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Biological maturity and its relationship to some anthropometric measurements and physical performance in 15-16 year old male cycling riders

النضج البيولوجي وعلاقته ببعض القياسات الأنثروبومترية والأداء البدني لراكبي الدراجات، ذكور، بعمر 15-16 سنة

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Abstract: The aims of this study are to Determine differences in selected anthropometric measurements and physical performance between the levels of biological maturation of a group of 15-16 year old riders.And estimate the contribution of biological age on riders' physical performance. Thirty male cycling riders (Age = 15,8±0,67 years), from the U17 category, are participated in the study. Riders were sub-divided into three biological maturation groups, early maturing (n=8), average maturing (n=8), and late maturing (n=14), using theWUTSCHERK'santhropometricmethod. All anthropometric measurements and assessments (Peak power output test and field tests), were performed. The present study shows that early maturing riders are taller and heavier (p<0,001), and performed better in physical tests that required, power, speed, and resistance (P<0,01).

Keywords:cyclingriders,biologicalage, peak power, adolescence.

الملخص:تهدف هذه الدراسة إلى تحديد الاختلافات في بعض القياسات الأنثروبومترية والأداء البدني بين مستويات النضج البيولوجي لراكبي الدراجات، بعمر 15-16 سنة. وتقدير مساهمة العمر البيولوجي في الأداء البدني للدراجين. شارك في هذه الدراسة دراجين،ذكور (العمر = 15،8 ± 0،67 سنة)، من فئة الأشبال. تم تقسيم الدراجين إلى ثلاثة مجموعات من النضج البيولوجي، النضج المبكر (n = 8)، متوسط النضج (n = 8) والنضج المتأخر (n = 14)، باستخدام طريقة WUTSCHERKالأنثروبومترية. تم إجراء جميع القياسات الأنثروبومتريةوالاختبارات البدنية (اختبار القدرة القصوى والاختبارات الميدانية). تظهر الدراسة الحالية أن الدراجين الناضجين أطول وأثقل (P<0,001)، ويتميزونبأداء أفضل في الاختبارات البدنية التي تتطلب القوة والسرعة والتحمل (P<0,01).

الكلمات المفتاحية:دراجي الطريق، العمر البيولوجي، القدرة القصوى، المراهقة.

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Introduction

Road cycling is a sport that requires performance on a wide variety of fields and competition. Cycling performance in each of the fields and competition are partly determined by anthropometric, physiological and physical characteristics.

The process of performance evaluation and sports characterization is currently the result of the analysis of multiple variables, among them, the physiological performance of the athlete, the analysis of biological maturation, and body composition (Thomas REILLY and others, 2009). Thus, the evaluation of these variables plays an important role in the analysis of athletic performance, due to the close relationship observed between anthropometric characteristics and the results in road cycling.

Maturation, growth and development, characterize the lives of children and youth between birth and adulthood. Maturation refers to progress towards the biologically mature stature, which varies among systems, skeletal, reproductive, somatic, neuromuscular, dental, etc. Biological maturation is a process that occurs in all tissues, organs and systems of the body, Robert M MALINA and others (2019).

According to Rhodri S LLOYDand others (2014), chronological age is traditionally used in sport to group teams by age, identify talent and set limits for exercise prescription. Chronological age is calculated at a single point in time from the date of birth and the prescribed cut-off date for age groups and seasons. However, chronological age is of limited utility in the assessment of growth and maturation. Because, there may be differences in biological maturity between boys of the same chronological age (Jon TORRES-UNDAand others, 2013), in terms of size, fitness acquisition,physiological and motor skills.

The range of variability between individuals of the same chronological age in somatic and biological growth is widespread and particularly accentuated around the adolescent growth spurt (Sandra IULIANO-BURNSand others, 2001).

The need to assess maturation, the pace and timing of progression to maturity, is imperative in the study of child growth. Similarly, the assessment of maturity has a specific application in the classification of children for sport during the period of adolescence.

The WUTSCHERK method is used for the determination of the levels of biological maturation using the KEI index, it is a simple and less expensive method than the other methods. In this method three biological maturation levels are determined, the late, average and early level of maturation.

Problematic

During puberty, the higher coefficients of increase in maximal strength and force-velocity, which are conditioned by hormonal metabolism, as well as the increase in anaerobic capacity (necessary in endurance-velocity and strength-endurance) produce significant gains in anaerobic power during this period. The latter, is considered as a main factor of successful performance at many sports fields and is influenced by age, inheritance and body exercise of an individual.

