The Motoric Functions of Children According to Maturity Coefficient

Olgunluk Katsayısına Göre Çocukların Motorik İşlevleri

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ABSTRACT Objective: This study compares performance levels among early, average, and late maturing boys and girls. So, the purpose of this study is to compare the age and gender related differences in motoric functions of according to chronological and biological age. **Material and Methods:** Research groups consist of n_{girl}=362 n_{boy}=331 with different academy of junior sports hall changing their age from 7 to 11 years, child players were instructed to give their maximal efforts during all tests. The research groups' training age (mean=1.77±0.28 year) was attained. All child 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. The research groups were measured for mass, 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 and body mass index was calculated. For the physical and motoric attributes, stretching, high jump, long jump, hand grip, medicine ball throw, velocity and agility test were applied. **Results:** As a result, chronological age has an important influence on more complex tasks in which coordination, the performance superiority was appeared. When examining the performance parameters according to age change in terms of gender, the boys at every age except 10 years, are superior in velocity, hand grip, medicine ball, agility and long jump parameter adds to these superiorities after 9 years. From the differences obtained in terms of performace parameters, it is seen that who is at the level of early maturity is superior. **Conclusion:** In this context, as a result of the research, it can be said that the maturity coefficient has positive effects in performance at different ages.

Key Words: Gestational age; athletic performance

ÖZET Amaç: Bu çalışmanın amacı, erken, ortalama ve geç olgunlaşan erkek ve kız çocukları arasındaki performans seviyelerinin kronolojik ve biyolojik yaşa göre motorik işlevlerdeki yaş ve cinsiyet ile ilgili farklılıkları karşılaştırmaktır. **Gereç ve Yöntemler:** Araştırma grupları, farklı spor salonlarından yaşları 7-11 yıl arasında değişen $n_{kız}$=362 n_{erkek}=331 sporculardan oluşmaktadır. Araştırma gruplarının antrenman yaşına (ortalama=1,77±0,28 yıl) ulaşılmıştır. Tüm çocuklar haftada üç gün antrenman yapmışlardır (bir antrenman günü 1-1,5 saat). Kronolojik yaş, 10'lu yaşa (yıl olarak) çevrilen gözlem tarihinden katılımcıların doğum tarihi çıkarılarak hesaplanmıştır. Araştırma gruplarının vücut ağırlıkları, ayakta boy ve oturarak boy değerleri alınmıştır. Bacak uzunluğu, katılımcıların boy uzunluklarından, oturarak boyları çıkarılarak hesaplanmıştır. Vücut ağırlıkları, ağırlık ölçme skalası kullanılarak ölçülmüş ve beden kitle indeksleri hesaplanmıştır. Fiziksel ve motorik özellikler için esnetme, yüksek atlama, uzun atlama, el kavrama, sağlık topu atışı, sürat ve çeviklik testleri uygulanmıştır. **Bulgular:** Sonuç olarak kronolojik yaş, koordinasyon ve performans üstünlüğünün görüldüğü daha karışık görevlerde önemli bir etkiye sahiptir. Cinsiyet bakımından yaş değişikliğine göre performans parametreleri incelendiğinde, 10 yaş hariç her yaştaki erkek çocuklar, sürat, el kavrama, sağlık topu ve çeviklik yetisi açısından daha üstünlerdir ve bu üstünlüklere uzun atlama parametresi 9 yaşından sonra eklenmiştir. Performans parametreleri bakımından elde edilen farklılıklardan, erken olgunluk evresinde olanların daha üstün oldukları görülmüştür. **Sonuç:** Bu kapsamda, araştırmanın sonucu olarak, olgunluk katsayısının farklı yaşlardaki çocukların performansına olumlu etkisinin olduğu söylenebilir.

Anahtar Kelimeler: Gestasyonel yaş; atletik performans

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The presence of the age effect has been widely mentioned; however, its underlying causes have not yet been determined. With this in mind, the present study examined if different maturity level and performance are different amongst children born in the same year. By this concept it is stated to give quotes related about maturity and age effect to the performance on this section.

Inter-individual variation in biological maturation is a factor that influences growth, performance and physical fitness, and is an important covariate of physical activity among adolescents, and of relationships between physical activity and behaviour and cardiovascular and metabolic risk.[1-4] Body size and maturation are also important contributors to success in sport and to sport selection.[5,6]

Biological maturation can be viewed in terms of status that the state of maturation at the time is called chronological age (CA), and timing of the CA at which specific maturational events are attained. Indicators of status include skeletal age (SA), stage of puberty (genitals, breasts and pubic hair) and percentage of mature stature attained at a given CA.[1]

It was hypothesized 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 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 exist when participants were aligned according to chronological age, but not when they were aligned according to biological age.

