PARAMETERS OF EFFECTIVE COMPETITION ACTIVITY AND SELECTION OF YOUNG GYMNASTS IN AGE 9-10 YEARS

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Annotation. *Purpose:* to determine the effective factors of competitive activities and criteria for selection of young gymnasts at the stage of preliminary basic training based on the tests of motor skills and physiological parameters using methods of statistical analysis. *Material*: results of psychophysical testing, anthropometry, data on the development of motor abilities of young gymnasts of 9-10 years and assessment of their technical training. The study group consisted of 29 young gymnasts aged 9-10 years. All of them had a sports category corresponding their ages. *Results:* among the sixteen benchmarks psychophysiological data figures stepwise regression equation determined the four most important factors that influence the effectiveness of the competitive activities of the young athletes. The stepwise regression equation allowed lowing the most influential factor affecting the competitive activity among anthropometric and motor performance from twenty- eight to twelve most significant factors. *Conclusions:* The application of regression analysis and stepwise regression method allowed developing the mathematical models of the efficiency of competitive activities of the gymnasts of 9-10 years that can be used in the practice of selection children for the pre basic training.
Keywords: selection, testing, anthropometry, young, gymnasts, sporting, gymnastics.

Introduction

The current rapid increase of the world sports achievement level entails a necessity of researching new efficient approaches, methods, and organizational forms for athletic reserves training [1, 2, 14]. The modern stage on the development of artistic gymnastics is marked by increasingly early specialization and a constantly growing level of exercise complexity, which requires earlier specialization [2, 3, 6]. Thus, the necessity of further enhancement of the efficiency of young athlete selection and introduction of innovative methods of estimating their athletic performance is increasing [2, 7, 8, 13].

The fundamental selection and orientation principle is comprehensive assessment of the young athlete's potential capabilities, as it is not possible to set an integral criterion for such capabilities. An analysis of the contemporary scientific and methodological literature has revealed that an approach aimed at identifying a set of properties to indicate future athletic achievements in any sport is mostly employed to solve the problem of capabilities assessment [9, 10, 15, 16]. Due to such research, extensive knowledge considering the basic factors defining athletic performance at early preparation stages, knowledge on the structural features of the set of characteristics contributing to athletic performance, on the stability of individual peculiar features of young athletes within a range of morphological and functional properties, and on the predictive value of pedagogical, medico-biological, and psychological athletic performance prediction tests has been accumulated in sports science [4, 5, 11, 12].

Defining an athlete's aptitude for artistic gymnastics mostly starts with the assessment of appearance-related merits, physical fitness, and constitution details. Preference is mostly given to the child whose appearance fits in our idea of the constitution of world's leading gymnasts to a certain extent [1, 10, 14].

Purpose, tasks of the work, material and methods

The aim of the present study is as follows: To define competition efficiency factors and stage selection for young gymnasts during the preliminary basic training by technical ability and psychophysiological testing, using statistical analysis methods.

The research data is as follows: The results of psychophysiological testing and anthropometry, technical ability data for young gymnasts aged 9 to10 and their technical competence evaluation.

The methods used within the research were as follows: Theoretical analysis of scientific and methodological literature, anthropometry, testing, mathematical statistics methods, theoretical and empirical analysis.

Results of the research

The increase in gymnasts' athletic expertise is closely connected with the problem of selecting potentially productive athletes as well as that of managing their training process.

The coach's possession of an estimate of a sportsman's current state and the model to be achieved is a prerequisite for successful training management. Before the training process is started, a prospective model should be created for the gymnast, which includes objective, the most precise data (motoric, physiological, and psychological). One of prerequisites for ultimately efficient training is the possession of the athlete's state-indicating data and his fitness model (for physical, technical, and tactical fitness) expressed numerically.

A model is practically important due to the fact that it allows for comparison of numerical characteristics with the base state data for every athlete to obtain the necessary information concerning the difference between them. This is the factor to define the focus in a certain candidate's training depending on her/his strong and weak points in this or that training aspect.

doi: 10.6084/m9.figshare.951919

Thus, model characteristics of young athletes at the stage of preliminary basic training should be regulating and defining while developing the primary selection system and setting criteria for assessing beginner gymnasts' fitness.

