Criteria of Initial Selection of Candidates for Artistic Gymnastics

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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Abstract

Background: *The effectiveness of the training process and the level of sports results largely depend on the selection of candidates with appropriate psycho-physical predispositions and the efficiency of the training system. Therefore, selection for artistic gymnastics must be based on coaches' thorough knowledge regarding physical development, interdependence of particular systems and analysers, motor skills and mental determinants.*
The aim of the study was to develop quantitative criteria of initial selection of candidates for artistic gymnastics.

Material/Methods: *The study material comprised 319 boys aged 6 qualified for gymnastic training at the Interschool Sports Club and the Academic Sports Association of the Academy of Physical Education and Sport in Gdańsk in 1998 and in years 2002-2008.*

Results: *The application of study results of correlative and factor analyses allowed determining that in the group of control indices one should consider independent most representative tests. They include somatic build indices of selected motor skills and special fitness.*

Conclusions: *On the basis of indices of asymmetry and the concentration of the values of results around the mean value, optimal parameters, which can be viewed as model characteristics, have been worked out.*

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Introduction

High progressiveness of the obtained results in various sports disciplines poses multi-aspect requirements for coaches. In order to meet them, it is necessary to explore solutions aiming at specifying factors which determine athletes' value and preparation [1,2,3,4,5]. Because of structural complexity and diversity in the dynamics of exercises performed on various apparatuses, artistic gymnastics is a discipline with special demands on athletes' organisms.

Factors determining a sports result include the so-called internal ones, which comprise athletes' psycho-physical capabilities, and the external ones resulting from environmental variables, which comprise rules, regulations, programmes, training methods and means, a tournament calendar, etc. That is why scientific research and prominent specialists point to the indispensability of a special selection of candidates with specific predispositions, with an ability to develop and the prospect to achieve best results internationally [6,7,8,9].

Admittedly, the selection of candidates for artistic gymnastics and directing them in the process of sports training stems from willingness not only to achieve sports mastery but also to improve general physical fitness for better well-being, compensation resulting from lack of physical activity, doctor's recommendations, etc. In the current social development, directing people who take exercise in their physical activity is one of the most important issues requiring explanation.

Due to genetic determination and the influence of the environment, each person develops individually. Hence, the selection of children for artistic gymnastics must take into consideration a possibility of verification or changes in the originally adopted aims. Many a time parents bring children to a gymnastic club in order to stimulate a young organism at the age of 5–7 to physical activity or to create conditions necessary to practise another sports discipline. This results from the fact that at the kindergarten or early school age – at the time of starting the training process – it is difficult to recognise a future Olympic champion or a world record breaker. In such circumstances the significance of a coach grows, as on the basis of his knowledge of the functioning of an organism, the speed of biological and mental development, he builds up an athlete's personality and physical fitness through a systematic and logically programmed training, thus creating a sports talent.

Candidates' initial selection is the beginning of their individual and supposedly long sports career. Pointing the path of development, bodily changes taking place and achieved motor skill to each practising person is an important task of all coaches. The effectiveness of a training process and the level of sports mastery of future national representatives will depend on a thorough assessment of predispositions of practising persons at the stage of selection and initial training.

Balsevich [10], Kochanowicz [11], Platonov [1], Raczek [12], Sawczyn [13], Volkov [14], Zaporożanow, Sozański [15] and others stress that at this stage a coach faces a vital and responsible mission – to choose the most talented children from a mass who start their sports training, who will achieve their sports mastery by developing their predispositions.

Due to different requirements resulting from the construction of particular gymnastic apparatuses and a multitude of exercises diversified in the structure of movement and the level of difficulty performed in various plains, obtaining high sports results in gymnastics is determined by a long-term training period. The optimal period counted from the beginning of specialist training to achieving the mastery level is 5–7 years in women and 8–10 years in men [16,17,18,19].

The aim of the study was to develop quantitative criteria of initial selection of candidates for artistic gymnastics.

Material and methods

The study material comprised 319 boys aged 6 qualified for gymnastic training at the Interschool Sports Club and the Academic Sports Association of the Academy of Physical Education and Sport in Gdańsk in 1998 and in years 2002–2008 (Tab.1).

