean*	*SD*	*p*	*Groups comparison*
4 Yrs	Late (n=9)	0.235	0.026	0.315		0.146	0.016	0.425	
	Ontime (n=8)	0.207	0.023			0.149	0.017		
	Early (n=7)	0.198	0.022			0.166	0.018		
5 Yrs	Late (n=7)	0.221	0.022	0.425		0.225	0.015	0.355	
	Ontime (n=7)	0.202	0.020			0.315	0.018		
	Early (n=9)	0.194	0.019			0.318	0.020		
6 Yrs	Late (n=10)	0.190	0.021	0.214		0.362	0.023	0.458	
	Ontime (n=9)	0.184	0.020			0.402	0.025		
	Early (n=9)	0.179	0.020			0.443	0.028		
7 Yrs	Late (n=11)	0.173	0.019	0.125		0.483	0.030	0.214	
	Ontime (n=10)	0.167	0.017			0.523	0.033		
	Early (n=12)	0.162	0.016			0.564	0.035		
8 Yrs	Late (n=9)	0.156	0.017	0.014	Early-Late	0.645	0.040	0.017	Early-Late
	Ontime (n=10)	0.150	0.017		Early ontime	0.685	0.043		Early ontime
	Early (n=11)	0.145	0.016						
9 Yrs	Late (n=12)	0.139	0.014	0.004	Early-Late	0.766	0.048	0.003	Early-Late
	Ontime (n=10)	0.134	0.013		Early ontime	0.807	0.050		Early ontime
	Early (n=11)	0.128	0.013						
10 Yr°	Late (n=14)	0.122	0.014	0.012	Early-Late	0.888	0.020	0.043	Early-Late
	Ontime (n=12)	0.117	0.013		Early ontime	0.928	0.015		Early ontime
	Early (n=13)	0.111	0.012						

other age groups, the children having different maturation coeffciencies have similar jumping frequency. It is seen that the difference of the children matures lately occurs during the age of 8 and above in terms of used area percentage ($p<0.05$). According to this finding, it is determined that the early matured children's percentage of sole area used during jumping is lower than the late and on time matured children.

The mean, SD and significant difference values belonging to some parameters are given in the Table 5.

It is stated that the contact time parameter of the girls composing the research group differs

Table 5: The mean, SD and significant difference values of contact and flight time of girls

Age groups	*Maturity category*	*Mean*	*SD*	*p*	*Groups comparison*	*Mean*	*SD*	*p*	*Groups comparison*
4 Yrs	Late (n=7)	0.294	0.033	0.512		0.195	0.018	0.725	
	Ontime (n=7)	0.259	0.029			0.199	0.021		
	Early (n=8)	0.248	0.028			0.221	0.023		
5 Yrs	Late (n=9)	0.276	0.028	0.425		0.300	0.019	0.424	
	Ontime (n=11)	0.253	0.025			0.420	0.023		
	Early (n=10)	0.243	0.024			0.424	0.025		
6 Yrs	Late (n=9)	0.237	0.026	0.035	E-LE-O	0.482	0.028	0.345	
	Ontime (n=12)	0.230	0.026			0.536	0.031		
	Early (n=10)	0.173	0.025			0.590	0.035		
7 Yrs	Late (n=11)	0.192	0.022	0.011	E-LE-O	0.537	0.038	0.124	
	Ontime (n=10)	0.186	0.021			0.582	0.041		
	Early (n=12)	0.180	0.020			0.627	0.044		
8 Yrs	Late (n=10)	0.173	0.022	0.017	E-LE-O	0.672	0.047	0.011	E-LE-O
	Ontime (n=9)	0.167	0.021			0.697	0.050		
	Early (n=10)	0.161	0.020			0.762	0.053		
9 Yrs	Late (n=11)	0.155	0.017	0.024	E-LE-O	0.707	0.056	0.018	E-LE-O
	Ontime (n=8)	0.141	0.017			0.779	0.060		
	Early (n=8)	0.135	0.016			0.849	0.063		
10 Yrs	Late (n=12)	0.129	0.017	0.008	E-LE-O	0.842	0.020	0.007	E-LE-O
	Ontime (n=10)	0.123	0.016			0.835	0.025		
	Early (n=11)	0.117	0.015			0.977	0.019		