The category that we will study matches with adolescence, this phase is the second phase of puberty, it starts around 14-15 years old, and ends around 18-19 years old in boys. It marks the end of an evolutionary process that begins in childhood and ends in adulthood.

In Algeria, most data, in the literature on adolescents cycling riders concern the establishment of an algorithm of selection for cyclists aged from 15 to 16 years, for resistance or power events orientations, orthe proposal of a specific physical test battery in cycling to determine the level of performance. To my knowledge, no study about the effect of biological maturation on physical performance in young Algerian cycling riders. Thus, in the present study, we compared the anthropometric parameters and physiological performance of the U17 cycling riders grouped on biological age and the effect of the biological maturation on the physical performance.

Several studies have investigated biological maturation and its effect on physical performance in different disciplines, including team sports such as football, handball,and basketball. However, their samples were different. Some have opted for extended age groups. Others opted for a sample with the same chronological age, and others, have opted for a single age category.

We selected the 15 to 16 year old male riders because in cycling, the U17 category is an intermediate stage between the initial preparation of the U15 category and the specific basic preparation of the U19 category. It is a decisive phase in the choice of the cycling specialty and, for the best ones, in the preparation to face international and world competitions. Despite the small sample size of our study, the effect of chronological age is not taken into account.Following this, two questions arise:

What are the anthropometric and physical performance differences that exist between adolescent road cyclists in the U17 category, grouped according to biological age?

What is the effect of biological maturation on physical performance?

Hypotheses

It is hypothesized that anthropometric and physical performance will be grater in more mature riders.

It is hypothesized that biological age is a good predictor of physical performance.

The objectives

Determine differences in selected anthropometric measurements and physical performance between the levels of biological maturation of a group of 15-16 year old riders.

Estimate the contribution of biological age on riders' physical performance.

1. Research Terms and Definitions

1.1. Road cycling

Road cycling requires of the cyclist an aerobic capacity for prolonged exertion and an anaerobic potential to be called upon in breakaways, hill climbing, and 'all-out' sprints. Road cycling is the hardest endurance sport. It includes several types of events, including stage races, one-day events, individual time trial and team time trial.

1.2. Anthropometry

Anthropometry is one of the most developed branches of morphology in comparison with methods such as radiography, ultrasound, histology, etc... It concerns the measurement and appreciation of the dimensional particularities and shape of a man.

1.3. Maturation

Maturation is the set of changes that a human being undergoes throughout childhood and adolescence, from conception to adulthood when he or she reaches maturity. Maturation varies according to the body system involved. Maturation should be studied according to two concepts which are : timing and tempo. Timing refers to the appearance of an event related to a specific maturation. Tempo refers to the speed of maturation progression. Emmanuel VANPRAAGH (2007, p, 02).

1.4. Anaerobic power

Anaerobic power is evaluated with different tests (Rachid MEDDAH, SACI, 2019; Chaker BOUNAB, 2014) in different disciplines (Abdellah BAFFA, 2019; Kaddour BRAHIMI and ZAOUI, 2014). Successful bicycle racing requires of the cyclist both speed and power. The cyclist needs a high anaerobic power for starts, acceleration, hill climbing, breakaways, sprints, and finishes. Therefore, some portion of the training schedule must address the short-term high-intensity cycling effort.

2. Previous and related studies

Study n°01: Abdelmalek Mohammed and others (2019)

Title : Biological age and chronological age: Evaluation of explosive strength of lower limbs in scholar girls of 12 to 15 years old

This study aimed to compare the effect of classification of pupils by chronological age and biological age at non-constant chronological age on the result of explosive strength measured by the standing long jump test and his rating. 542 scholar girls participated in this study. The biological age has been determined by WUTSCHERK's anthropometric method (Mohammed ABDELMALEK and others, 2006; Heinz WUTSCHERK, 1988). The results indicate that consideration of biological age at non-constant chronological age for the classification of pupils affects girl's performance.

