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Anaerobic performance in prepubertal girls practicing racing skating

Rendimiento anaeróbico en niñas prepúberes que practican patinaje de carreras

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Abstract
A high anaerobic demand in skating is a determining factor in the possibilities of success, however, it has been little studied in younger categories. the present study aimed to analyze the anaerobic performance in prepubertal girls who practice roller skating. through a random sampling, 44 girls between 7 and 10 years old, who practice roller speed skating in the Department of Sucre-Colombia, all with tanner stage 1 for sexual maturation, were evaluated. The RAST test adapted to pediatric population and the Abalakov bipodal jumps (ABK) and right unipodal jumps (RUJ) and left unipodal jumps (LuJ) measured by the myjump2 © application were applied. In the statistical analysis, the SPSS © version 25.0 program was used to perform the analysis of variance and the correlation between the power and height of jumps between ages. It can be observed that girls of 7 and 8 years old, present better power production in comparison with the other groups, differences p<.05 were found in the fatigue index between girls of 8 and 10 years old. Correlations p<.05 were found between absolute power (W) and relative power (W/kg) with ABK, RUJ and with LuJ. It is concluded that the

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improvement of the mechanical power produced in jumps increases the probabilities of improvement of the anaerobic power in the group of prepubertal girls evaluated who practice racing skating.

Keywords: sports performance; girls; skating; anaerobic resistance.

Resumen
Una alta demanda anaeróbica en el patinaje es un factor determinante en las posibilidades de éxito, sin embargo, ha sido poco estudiado en categorías menores. el presente estudio tuvo como objetivo analizar el rendimiento anaeróbico en niñas prepúberes que practican patinaje sobre ruedas. a través de un muestreo aleatorio, se evaluaron 44 niñas entre 7 y 10 años de edad, que practican patinaje de velocidad sobre ruedas en el departamento de Sucre-Colombia, todas con estadio tanner 1 de maduración sexual. Se aplicó el test RAST adaptado a población pediátrica y los saltos bipodales de Abalakov (ABK) y saltos unipodales derecho (RUJ) e izquierdo (LuJ) medidos por la aplicación myjump2 ©. En el análisis estadístico se utilizó el programa SPSS © versión 25.0 para realizar el análisis de varianza y la correlación entre la potencia y la altura de los saltos entre edades. Se puede observar que las niñas de 7 y 8 años, presentan mejor producción de potencia en comparación con los otros grupos, se encontraron diferencias $p<.05$ en el índice de fatiga entre las niñas de 8 y 10 años. Se encontraron correlaciones $p<.05$ entre la potencia absoluta (W) y la potencia relativa (W/kg) con ABK, RUJ y con LuJ. Se concluye que la mejora de la potencia mecánica producida en los saltos aumenta las probabilidades de mejora de la potencia anaeróbica en el grupo de niñas prepúberes evaluadas que practican patinaje de carreras

Palabras clave: rendimiento deportivo; niñas; patinaje; resistencia anaeróbica.

Introduction

Speed skating or racing skating is one of the eleven sports disciplines of the International Skating Federation. (World Skate 2019), currently has an important growth in the last decade, where its number of practitioners worldwide has been increasing (Lozada 2013; Egocheaga-Rodríguez et al. 2004). In this sense, speed skating or racing skating, from a functional point of view, is defined as an aerobic sport, where constant oxygen rhythms are required, as well as a high anaerobic demand, based on the need for explosion at a given moment during the execution of long and short distance competitions (Lozano Zapata, Villa Vicente, and Morante 2009; Marino 1998).

has been indicated that speed skating or inline skating is a sport of high intensities in terms of energy demand and a high level of complexity in terms of movement. (Piucco and Dantas de

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Lucas 2014). Other authors indicate that skating is an internationally recognized sport with a gradual increase in the number of practitioners, however, it is a little known sport from the physiological point of view being scarce the works that study it (Egocheaga-Rodríguez et al. 2004).

In this order of ideas, some studies are observed that guide the process of training control and explain the functional characteristics of the senior skater, by means of laboratory and field evaluations. (Giorgi, 1999; Krieg, Meyer, Clas, & Kindermann, 2006; R. E. Lozano, 2005; Lozano Zapata et al., 2009; van Ingen Schenau, de Groot, Hutter, de Boer, & Vos, 2004). In this regard, maximum oxygen uptake (VO2 max) has been compared using laboratory and field protocols between roller and ice speed skating in well-trained long-distance skaters with an average age of 32 years. (de Boer et al. 1987); other studies have compared the physiological response by monitoring absolute and relative VO2 max and heart rate using field protocols on inline skates and in the laboratory with treadmill running in active skaters between 16 and 37 years of age. (Wallick et al. 1995).