Tab 1. The number of boys qualified for sports training in gymnastics

Year of study	1998	2002	2003	2004	2005	2006	2007	2008
Number of subjects	50	30	20	70	48	60	20	21

Qualification for initial sports training took place on the basis of somatic build and physical fitness indices. Among somatic build indices, height and body mass, the width of shoulder and pelvic girdles were considered.

To assess physical fitness, the following indices were used:

- pull-ups on a bar from hanging (the number of full pull-ups counted);
- time of hanging from a bar with bent arms (measured in seconds);
- maintaining horizontally straightened legs in hanging with one's back to wall bars (counted in seconds);
- walking on a balance beam and jumping off at a mattress (assessed in a 10-point scale);
- forward bend (measured in centimetres).

All measurements were taken in the same conditions ensuring their uniformity. The study was carried out in accordance with the organisational-methodological description presented by K. Kochanowicz in 1998 [5].

The results were subject to a statistical analysis with the use of means, minimal and maximal values, standard deviation and statistical distribution.

Results

An analysis of the study results as to the indices of somatic build showed that extensively diversified boys were qualified for artistic gymnastics at the initial stage of training. The standard deviation amounted to 3.5–6.8 cm. The greatest diversification in height was noted in boys starting the training process in 2005. The tallest boy was 139 cm tall and the shortest one 105 cm (Fig. 1).

The difference between the maximal and the minimal value was 34 cm. The slightest differentiation among the subjects was noted in 2002 and 2007. The standard deviation was 3.5 cm. The difference between the tallest and the shortest boys was 12 cm. Mean values amounted to 118–126 cm.

The greatest differentiation among boys in body mass was 24.6 kg – it was noted in 2006 (Fig. 2). The highest BMI was held by a boy who weighed 39.2 kg. The lightest boy also started training in the same year. His body mass was 14.6 kg. Mean values in the studied years amounted to from 21 to 24.5 kg. Standard deviation oscillated from 2.3 to 3.9 kg. The slightest differentiation among the studied boys was noted in 1998 and 2008. It was 8.5 kg with the standard deviation at 2.3–2.4 kg.
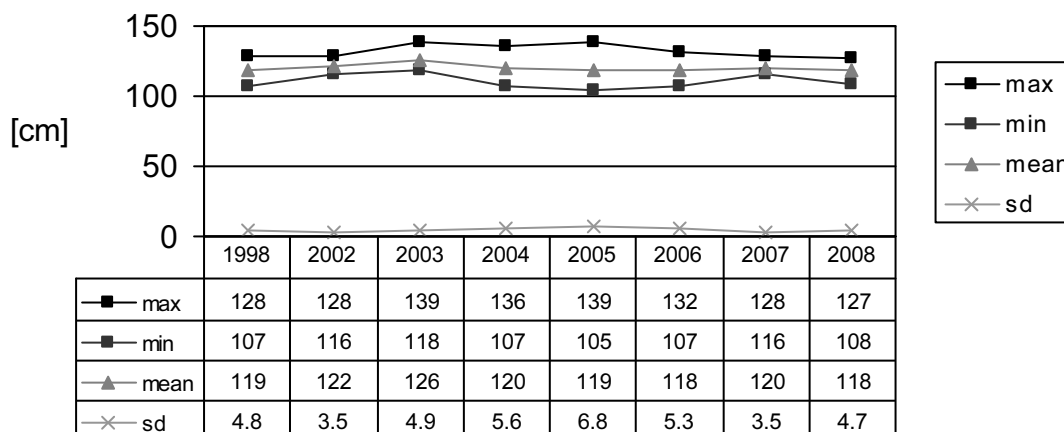
	1998	2002	2003	2004	2005	2006	2007	2008
■— max	128	128	139	136	139	132	128	127
■— min	107	116	118	107	105	107	116	108
▲— mean	119	122	126	120	119	118	120	118
✕— sd	4.8	3.5	4.9	5.6	6.8	5.3	3.5	4.7