Study n°02: Mohammed ABDELMALEK and others (2006)

Title:A study of WUTSCHERK's anthropometric method for evaluation of biological maturation level of soccer players (11-18 years)

The aim of this study is to check the validity of the WUTSCHERK method (H WUTSCHERK 1988) in determining the biological maturity age by the KEI index on soccer players. 49 subjects of chorological age from 11 to 18 years have participated in this study. The KEI is determined by measuring the weight, height, Biacromial, and bicretal breadth and the circumference of the forearm along with the calculation of the RHÖRER index. The bone age is assessed by X rays at the level of the left wrist and hand and by the use of the DE ROO AND SCHRÖDER Atlas (1977). The correlation between (AO_{L2-2L}) and AB_{KEI} is much higher (r=0,91) which shows that they would both evaluate the biological maturity. Nevertheless, the comparison of the averages of both ages demonstrates that AB_{KEI} is significantly higher (p<0,05) and overestimate therefore the biological maturity age. Meanwhile, there exist many regression models that can estimate biological maturity.

Study n° 3: Mahrez HAMMAMI and others (2019)

Title: Field tests of performance and their relationship to age and anthropometric parameters in adolescent handball players.

The aims of this study were, to determine differences in anthropometric characteristics and physical performance between adolescent handball players across age categories, and (ii) to determine which anthropometric and maturity variables have the greatest relative importance in fitness for this sport. Seventy-nine male handball players drawn from a team in the elite Tunisian Handball league [U18 (n = 10); U17 (n = 12); U16 (n = 17); U15 (n = 18); and U14 (n = 22)] volunteered for the investigation. Assessments included sprint performances; change in direction tests; jumping tests (squat jump; counter movement jump; countermovement jump with aimed arms; five-jump test); medicine ball throwing; handgrip force; back extensor force and selected anthropometric measurements. We conclude that U17 and U18 players show significantly better absolute results than the younger players on all physical tests. Multiple linear regressions, using block-wise entry, indicate that age is the strongest predictor of jump and sprint performances. Several anthropometric characteristics, including body mass, standing height and lower limb length were closely correlated with performance test scores, but after allowing for age only body mass added to the prediction of jumping ability.

3. Methodological procedures of the study

3.1. Research Methodology

We opted forthe descriptive method, which is adapted to the nature of the problem and the variables in our study.

3.2. Society and sample Study

Our study community is composed of well-trained cyclists, competing in the U17 category and belonging to specialized clubs affiliated to cycling leagues in Algeria. The study sample was selected in a deliberate manner. Within the context of the detection of young talents and the preparation of both, the African Youth Games 2022 (Maseru, Lesotho) and the youth Olympic games (Dakar, Senegal), a training camp was organized by the Algerian Cycling Federation at the Oum el Bouaghi youth center for the U17 category from the 1st to 10thAugust 2019. Thirty male riders (Age = 15,8±0,67 years, height = 173,25±6,36 cm, weight = 58,09±5,89 kg and previous training experience 4,07±2,24 years) participated in the study. Riders were sub-divided into three biological maturation groups, early maturing (n=8), average maturing (n=8), and late maturing (n=14). All measurements and assessments were performed. Riders' characteristics within the biological maturation groups are presented in table 1.

Table 1. Descriptive statistics (Mean (M) ± standard deviation (sd)) of riders groupedby biological maturation levels.

Variables	Late (n=14) M±sd	Average (n=8) M±sd	Early (n=8) M±sd
Chronological age (year)	15,76±0,68	15,62±0,64	16,06±0,66
Biological age (year)	13,88±1,10	15,82±0,41	17,81±1,03
Anthropometry(n=30)			
Height (cm)	169,03±5,33	174,76±3,11	179,11±5,25

Weight (kg)	54,88±5,52	57,90±4,12	63,89±3,29
Lower limb length (cm)	91,28±3,43	95,44±2,95	96,15±3,50
Fat mass(Kg)	5,58±0,96	5,69±0,8	6,35±0,38
Muscle mass (Kg)	23,27±2,62	25,34±1,84	28,60±2,02
Bone mass (Kg)	10,12±0,98	10,97±0,49	11,59±0,97
Physical performance			
Peak power output test (n=29)			**n=7**
Peak power (W)	933,64±126,05	1032,63±67,46	**1108,57±73,79**
Peak power (W/Kg)	17,01±1,61	17,86±0,91	**17,54±1,10**
Mean power 10'' (W)	677,50±106	783,75±56,68	**839,14±115,22**
Mean power 10'' (W/Kg)	12,35±1,57	13,57±1,12	**13,24±1,42**
Field tests (n=30)			
60 m (s)	8,09±0,63	7,84±0,48	7,68±0,40
200 m (s)	16,27±0,87	16,17±0,78	15,73±0,71
4 km (s)	474,35±42,45	456,96±17,02	455,30±22,34

