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INVESTIGATING THE BIO-MOTOR AND MENTAL LEVEL OF JUNIORS AT THE STAGE OF SPECIALIZED TRAINING IN SPRINTING-HURDLING-JUMPING EVENTS

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Abstract: *Sports selection must be seen as a continuous process, correlated and directed towards a certain specialization of the child* [1]*. In our methodological research we investigated the bio-motor and mental level of Romanian juniors aged 15 in order to evaluate the level of compliance of their anthropometric, psychomotor and psychological parameters with the performance requirements of the sprinting-hurdling-jumping events. We found an early specialization, the inconsistency of some anthropometric parameters (e.g. height) with the structural models of the events, as well as the need to improve self-confidence and to manage psychological and physical anxiety.*

Key words: *sports performance, specialization, selection, athletics.*

1. Introduction

The identification of people capable of performance of any nature (artistic, intellectual, entrepreneurial, sports etc.) is a mandatory function of today's society. In sports, selection - *the engine of performance* [8] must be seen as a continuous process, correlated and directed towards a certain specialization of the child and junior [1]. The great challenge of selection lies in the long-term forecasting character by identifying those children and young people who present certain anthropometric, motor and psychological characteristics that will ensure them the success after a decade. Athletics has a huge symbolic value, that of the search for human limits [2]. The athlete performs natural movements all in battle with time or space. Running, jumping and throwing skills are highly dependent on individual physical abilities, which are genetically conditioned and honed over a lifetime through training [4]. Specialists explain the impossibility of clearly identifying abilities at a certain stage of development by the complex nature of the relationship between hereditary factors, which manifest as potential, and factors acquired through specific training. A very high potential, based on natural aptitude, is essential for selection, but true abilities can be

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revealed during the process of education and training, being the result of a complex dialectical unity of natural endowment and biological and social acquisition [13]. Predispositions represent a complex set of individual properties (biophysical, psychological and personality) that do not manifest simultaneously in a certain period, but rather in different stages, depending on age and the type of training [15]. For these reasons, the identification of individual predispositions for a certain sport must be implemented as a repeated process in multiple stages.

Although most of the selection approaches in athletics are based on the results obtained in competitions, numerous longitudinal studies on the evolution of elite athletes demonstrate that sports success at the senior level is not conditioned by sports success at the junior level and it is not conditioned by an early specialization either [6].

The age of interest for the present study (15 years) corresponds to the secondary selection, the true selection for sports performance [8]. At this level, the selection intends to create the biological micromodel of the athletic event performer [8]. In order to have an objective secondary selection, collaboration between the coach and the sports doctor is recommended [4].

Numerous researchers have tried to identify the key variables useful for the right specialization of athletes; some of them highlight the ability to produce force quickly, the ability to move body segments quickly and the somatic type [14]; others focus on the main affective and emotional characteristics like ability to concentrate, to pay attention, ambition, mental strength and the ability to manage stress, to overcome failure [5], [7]. Another factor with influence over the secondary selection of the athletes is the national competitive system. Some of the most effective ones in the world allow the participation of children and youth only in combined events, postponing the moment of specialization, allowing the formation of various skills and also the right identification of the somatic type and the skills possessed [14].

2. Material and Methods

In the course of this research, we used the documentary method, the observation, methods of evaluation and assessment and statistical-mathematical method. In order to achieve the purpose of this research, we developed an evaluation protocol based on anthropometric measurements, motor tests and psychological assessment. We used the statistical-mathematical method in order to analyze and interpret the quantitative data. The following statistical indicators were calculated: arithmetic mean ($\overline{X}$), standard deviation (SD), median (Me), coefficient of variability (CV), level of error (NE 95%) and confidence interval (CI).

The subjects were 25 athletes (15 girls and 10 boys) born in 2007 (U18 category) who competed in sprints-hurdles-jumps in 2022. All participants reported a frequency of 3-4 trainings per week and an average experience of 7.8 ± 1.87 years in athletic training. Parents gave their written consent before allowing the subjects into the research, in accordance with the Helsinki Declaration. Subjects were also informed of the right to withdraw at any stage of the research. Our study received the approval of the sports clubs through the coaches.