Table 4: The mean, SD and significant difference values of Jumping height, pace and used area of boys

Age groups	*Maturity category*	*Mean*	*SD*	*p*	*Groups comparison*	*Mean*	*SD*	*p*	*Groups comparison*	*Mean*	*SD*	*p*	*Groups comparison*
4 Yrs	Late (n=9)	2.7	0.30	0.754	-	1.80	0.14	0.536	-	22.80	2.53	0.247	-
	Ontime (n=8)	3.4	0.38			1.92	0.41			20.70	2.30		
	Early (n=7)	4.6	0.51			2.01	0.24			19.60	2.18		
5 Yrs	Late (n=7)	6.2	0.62	0.354	-	1.98	0.15	0.478	-	20.30	2.03	0.321	-
	Ontime (n=7)	7.8	0.78			2.03	0.32			18.40	1.84		
	Early (n=9)	9.5	0.95			2.07	0.21			17.60	1.76		
6 Yrs	Late (n=10)	6.6	0.73	0.012	E-LE-O	2.13	0.41	0.235	-	16.68	1.85	0.234	-
	Ontime (n=9)	8.1	0.90			2.18	0.24			15.76	1.75		
	Early (n=9)	10.1	1.12			2.23	0.34			14.84	1.65		
7 Yrs	Late (n=11)	10.8	1.08	0.018	E-LE-O	2.27	0.25	0.037	E-L E-O	13.92	1.39	0.078	-
	Ontime (n=10)	11.7	1.17			2.32	0.43			13.00	1.30		
	Early (n=12)	12.5	1.25			2.37	0.22			12.08	1.21		
8 Yrs	Late (n=9)	11.3	1.28	0.007	E-LE-O	2.42	0.24	0.024	E-LE-O	12.14	1.35	0.008	E-LE-O
	Ontime (n=10)	12.7	1.39			2.46	0.31			14.12	1.57		
	Early (n=11)	13.9	1.50			2.51	0.28			13.14	1.46		
9 Yrs	Late (n=12)	13.2	1.45	0.003	E-LE-O	2.56	0.35	0.016	E-LE-O	12.21	1.12	0.002	E-LE-O
	Ontime (n=10)	14.5	1.55			2.60	0.41			10.14	1.01		
	Early (n=11)	16.4	1.65			2.65	0.30			10.02	1.00		
10 Yrs	Late (n=14)	14.5	1.94	0.008	E-LE-O	2.70	0.31	0.032	E-LE-O	11.52	1.35	0.016	E-LE-O
	Ontime (n=12)	17.75	2.06			2.72	0.35			11.23	1.25		
	Early (n=13)	19.3	2.17			2.79	0.36			10.27	1.14		

during the age of 6 and above in terms of the maturation coefficient ($p<0.05$). Especially, it is found that the early matured children can reach a lower contact time than the late and on time matured children at the stated ages. When examining in terms of flight time, the difference is determined in terms of maturation coefficiencies at the ages of 8 and above. When analysing this difference originates from which group, it is detected that the girls having an early maturation coefficient have higher values than the other maturation coefficiencies at the ages of 8 and above according to the flight time parameter.

The mean, SD and significant difference values belonging to some parameters are given in the Table 6.

When examining Table 6, the jumping height parameters of the girls composing the research group differ in terms of maturation coefficiencies at the ages of 7 and above ($p<0.05$). It is especially found that the children who mature early can reach a lower contact time than the late and on time matured children at the stated ages. For the pace parameter taken from the girls, the difference is seen in terms of maturation at the ages of 6 and above ($p<0.05$). It is determined that the girls having an early maturation coefficient have faster, jumping frequency than the late and on time matured children. For the other age groups, it is seen that the children having different maturation coefficiency have similar jumping frequency. In terms of the percentage of sole area used by girls during jumping, the difference of the early matured children appears at the ages of 6 and above ($p<0.05$). According to this finding, it is determined that the early matured children's percentage of sole area used during jumping is lower than the late and on time matured children.