Fig. 1. Height of 6-year-old candidates for gymnastics in 1998–2008

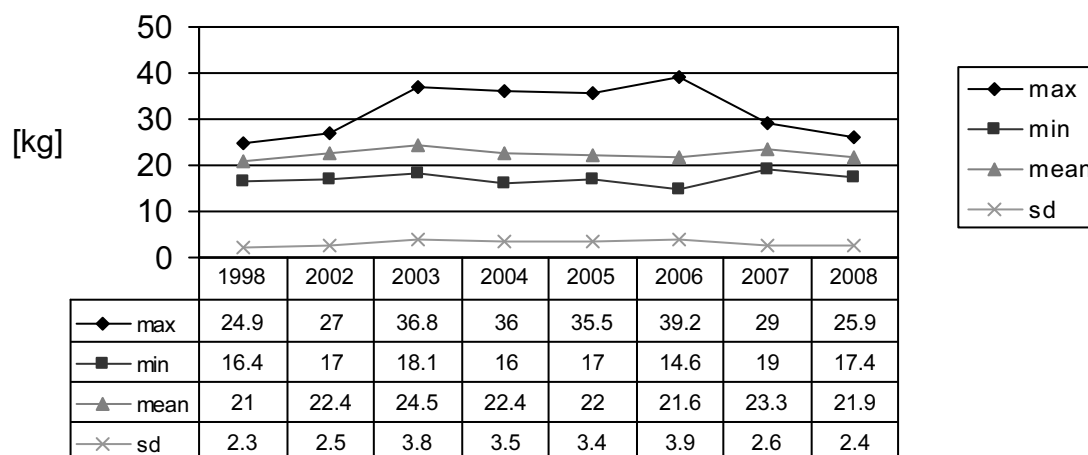|	1998	2002	2003	2004	2005	2006	2007	2008
◆— max	24.9	27	36.8	36	35.5	39.2	29	25.9
■— min	16.4	17	18.1	16	17	14.6	19	17.4
▲— mean	21	22.4	24.5	22.4	22	21.6	23.3	21.9
✕— sd	2.3	2.5	3.8	3.5	3.4	3.9	2.6	2.4

Fig. 2. Body mass of 6-year-old candidates for gymnastics in 1998–2008

The index of shoulder and pelvic girdles width less distinguished young novice gymnasts (Fig. 3–4). The greatest differences in the width of the shoulder girdle was noted in 1998; 2004 – they were 7.6–7.7 cm, and of the pelvic girdle in 2005 – 4.1 cm. Standard deviation in the parameters of the pelvic girdle width was running at 1.0–1.9 cm. Its highest value was noted in 1998 and the lowest one in 2002. The lowest standard deviation in the pelvic girdle width was noted in 2003. It was 0.6 cm, and the highest one in 2005. It was 1.2 cm.