A group of boys aged 9 to 19 who practice artistic gymnastics at children's and youth sports schools at the preliminary basic preparation stage was selected to define the model characteristics for gymnasts. This is the age when childhood ends and puberty begins. Physical and physiological fitness for various sports in boys are characteristic of this period. In artistic gymnastics, the age is the period of participating in one's first qualification sports contests and reaching classification standards. The group consisted of 29 young gymnasts aged 9 to 10, all of who had achieved a sports category adequate for their age group.

To present a mathematical model of the young gymnasts' contest performance, we employed the regressive analysis method.

Young athletes were tested physchophysiologically with the help of the Psychophysiologist hardware and software system (Russia). We used the hardware and software system to measure the following indicators: light response time; sound response time; moving object response time; choice reaction time; tapping test; individual minute; % by error rate modulus during object angular speed identification; % by error rate modulus during interval presentation according to the time filled with a light stimulus; % by error rate modulus during interval presentation according to the time filled with an audio stimulus; % by error rate modulus during interval measuring; % by error rate modulus during angle identification. The data received provide a wide range of information concerning the young athletes' capabilities for accuracy complex coordination movement performance, state of sensory systems and systems providing for a high level of technical fitness and, by the same token, a high efficiency in competitive activities. The data obtained after a preliminary statistical treatment underwent a regressive analysis afterwards to identify the most significant psychophysiological factors influencing competitive performance. As a result, a psychophysiological mathematical model of efficient competitive activity was obtained (Table 1).

Table 1

Competitive Performance-Psychophysiological Data Equation of Stepwise Regression

Group	Regression equation	R, R^2, p determination coefficient
9-10 years	$Zn = 30{,}6745 + 75{,}3964 \cdot x_1 + 1{,}79375 \cdot x_{10} - 0{,}0319517 \cdot x_{11} - 0{,}759165 \cdot x_{12} - 0{,}303673 \cdot x_{13} + 0{,}2201 \cdot x_{14} - 0{,}224385 \cdot x_{15} - 0{,}0781723 \cdot x_{16} - 8{,}08657 \cdot x_2 - 8{,}3365 \cdot x_3 - 13{,}327 \cdot x_4 - 0{,}83022 \cdot x_5 + 0{,}896074 \cdot x_6 - 0{,}0373054 \cdot x_7 - 0{,}477945 \cdot x_8 0{,}69824 \cdot x_9$	R =0,8051 R^2=0,6482, p<0,28881

Note: Z – competitive result, x_1 – light response time, x_2 – sound response time, x_3 – moving object response time, x_4 – choice reaction time, x_5 – tapping test 1, x_6 – tapping test 2, x_7 – tapping test 3, x_8 – tapping test 4, x_9 – tapping test 5, x_{10} – tapping test 6, x_{11} – individual minute, x_{12} – % by error rate modulus during moving object angular speed identification, x_{13} – % by error rate modulus during interval presentation according to the time filled with a light stimulus, x_{14} – % by error rate modulus during interval presentation according to the time filled with an audio stimulus, x_{15} – % by error rate modulus during interval measuring, x_{16} – % by error rate modulus during angle identification.

Out of sixteen target psychophysiological values, the stepwise regression equation identified the four most significant factors which influence the efficiency of young athletes' competitive activity (Table 2), зокрема: light response time, tapping test, object angular speed identification time, and interval presentation according to the time filled with a light stimulus. All these parameters are indicators of the efficiency level of complex coordination movement control systems, that is, they are necessary for gymnasts to successfully perform technically complicated high accuracy and space orientation exercises. While performing gymnastic movements, an athlete uses mostly his/her visual analyzer for space orientation, responding to the position of photic images (details of apparatuses, walls, floor, etc.), so light response was found to be highly significant.