Furthermore, field tests have been applied to characterize the aerobic functional response to a laboratory test on a cycloergometer and another field test with skates, presenting incremental and intervallic characteristics and the effect of drafting during the race on skates of male athletes with an average age of 25 years old. (Krieg et al. 2006). In the Latin American context, we present the studies that addressed the physiological characteristics, specifically the VO2 max of the roller speed skater determined in a laboratory test and where 7 males and 3 females between 15 and 18 years of age were evaluated. (Lozano Zapata, Vlla Vicente, and Morante 2009).

Likewise, the validation of the intervallic test of resistance on skates (TIVRE Skate) to assess the aerobic capacity of the roller skater is presented, in a population of 28 men and 14 women with average ages of 18 and 17 years, respectively (E. Lozano, 2010). Similarly, in the Venezuelan context, they present the evaluation of skaters in the cadet category with an average age of 13 years, where they also validated a field test, with incremental characteristics called Barinas test, being this the only work reviewed that considers the study of skaters under 14 years of age (Lozada et al. 2013).

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With respect to the anaerobic power in speed skating, it has been little studied scientifically, despite the fact that it is a determining factor within the possibilities of sporting success in racing skating competitions, such is the case of the tests of the speed modality, like the individual time trial races where the maximum lactic anaerobic power is expressed, the group speed tests where power maintenance is required and for the long-distance modality where high intensity actions are eventually necessary executed for the accelerations that are required.

Some of the works obtained from the documentary research oriented to the control of anaerobic power will be reviewed below, highlighting that they correspond to high performance ages where the effects of a high intensity progressive training protocol on aerobic and anaerobic performance in male speed skaters were studied, performing 3000 meters test for aerobic capacity and 300 meters test for anaerobic capacity in 24 male athletes (Sheikh-Jafari, Aghaalinejad, and Piri 2014).

Additionally, a study of the longitudinal development of talented speed skaters and their anthropometric and physiological aspects was carried out, where the Wingate test was applied for the control of anaerobic power, evaluating 24 male skaters aged 16-17 years for the pretest and 20-21 years for the post-test (de Koning et al. 1994). Another study evaluated 15 high-level youth athletes, 7 women and 8 men, using the Wingate test, indicating that despite the usefulness of the assessment of these variables and their follow-up, they were not usually considered in the control for the programming of the training plan (van Schenau, de Koning, and de Groot 1994).

In view of the above, it is evident that there are few studies that support the analysis of anaerobic performance in the younger categories, where the training process becomes fundamental, and it is indicated that in the stage of 5 to 6 years and up to 12 to 13 years of age there is the basic training, the development of basic qualities of technique, speed, mobility and skills (Lugea 2010), it is also noted that between the ages of 7 to 10 or 11, is the golden age for the development of speed, having passed through its sensitive phase (Lunari 2002), where it is necessary to generate sufficient fundamentals to later achieve its integration with other more complex capabilities such as the power.

The study of physical responses requires an adequate data collection process where, in addition to respecting ethical aspects related to the age and condition of each subject, it is very important to respect the established protocols to ensure the reliability of the data. Especially in the evaluation of anaerobic performance, since during childhood and adolescence, direct measurements of the speed or capacity of the anaerobic pathways for energy production present several ethical and methodological difficulties (Van Praagh and Doré 2002).

Considering that there is less ability of children to generate mechanical energy from chemical energy sources during intense activity of short duration (Van Praagh and Doré 2002), Anaerobic capacity and power can affect sports performance and therefore the trainability of these attributes is of interest to coaches, athletes and sports scientists (Matos and Winsley 2013). However, there is no ideal assessment; therefore, it is important to recognize the limitations of each assessment. In addition, when assessing the trainability of speed and other short-duration activities, such as high jumps and countermovement, the development of neuromuscular coordination and motor skills should be considered.

It is common to observe in the daily practice of training the application of jump and acceleration speed tests to evaluate anaerobic performance in children skaters, however, there is little specialized bibliography on anaerobic evaluation for the younger categories, knowing that the studies conducted in children have been applied in populations aged 11 to 14 years, being oriented to the straight technique (García Londoño and Bolívar Moreno 2011), to anthropometric and body composition control (Contreras and Lozano Zapata 2009), to strength training (Torres 2013; Barrera and Ramirez 2007).

Based on the review of the statistics and results of the world championships, it is shown that the competitive level is widely dominated by Colombia, and internally the leagues of Valle, Bolivar, Antioquia, Bogota and Magdalena, present relevant results according to the medals of skating of the national games 2019, as well as the growing boom that has skating races in the department of Sucre in girls residents. Therefore, it is of vital importance to consider the importance of exploring the response of prepubertal subjects during anaerobic

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evaluations. Based on the above elements, the present study aims to analyze the anaerobic performance in prepubertal girls who practice racing skating.

Methodology

The study presents a quantitative approach in nature, with a descriptive correlational level, the design is field-based, therefore, the paradigm is positivist with an analytical empirical model, and the authors report there are no competing interests to declare.