The level of physical fitness, assessed on the basis of the number of pull-ups on a bar, the duration of hang with bent arms, the duration of keeping horizontally straightened legs in a hang with one's back to wall bars, walking on a balance beam and forward bend, was specific in each study year. The most pull-ups on a bar, as many as 11, were achieved by a 6-year-old boy in 1998. In that year also the greatest differentiation in the group was noted. Standard deviation was 2.6 pull-ups. The slightest differentiation and the lowest level results were noted in 2003. A boy who pulled up 3 times achieved the highest value. By contrast, the highest level of mean values was noted in 2007 – 4.16 (Fig. 5). It needs to be emphasised that it was the only year throughout the studied period when all candidates for gymnastics pulled up on a bar at least twice.
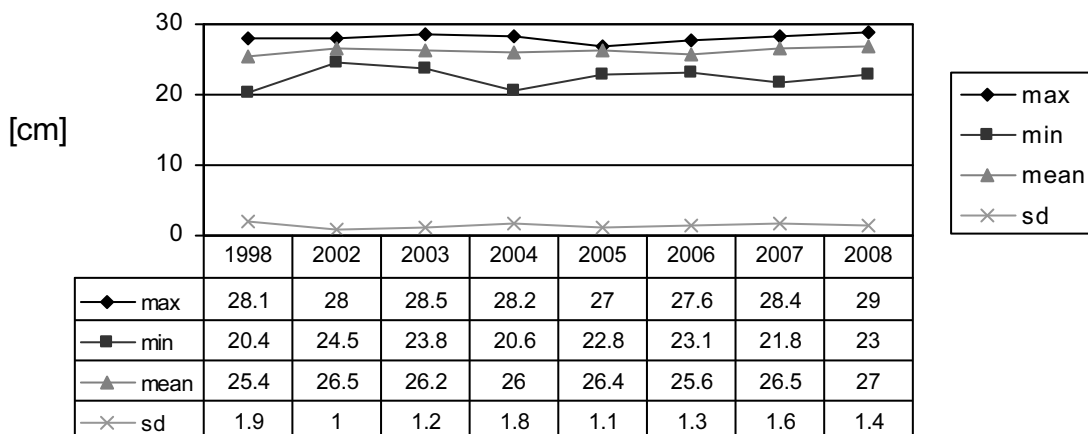
Fig. 3. Shoulder girdle width of 6-year-old candidates for gymnastics in 1998–2008
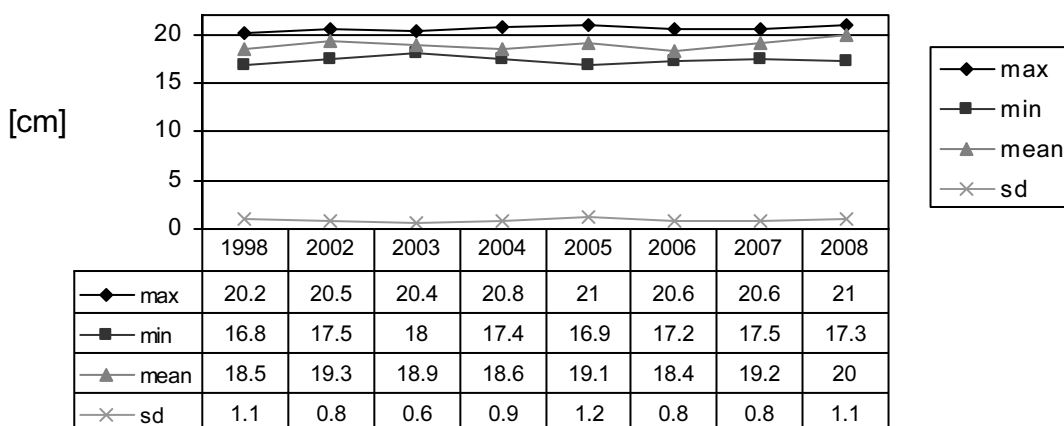
	1998	2002	2003	2004	2005	2006	2007	2008
max	28.1	28	28.5	28.2	27	27.6	28.4	29
min	20.4	24.5	23.8	20.6	22.8	23.1	21.8	23
mean	25.4	26.5	26.2	26	26.4	25.6	26.5	27
sd	1.9	1	1.2	1.8	1.1	1.3	1.6	1.4

Fig. 4. Pelvic girdle width of 6-year-old candidates for gymnastics in 1998–2008

	1998	2002	2003	2004	2005	2006	2007	2008
max	20.2	20.5	20.4	20.8	21	20.6	20.6	21
min	16.8	17.5	18	17.4	16.9	17.2	17.5	17.3
mean	18.5	19.3	18.9	18.6	19.1	18.4	19.2	20
sd	1.1	0.8	0.6	0.9	1.2	0.8	0.8	1.1

Fig. 5. The number of pull-ups on a bar of 6-year-old candidates for gymnastics in 1998–2008

	1998	2002	2003	2004	2005	2006	2007	2008
max	11	7	3	9	8	7	9	6
min	0	0	0	0	0	0	2	0
mean	2.5	1.98	0.96	1.3	0.82	0.95	4.16	2.1
sd	2.6	1.6	0.9	2.1	1.9	1.8	1.7	1.4

Boys kept hanging from a bar with bent arms the longest in 2008. The mean value for the group was 17.8 sec. compared to 12–13 sec. in other years. The lowest value was achieved by a boy hanging from a bar for 78 s (Fig. 6). Here also the greatest differentiation in the results was noted, which is proved by standard deviation (17.2 s). The slightest differentiation in the results was noted in 2002, when standard deviation was 5.1 s.