Most sports branches group athletes according to their chronological age. Thus, a selected date of birth is used to group children into age-specific teams. This particular date of birth, often known as the cut-off date, is the 1st of January in most European countries. In these countries, the majority of sports teams are made up of participants born between the 1 January and 31 December of the same year, but occasionally spanning two consecutive years. Thus, 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. Nevertheless, they will play sports together.[7]

The term relative age refers to a person's age relative to that of his/her peers within the same annual group. This characteristic depends on the date of birth relative to the selection data used to place a child in a specific age group. The variations in age within an annual age group have been referred to as relative age differences, and its consequence as the relative age effect (RAE).[8]

It has been well documented that RAE is more relevant in high-level teams. The date of birth of 36-50% of soccer players was within the first 3 months of the year, whereas about 4-17% was within the last 3 months in selected players and in Under-15 (U-15) to Under-18 international players.[9-14]

Physical and physiological growth and maturation have been hypothesised several times as the underlying cause of RAE, but conclusive results are scarce. In the light of conflicting findings regarding the presence of RAE in young soccer players, we set out to determine if RAE was present in a group of young non-elite soccer players. To this end, we selected young boys aged 9-10 years and evaluated the hypothesis that RAE would be also present in soccer players of young age. We evaluated the hypothesis that players born in the beginning of the year would have some physical advantages and would also have better performances than their younger peers, by comparing anthropometric variables, maturity-related variables and physical test performance amongst players of different relative ages born in the same year.[11,15,16]

In the present study, an overrepresentation of players born during the beginning of the year, known as RAE, was confirmed. In fact, the date of birth of only 17% of the players was in the last 3 months. Similar results have been widely reported for soccer and other sports. Nevertheless, the reasons for RAE have been hypothesised but not

clearly demonstrated. In this group of pre-pubertal soccer players, born in the same year, older players were taller and had longer legs. Moreover, they performed better in the physical tests (velocity and agility), and the difference was more evident in the overall performance score. Although larger studies are needed, it has been demonstrated here that both differences in body size and also in physical performance may underlie RAE.[12,16,17]

Biological maturation is often discussed in terms of status and timing. Maturity status refers to the state of maturation of the individual at a given point in time, for example, skeletal age or percentage of mature height attained at a specific chronological age, pre-and post menarcheal girls of the same chronological age, and prepubertal, pubertal, and post pubertal youth of the same chronological age. Some indicators of maturity status are considered invasive. Skeletal maturity assessment requires radiographs; pubertal status is best assessed at clinical examination implying direct examination of secondary sex characteristics.[1,18]

Maturity timing, on the other hand, refers to when specific maturational events occur for example, age at menarche, age at peak height velocity (PHV), age at attaining a specific percentage of mature height, and so on. Estimates of maturity timing in individual youth require longitudinal data.[1]

Given the difficulties in obtaining a measure of maturity status and timing, several noninvasive estimates have been proposed. Expressing current height as a percentage of predicted mature height requires an estimate of mature height, which can be predicted. During the adolescent growth spurt, however, estimates of skeletal maturity are required to obtain more accurate predictions.[19,20]

Chronological age at the time of measurement plus maturity offset can permit an estimate of age at PHV. This approach has been used for swimmers, gymnasts, and a combined sample of figure skaters and ballet dancers.[21,22]

Given logistical difficulties in obtaining measures of maturation, non-invasive estimates are potential alternatives. Self-assessment of pubertal status has been used for some time, though protocols vary in detail and application, and may be personally invasive to youth.[1] Percentage of predicted mature stature at a given CA has been proposed as a non-invasive alternative.[23] Although commonly used stature prediction equations require SA, alternatives without SA are available.[24-26] Percentage of predicted mature stature attained at a given CA has been used in studies of physical activity and of youth athletes.[4,27-30] Percentage of predicted mature stature has moderated concordance with SA in youth athletes.[31,32]

Two recent studies reported that significant gender differences in physical activity became nonsignificant when boys and girls were aligned according to biological age (i.e. years from PHV) instead of chronological age. These results demonstrate that biological age is an important consideration when comparing physical activity among genders. Surprisingly, little work has been done to examine the influence of maturity status on levels of physical activity within each gender.[2,33]

The purpose of this study was to compare the age and gender related differences in motoric functions of according to biological age.

MATERIAL AND METHODS

SUBJECTS

Research groups consisting of n_{girl}=362 n_{boy}=331 with different academy of junior sports hall changing their age from 7 to 11 child players were instructed to give their maximal efforts during all tests. The research groups' training age (mean=1.77±0.28 year) was attained and their descriptive functions gave in Table 1 and Table 2.