Tapping test results indicate strength or weakness of an athlete's nervous system, which is significant for her/his ability of maintaining a high intensity of muscle contractions and thus performing an efficient and gymnastics-specific competitive activity.

An overwhelming majority of gymnastic events involve rotational movement around various axes (on a horizontal bar and rings, or while performing floor exercises), so an athletes' ability to identify an object's angular speed influences her/his performance.

Another significant indicator of gymnastic movement performance accuracy is the ability of presenting intervals according to the time filled with a light stimulus; it enables duration control for various stages of exercise performance, their rhythmic structure, providing the necessary technical performance level.

Engaging the ability of presenting intervals according to the time filled with a light stimulus for assessments makes an integral evaluation of the specific features of the athlete's sensory support of physical activity possible.

As described above, the regressive analysis has revealed the factors which define the efficiency of a young gymnast's competitive activity (Table 2)

Table 2

Competitive Performance-Principal Psychophysiological Factor Regressive Model for Young Gymnasts

Group	Regression equation	R, R^2, p determination coefficient
9-10 years	$Z = 15{,}2536 + 39{,}3453 \cdot x_1 + 0{,}692512 \cdot x_{10} - 0{,}301876 \cdot x_{12} - 0{,}182861 \cdot x_{13}$	R =0,8051 R^2=0,6482, p<0,28881

Note: Z – competitive result, x_1 – light response time, x_{10} – tapping test 6, x_{12} – % by error rate modulus during moving object angular speed identification, x_{13} – % by error rate modulus during interval presentation according to the time filled with a light stimulus,

We included the following into the second efficient competitive activity factor group for regressive analysis: anthropometric data (head and chest circumference, lateral shoulder and pelvis size, upper and lower limb length, and body weight), lung capacity, technical competence (the total of scores obtained in competitions), and motoric tests (test for strength, flexibility, speed, and coordination abilities performance). The aim of using the regressive analysis method is to demonstrate whether the indicators selected can be used by sports school coaches as motoric and morphofunctional indicators of young gymnasts' competitive activity efficiency at various stages of sports (Table 3).

Table 3

Competitive Performance-Anthropometric and Motoric Test Data Regressive Model for Children Aged 9-10

Group	Regression equation	R, R^2, p determination coefficient
9-10 years	$Zn = -393{,}776 + 2{,}50754 \cdot x_{10} + 1{,}91322 \cdot x_{11} - 0{,}605832 \cdot x_{12} - 0{,}0000948725 \cdot x_{13} + 0{,}226469 \cdot x_{14} + 0{,}244778 \cdot x_{15} + 0{,}0837517 \cdot x_{16} - 0{,}727752 \cdot x_{17} - 0{,}161015 \cdot x_{18} - 0{,}259899 \cdot x_{19} + 3{,}81706 \cdot x_2 + 5{,}64854 \cdot x_{20} + 0{,}590876 \cdot x_{21} + 0{,}114823 \cdot x_{22} - 1{,}83458 \cdot x_3 - 0{,}0617494 \cdot x_4 + 0{,}838921 \cdot x_5 - 0{,}0414101 \cdot x_6 + 1{,}61499 \cdot x_7 - 2{,}00683 \cdot x_8 + 2{,}22476 \cdot x_9$	R =0,9842, R^2=0,64201, p<0,28881

*Note: Z – competitive result, x_1 – competition rating, x_2 – head circumference, x_3 chest circumference, x_4 – chest circumference (inspiration), x_5 – chest circumference (expiration), x_6 – shoulder width, x_7 – pelvis width, x_8 – body length, x_9 – body length (sitting), x_{10} – arm length, x_{11} – leg length, x_{12} – body weight, x_{13} – lung capacity, x_{14} – pull-up from suspension, x_{15} – floor dips, x_{16} – standing long jump, x_{17} – standing high jump, x_{18} – net suspension, x_{19} –sit-ups in 30 sec., x_{20} – 20 m running, x_{21} – extended arm lifting in 30 sec., x_{22} – Romberg test, x_{23} – full twist jump, x_{24} – three forward rolls, x_{25} – shuttle run 3*10 m, x_{26} – seated body forward bows, x_{27} – lying crab, x_{28} – cross of side split.*

The stepwise regression equation made it possible to limit the number of the most significant competitive activity efficiency factors from twenty eight to twelve. Out of anthropometry factors, the following were found the most significant with the help of the equation: head and chest circumference; body, leg, and arm length; out of motoric factors – floor dips, sit-ups in 30 seconds, standing long and high jump, and extended arm lifting in 30 seconds (Table 4).