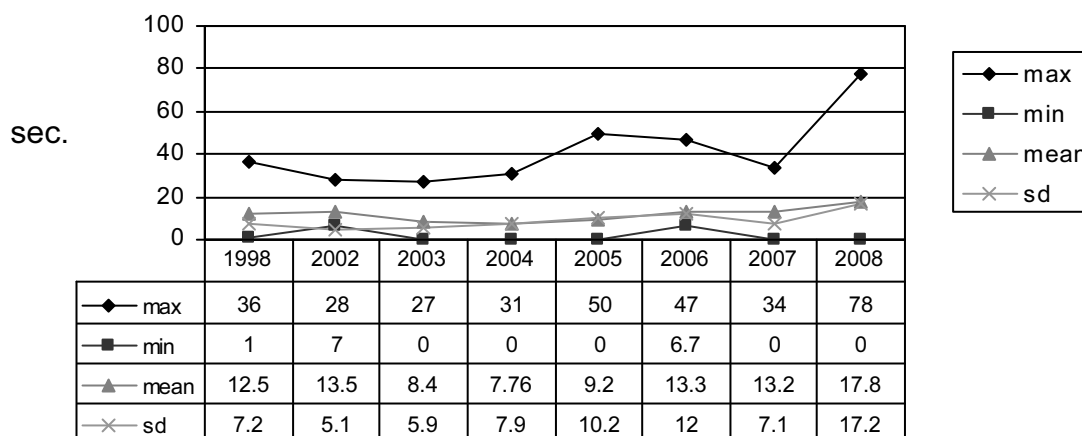|	1998	2002	2003	2004	2005	2006	2007	2008
max	36	28	27	31	50	47	34	78
min	1	7	0	0	0	6.7	0	0
mean	12.5	13.5	8.4	7.76	9.2	13.3	13.2	17.8
sd	7.2	5.1	5.9	7.9	10.2	12	7.1	17.2

Fig. 6. Time of hanging from a bar of 6-year-old candidates for gymnastics in 1998–2008

Keeping straightened legs horizontally in a hang with one's back to wall bars proved substantial differentiation in particular years of the study (Fig. 7). Boys presented the highest level in 2007, definitely exceeding their peers from other years. Also standard deviation was the greatest then (15.2 sec.), indicating a significant differentiation in the results. This is also confirmed by the mean value of 33.36 sec., compared to 6–12 sec. in the other years, as well as the maximal value 62 sec., compared to 10–36 sec., obtained by novice gymnasts of other years.

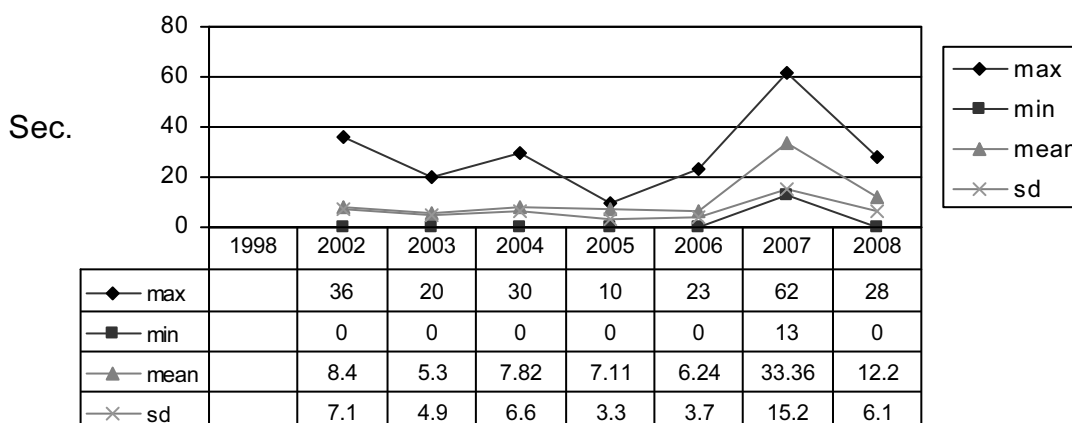|	1998	2002	2003	2004	2005	2006	2007	2008
max		36	20	30	10	23	62	28
min		0	0	0	0	0	13	0
mean		8.4	5.3	7.82	7.11	6.24	33.36	12.2
sd		7.1	4.9	6.6	3.3	3.7	15.2	6.1

Fig. 7. Time of keeping legs horizontally straightened in hang with one's back to wall bars of 6-year-old candidates for gymnastics in 1998–2008

The studied boys' walking on a balance beam with a jump off at a mattress was assessed at a similar level in all years (Fig. 8). Mean values were running from 5.8 to 7.9 points in each year. Standard deviation amounted to from 1.94 to 2.19 pts. One needs to stress, however, that in 2002 and 2004 the span of the results between the best and the worst one was 9 pts.