STUDY DESIGN

A written informed consent was received from all parents after verbal and written explanation of the experimental design of the study. The measurements were performed according to the ethical standards of the Helsinki Declaration. All child 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

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 11	Mean	10.58	30.58	131.47	69.68	61.79	17.61
(n=83)	SD	.30	5.86	5.76	3.83	4.32	2.76
Age 10	Mean	9.60	26.21	123.97	66.78	57.19	16.91
(n=69)	SD	.24	6.18	7.06	4.02	6.01	2.84
Age 9	Mean	8.60	25.33	119.85	64.86	55.00	17.47
(n=79)	SD	.25	5.95	7.25	3.92	5.17	2.89
Age 8	Mean	7.55	22.12	114.47	62.25	52.21	16.73
(n=55)	SD	.29	5.07	6.30	3.97	4.82	2.57
Age 7	Mean	6.51	19.30	108.78	58.70	50.08	16.29
(n=45)	SD	.28	3.08	7.48	5.00	5.63	1.73

BMI: Body mass index; SD: Standard deviation.

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 11	Mean	10.65	31.14	130.10	69.11	60.99	18.21
(n=75)	SD	.23	7.29	8.42	4.32	6.15	2.80
Age 10	Mean	9.53	28.55	125.91	68.31	57.60	17.94
(n=76)	SD	.29	4.65	7.57	4.34	5.48	2.15
Age 9	Mean	8.46	23.26	117.08	63.44	53.64	16.79
(n=75)	SD	.30	5.46	7.25	4.57	3.85	2.59
Age 8	Mean	7.47	21.28	113.82	62.25	51.57	16.29
(n=72)	SD	.21	4.40	5.38	3.57	4.21	2.22
Age 7	Mean	6.53	17.86	104.98	56.94	48.04	16.12
(n=64)	SD	.29	2.94	4.75	2.82	3.55	1.69

BMI: Body mass index; SD: Standard deviation.

date transformed into decimal age (in years) and maturity offsets were calculated. One-year age groups were created based on the participant's chronological age, where a 9 year old would include participants between 9.0 and 9.99 years.[33] **Biological Maturity Status;** Maturity offset was estimated using an established, noninvasive equation. The equation estimates the number of years each participant was from PHV using anthropometric variables and age. A negative (-) maturity offset represents 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 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 x 100)]. **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).[1]

The need to multiply the mass by stature ratio by 100 was overlooked in the original publication.[20] The original validation study reported a correlation coefficient of r=.83 between skeletal age and ma-

turity offset. The maturity-offset equation has also been cross-validated with 121 boys and 88 girls. Mean differences between 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 assessing maturation with skeletal, somatic, and sexual indicators, the maturity offset equation provides a reasonably accurate estimate of years away from PHV for field-based research.[34]

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 is similar to previous studies that use differences between skeletal and chronological ages to classify youth into maturity categories.[1]

DATA COLLECTION

Measurements were taken under the same external conditions; for the anthropometric measurements, players only wore shorts and for the performance tests they wore shorts, T-shirt and soccer boots, except from 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).[33,35]

The following tests were carried out on all players in the same sports hall at the same time of the day and in the same order: For stretching ability sit and reach test was used. Test was performed as the participants sat on the floor with shoes on, and fully extended two legs so that the sole of the foot was flat against the end of the box. They extended their arms forward, placing one hand on top of the other. With palms down, they reached forward sling hands along the measuring scale as far as possible without bending the knee of the extended leg.[36] For long jump abilty, the athlete stands behind a line marked on the ground with feet slightly apart. A two foot takeoff and landing is used, with swinging of the arms and bending of the knees to provide forward drive. The athlete attempts to jump as far as possible, landing on both feet without falling backwards. The measurement is taken from take-off line to the nearest point of contact on the landing.[37] For vertical jump, tests were performed by using jump platform on which flight and ground contact time were measured. The height (cm) of each jump was measured using an optical measurement system (Newtest, Finland). Squat jump values were taken, a complete jump upward was performed while knees were in 90° flexion of squat position and hands were on waist. In the test of standing long jump, after the subjects jumped, the starting line and the nearest trail were based; the best grade was noted at the end of two test for each subject.[38]

In order to determine strength of the forearm flexor, clutching power was obtained by using manual dynamometer of Holtain brand. Manual dynamometer was set for subject's hand size; the subject was trying to tighten the dynamometer with his hand when his arm was flat and rested in 10-150 angles to shoulder without bending his elbow and at the side. The best performance of the subject was determined after 2 attempts done with dominant hands of child.[39] Throwing medicine ball test; the aim of this test is determining explosive power of the arm muscles. The test was performed with 2 kg medicine ball. When the medicine ball throw test was administered, one researcher demonstrated the skill. Each student sat on the floor with his or her back against the wall. The student held the ball in front of him or her with both hands, resting it against his or her lap. Each subject performed two practice throws. The measurement was taken to the nearest eighth of an inch and converted to a metric unit. The lane for throwing the medicine ball forward was marked to be exactly 36 in wide.[40]

For agility the pro-agility test applied. The Pro-Agility test was set up and administered using the protocol outlined.[41] The subjects started in a neutral stance, straddling the start line. On the "Go" command, the subjects were instructed to turn and sprint to the right 4.55 m., touching the cone with their right hand. They then turned to the left and ran 9.10 m. to the far cone. The subjects touched this cone with their left hand and then sprinted 4.55 m. to the finish. For velocity, 20 m sprint test was used which involved a stationary start with the player initiating the sprint in their own time, that is, with no requirement to react to a starting signal. Each subject performed two practice of sprint.[42]

STATISTICAL ANALYSIS

All statistical analyses were conducted using SPSS for Windows 17.0. Descriptive statistics were calculated. Data were expressed as means and standard deviations for each variable. Normality assumption was checked 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 transformed into z-scores. To identify significant differences in all the variables among the child born in different parts the analyze of variance (ANOVA) and scheffe statistics were performed.