3. Results

3.1. Subjects' characteristics regarding age of onset and age of specialization by gender

In order to achieve an overview of the experience of the subjects, they were also investigated regarding the age of onset and the age of specialization in athletic events. The average age of athletics onset is 8.33 years for the girls and 7.80 years for the boys. Analyzing the values of the median (Me), that indicator of the central tendency that represents the middle value in a series, we obtain the median age of onset in athletics of 8 years for boys and 9 years for girls. As for the coefficient of variation (CV), the most reliable indicator of the dispersion of a statistical series, it is accepted that the series has a high degree of homogeneity if CV<35% and if CV>70-75% it is stated that the variation is very large, the mean is not significant and hides a heterogeneous structure of the series. The value of 23% of the coefficient of variation calculated for the age of onset in athletics is less than 35%, which reflects individual values concentrated around the mean both in the case of the boys and the girls (18% in boys and 25% in girls). It can be stated with a probability of 95% that the average age of onset falls within the range of 6.93 - 8.67 years for boys and 7.27 - 9.39 years for girls.

Early specialization is also observed, with values of 12.73 years among girls and 11.00 years among boys. The median age of specialization is 11 years for boys and 13 years for girls. As CV<35%, it follows that the analyzed series has a high degree of homogeneity and the central tendency indicators are representative (CV for boys is 14% and for girls 15%). It can be stated with a probability of 95% that the average age of specialization falls within the range of 10.03 - 11.97 years for boys and 11.79 - 13.68 for girls.

3.2. The level of physical development of the subjects by gender

The main investigated parameter was the height, to which all other anthropometric measurements can be related. An obviously higher average height is observed among boys (Table 1) compared to girls (Table 2), 180.90 cm and 167.30 cm, respectively. The confidence interval for the series of values for height among boys is between 176.49 cm and 185.31 cm and between 164.70 cm and 169.90 cm among girls.

Antropometric characteristics among boys Table 1

	Boys (n=10)					
CRITERIA [cm]	$\overline{X}$	**SD**	**Me**	**CV**	**NE 95%**	**CI**
Height	180.9	7.11	180.00	4%	4.41	(176.49, 185.31)
Torso	92.48	5.15	90.50	6%	3.19	(89.29, 95.67)
Lean body mass [kg]	65.32	8.36	63.00	13%	5.18	(60.14, 70.50)
Lower limb lenght	88.42	3.40	88.60	4%	2.11	(86.31, 90.53)
Biacromial diameter	36.10	2.04	36.25	6%	1.26	(34.84, 37.36)
Bitrochanteric diameter	33.55	1.50	33.75	4%	0.93	(32.62,34.48)

We compared these recorded data with scientific ones proved at international level. I consulted the article *A century of trends in adult human height*, produced by the NCD Risk Factor Collaboration [12], an article that presents a study of height by countries and the evolution of this parameter in the last 100 years. This study shows that the average height of Romanian men (174.7 cm) places them in third last place in the European ranking, ahead of the Turks (174.2 cm) and the Portuguese (172.9 cm). Therefore, the average height recorded among the boys participating in the research (180.90 cm) is above the national average, with the mention that they can still grow in height considering their current age (15 years).

Antropometric characteristics among girls Table 2

CRITERIA [cm]	**Girls (n=15)**					
	$\overline{X}$	**SD**	**Me**	**CV**	**NE 95%**	**CI**
Height	167.30	5.14	167.00	3%	2.60	(164.70, 169.90)
Torso	88.40	3.36	88.00	4%	1.70	(86.70, 90.10)
Lean body mass [kg]	54.05	6.87	53.00	13%	3.48	(50.58, 57.53)
Lower limb lenght	78.90	3.52	79.00	4%	1.78	(77.1, 80.68)2
Biacromial diameter	32.23	1.37	32.00	4%	0.70	(31.54, 32.93)
Bitrochanteric diameter	30.90	1.70	31.00	6%	0.86	(30.04, 31.76)

According to the same study, Romanian women are placed in second last place (162.7 cm), in front of Turkish women (160.5 cm). The average height recorded among girls (167.30 cm) is also above the average of the female population in Romania, but with little chance of further progress (girls mature two years earlier than boys and reach their maximum height around the age of 14.