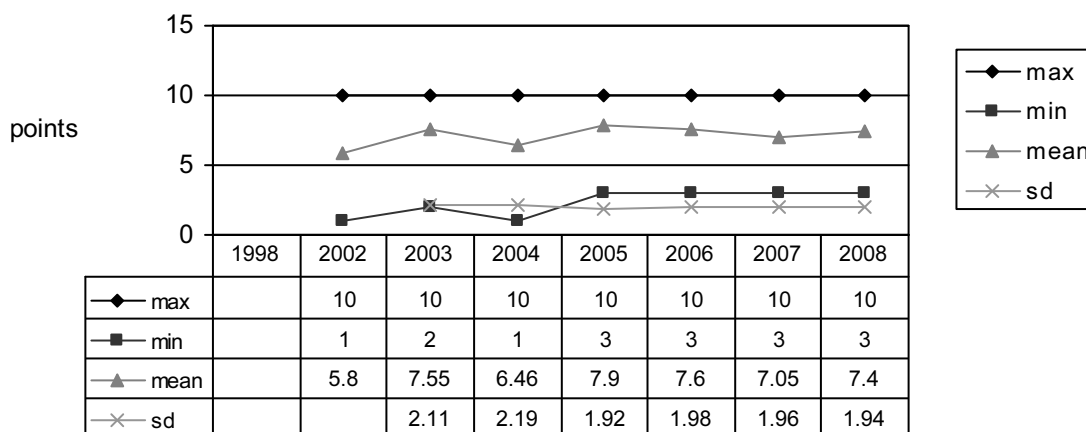|	1998	2002	2003	2004	2005	2006	2007	2008
max		10	10	10	10	10	10	10
min		1	2	1	3	3	3	3
mean		5.8	7.55	6.46	7.9	7.6	7.05	7.4
sd			2.11	2.19	1.92	1.98	1.96	1.94

Fig. 8. Walking on a balance beam by 6-year-old candidates for gymnastics in 1998–2008

The flexibility index defined by a forward bend showed a significant differentiation between the individual years as well as within each group of boys from a given year. It was from 2 to 18 cm. The greatest value of flexibility, which was 9.5 cm, was exhibited by the studied boys in 2002 (Fig. 9).
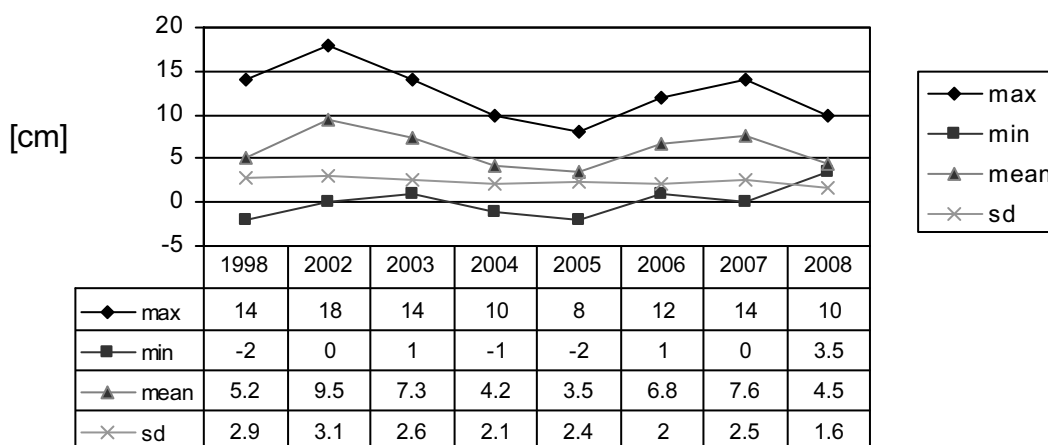

	1998	2002	2003	2004	2005	2006	2007	2008
max	14	18	14	10	8	12	14	10
min	-2	0	1	-1	-2	1	0	3.5
mean	5.2	9.5	7.3	4.2	3.5	6.8	7.6	4.5
sd	2.9	3.1	2.6	2.1	2.4	2	2.5	1.6

Fig. 9. Forward bend of 6-year-old candidates for gymnastics in 1998–2008

Discussion and conclusions

Initial selection of candidates for particular sports disciplines requires applying practical methods as to the assessment of the duration and necessary condition to run it [2,16,17].