3.3. Research Tools and Data Processing

3.3.1. Anthropometry

Before starting the anthropometric measurements, each rider had to fill in an investigation form containing a caption that made it possible to decipher its contents, indicating the surname, first name, date and place of birth, number of years of practice, and the number of training sessions per week. During the measurements, the rider kept a conventional position that was checked to ensure that it was respected. The rider must wear only clothing that does not interfere with observing. Measurements are done in pairs; one person takes the measurements, the other records the results. Measurements are done in pairs; one person takes the measurements, the other records the type. The instruments used during this anthropometric investigation are: The anthropometric suitcase of the G.P. type. M (SiberHegner), consisting of : an anthropometer of the

MARTIN (made up of 4 metal branches, graduated in centimeters, with a precision of 5 mm, a pair of graduated rulers on the right side and a pair of curved rods), to measure the height and to take the anthropometric points useful to calculate the different lengths. A thickness compass with olive tips, to measure body breadths). A tape measure, to measure body circumferences. A Harpendenskinfold caliper to take adipose panicles with an accuracy of $10g/mm^2$. In addition, a medical scale (SECA) to take the weight with an accuracy of ± 50 grams).

3.3.2. Muscle mass, according to the following formula : Muscle mass (MM) is the absoluteamount of muscle tissue (Kg), according to the following formula :

$$\mathbf{MM = L \times R^2 \times 6{,}5}$$

L : height in cm

R : $\frac{\text{circumferences (arm+forearm+thigh+calf)}}{2\times\pi\times4} - \frac{\text{skinfolds (arm+forearm+thigh+calf)}}{2\times4\times10}$

In the area of the arm, the skin fold is equal to the :

Skinfold (arm) = $\frac{\text{biceps skinfold+triceps skinfold}}{2}$

3.3.3. Fat mass, according to the following formula : Fat mass (FM) : amount of general and skin fat (Kg), according to the following formula : $\mathbf{FM = 1{,}3 \times D \times Surface}$

D : 1/2 $\times$ (Sub-scapular skinfold + pectoral skinfold + abdominal skinfold + biceps skinfold + triceps skinfold + forearm skinfold + hand skinfold)/7

Surface (IZAKSON formula (1958)) : Surface(m^2)= 100+W + (H-160)/100

W : weight in kg

H : height in cm

3.3.4. Bone mass, according to the following formula : Bone mass : the absolute mass of bone tissue in kg,according to the following formula : $\mathbf{BM = L \times O^2 \times 1{,}2}$

L: height in cm

O: $\frac{\text{diamètres (arm+ forearm+ thigh+calf)}}{4}$ (cm)

3.4. Biological maturation

Biological maturation groups were formed using the anthropometric method described by WUTSCHERK (Heinz WUTSCHERK, 1988) in determining the biological maturity age by the index of conformation of corporal development (KEI: KoperbauEntwicklungs indexes). Heinz WUTSCHERK (1988) found a high correlation between KEI and bone age (r=0,85). The same method was readjusted on Algerian subjects by Mohammed ABDELMALEK and others(2006), with a correlation between the biological age determined by the KEI index and the bone age of the 2nd reader on his second reading of a coefficient (r=0,914).

KEI Index

Body conformation and development index by Heinz WUTSCHERK (1988) : indicates biological age with an accuracy of about 85%.

- The following parameters should be considered for this method :

The weight (kg), height (cm), biacromial breadth (BAB) and bicretalbreadth (BCB) in cm. Circumferences in cm (bulky forearm for boys).

$$\textbf{RÖHRER Index} = \textbf{Weight}/10\textbf{x}\textbf{Height}^3$$

The RÖHRER index determines the circumference correction value.

Mean breadth =BAB+ BCB/2 (cm)

$$\textbf{KEI Index} = \frac{\text{2X Corrected arm circumferenceX mean breadth}}{\text{10X height}}\ (\textbf{cm}^2/\textbf{cm})$$

The biological age according to the KEI is determined either by a correspondence table or by a regression equation. The regression equation is expressed by the following formula (Mohammed ABDELMALEK and others, 2006): Biological age= 34,204x KEI -13,098 (years)

To judge a rider's level of biological development, biological age is compared to chronological age.