The mathematical competence model for young athletes aged 9-10 identified strength, speed, and anthropometry data as some of the most significant factors. The following anthropometry data are informative: head and chest circumference, chest circumference (exhalation), body length, and sitting body length. Head circumference is a criterion of children's physical development, which is important for working out a training schedule for gymnasts. Inspiratory, expiratory, and rest chest circumference data allow us to judge chest excursion and upper body muscle development (chest muscles and latissimus) indirectly. A large muscle cross section is an indicator of well-developed strength capabilities, which facilitates exercises included into most of gymnastic events (strength exercises in suspension and support).

Table 4

Competitive Performance-Anthropometric and Motoric Test Data Regressive Model for Children Aged 9-10

Group	Regression equation	R, R^2, p determination coefficient

9-10 years	$Z = -296{,}749 + 2{,}03144 \cdot x_{10} + 1{,}68291 \cdot x_{11} + 0{,}230848 \cdot x_{15} + 0{,}122191 \cdot x_{16} - 0{,}747275 \cdot x_{17} - 0{,}7399 \cdot x_{19} + 3{,}89423 \cdot x_2 + 0{,}493236 \cdot x_{21} - 1{,}37852 \cdot x_3 + 0{,}76873 \cdot x_5 - 2{,}03928 \cdot x_8 + 1{,}93038 \cdot x_9$	R =0,9842, R^2=0,64201, p<0,28881

Notr: Z – competitive result, x_2 – head circumference, x_3 – chest circumference, , x_5 – chest circumference (expiration), x_8 – body length, x_9 – body length (sitting), x_{10} –arm length, x_{11} – leg length, x_{15} – floor dips, x_{16} – standing long jump, x_{17} – standing high jump, x_{19} – sit-ups in 30 sec., x_{21} – extended arm lifting in 30 sec.

Arm length, leg length, and their relation to body lengths influence the evaluation of a future athlete's body proportionality and his potential future performance. The most significant motoric abilities include strength endurance, according to the floor dip test results, as a gymnast performs numerous exercises in support on parallel bars, rings, horse exercises, and successful performance of them depends on how well-developed the athlete's arm muscles are. The importance of explosive strength performance (tested in standing long jumps and standing high jumps) is significant in terms of such exercises as somersaults, falls over, and vault jumps, which require the athlete to be capable of powerful muscle contraction in an extremely short time. Apparatus activities require the athlete to perform fast and highly accurate arm moves for most of exercises, which is the reason why the stepwise regression equation included he extended am lifting in 30 sec. test result into the competitive activity efficiency model.

Conclusions:

1. The regressive analysis revealed the following psychophysiological factors to be the most significant in terms of competitive activity efficiency: light response time; a 60 second tapping test during which the value obtain is recorded each 10 sec.; % by error rate modulus during moving object angular speed identification; and % by error rate modulus during interval presentation according to the time filled with a light stimulus.

2. The regressive analysis revealed the following anthropometrical factors to be the most significant in terms of competitive activity efficiency: head circumference, chest circumference, chest circumference (exhalation), body length, arm length, leg length, and sitting body length.

3. The regressive analysis revealed the following physical development indicators to be the most significant in terms of competitive activity efficiency: strength performance, explosive strength, and speed-strength capabilities.

4. Employing the regressive analysis method and the method of stepwise regression, we have worked out competitive activity efficiency mathematical models for gymnasts aged 9 to 10, which allows to use the factors identified for selection at the preliminary basic preparation stage.