It seems that the accuracy of choice and the ease of carrying out the selection attempts is the basic prerequisite of popularity among coaches, instructors and physical education teachers. Zaporożanow, Sozański [15], Ważny [8], Volkov [14] and others draw attention to the need to run a promotional activity through mass media, posters, leaflets, shows, etc. in order to raise interest in a given sports discipline.

Putting together various modes of selections used in studies by Cichalewska [19], Janowski [20], A. Kochanowicz [21], Kruczkowski [22], Rozin [23], Sawczyn [13], Szczepańska [24] allows singling out what is common and seems the most valuable – the multi-stage nature of initial selection giving an opportunity to assess predispositions to gymnastics with designing an individual

path of sports development. The current study results extend the range of information on the somatic build and physical fitness of boys taking up training in artistic gymnastics throughout the period of 10 years.

The application of the above study results as well as earlier observations presented in works by K. Kochanowicz [5,11], Sawczyn [7,13] or Kruczkowski [22], at the initial stage of selection for artistic gymnastics allowed us to single out in the somatic build the indices of the body height and mass, shoulder and pelvic girdles widths.

On the basis of statistical distribution, with consideration for minimal, maximal and mean values, a point scale has been worked out to allow obtaining information on the quantitative characteristics of the studied gymnasts (Tab. 2.). It enabled choosing from a group of practising persons the ones who manifest optimal development capabilities insofar as the demands posed in artistic gymnastics. For example, the highest point values for the body height have been determined in the range of 120 cm – 119 cm and lower, while for the body mass – 20 kg and less.

Tab. 2. Optimal parameters of the somatic build in 6-year-old gymnasts

Somatic build indices	Points				
	20	40	60	80	100
K_1- Body height (cm)	130 – 132	127 – 129	124 – 126	121 – 123	120 – 119 and less
K_2 – Body mass (kg)	28 – 27	26 – 25	24 – 23	22 – 21	20 and less
K_3 – Pelvic width (cm)	22	21	20	19	18
K_4 – Shoulder width (cm)	29 – 30	28 – 29	27 – 28	26 – 27	25 – 26

$$K_{sm} = \frac{K_1 + K_2 + K_3 + K_4}{4} + 15$$

The maximal number of points which a gymnast can obtain for the somatic build (including a bonus) is 115 points.

Owing to a mathematical analysis, the results of a systematically conducted control of physical fitness of prospective gymnasts allowed working out optimal norms (Tab. 3). They enable determining athletes' predispositions insofar as the posed requirements at the initial stage of sports training. Each attempt characterised by various values (duration, the number of repetitions, experts' assessment) has been presented in a uniform point scale. It enables the assessment of the level of development of particular indices of physical fitness with reference to one another. For instance, to obtain 100 points, one needs to pull up ten times on a bar, hang for 30 sec. from a bar with bent arms, bend forward while standing reaching 12 cm below the ground level, etc.

Tab. 3. Optimal parameters of physical fitness in 6-year-old gymnasts

Parameters of physical fitness	Points									
	100	90	80	70	60	50	40	30	20	10
K1 – pull-ups on a bar	10	9	8	7	6	5	4	3	2	1
K2 – time of hanging with bent arms	30	28	25	22	19	16	13	10	7	5
K3 – flexibility in forward bend	12	11	10	9	8	7	6	5	4	3
K4 – keeping horizontally straightened legs in hanging from wall bars	50	45	40	35	30	25	20	15	10	5
K5 – walking on a balance beam	9.5	9.0	8.0	7.5	7.0	6.5	6.0	5.5	5.0	4.0

The index of integrated assessment of physical fitness may be presented in the following way :

$$K_F = \frac{K_1 + K_2 + K_3 + K_4 + K_5}{5}$$

The point list of the studied indices allows determining an individual profile of prospective gymnasts' physical fitness.

Due to their universal meaning, control indices regarding physical fitness of gymnastics novices should be considered with careful attention. Information on the level of motor fitness and motor skills plays an important role at all stages of a sports career. It helps in selection of appropriate training methods and means as well as in programming the most accurate gymnastic routines adapted for competitors' individual capabilities.

On the basis of quantitative criteria of the assessment of somatic build and physical fitness, there is a possibility to evaluate the athletes' talent and to plan appropriate stages of sports training.

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