RESULTS

The statistical analysis results belonging to some parameters obtained from the players in the research group were given as Table 1 and Table 2.

Mean and standart deviation (SD) descriptive statistics for the boy sample of mass, height, sitting length, leg length and BMI parametres were 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 were given in the Table 2.

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

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

The parameters of vertical jump, long jump, hand grip and medicine ball of boys differ and the parameters of velocity, vertical jump, long jump and stretching of girls differ in terms of maturity coefficient. When examining the maturity coefficients of the boys, it was observed that the vertical jump and long jump parameters of those having late maturity coefficient are lower than those having early and on-time maturity coefficients. Also it was observed that the medicine ball throw parameters of those having early maturity coefficient are higher than late and on-time maturity coefficients. For hand grip parameters of those having early maturity coefficient are higher than late maturity coefficients. When examining the maturity coefficients of the girl, it was observed that the vertical jump and long jump parameters of those having early maturity coefficient are higher than those having late and on-time maturity coefficients. Also it was observed that the velocity parameters of those having late maturity coefficient are higher than early and on-time maturity coefficients. In stretching parameters of those having early maturity coefficient are higher than late maturity coefficients (Table 3).

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

The parameters of vertical Jump, long jump, Hand grip and Medicine ball of boys differ and the parameters of velocity, vertical Jump, long jump and stretching of girls differ in terms of maturity coefficient. When examining the maturity coefficients of the boys, it was observed that the long jump and medicine ball throw parameters of those having early maturity coefficient are higher than those having late maturity coefficients. Also it was observed that the hand grip parameters of those having late maturity coefficient are lower than early and on-time maturity coefficients. When examining the maturity coefficients of the girl, it was observed

TABLE 3: The mean, SD and significantly different values of some parameters of 7 age child.

		Boy players n_{early}=14; n_{late}=16 o_{ntime}=15					Girl players n_{early}=18; n_{late}=22; n_{ontime}=24				
Motoric Parametres	Maturity category	Mean	S.D.	p	Groups Comparison	p_{groups}	Mean	S.D.	p	Groups Comparison	p_{groups}
Velocity	Early	6.17	0.61	0.151			6.33	0.24	0.006	Early-Late	0,000
(sec)	Late	7.65	0.85				7.29	1.05		Early-Ontime	0,214
	Ontime	6.43	0.88				6.54	1.06		Late-Ontime	0,013
Vertical	Early	16.00	9.90	0.028	Early-Late	0,030	21.00	3.46	0.017	Early-Late	0,007
Jump (cm)	Late	10.23	2.83		Early-Ontime	0,125	14.50	6.36		Early-Ontime	0,014
	Ontime	15.84	5.84		Late-Ontime	0,034	14.78	4.21		Late-Ontime	0,254
Long	Early	74.00	14.14	0.012	Early-Late	0,000	81.67	11.55	0.014	Early-Late	0,024
Jump (cm)	Late	63.50	10.61		Early-Ontime	0,457	77.67	19.14		Early-Ontime	0,004
	Ontime	68.44	21.79		Late-Ontime	0,024	76.67	24.78		Late-Ontime	0,254
Stretching	Early	25.75	8.84	0.503			30.33	4.04	0.023	Early-Late	0,247
(cm)	Late	20.00	6.08				22.30	2.75		Early-Ontime	0,007
	Ontime	23.74	5.82				28.68	4.28		Late-Ontime	0,365
Hand Grip	Early	10.50	1.27	0.036	Early-Late	0,256	6.37	1.03	0.855		
(kg)	Late	9.45	5.01		Early-Ontime	0,021	6.35	0.49			
	Ontime	7.14	1.80		Late-Ontime	0,587	6.89	1.93			
Medicine	Early	2.83	0.46	0.002	Early-Late	0,004	2.02	0.51	0.594		
Ball (m)	Late	1.60	1.42		Early-Ontime	0,012	1.63	0.18			
	Ontime	1.78	0.71		Late-Ontime	0,478	2.01	0.63			
Agility (sec)	Early	7.72	0.42	0.415			8.70	0.82	0.937		
	Late	10.16	5.10				8.61	1.05			
	Ontime	8.72	2.62				8.38	1.50			

SD: Standard deviation.

that the velocity parameters of those having early maturity coefficient are lower than those having late and on-time maturity coefficients. Also it was observed that the vertical jump parameters of those having early maturity coefficient are higher than late maturity coefficients. In stretching parameters of those having early maturity coefficient are higher than late and ontime maturity coefficients (Table 4).