Population and sample

The population comprises girls between 7 and 10 years old who practice roller speed skating, being a total of 120 according to the official records of the skating league of the Department of Sucre for the second semester of 2019. The sampling carried out was simple random probability sampling, applying the following formula for finite populations (Arias 2006):

$$n = \frac{N \times Z^2 c \ \times p \times q}{N \times e^2 + Z^2 c \ \times p \times q}$$

The legend data are as follows:

n = Sample size.

N= Total number of skater girls between 7 and 10 years old (120 cases).

Z2 c=Critical zeta: value determined by the confidence level adopted, in this case 90%, for a critical Z of 1.65.

e= Sampling error: failure that occurs when extracting the sample from the population. In this case 6%.

p= Proportion of elements that present a certain characteristic to be investigated, it is expected that 90% of the cases present prepubertal stage of maturation.

q= Proportion of elements that do not present the characteristic to be investigated, which is estimated to be no more than 10% of the cases that have surpassed the prepuber stage of maturation.

In this way, a sample of 44 girls who practice roller speed skating in the Department of Sucre, municipality of Sincelejo, was obtained.

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Procedure

The procedure began with the authorization of the parents and the clubs to allow the cross-sectional intervention in order to collect information related to general morpho-functional performance, including anaerobic performance, Similarly, parents were asked to characterize the degree of sexual maturation of the girls, indicating whether there was any pubertal sprouting, which should coincide with stage 1 of the self-assessment images suggested by Tanner to characterize sexual maturation. (Vermont Department of Health 1999) in case of coincidence with stage 2 or higher, the girl was ruled out to continue in the study since she had started the pubertal phase and therefore had already started her adolescence stage (Faigenbaum 2001).

The RAST test was used to collect the data (Zacharogiannis, Paradisis, and Tziortzis 2004), and Abalakov's bipodal jumps (ABK) and right (RUJ) and left (LuJ) unipodal jumps. Prior to the execution, a morphofunctional conditioning adjusted to the energetic requirements of the tests was carried out, with the purpose of adequately preparing the organism, performing all the tests on the same day, starting with the collection of anthropometric variables, followed by the jumps and ending with the RAST test. Likewise, information was provided and the adequate execution of each test was sufficiently demonstrated in order to avoid biases due to malpractice, also requesting the maximum effort in each performer.

Protocols applied

RAST test

The RAST test adapted to the pediatric population was applied. (Bongers et al. 2015a), which consists of completing 6 sprints or maximum speed runs in a 15-meter course, considering 10 seconds of rest or micro pause between each sprint. For the first sprint, a countdown "ready, 3, 2, 1, go" was performed, while for the next 5 sprints, the countdown from the second 6 to 1 was performed before starting with the signal "go". The power is expressed in watts (W) by applying the following formula for each sprint:

$$Power\ (W) = \frac{body\ mass\ (kg) \times\ distance\ (mts)^2}{sprint\ time\ (s)^3}$$

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Vertical jump

For the evaluation of the vertical jump, the abalakov test (ABK) or free jump was applied (Garrido 1974) performing in a bipodal and unipodal way for each leg, executing the unipodal jump with right foot (RUJ) and left foot (LuJ), measured using the myjump2 © application (Balsalobre-Fernández, Glaister, and Lockey 2015). It consists of reaching the maximum possible height with the participation of the upper limbs, serving as balance, impulse and generating coordination contribution, in order to obtain the best possible result. It should be noted that this type of jumps is recommended for the control of children skaters (Lozada-Medina 2018; Zenga, Lollobrigida, and Giorgi 2017).

Data analysis

SPSS version 25.0 was used for the statistical analysis, describing the data by age groups, comparing means for the values of power and height of jumps by means of an analysis of variance.

Results

First, the Shapiro Wilk nonparametric test was performed to verify the normality of the data, finding evidence of normality ($p>0.05$) for the variables in each age group. Subsequently, the description of the data by age group is presented, and in all cases, the comparison of means for the values of the power and height of the jumps was carried out by means of ANOVA.

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Table 1 shows how body mass (kg) and height (cm) increase as the group gets older.

Table 1

Descriptive statistics of the basic variables of the skater girls by age groups

Variables	Age Group	N Valid	N Missing	Mean	Standard Deviation	Minimum	Maximum
Age (years)	7	13	0	7,4	0,4	6,9	7,9
	8	12	0	8,6	0,3	8,0	9,0
	9	11	0	9,4	0,3	9,1	9,8
	10	8	0	10,5	0,4	10,0	10,9
	All	44	0	8,8	1,2	6,9	10,9
Body Mass (kg)	7	13	0	24,3	3,8	20,1	32,6
	8	12	0	27,8	9,4	19,2	46,4
	9	11	0	30,4	3,5	25,6	37,2
	10	8	0	34,7	3,5	30,4	41,3
	All	44	0	28,7	6,7	19,2	46,4
Height (cm)	7	13	0	121,2	5,3	110,0	131,1
	8	12	0	127,5	8,8	107,0	138,0
	9	11	0	133,2	4,4	126,0	140,0
	10	8	0	140,9	5,5	133,0	151,0
	All	44	0	129,5	9,3	107,0	151,0

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Table 2 shows that 10-year-old girls have higher values in all jumps, and that the left foot jump has a higher value than the right foot jump in all age groups except for the 8-year-old group.