The average body mass recorded for the entire sample is 58.56 kg, with an average of 65.32 kg for boys and 54.05 kg for girls. Reporting these values to the average height we obtain a normal body mass index (BMI). The average number of kilograms deposited annually varies in adolescents between 6-12 kg in boys and 5.5-10.5 kilograms in girls, with an increasing trend of the accumulation of adipose tissue and active mass. Muscle mass increases during adolescence in both boys and girls. Muscle hypertrophy is greater in boys due to high testosterone secretion), directly proportional to muscle strength. Gender differences in the amount of muscle mass and muscle fiber size are noted around the age of 16. If between 7 and 13.5 years the average annual growth of muscle mass in boys is 0.6%, in the next two years it reaches 29% due to the secretion of creatine [17].

The average value of the torso lenght among boys is 92.48 cm and among girls 88.40 cm. The torso length represents 52% of a man's height and 53% of a woman's [10]. We find that among the boy of our research the average length of the torso represents 51.12% of the average height, while among the girls the percentage is 52.84%, proportions that confirm scientific recommendations.

The average value of the length of the lower limbs (the difference between the height and the torso) is 88.42 cm among boys and 78.90 cm among girls.

The average value of the biacromial diameter is 36.10 cm among boys and 32.23 cm among girls. Comparing these data with the scientific recommendations of 43 cm for men and 39 cm for women [10] we can observe major differences, but to a large extent explainable by the still young age of the research subjects and implicitly the non-completion of bone and muscle development.

The average value of the bitrochanteric diameter is 33.55 cm among boys and 30.90 cm among girls. The scientific recommendations regarding the values of this anthropometric parameter are 4-5 cm below the value of the biacromial diameter in adulthood [8]. Considering the age of the subjects and the particularities of growth and development, we can accept the obtained data as adequate.

3.3. The level of psycho-motor ability of the subjects by gender

Given that girls reach a plateau in muscle strength around the age of 15 and it is also around this age that clear gender differences in the amount of muscle mass are found [5], we can admit that the difference between the speed and strength indices between the girls and the boys subjected to our research is normal from a physiological and morphological point of view at this age level, the boys registering significantly higher average values for all the evaluated criteria like speed, explosive strength, elastic strength and segmental strength (Tabel 3). The coefficients of variation calculated for these data series present values below the 35% threshold, which reflects the homogeneity of the series and the representativeness of the average.

Authors mention a significant improvement in coordination abilities and skill level during adolescence [10]. Until the age of 15 there are no differences between genders in terms of skill, but after this age girls become more skillful (there is the possibility of more precise limitation of effort on certain segments and muscle groups, based on inhibition of differentiation, much improved at this age). Therefore, the difference in favor of girls in terms of the level of mobility of the back area, evaluated with the help of the Sit and Reach test (11.07 ± 5.91 cm vs. 5.80 ± 8.61 cm) is also normal. With regard to this criterion, the high value of the coefficient of variation calculated for the boys' data series (43%) reflects the inhomogeneity of the series and differences between the values and the average. Regarding the data series recorded among girls, the coefficient of variation shows an even higher value (148%), which reflects the total unrepresentativeness of the average.

Endurance efforts are very well reported during this period, with higher indices in boys; joint mobility decreases more significantly in boys, too [10]. As a result, the data recorded by boys in endurance speed tests (on 150 m and 300 m) are clearly superior to those recorded by girls.