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

The parameters of long jump, hand grip of boys differ and the parameters of velocity, stretching and medicine balls of girls differ in terms of maturity coefficient. When examining the maturity coefficients of the boys, it was observed that the long jump parameters of those having early maturity coefficient are higher than those having late and ontime maturity coefficients. Also it was observed that the hand grip parameters of those having late maturity coefficient are lower than early and on-time maturity coefficients. When examining the maturity coefficients of the girl, it was observed that the velocity parameters of those having early maturity coefficient are lower than those having late and on-time maturity coefficients. Also it was observed that the stretching and medicine ball throw parameters of those having early maturity coefficient are higher than late and ontime maturity coefficients. (Table 5).

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

The parameters of velocity, hand grip and medicine ball of boys differ and the parameters of velocity, vertical jump, stretching and medicine ball of girls differ in terms of maturity coefficient. When examining the maturity coefficients of the boys, it was observed that the velocity parameters of those having early maturity coefficient are lower

TABLE 4: The mean, SD and significantly different values of some parameters of 8 age child.

		Boy players n_{early}=18; n_{late}= 17; n_{ontime}=20					Girl players n_{early}=22; n_{late}=23; n_{ontime}=27				
Motoric Parametres	Maturity category	Mean	S.D.	p	Groups Comparison	p_{groups}	Mean	S.D.	p	Groups Comparison	p_{groups}
Velocity	Early	5.92	0.46	0.718			6.24	0.68	0.025	Early-Late	0,012
(sec)	Late	5.65	0.56				7.75	0.80		Early-Ontime	0,000
	Ontime	5.95	1.06				6.85	0.24		Late-Ontime	0,259
Vertical	Early	14.63	6.19	0.809			17.50	0.71	0.046	Early-Late	0,012
Jump (cm)	Late	13.54	4.75				16.80	5.28		Early-Ontime	0,368
	Ontime	13.45	5.32				17.00	1.41		Late-Ontime	0,874
Long	Early	78.25	19.54	0.036	Early-Late	0,002	81.50	24.75	0.943		
Jump (cm)	Late	69.40	20.80		Early-Ontime	0,256	78.21	22.77			
	Ontime	73.82	23.81		Late-Ontime	0,365	80.50	20.51			
Stretching	Early	25.92	4.74	0.301			28.50	2.83	0.037	Early-Late	0,006
(cm)	Late	22.07	3.10				26.45	4.76		Early-Ontime	0,000
	Ontime	24.78	5.00				26.40	7.64		Late-Ontime	0,253
Hand Grip	Early	8.89	2.03	0.039	Early-Late	0,003	6.70	1.70	0.959		
(kg)	Late	6.86	1.89		Early-Ontime	0,254	6.79	1.85			
	Ontime	7.60	2.30		Late-Ontime	0,014	6.40	0.42			
Medicine	Early	2.32	0.49	0.026	Early-Late	0,025	2.13	0.11	0.792		
Ball (m)	Late	2.00	0.88		Early-Ontime	0,365	1.69	0.63			
	Ontime	2.12	0.54		Late-Ontime	0,357	1.99	0.09			
Agility (sec)	Early	7.38	1.33	0.541			8.97	0.16	0.845		
	Late	7.74	1.64				8.37	1.44			
	Ontime	7.67	2.45				8.64	1,10			

SD: Standard deviation.

than those having late and ontime maturity coefficients. Also it was observed that the hand grip and medicine ball throw parameters of those having early maturity coefficient are higher than late and on-time maturity coefficients. When examining the maturity coefficients of the girl, it was observed that the velocity parameters of those having early maturity coefficient are lower than those having late and on-time maturity coefficients. Also it was observed that the vertical jump and medicine ball throw parameters of those having early maturity coefficient are higher than late and ontime maturity coefficients. In stretching parameters of those having early maturity coefficient are higher than late and ontime maturity coefficients (Table 6).

The mean, SD and significant differences values belonging to some parameters were given the Table 7.

The parameters of velocity, hand grip and medicine ball of boys differ and the parameters of velocity, vertical jump, medicine ball and pro-agility of girls differ in terms of maturity coefficient. When examining the maturity coefficients of the boys, it was observed that the velocity and agility parameters of those having early maturity coefficient are lower than those having late and on-time maturity coefficients. Also it was observed that the hand grip and medicine ball throw parameters of those having early maturity coefficient are higher than late and on-time maturity coefficients. When examining the maturity coefficients of the girl, it was observed that the velocity parameters of those having early maturity coefficient are lower than those having late and on-time maturity coefficients. Also it was observed that the vertical jump and medicine ball throw parameters of those having early maturity coefficient are higher than late and ontime maturity coefficients. In agility parameters of those having early maturity coefficient are lower than late maturity coefficients (Table 7).