Conventionally: Biological maturation level is average (Chronological Age - Biological Age (-1 , +1 year);Biological maturation level is early (Chronological Age - Biological Age < -1 year;Biological maturation level is late (Chronological Age - Biological Age) > +1 year.

3.5. Physical performance

Physical performance was assessed using the following four tests:

3.5.1. Peak power output test

The subject uses his personal bike attached to an Elite Realaxiom electromagnetic home trainer to put him in situations similar to the field ones. The data is measured with a Power Tap G3 hub Power meter with an accuracy of 1,5%. The test begins with a 15-minute warm-up at a medium intensity. After 5 minutes of recovery, the cyclist performs two maximum 10 second sprints with braking force (simulation of a 7% gradient), with the same developments (6,84 meter), interspersed with at least 5 minutes of active recovery with low intensity. The data were recorded on a Garmin Fenix 3 watch and processed using Garmin connect software, Frédéric GRAPPE (2012, p, 120).

3.5.2. The 60 meters standing start test

It is a time trial with a standing start, involving an intensity of fewer than 10 seconds for the estimation of maximum anaerobic power. The test is carried out on a flat road of 60 meters, with a development of 6,53 meter. Materialize two lines on the ground (departure and arrival) 60 meters apart (visualize the arrival with 2 cones) and provide a deceleration zone. The rider is held in balance by the saddle. The rider starts when he feels ready, and sprints out of the saddle to the finish line. The performance is recorded in seconds. The rider is allowed two tries and the best is taken into account. According to Ilies LAROUI (2017), the test-retest reliability coefficient was positive where it reached (r = 0,924). The validity coefficient (r = 0,961).

3.5.3. The 200 meters flying start test

It is a test for estimating maximum anaerobic power. It is carried out on a flat road over a distance of 200 meter with a flying start. On a flat road of about 500 meters with no danger, a run-up and deceleration zone of 100 to 150m each is determined. Materializetwo lines on the ground (adhesive strips) 200 meters apart (visualize the line of the last 200 meters and the finish with cones). With the maximum permitted development (6,94 m), with his hands in the handlebars, the rider starts out of the saddle in the run-up zone to cross the last 200-meter line at maximum speed, sits on the saddle(approximately at the level of the last 200-meter line) and sprints out of the saddle to the finish line. The chronometer starts as soon as he passes the last 200-meter line. The performance is recorded in seconds and hundredths of a second. The rider is allowed two tries and the best is taken into account. According to Ilies LAROUI (2017), the test-retest reliability coefficient was positive where it reached (r = 0,926). The validity coefficient (r = 0,949).

3.5.4. The 4 km standing start

Maximal aerobic power represents the maximum power a cyclist is capable of developing over a 5-minute effort. Before the start, the rider performs a warm-up. The 4 km standing start is an individual time trial, which consists of achieving the best possible time on a flat road, with a round trip of 2 km, and with maximum development of 6,94. The start is taken from a standing position. Riders start at identical intervals of one minute. The rider goes around the roundabout and returns to the start line, which is also the finish line. The performance is recorded in minutes and seconds. According to Ilies LAROUI(2017), the test-retest reliability coefficient was positive where it reached (r = 0,902). The validity coefficient (r = 0,949).

3.6. Statistical methods

Descriptive statistics were means and standard deviations (M ± sd). Comparisons between biological maturation groups were performed using one-way analyses of variance (ANOVA) with Bonferroni's test for post hoc multiple comparisons. Simple linear regressions were employed to estimate the predictive power of biological age and interactions on each physical performance. Semi-partial squared correlations (spr^2) were used as measures of effect size and Standardized beta coefficients. All data analyses were performed using SPSS Statistics version 21.0 (IBM Corp., Armonk, NY, USA), and the significance level was set at 5%.