Table 2

Descriptive statistics of Abalakov jump variables and free unipodals jumps by age group.

Variables	Age Group	N Valid	N Missing	Mean	Standard Deviation	Minimum	Maximum
Abalakov Jump (cm)	7	13,0	0,0	19,7	4,7	9,9	26,9
	8	12,0	0,0	20,0	4,5	14,7	27,8
	9	11,0	0,0	23,0	4,5	15,7	29,1
	10	8,0	0,0	23,2	3,0	17,7	26,9
	All	44,0	0,0	21,2	4,5	9,9	29,1
Unipodal jump Right (cm)	7	13,0	0,0	10,6	3,0	5,7	15,5
	8	12,0	0,0	11,1	3,3	6,0	17,5
	9	11,0	0,0	11,7	3,6	4,6	16,1
	10	8,0	0,0	12,0	3,0	7,9	16,9
	All	44,0	0,0	11,2	3,2	4,6	17,5
Unipodal jump Left (cm)	7	13,0	0,0	10,8	3,8	4,4	18,8
	8	12,0	0,0	9,8	3,1	4,8	14,8
	9	11,0	0,0	11,8	3,3	4,6	15,5
	10	8,0	0,0	13,3	4,0	7,9	17,8
	All	44,0	0,0	11,3	3,6	4,4	18,8

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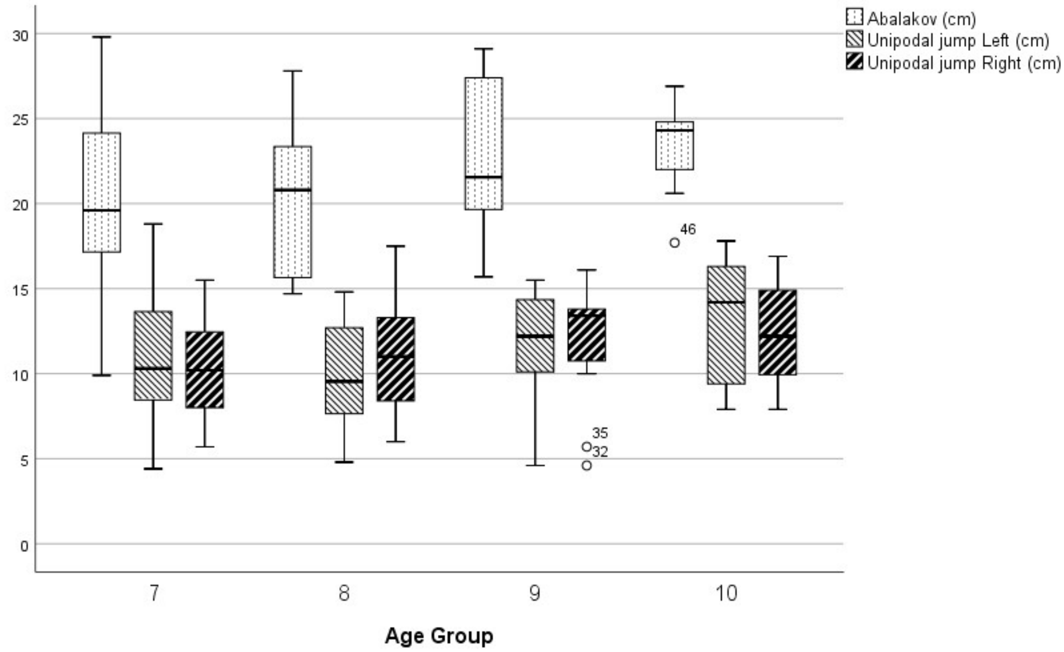

Figure 1. Median, extreme values and confidence zone (Q1-Q3) of jumps performed by age group.

A comparison of the jump data (Figure 1) clearly shows a greater homogeneity in jumping with the right foot, while the average values for jumping with the left foot show a tendency to increase in the older age groups, as well as for jumping with the feet together.

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Table 3 shows that 7-year-old girls have higher values of relative power than the other groups, however, this same group has a higher % of fatigue than the other age groups.