TABLE 5: The mean, SD and significantly different values of some parameters of 9 age child.

		Boy players $n_{early}=27$; $n_{late}=29$; $n_{ontime}=23$					Girl players $n_{early}=28$; $n_{late}=26$; $n_{ontime}=21$				
Motoric Parametres	Maturity category	Mean	S.D.	p	Groups Comparison	p_{groups}	Mean	S.D.	p	Groups Comparison	p_{groups}
Velocity	Early	5.58	0.81	0.881			5.59	0.52	0.034	Early-Late	0,007
(sec)	Late	5.46	0.44				6.28	1.04		Early-Ontime	0,000
	Ontime	5.63	0.92				5.75	0.93		Late-Ontime	0,501
Vertical	Early	14.09	4.30	0.938			14.91	3.99	0.588		
Jump (cm)	Late	13.88	6.27				14.57	6.40			
	Ontime	14.48	5.11				15.64	0.94			
Long	Early	101.18	18.09	0.043	Early-Late	0,000	83.43	23.61	0.460		
Jump (cm)	Late	91.25	30.06		Early-Ontime	0,004	79.74	21.35			
	Ontime	93.58	28.20		Late-Ontime	0,064	81.82	18.51			
Stretching	Early	24.75	5.69	0.780			27.96	3.75	0.027	Early-Late	0,001
(cm)	Late	22.94	4.23				27.01	6.72		Early-Ontime	0,032
	Ontime	23.94	5.66				26.88	3.09		Late-Ontime	0,951
Hand Grip	Early	9.77	3.03	0.033	Early-Late	0,004	7.99	1.04	0.501		
(kg)	Late	7.59	2.05		Early-Ontime	0,568	7.66	2.88			
	Ontime	8.69	3.35		Late-Ontime	0,007	7.22	2.08			
Medicine	Early	2.87	0.97	0.732			3.07	0.34	0.044	Early-Late	0,006
Ball (m)	Late	2.66	1.04				2.44	0.79		Early-Ontime	0,001
	Ontime	2.59	1.11				2.67	0.34		Late-Ontime	0,125
Agility (sec)	Early	7.65	0.70	0.845			7.92	0.52	0.486		
	Late	7.91	0.90				7.39	1.30			
	Ontime	7.57	1.63				7.95	0.61			

SD: Standard deviation.

DISCUSSION

This study examined the child players physical performance with relationship to biological age and maturity related parameters. It has been suggested that RAE is due to a bigger body size and due to an advanced physical maturity and also due to the advantage in performance in the older players. Thus, RAE has been widely reported, but its underlying causes largely remain a matter of speculation.

Physical growth is a continuous process which occurs during the years of infancy, childhood and puberty until adult stature is reached. Consequently, boys born earlier in the year can be up to 10-12 months longer undergoing this growth process than those born towards the end of the year, thus acquiring a physical advantage. The difference in height between players born in first part of year (January-March) and last part of year (October-December) was around 3.7 cm, which is consistent with normal growth at this age (i.e.˜3 cm every 6 months).[43]

It is carried out a study of 160 young elite soccer players to compare the anthropometric and fitness characteristics of boys born during each of the 4 birth quarters. The authors did not find significantly differences across any of the measured performance characteristics. Nevertheless, there was a trend for the older players to outperform the younger players in most of the fitness tests.[11]

In the same way, it was analysed the physical performance of 69 soccer players. The study of a subsample of players aged 14 showed no clear trend in experience, size, functional capacities and composite skill score. In this group, most players were nearing maturity or already mature. Therefore, the authors concluded that the homogeneous results probably reflected low pubertal variation

TABLE 6: The mean, SD and significantly different values of some parameters of 10 age child.