As a further research prospect, other statistical data processing methods, including factor analysis, are planned to be employed to identify other significant indicators of young athletes' motoric competence.

References:

1 Bal'sevich V.K. *Ocherki po vozrastnoj kineziologii cheloveka* [Essays on human age kinesiology], Moscow, Soviet sport, 2009, 220 p.

2 Borshchov S.M. *Diagnostika obdarovanosti i zdibnosti iunikh sportsmeniv* [Diagnosis talents and abilities of young athletes], Slovyansk, SDPU, 2011, 120 p.

3 Guba V.P. *Teoriia i praktika sportivnogo otbora i rannej orientacii v vidy sporta* [Theory and practice of sports selection and early orientation in sports], Moscow, Soviet sport, 2008, 304 p.

4 Korobiejnikov G.V., Kozina Zh.L., Lakhno O.G. *Pedagogika, psihologia ta mediko-biologicni problemi fizicnogo vihovanna i sportu* [Pedagogics, psychology, medical-biological problems of physical training and sports], 2011, vol.10, pp. 37-41.

5 Lizogub V.S., Makarenko M.V. *Fiziologichnij zhurnal* [Physiological journal], 2006, vol.2(52), pp. 76.

6 Bykov V.A. *Prognozirovanie dvigatel'nykh sposobnostej i osnova rannej orientacii v sporte* [Prediction of motor abilities and background of the early orientation in sport], Moscow, Olympia Press, 2007, 155 p.

7 Rozin E.Iu. *Fizicheskaia kul'tura* [Physical culture], 2001, vol.4, pp. 2-10.

8 Semenov L.A. *Opredelenie sportivnoj prigodnosti detej i podrostkov: biologicheskie i psikhologo-pedagogicheskie aspekty* [Defining sports fitness of children and adolescents: biological, psychological and pedagogical aspects], Moscow, Soviet sport, 2005, 142 p.

9 Sergiienko L.P. Teoretichni osnovi sportivnogo vidboru [The theoretical basis of sports selection] *Sportivnij vidbir: teoriia ta praktika* [Sports selection: theory and practice], Ternopil: Educational book, 2009, T.1, 672 p.

10 Sergiienko L.P. Vidbir u rizni vidi sportu [Selection in different sports] *Sportivnij vidbir: teoriia ta praktika* [Sports selection: theory and practice], Ternopil: Educational book, 2010, T.2, 784 p.

11 Sergiienko L.P. *Testuvannia rukhovikh zdibnostej shkoliariv* [Testing of motor abilities of students], Kiev, Olympic Literature, 2001, 440 p.

12 Sergiienko L.P. *Sportivna metrologiia: teoriia i praktichni aspekti* [Sports metrology: theory and practical aspects], Kiev, 2010, 776 p.

13 Smolevskij V.M., Gaverdovskij Iu.K. *Sportivnaia gimnastika* [Gymnastics], Kiev, Olympic Literature, 1999, 160 p.

14 Filin V.P., Fomin N.A. *Osnovy iunosheskogo sporta* [Fundamentals of youth sports], Moscow, Physical Culture and Sport, 2000, 255 p.

15 Khoroshukha M.F. *Pedagogika, psihologia ta mediko-biologicni problemi fizicnogo vihovanna i sportu* [Pedagogics, psychology, medical-biological problems of physical training and sports], 2011, vol.9, pp. 130-134.

16 Starosta W., Giaz A. Elements of recruitment and selection in wrestling [Elementy doboru i selekcji w zapasach]. *Materials training* [Materiaiy Szkoleniowe], Polish, Wrestling Federation, 1987, vol.1, pp. 1-24.

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Cite this article as: Bolyak A.A., Pomazan A.A. Parameters of effective competition activity and selection of young gymnasts in age 9-10 years. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2014, vol.4, pp. 3-7. doi:10.6084/m9.figshare.951919

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Received: 01.02.2014
Published: 05.02.2014