Table 3

Descriptive statistics for relative power and fatigue index obtained by the RAST test

Variables	Age Group	N Valid	N Missing	Mean	Standard Deviation	Minimum	Maximum
Max. power Rel (W/kg)	7	13,0	0,0	3,4	1,3	1,3	6,1
	8	12,0	0,0	3,1	1,3	1,0	5,2
	9	11,0	0,0	2,9	0,8	1,6	4,2
	10	8,0	0,0	3,2	1,4	1,8	5,8
	All	44,0	0,0	3,1	1,2	1,0	6,1
Power min Rel (W/kg)	7	13,0	0,0	2,1	0,8	0,7	3,6
	8	12,0	0,0	2,2	1,1	0,5	4,0
	9	11,0	0,0	1,9	0,5	1,1	2,6
	10	8,0	0,0	2,0	0,9	0,9	3,5
	All	44,0	0,0	2,0	0,8	0,5	4,0
Average Power Rel (W/kg)	7	13,0	0,0	2,6	1,0	1,0	4,4
	8	12,0	0,0	2,6	1,2	0,7	4,5
	9	11,0	0,0	2,4	0,6	1,4	3,3
	10	8,0	0,0	2,6	1,1	1,3	4,4
	All	44,0	0,0	2,5	1,0	0,7	4,5
Fatigue Index (W/kg)	7	13,0	0,0	0,7	0,4	0,0	1,5
	8	12,0	0,0	0,5	0,2	0,2	0,7
	9	11,0	0,0	0,7	0,3	0,2	1,0
	10	8,0	0,0	1,0	0,5	0,5	1,9
	All	44,0	0,0	0,7	0,4	0,0	1,9
Fatigue Index (%)	7	13,0	0,0	9,8	4,4	1,3	17,6
	8	12,0	0,0	7,8	4,4	4,4	19,4
	9	11,0	0,0	7,3	2,5	3,7	11,2
	10	8,0	0,0	8,5	3,4	4,6	13,6
	All	44,0	0,0	8,4	3,9	1,3	19,4

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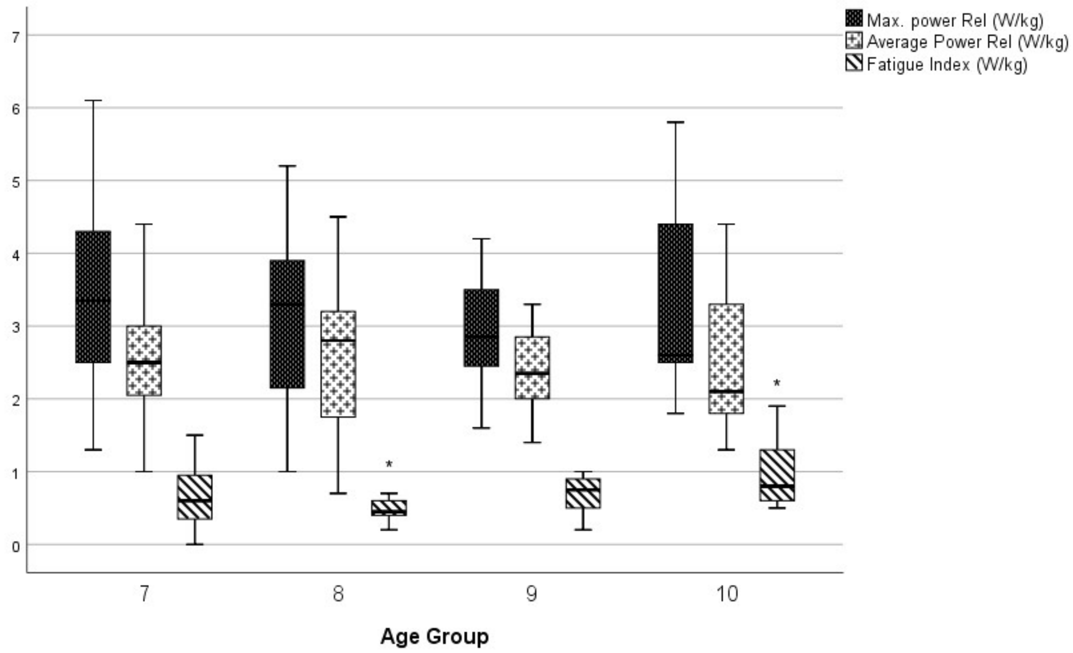

Figure 2: Median, extreme values and confidence zone (Q1-Q3) of maximum relative power, average and fatigue index.

Absolute power presented higher values for the older age group (10 years old) for maximum, minimum and average power (see Table 4). In figure 2 can be observed that the girls of the 7- and 8-years old group, present better power production compared to the other groups, the best average power is observed in the 8 years old group and the lowest fatigue index is observed in the 8 years old group and the highest index in the 10 years old group. Shows how the fatigue index is lower in subjects aged 7 and 8 years, compared to the groups of 9 and 10 years, it is also observed that the mean of the group of 8 years does not coincide with the confidence zone of the group of 10 years being that difference significant (table 6).