Results recorded in physical tests and assessments Table 3

PHYSICAL TESTS AND ASSSESSMENTS	GIRLS (n=15)				BOYS (n=10)			
	$\overline{X}$	SD	Me	CV	$\overline{X}$	SD	Me	CV
30 m sprint [sec.]	4.08	0.25	4.00	6%	3.68	0.19	3.72	5%
Flying 30 m sprint [sec.]	3.82	0.26	3.81	7%	3.29	0.26	3.36	8%
60 m sprint [sec.]	7.69	0.45	7.66	6%	6.98	0.12	6.99	2%
150 m running [sec.]	19.74	1.41	19.70	7%	16.71	1.56	17.17	9%
300 m running [sec.]	43.28	2.33	43.00	5%	37.44	0.20	37.50	1%
25 m hops on right leg with 10 m running aproach [sec.]	6.64	0.84	6.40	13%	4.57	0.33	4.63	1%
25 m hops on left leg with 10 m running aproach [sec.]	6.81	0.92	6.59	14%	4.64	0.31	4.59	7%
30 m bounding [sec.]	5.98	0.58	5.98	10%	5.05	0.42	5.09	8%
30 m bounding [no. of steps]	13.87	1.06	14.00	8%	11.90	1.60	12.50	13%
Standing long jump [m]	2.23	0.23	2.20	10%	2.72	0.14	2.70	5%
Triple jump [m]	6.49	0.77	6.50	12%	7.75	0.57	7.59	7%
Five steps jump [m]	10.85	0.87	10.83	8%	13.55	0.90	13.19	7%
Ten steps jump [m]	23.71	2.26	24.40	10%	28.25	1.90	27.79	7%
Standing triplejump [m]	6.35	0.78	6.20	12%	7.61	0.62	7.56	8%
Vertical jump [cm]	36.47	7.07	36.00	19%	43.30	9.93	45.50	23%
Countermov. jump [cm]	43.13	5.87	42.00	14%	54.70	7.53	54.00	14%
3 kg medicine ball forward throw [m]	7.73	1.40	7.95	18%	8.68	2.60	6.90	30%
Sit and Reach test [m]	11.07	5.91	10.00	53%	5.80	8.61	6.50	148 %

3.4. The level of mental capacity of the subjects by gender

Through the Illinois questionnaire we tried to identify the mental and physical states felt by the responding athletes in order to determine the level of anxiety and self-confidence. A score lower than 15 is considered a low score; between 15 and 24 medium score; greater than 24 high score [11]. The girls recorded higher values of psychological anxiety compared to the boys. The score related to the self-confidence indicator recorded approximately equal values among all participants (around 17, low to medium value), a result that corresponds to the average psychological anxiety score mentioned above. The data recorded among the subjects regarding states of body tension and blockage indicate higher mean values among boys (29.10) compared to girls (24.27). The values of the coefficient of variation are less than 35% for all data series, except for the one related to psychological anxiety among boys, where it registers the value of 44%.

3. Discussions

This research reflects the strict bio-motor and psychological level of the subjects so the conclusions drawn cannot be generalized.

4. Conclusions

Considering what we have found through our research, we can affirm that the bio-motor and mental level of the subjects at the transition to the advanced stage (specialized training in sprinting-hurdling-jumping events) corresponds to the psychomotor and mental requirements of these athletic events, but we want to make certain clarifications, as follows:

1. The average age of athletics onset of 8.33 years for the girls and 7.80 years for the boys is much lower compared to the international practice; specialists recommend the age of onset in athletics of 10-12 years and even older for jumping and throwing events [4], [9], [13]. The collected data also reflects an early specialization, around 12 years; specialists recommend the age of specialization for athletic events over 14-15 years, even 17-19 years for jumps and throws [4], [9], [13]. This conclusion is supported by expert opinion that an athlete's potential and predispositions in relation to a particular athletic event can be identified with reasonable certainty towards the end of puberty and after 4-5 years of basic training [3].

2. The average height of the subjects does not correspond to the requirements of the current structural model, characterized by high values. Authors draw attention to the anthropometric peculiarities of the new performers, which tend to be taller and leaner [16], [18];

3. The level of lower back and hamstring muscles flexibility, investigated with the Sit and Reach test is average for most subjects (around 10 cm) and even low among the boys, who also recorded negative values. The standards of this test provide values between 17-27 cm for boys and 21-30 cm for girls for excellent level;

4. The average score of psychological anxiety correlated with that of low self-confidence and with that of very high physical anxiety are in contradiction with the structural model of the athletes specialized in sprinting-hurdling-jumping events [7 -8].