DISCUSSION

The present study had purpose to examine the level of influence of children's early maturation on some jumping parameters

In research group, girls having early maturation coefficiency have superiority at the early ages in terms of contact time. For the flight time parameter, the difference appears at the similar ages. The boys having an early maturation coefficient in the jumping time parameter have had higher values than the others one year ago. In the pace parameter, the girls having early maturation coefficiency have faster, jumping frequency than the boys. In the used area, this superiority appeared two years ago.

Anthropometric properties and also suitable physical fitness are important essentials for outstanding performance of sports skills and play a crucial role in sports' successful achievements (Stamm et al. 2003). So, physical structures provide~~s~~ a substructure for forming and improving motor techniques for various sports' physical performances. Zhang (2010) examined this subject by taking into account the difference in gender. It is notable that jumping styles in females and males are different because of a greater extension of the knee joint and back and lower plantar flexion of the ankle in females compared to males (Rupesh 2010).

The rate of vertical jump is affected by various physiological and bio-mechanical parameters (Stangelli et al. 2008). Vertical jump is decided by vertical velocity components and gravity during the takeoff phase. The jumping process requires a ground reaction force resulting from generated torque transmission to the ground. Joint's Torque occurs from muscle contraction during structure displacement. Final torque in a joint is a difference of contractile forces in agonist and antagonist muscles. Furthermore, amount of force also deepens on muscular properties. Ground reaction force should be greater than weight. Then, it will be transmitted to the body and specify the velocity of centre of mass (Rupesh 2010).

Dalui et al. (2014) examined the anthropometric factors' effects on vertical jump height based on gender. This study showed the hypothesis - one is that males have higher VJT score than the females and the second hypothesis is that a significant relationship exists between VJT score and anthropometric factors is both genders.

Wickel and Eisenmann (2007) also concluded their studies as follows; the average amount of pedometer- determined physical activity was not significantly different among early, average and late maturing boys and girls. An interesting trend observed among girls in this study was the apparent step-wise decline in physical activity among early (12, 427 steps/day), average (9,982 steps/day) and the late maturing (8642 steps/day). It is likely that the tremendous amount of variability in average pedometer steps/day between maturity groups combined with the rela-

Table 6: The mean, SD and significant difference values of jumping height, pace and used area of girls

Age groups	*Maturity category*	*Mean*	*SD*	*p*	*Groups comparison*	*Mean*	*SD*	*p*	*Group comparison*	*Mean*	*SD*	*p*	*Groups comparison*
4 Yrs	Late (n=7)	3.6	0.3	0.647		3.21	0.15	0.256		26.21	2.59	0.747	
	Ontime (n=7)	4.5	0.5			3.43	0.26			23.79	2.88		
	Early (n=8)	6.1	0.6			3.59	0.32			22.53	2.72		
5 Yrs	Late (n=9)	8.3	0.8	0.547		3.54	0.46	0.477		23.33	2.54	0.231	
	Ontime (n=11)	10.4	1.0			3.63	0.26			21.15	2.30		
	Early (n=10)	12.7	1.2			3.70	0.46			20.23	2.20		
6 Yrs	Late (n=9)	8.8	0.9	0.253		3.81	0.22	0.015	E-LE-O	19.17	2.32	0.034	E-LE-O
	Ontime (n=12)	10.8	1.1			3.89	0.21			18.11	2.19		
	Early (n=10)	13.5	1.4			3.98	0.17			17.06	2.06		
7 Yrrs	Late (n=11)	12.0	1.4	0.012	E-LE-O	4.06	0.15	0.042	E-LE-O	16.00	1.74	0.023	E-LE-O
	Ontime (n=10)	13.0	1.5			4.15	0.41			14.94	1.63		
	Early (n=12)	13.9	1.6			4.23	0.21			13.89	1.51		
8 Yrs	Late (n=10)	12.8	1.6	0.009	E-LE-O	4.31	0.17	0.033	E-LE-O	13.95	1.69	0.004	E-LE-O
	Ontime (n=9)	13.9	1.7			4.40	0.52			16.23	1.96		
	Early (n=10)	15.0	1.9			4.48	0.24			15.10	1.83		
9 Yrs	Late (n=11)	16.3	1.8	0.014	E-LE-O	4.57	0.18	0.008	E-LE-O	12.89	1.40	0.000	E-LE-O
	Ontime (n=8)	16.8	1.9			4.65	0.36			11.66	1.27		
	Early (n=8)	17.2	2.1			4.74	0.32			11.52	1.25		
10 Yrs	Late (n=12)	18.4	2.4	0.002	E-LE-O	4.82	0.18	0.001	E-LE-O	13.93	1.68	0.000	E-LE-O
	Ontime (n=10)	18.3	2.6			4.90	0.32			12.91	1.56		
	Early (n=11)	19.2	2.7			4.99	0.24			11.80	1.43		