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Table 4

Descriptive statistics for absolute fatigue power obtained by the RAST test.

Variables	Age Group	N Valid	N Missing	Mean	Standard Deviation	Minimum	Maximum
Max power (W)	7	13,0	0,0	80,0	30,2	42,2	137,2
	8	12,0	0,0	76,0	21,3	45,3	123,8
	9	11,0	0,0	86,8	20,1	45,0	111,5
	10	8,0	0,0	107,3	37,5	76,2	175,3
	All	44,0	0,0	85,6	28,6	42,2	175,3
Power min (W)	7	13,0	0,0	49,7	17,0	22,2	77,8
	8	12,0	0,0	52,4	22,1	20,8	100,8
	9	11,0	0,0	55,5	12,3	32,5	68,9
	10	8,0	0,0	67,4	24,1	39,0	107,0
	All	44,0	0,0	55,1	19,4	20,8	107,0
Average Power (W)	7	13,0	0,0	60,8	20,3	31,3	99,7
	8	12,0	0,0	62,8	20,7	33,7	108,1
	9	11,0	0,0	71,5	15,7	40,8	89,1
	10	8,0	0,0	86,5	31,4	54,3	132,9
	All	44,0	0,0	68,7	23,1	31,3	132,9

Table 5 shows the comparisons of the variance of each variable between the age groups, only the fatigue index of relative power (W/kg) presents significant differences ($p<0.05$), to verify between which groups the difference is presented a posthoc analysis is performed (Table 6), where it is evident that there are significant differences ($p<0.05$) between the groups of 8 and 10 years of age.

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Table 5

Analysis of Variance for power and jumping variables between age groups for prepubertal female skaters

Variables	Comparison	Sum of squares	lg	Sum of squares	F	Sig.
Max power (W)	Between groups	5308,16	3	1769,4	2,371	0,085
Min Power (W)	Between groups	1678,10	3	559,4	1,551	0,216
Average power (W)	Between groups	3835,12	3	1278,4	2,689	0,059
Power max Rel (W/kg)	Between groups	1,27	3	0,4	0,282	0,838
Power min Rel (W/kg)	Between groups	0,61	3	0,2	0,273	0,844
Average power Rel (W/kg)	Between groups	0,27	3	0,1	0,089	0,965
Fatigue Index (W/kg)	Between groups	1,13	3	0,4	3,101	**0,037***
Fatigue Index (%)	Between groups	44,91	3	15,0	1,005	0,401
Abalakov (cm)	Between groups	114,24	3	38,1	2,009	0,128
Unipodal jump Right (cm)	Between groups	12,80	3	4,3	0,403	0,752
Left unipodal jump (cm)	Between groups	63,76	3	21,3	1,703	0,182

* significance at p<0,05

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Table 6

Post hoc test for comparison of means of fatigue index (W/kg) between age groups

Dependent variable				Mean difference (I-J)	Standard error	Sig.	95% Confidence interval	
							Lower limit	Upper limit
Fatigue Index (W/kg)	HSD Tukey	7	8	0,16	0,14	0,654	-0,21	0,54
			9	-0,04	0,14	0,994	-0,42	0,35
			10	-0,32	0,16	0,188	-0,74	0,10
		8	7	-0,16	0,14	0,654	-0,54	0,21
			9	-0,20	0,15	0,526	-0,59	0,19
			10	-,4833*	0,16	***0,021**	-0,91	-0,06
		9	7	0,04	0,14	0,994	-0,35	0,42
			8	0,20	0,15	0,526	-0,19	0,59
			10	-0,28	0,16	0,311	-0,72	0,15
		10	7	0,32	0,16	0,188	-0,10	0,74
			8	,4833*	0,16	***0,021**	0,06	0,91
			9	0,28	0,16	0,311	-0,15	0,72