4. Exposure, Analyses and results exam

4.1. Comparative analysis of riders by level of biological maturation

Morphologically, riders with early biological maturation are taller ($p<0,001$, $\eta p^2 = 0,46$) and heavier ($p<0,001$, $\eta p^2 = 0,41$) than riders with average and late maturing. For lower limb length ($p<0,01$, $\eta p^2 = 0,34$), muscle mass ($p<0,01$, $\eta p^2 = 0,46$), and bone mass ($p<0,01$, $\eta p^2 = 0,36$), early maturing riders have larger than average and late maturing averages (Table 2). However, the difference was non-significant for fat mass ($p>0,05$) with slightly lower values for the late maturing. For the peak power output test, the early maturing had higher average peak power ($p<0,01$, $\eta p2 = 0,36$) and mean power ($p<0,01$, $\eta p2 = 0,36$) than the average and late maturing. However, the differences were non-significant (p>0,05) for relative values with a slight superiority in favor of average maturing. At the field tests, the early maturing riders perform better performers than the average and the late riders, the difference was non-significant for (p>0.05). The results of the simple linear regression model are shown in table 3. Within the physical performance model, approximately 8% to 47% of the total variance in four of seven was accounted for by biological age.

Table 2.Analytic statistics of riders grouped by biological maturation levels

Variables	F	η_p^2	Sig	Contrast		
				Early vs average	Early vs Late	Average vs Late
Chronological age (year)	0,899	0,06	Ns	ns	ns	Ns
Biological age (year)	44,32	0,77	p<0,001	p<0,001	p<0,001	p<0,001
Anthropometry (n=30)						
Height (cm)	11,62	0,46	p<0,001	ns	p<0,001	p<0,05
Body mass (kg)	9,44	0,41	p<0,001	p<0,05	p<0,001	Ns
Lower limb length (cm)	6,95	0,34	p<0,01	p<0,01	ns	p<0,05
Fat mass(Kg)	2,47	0,15	Ns	ns	ns	Ns
Muscle mass (Kg)	13,80	0,50	p<0,01	p<0,05	p<0,001	Ns
Bone mass (Kg)	7,52	0,36	p<0,01	ns	ns	Ns
Physical performance						
Peak power output test (n=29)						
Peak power (w)	7,31	0,36	p<0,01	ns	p<0,01	Ns
Peak power (w/kg)	1,09	0,08	Ns	ns	ns	Ns
Mean power 10'' (w)	7,22	0,36	p<0,01	ns	p<0,01	Ns
Mean power 10'' (w/kg)	2,15	0,14	Ns	ns	ns	Ns
Field tests (n=30)						
60 m (s)	1,53	0,10	Ns	Ns	ns	Ns
200 m (s)	1,20	0,08	Ns	Ns	ns	Ns
4 km (s)	1,16	0,08	Ns	Ns	ns	Ns

η_p^2= partial eta squared; sig = signification; ns= no significant p>0,05.

Biological age was a contributor to the variance in peak power (spr^2 = 47 %) and mean power 10" (spr^2 = 44 %)in absolute values. Then, for the sixty meter (spr^2 = 14 %) and the four kilometer (spr^2 = 31 %).

In addition, there was not a predictor of performance for the 200-meter, the peak power and the mean power in relative values.

Table 3. Simple linear regressions with biological age as performance predictor

Variables	F	Sig	Standardized beta coefficients	spr^2
Peak power output test (n=29)				
Peak power (W)	23,67	P<0,001	0,68	0,47
Peak power (W/Kg)	0,89	ns	0,18	0,32
Mean power 10" (W)	21,19	P<0,001	0,66	0,44
Mean power 10" (W/Kg)	2,41	ns	0,29	0,08
Field tests (n=30)				
60 m (s)	4,43	P<0,05	- 0,37	0,14
200 m (s)	3,30	ns	-0,32	0,10
4km (s)	12,72	P<0,001	-0,56	0,31

spr^2 =semi-partial squared correlation; sig = signification;ns= no significant p>0,05.

Our bivariate data showed (Table 3) substantial correlations between biological age and physiological performances. The peak power and mean power with absolute values correlated with biological age (with positive coefficients (p<0.001, r=0.68; p<0.001, r=0.66) respectively. Although, the peak power and mean power related to body mass were not related to biological age.

Concerning field tests, we noted correlations with a negative coefficients for 60 meters (p<0,05, r=-0,37) and 4 km (p<0,001, r=-0,56).

Discussion

The purpose of this study was to Determine differences in selected anthropometric measurements and physical performance between riders with different biological maturation levels. Also, estimate the contribution of biological age on riders' physical performance. This is the first study to investigate the effect of biological maturation on the physical performance of Algerian male cycling riders within the U17 category.