References

1. Alexe, N.: *Antrenamentul sportiv modern* (*Modern Sports Training*). EDITIS, 1993, p. 44,47.
2. Alexei, M.: *Abordarea interdiscipl. în sport (The interdisciplinary aproach in sport)*. Cluj, Napoca Star, 2006, p. 16.
3. Baker, J., Schorer, J. et al.: *Issues in Athlete Identification and Selection: Are we compromising Talent,* In: SIRC, 2018, Available at: https://sirc.ca/blog/issues-in-athlete-identification-and-selection-are-we-compromising-talent/ Accessed: 10-08-2022.
4. Bompa, T.O.: *Periodizarea: Teoria și Metodologia Antren.(Periodization: Theory and Methodology of Training)*. București. EX PONTO, 2002, p. 237
5. Brown, K.A., Patel, D.R. et al.: *Participation in sports in relation to adolescent growth and development*. In: Transl. Ped., 2017, vol. 6(3), p. 150-159. DOI: 10.21037/tp.2017.04.03.
6. Cardinale, M.: *Developing young talent to olympic champions in*

athletics. In: ASPETAR Sp. Med. J., 2020, p.250..Available at:.https://www.aspetar.com/journal/viewarticle.aspx?id=469#.Ym8WlGhBU, 06-08-2022.
7. Chun, J.: *Identifying highly talented athletes: Conception and design of an expert system. Specific to track and field.* In: Ph.D. Thesis, Technical University of Darmstadt, 2007, Available at: https://www.grin.com/document/73598, Accessed: 12-09-2022.
8. Drăgan, I.: *Medicină Sportivă* (*Sports Medicine).* București, Ed. Medicală, 2002, p. 239-241.
9. Krasilshchikov, O.: *Talent Identification an Development: Reassessing the Principle Model*. In: AFEPUC, 2013, No. LIII(I), p. 25-32.
10. Lloyd, R.S. and Oliver, J.L.: *The Youth Physical Development Model*. In: Strength and Conditioning Journal, 2012, vol. 34(3), p. 61-72. Available at: https://www.researchgate.net/publication/271953822_The_Youth_Physical_Development_Model, 27-08-2022.
11. Martens, R. et al: *Competitive Anxiety in Sport*. In: Human Kinetics, 1990. https://www.brianmac.co.uk/iseq.htm#ref , Accessed: 12-05-2023.
12. NCD-RisC. *A century of trends in adult human height*. In: *eLife*, No. 5:e13410, 2016,https://doi.org/10.7554/eLife.13410, Accessed: 10-09-2022.
13. Platonov, V.: *Theoretical and methodological background for sports selection and orientation in modern elite sports*. In: Science in Olympic Sport, 2018, vol. 3, p. 24-51.https://pdfs.semanticscholar.org/2332/efe4ce6f4649308f06dd52f3bd4cf9b3b440.pdf?_ga=2.76134741.1131997308.1666637662272588806.1666637662, Accessed: 09-09-2022.
14. Schexnayder, B.: *Talent identification and event placement for speed and power athletes.* In: Complete Track and Field. 2022. Available at: https://www.completetrackandfield.com/talent-identification/, 11-12-2022.
15. Shynkaruk, O., Blazhko, N. et al.: *The athletes system of selection and orientation in contemporary sports*. In: Sport. Olimpism. Sănătate International Scientific Congres. Chișinău, Moldova, 2020, Available at: https://ibn.idsi.md/sites/default/files/imag_file/647-654.pdf, 21-07-2022.
16. Trofin, P.F., Martinaș, F.P. et al.: *The opinion of practitioners on the biomotor characteristics necessary for practicing high-performance sports.* In: Bulletin of the Transilvania University of Braşov Series IX: Sciences of Human Kinetics, vol. 15(64), No. 1, 2022, p.6. https://doi.org/10.31926/but.shk.2022.15.64.1.7, 28-10-2023.
17. Viru, A., Harro, M. et al.: *Critical Periods in the Development of Performance Capacity During Childhood and Adolescence*. Researchgate,1999,*https://www.researchgate.net/publication/232961144_Critical_Periods_in_the_Development_of_Performance_Capacity_During_Childhood_and_Adolescence*, 20-08-2022.
18. Watts, A.S. et al.: *The changing shape characteristics associated with success in world-class sprinters*. In: J. of Sp. Sci., 2012, vol. 30(11), p. 1085-95. https://www.researchgate.net/publication/51629820_The_changing_shape_characteristics_associated_with_success_in_world-class_sprinters