* significance at p<0,05

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Table 7

Bivariate correlations for the anaerobic variables for the girl skaters

Variables	Statistical	Power Min (W)	Average power (W)	Max Rel (w / kg)	Power Min Rel (w / kg)	Average power (w / kg)	Fatigue Index (w / kg)	Fatigue Index (%)	Abalakov (cm)	Right unipodal jump (cm)	Left unipodal jump (cm)
Max (W) power	Pearson correlation	,911**	,964**	,834**	,708**	,785**	,894**	0,087	,659**	,725**	,711**
	Sig. (bilateral)	0,000	0,000	0,000	0,000	0,000	0,000	0,575	0,000	0,000	0,000
Power Min (W)	Pearson correlation		,967**	,836**	,855**	,868**	,637**	-0,273	,617**	,713**	,667**
	Sig. (bilateral)		0,000	0,000	0,000	0,000	0,000	0,073	0,000	0,000	0,000
Average power (W)	Pearson correlation			,814**	,767**	,829**	,772**	-0,166	,654**	,738**	,719**
	Sig. (bilateral)			0,000	0,000	0,000	0,000	0,282	0,000	0,000	0,000
Max Rel (w / kg)	Pearson correlation				,936**	,970**	,662**	-0,045	,477**	,645**	,574**
	Sig. (bilateral)				0,000	0,000	0,000	0,770	0,001	0,000	0,000
Power Min Rel (w / kg)	Pearson correlation					,979**	,412**	-,327*	,398**	,592**	,496**
	Sig. (bilateral)					0,000	0,005	0,030	0,007	0,000	0,001
Average power (w / kg)	Pearson correlation						,543**	-0,260	,450**	,638**	,562**
	Sig. (bilateral)						0,000	0,088	0,002	0,000	0,000
Fatigue Index (w / kg)	Pearson correlation							,417**	,559**	,562**	,610**
	Sig. (bilateral)							0,005	0,000	0,000	0,000
Fatigue Index (%)	Pearson correlation								0,012	-0,048	-0,062
	Sig. (bilateral)								0,937	0,759	0,689
Abalakov (cm)	Pearson correlation									,745**	,698**
	Sig. (bilateral)									0,000	0,000

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Table 7

Bivariate correlations for the anaerobic variables for the girl skaters

Right unipodal jump (cm)	Pearson correlation	**,786****
	Sig. (bilateral)	0,000

** The correlation is significant at level 0.01 (bilateral).

*. The correlation is significant at level 0.05 (bilateral).

The figures below show the dispersion of the data and the line of adjustment for the correlation, as well as the coefficient of determination for the bivariate correlations, in this sense we have that in figure 4 the absolute power and the abalakov jump present a determination of 44% (R^2=,441), the absolute power and the unipodal jump with the right foot is determined in 54% (R^2=535) (see figure 5), when corroborating the coefficient of determination with respect to the unipodal jump with the left foot (see figure 6) it is located in 50% (R^2=0.502).

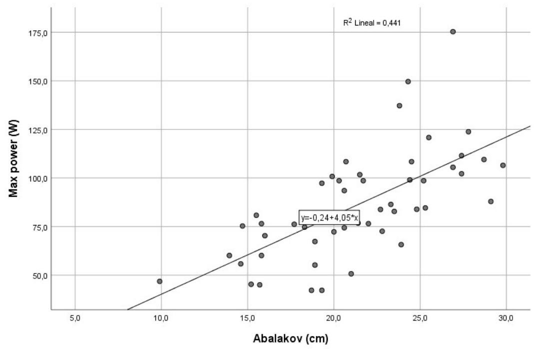

Figure 3: Coefficient of determination between absolute maximum power and Abalakov jump

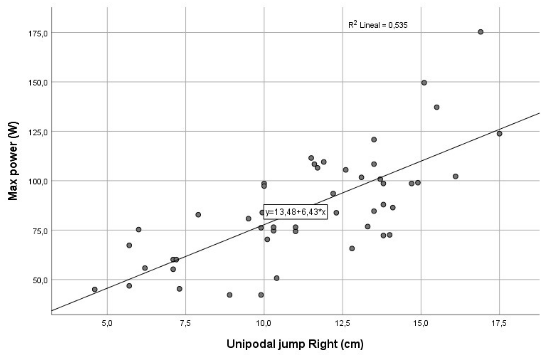

Figure 4: Coefficient of determination between absolute maximum power and unipodal jump of the right foot.

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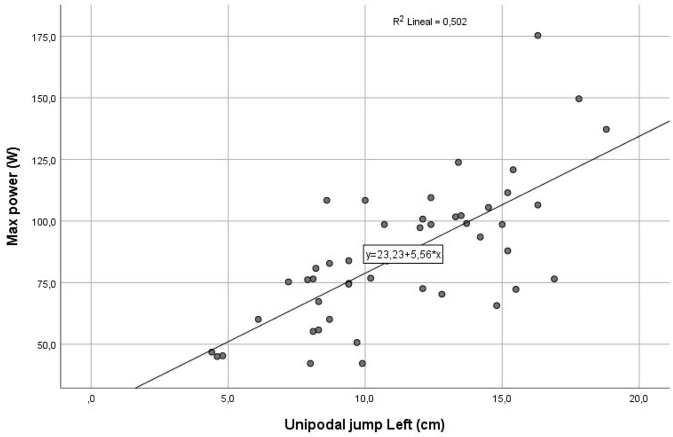

Figure 5: Coefficient of determination between absolute maximum power and left foot unipodal jump.