Our finding for the first aim of this study revealed that early maturing riders, are taller, and with higher body mass, i.e. muscle mass, in absolute values than average and late maturing. These results corroborate what has been reported by several authors (Pamela HAIBACH and others, 2011; Mohammed ABDELMALEK and others (2017).Early maturing cycling riders outperformed their late and average maturing peers in five physical performances (peak power and mean power in absolute values, 60 meters, 200 meters, and 4 km). this finding, (Mohammed ABDELMALEK and others, 2019; Mannuel J COELHO-e-SILVA, 2008; Belkacem KHIAT, MEHIDIOUI, 2015; Sasa JAKOVLJEVICand others, 2016;Thiago José LEONARDIandothers,2018) successfulness in this tests are conditioned by greater height, body mass, muscle and bone mass in absolute values, Pamela HAIBACH and others, 2011)

However, average maturing riders were slightly better than early and late maturing riders in peak power and mean power performance in relative values.This result is contradicted by the results of (Stanislas SZCZESNY,COUDERT, 1983) which confirm that late maturing has superiority in the relative values.

The early maturing riders have a bigger muscle mass and longer lower limb length than late and average maturing. That explains their superiority in peak power performance in absolute values. These results support the previous speculation that leg lengthens and muscle strength (Karim CHAMARI and others

2008; Ridha AOUADI and others, 2012) influencing explosive actions such as sprinting. Furthermore, the lower limb length is a real lever of strength on the pedals and on the other hand, muscle mass is a determining factor of strength, (Jürgen WEINECK, 2001, p, 89).

As a result of maturation, by increasing testosterone levels,this male hormone has a direct impact on the muscle mass(Emmanuel VAN PRAAGH, DORE, 2002).Sprint performance (Robert M MALINA, 2004; Roel VAEYENS and others, 2006),aerobic fitness (Robert M MALINA, 2004; Humberto Moreira CARVALHO, 2011),and anaerobic power of lower limb increase (Humberto Moreira CARVALHO, 2013; Thiago José LEONARDIand others, 2018; Mannuel J COELHO-e-SILVA and others, 2008), this is a consequence of the adaptation, which can be experienced by the adolescent, Rhodri S LLOYD and others (2014). This explains the effect of biological age on the performance, in 60 meters, 4 km, peak power and mean power in this study.

The relation of biological age with peak power and mean power with positive coefficients, shows that the more early maturing the athlete is, the more powerful he is, this could be explained by the fact that adolescents in this age group will experience growth spurts, where differences in maturation can have a particularly large impact on performance, Jurgen Weineck (2001).

Similarly, the present relationship between biological age with the two field tests namely the 60-meter test and the 4 km test is the result of a development that undergoes the body of the adolescent in this age category with an increase in height and weight, speed, resistance, agility and strength improve, Manuel J COELHO-e-SILVA and others (2010).In this sense, Robert M MALINA and others (2015), assert that early maturing athlete can be an advantage for adolescents athletes in a sport characterized by power, strength, and speed.

Conclusion

In the cycling, riders in the U17 category, present large variation in maturity. Results show that:

- Early maturing riders presenting greater body size,
- Early maturing presented greater physical performance than average and late maturing cycling riders.
- Looking at the presence of two ages in the studied category, the differences in biological age between riders with early and late biological maturity, have reached 4 years, and this reflects the difficulties that riders with late biological maturity find in the competition throughout the season.
- Significant relationships between biological age, peak power output test, and field test performances.

In light of the objectives of the study, the presentation and, discussion of its results, the researcher recommends the following:

- One of the proposed solutions to improve the chances of success for this group is to divide age categories by biological age (bio-banding), as in team sports.
- Trainers, must take the differences in biological age between ridersin dealing with this category, and not rush to make decisions that may cause the loss of riders who will have a chance in the near or distant future.
- Psychological and technical preparation, rather than physical, because the cyclist will have the full time to develop his physical abilities in the years to come.

- Coaches might regard physical and biological maturation as important components in the selection process.

It has already been mentioned that due to the small sample size of the research, the effect of the chronological age has not been taken into account. However, if there is a large sample, opening the way to study the differences that may be relative to biological maturity levels at the age of 15 and 16 years apart, it will be very interesting.

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