		Boy players $n_{early}=24$; $n_{late}=25$; $n_{ontime}=20$					Girl players $n_{early}=25$; $n_{late}=28$; $n_{ontime}=23$				
Motoric Parametres	Maturity category	Mean	S.D.	p	Groups Comparison	p_{groups}	Mean	S.D.	p	Groups Comparison	p_{groups}
Velocity	Early	4.74	0.42	0.028	Early-Late	0,006	4.68	0.33	0.048	Early-Late	0,007
(sec)	Late	5.62	0.32		Early-Ontime	0,005	5.37	0.36		Early-Ontime	0,019
	Ontime	5.15	0.57		Late-Ontime	0,325	5.41	0.56		Late-Ontime	0,078
Vertical	Early	18.13	4.96	0.224			19.02	3.18	0.007	Early-Late	0,038
Jump (cm)	Late	15.62	1.98				17.24	2.84		Early-Ontime	0,015
	Ontime	17.34	5.00				14.58	2.16		Late-Ontime	0,548
Long	Early	104.50	21.63	0.989			100.25	11.79	0.615		
Jump (cm)	Late	104.00	37.40				93.13	23.86			
	Ontime	103.10	26.37				91.40	18.02			
Stretching	Early	20.44	5.07	0.452			30.03	0.06	0.018	Early-Late	0,015
(cm)	Late	19.16	5.48				27.67	5.99		Early-Ontime	0,564
	Ontime	21.47	5.70				29.10	5.47		Late-Ontime	0,965
Hand Grip	early	11.61	3.79	0.010	Early-Late	0,005	10.41	2.58	0.666		
(kg)	late	7.09	1.32		Early-Ontime	0,000	9.83	3.17			
	Ontime	9.08	3.28		Late-Ontime	0,124	8.12	0.51			
Medicine	early	3.47	0.88	0.001	Early-Late	0,014	3.49	1.24	0.035	Early-Late	0,003
Ball (m)	late	2.22	0.35		Early-Ontime	0,028	2.75	1.33		Early-Ontime	0,000
	ontime	2.71	0.59		Late-Ontime	0,954	2.29	0.66		Late-Ontime	0,087
Agility (sec)	early	6.44	0.74	0.663			6.11	0.48	0.745		
	late	6.71	2.98				7.07	2.38			
	ontime	6.62	1.45				6.48	0.54			

SD: Standard deviation.

within the sample due to maturity having been reached.[34]

Similarly, it was observed that basketball players (aged 13-14 years) born in the first semester were taller and heavier. These players had a lower heart rate after the endurance test, and they also performed better in the counter movement jump and the dribbling tests. Moreover, they had a higher score in the point average.

Neuromuscular maturation may play an important role in motor performance during childhood. However, chronological age, due to its influence on the maturation of the nervous system, may have an important influence on more complex tasks in which coordination is important, such as in the agility test and the overall score, independently of body size.[1]

In this sense, it was observed that chronological age as a more important predictor than age at PHV and body mass during the first selection during a selection process of hockey players. Besides, 77.5% of the boys selected at the final selection were born in the first 6 months of the year implying a close relationship between performance and chronological age.[33]

Older players were around 3.5 years from their maturity offset, whereas younger players were almost 4 years. Thus, older players were closer to puberty. This result is in agreement with was founded a trend for the maturation difference to be smaller in players born during the first quarter of the year. It is important to remember that boys of the first quartile can be up to 10-12 months older than boys belonging to the last quartile. Therefore, this result should be taken cautiously, because the aforementioned difference in maturity offset may be due to differences in chronological age rather than due to an advanced maturity in the older boys. In fact, age at PHV was similar in all

TABLE 7: The mean, SD and significantly different values of some parameters of 11 age child.

		Boy players n_{early}=22; n_{late}=27; n_{ontime}=34					Girl players n_{early}=26; n_{late}=22; n_{ontime}=27				
Motoric Parametres	Maturity category	Mean	S.D.	p	Groups Comparison	p_{groups}	Mean	S.D.	p	Groups Comparison	p_{groups}
Velocity	Early	4.58	0.88	0.008	Early-Late	0,004	4.70	0,53	0.045	Early-Late	0,018
(sec)	Late	5.07	0.26		Early-Ontime	0,000	5.14	0.62		Early-Ontime	0,000
	Ontime	5.00	0.89		Late-Ontime	0,754	4.94	0.26		Late-Ontime	0,326
Vertical	Early	15.39	4.74	0.486			22.33	4.93	0.015	Early-Late	0,018
Jump (cm)	Late	17.81	6.62				15.13	6.14		Early-Ontime	0,023
	Ontime	17.46	4.79				16.74	2.96		Late-Ontime	0,956
Long	Early	118.00	20.44	0.527			114.67	41.86	0.601		
Jump (cm)	Late	110.00	18.95				100.76	30.09			
	Ontime	115.08	26.27				93.83	15.68			
Stretching	Early	24.46	5.21	0.376			30.00	7.07	0.533		
(cm)	Late	21.28	6.33				23.77	7.33			
	Ontime	23.09	7.69				23.55	7.92			
Hand Grip	Early	15.95	2.75	0.031	Early-Late	0,000	9.93	4.52	0.574		
(kg)	Late	10.80	2.71		Early-Ontime	0,008	10.11	2.87			
	Ontime	11.20	3.32		Late-Ontime	0,254	8.58	2.58			
Medicine	Early	4.10	0.81	0.016	Early-Late	0,014	3.50	0.85	0.024	Early-Late	0,004
Ball (m)	Late	3.19	0.85		Early-Ontime	0,002	3.28	0.70		Early-Ontime	0,008
	Ontime	3.41	0.91		Late-Ontime	0,219	3.34	0.66		Late-Ontime	0,259
Agility (sec)	Early	5.90	2.62	0.018	Early-Late	0,041	6.75	2.43	0.048	Early-Late	0,007
	Late	6.80	1.47		Early-Ontime	0,024	7.08	1.03		Early-Ontime	0,265
	Ontime	6.62	1.54		Late-Ontime	0,256	6.93	1.59		Late-Ontime	0,397