Discussion

The objective of this study was to analyze the anaerobic performance in prepubertal girls who practice racing skating, finding that the performance for absolute power is higher in the older age groups, however, no evidence of significant differences between ages was found (p>0.05). Regarding the relative power, it is internally observed that the group of 7 years old presents better performance in the maximum relative power, however, no significant differences are evidenced between the different age groups for the maximum, minimum or average power (p>0.05), being only the fatigue index (W/kg) different between groups, being observed in the post hoc analysis that only the groups 8 with respect to 10 years old present significant differences (p<0.05) for these variables.

When comparing with groups of children of similar age, they show a low performance (3.4 W/kg) in relative peak power compared to prepubertal 8-year-old children who obtained 7.8 W/kg. (Birat et al. 2018). When comparing the result of the skater girls with girls of 9.9 average age evaluated by the same test, the group under study shows an inferior performance for the relative peak power 2.3W/kg less and 2.7 W/kg less for the average power (Bongers et al. 2015b).

With regard to the jumps, although the average abalakov jump is higher in the 10-year-old group, the maximum values are observed in the 9-year-old group, without these

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differences being significant (p>0.05). When comparing the values with studies of children where the abalakov jump was evaluated, it was found that children with an average of 10.3 years of age and practicing swimming and baseball reached 21.8 cm (Gamardo 2017), values similar to those of girls aged 7 to 9 years, lower than those presented in the 10-year-old group, which corresponds to studies indicating that differences in physical performance between boys and girls do not represent an advantage for one or the other sex from a biological point of view (Losada 2008).

Regarding the unipodal jump, it can be observed that the 10-year-old group presents higher values than the right foot, which can be justified in the training time that probably has accumulated with age, considering that the left foot usually supports the body weight in dynamic proprioception at the moment of executing the curve, being that it turns to the left. However, these differences between both feet do not show evidence of significant differences (p>0.05).

The previous analysis contradicts some scientific positions that indicate a linear increase in strength with age (Lloyd et al. 2012, 27; Branta, Haubenstricker, and Seefeltdt 1984), although in the present study an increase in anaerobic and mechanical power is observed through jumps, these differences do not present sufficient statistical evidence, which may have its origin in the development of the necessary coordinative input for the execution of the jumps performed, also considering that due to the non-linear development of physiological processes such as stature and body mass during childhood and adolescence, the assessment and monitoring of muscle strength can be a difficult task during the growing years (Lloyd et al. 2014, 499; Ford et al. 2011).

In view of this, it can be anticipated that a longitudinal follow-up of the population, in addition to an adequate follow-up by appropriately qualified personnel, being that the initial positive experiences in physical education and sport have been associated with physical activity throughout life (Lloyd et al. 2012). In addition, the ontogenetic process can also positively affect performance at certain times of growth that are considered critical periods (Viru et al. 1999).

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In consideration of the results and the analysis performed, correlation analyses were carried out between the power values obtained through the RAST test with the height of the highs, evidencing the significant relationship (p<0.01). between the pairs of variables: absolute maximum power (PMA)- Abalakov (ABK) r=.659; PMA- Right unipodal jump (RUJ) r=.725; PMA- Left unipodal jump (LuJ) r=.711; relative maximum power (PMR)-ABK r=.477; PMR- RUJ r=.645; PMR-LuJ r=.574; Absolute average power (PPA)-ABK r=.654; PPA-RUJ r=.738; PPA-LuJ r=.719; Relative average power (PPR)-ABK r=.450; PPR-RUJ r=.638; PPR-LuJ r=.496; and fatigue index (FI)-ABK r=.559; FI-RUJ r=.562 FI-LuJ r=.610; which indicates the possibility that by means of bipodal and unipodal jumps the mechanical power produced by prepubertal girls can be estimated and thus obtain control parameters within the reach of coaches. In consideration of the coordinative contribution of the ABK jump and the unipodal jumps, as well as the high correlation with the power production and the coefficient of determination that is evident in the study group, it is argued that by improving the development of the coordinative capacities there is a high probability of improving the performance in terms of the height of the jumps and consequently in the production of power during the race, which eventually has a positive impact on the special sports performance.

Conclusions

In view of the results found, it can be concluded that in the group studied, the production of absolute power is determined by 44% of the height reached in the bipodal jump with coordination contribution and 54% and 50% of the contribution of the unipodal jump with the right and left leg, respectively. While the maximum power relative to the body mass is determined in 22% by the contribution of the bipodal jump with arms, and in 42% by the jump with the right leg and 33% with the left leg, therefore, the improvement of the mechanical power produced in the jumps increases the probabilities of improvement of the anaerobic power in prepubertal girls who practice racing skating.

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Prospective of the study

In consideration of the need to deepen the study and interpretation of training in preadolescent or prepubertal children, it is recommended to perform longitudinal studies; in consideration of the results of the present work, it is recommended to consider evaluations of coordination, general dynamics and considering the coordination of the upper segments (arms, forearms and hands) and lower segments (thigh, leg and foot) separately.

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