tively small sample size for early and late maturers, contributed to the non-significant results.

The anthropometric variables (sitting and standing height, leg length, body mass, waist size, BMI, fat percent and leg muscle volume) increased with age. The reason of this is the growth and maturity processes. In fact, the hormonal production during pubertal development causes the changes in body composition and shape (Rogol et al. 2000).

As a result of descriptive analyses, male athletes had higher anthropometric values than female athletes. For example, standing height in the 15 to 19-year-old age groups, body mass in the 16 to 19-year-old age groups, fat-free mass in the 13 to 19-year-old age groups and leg muscle volume in the 14 to 19-year-old age groups were higher in male athletes than in female athletes. Muscle mass differences in terms of gender are the result of to hormonal influences. Generally, boys have a meaningful increase in bone and muscle growth and a loss of fat in the limbs under the influence of testosterone. For instance, it is found that boys jumped higher than girls from the 13-year-old age group onwards (Wakahara 2010).

Male athletes can jump higher because they have larger thigh and calf girth than female athletes. Boys have a lower body fat percentage than girls because of this reason, the difference in jumping height between boys and girls occurs. Besides, changes in vertical jump technique from childhood to adulthood may result in increased active state of stretch–shortening cycle and influence vertical jump performance (Aouichaoui 2014).

It is seen that the findings of the different studies mentioned above support the results of performance changes showed during the growth period by the girls and boys, in our research.

CONCLUSION

In this study, girls and boys' maturation coefficients were examined according to jumping parameters. Among them, who has an early maturation coefficient showed the superiorities during different ages for both sexes.

The findings resulted from the research group support the effect of early and late maturation. The contact time and flight time parameters of boy consisting the research group are different in terms of maturation coefficient of 7 age and under 7 age. It is also seen that the maturation coefficients are different for 6 ages and above 6 ages in jumping height parameters. Especially, the children mature at early ages have higher values than the children mature late and on time during the ages specified. For example, the children mature at early ages have faster, jumping frequency that the children mature lately and on time. It also is explained that the contact time parameter of the girls in the research group differs during the age of 6 and above in terms of maturation coefficient. Especially the early matured children can reach a lower contact time than the late and on time matured children at the stated ages.

Finally, the jumping height parameters of the girls composing the research group differ in terms of maturation coefficients at the ages of 7 and above. It is especially found that the early matured children can reach a lower contact time than the late and on time matured children at the stated ages. For the pace parameter taken from the girls, the difference is seen in terms of maturation at the ages of 6 and above. It is determined that the girls having early maturation coefficient, have faster jumping frequency than the late and on time matured children. For the other age groups, it is seen that the children having different maturation coefficients have similar jumping frequency. In terms of the percentage of sole area used by girls during jumping, the differences of the early matured children appear at the ages of 6 and above. According to this finding, it is determined that the early matured children's percentage of sole area used during jumping, is lower than the late and on time matured children.

RECOMMENDATIONS

Talent selection stage to be followed longitudinally of children jumping ability can be included in the future studies. Children's sprinting ability can also examine changes in different ages tested.

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