SD: Standard deviation.

boys denoting no particular differences in the maturity status of the boys when they were divided according to their chronological age.[44]

Competition to obtain a place in a team seems to be one of the causes of RAE. Moreover, this competition will come from the number of players available for the places, and this number will depend on the popularity of a given sport in a given country.[45] The other large study on 363,590 French male soccer players observed that the number of drop outs was significantly higher among players born in the last quarter of the year. This phenomenon was evident from the group of players Under-9 to Under-18. Thus, the competition for a place in a team and external selection caused by an advantageous physique and a better performance of older boys, together with a self-restriction and/or a higher number of dropouts in disadvantaged younger players, may be the reasons why RAE is present in particularly popular sports.[46]

In a recent study of the differences between younger (aged 9.4) and older soccer players (aged 11.8), most differences were found in physiological performance, while the only technical skill difference was observed in heading.[47] Nevertheless, it would be very interesting to measure similar parameters in a larger sample of soccer players in order to ascertain if some of the subtle differences found in this group of 88 players become more evident.

The gender-specific maturity offset equations used in the study provided a noninvasive method to estimate the number of years away from PHV, a somatic indicator of biological maturity, using cross-sectional anthropometric variables.[20]

This finding suggests that physical activity levels may decline with increasing chronological age, regardless of somatic characteristics.

Adjusting for differences in chronological age between maturity groups as in that study, is one

way to examine the independent association between maturity status and the level of physical activity. Another approach to examine the independent association between maturity status and level of physical activity involves selecting boys and girls of similar chronological age. Using this approach, similar mean levels of pedometer steps/day between early (11,295 steps/day), average (12,836 steps/day), and late (12,927 steps/day) maturing boys. Although nonsignificant, an interesting observation from this previous study was a step-wise decline in pedometer steps/day between early (12,427 steps/day), average (9982 steps/day), and late (8642 steps/day) maturing girls. A relatively low number of early (n=6) and late (n=6) maturing girls, combined with large standard deviations, likely contributed to the nonsignificant mean difference between maturity groups.[48] In an earlier study, serial measurements of self-reported physical activity among 200 participants were collected at ages 13, 14, 15, 16, and 21 years. Hand-wrist radiographs were measured on 4 occasions between 12 and 17 years to estimate skeletal age and categorize participants into maturity groups. Among boys and girls, no significant difference in physical activity was found between maturity groups. A similar conclusion was reported among a younger group of adolescent girls (mean age=11.8±0.4 years). In contrast, others have reported significant differences in physical activity among maturity groups specifically among girls.[49,50] This finding suggests that activity levels are similar among maturity groups when age is controlled. It is important to point out that the data are cross-sectional so definitive conclusions about the association between maturity status and level of physical activity cannot be made. Longitudinal studies that track early, average, and late maturing boys and girls throughout childhood and adolescents are needed to determine if maturity status or the process of pubertal maturation may influence physical activity patterns and trajectories over time.

When examine the age and gender-related differences in physical activity according to chronological and biological age. A chronological age scale provides a practical approach to align individuals; however, maturity-related differences between individuals may be overlooked. In that study, age and gender-related differences in Physical Activity were revealed when boys and girls were aligned by chronological age. Mean levels of Physical Activity progressively declined among boys and girls with increasing chronological age even after controlling for differences in BMI. This observation suggests that activity levels decrease naturally with age; however, the driving mechanism behind this observation, whether psycho-social or biological, cannot be concluded from this study. In agreement with previous findings, gender differences in physical activity observed on a chronological age scale disappeared when boys and girls were aligned by biological age.[51] All of the results suggest that maturational differences between boys and girls should be considered when activity levels are compared between genders. However, the actual association between biological age and level of physical activity is difficult to determine because, on average, boys and girls further away from PHV were also chronologically younger compared with boys and girls close to or beyond PHV.

The mean differences in physical activity between early, average, and late maturing boys and girls could largely be explained by the differences in chronological age, rather than the differences in body mass or BMI scores. However, additional work is needed in this area to clarify the implications of early, average, or late maturation on levels of physical activity during adolescence. Continued work in this area will help better understand the relative importance of biological and behavioral factors in the well documented decline in physical activity levels during adolescence. All studies of children need to come after their maturity changes that also affect the performance level. Age and gender-specific changes takes into consideration performance impacted by biological maturity raher than choronologically age.

CONCLUSION

As chronological age has an important influence on more complex tasks in which coordination, the performance superiority appeared. When examin-

ing the performance paramenters according to age change in terms of gender, the boys at every age except 10 years, are superior in velocity, hand grip, medicine ball, agility and long jump parameter add to these superiorities after 9 years. From the differences obtained in terms of performace parameters, it is seen that who is at the level of early maturity is superior. In this context, as a result of the research, it can be said that the maturity coefficient has positive effects in performance at different ages.

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