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Model Characteristics of Special Fitness of Pole Vault Jumpers Aged 12–17

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

Key words: *model characteristics, grading scales, pole vault*

Abstract

Background: *The aim of the research was to define model characteristics of special fitness in pole vault jumpers of different age categories.*

Material/Methods: *Experimental research was conducted between 2002 and 2009 involving 78 sportsmen doing pole vault at sports club "Zawisza" Bydgoszcz, "Gwardia" Piła, "Śląsk" Wrocław, pole vault centre Gdańsk, and TS "Olimpia" Poznań. In comprised: an assessment of physical development, testing physical fitness, and recording sports results.*

Results: *An analysis of the contestants' physical development dynamics gave a chance to isolate significant moments of differentiation of somatic build features as a result of the applied training stimulus in pole vault.*
It can also be observed that the sportsmen achieving the best scores in pole vault achieved better results in particular physical fitness attempts than their peers.
Results of a correlative analysis, taking into account statistical distribution, allowed defining special fitness indices in a uniform grading scale.

Conclusions: *The above grading scale allows assessing the level of development of particular indices in a normalised scale making it possible to compare them against the value of changes occurring during the training process.*
The analysis of particular indices in a uniform grading scale creates the basis for a generalised assessment of special preparation of pole vault jumpers, presentation of their individual model and programming further development. Generalised characteristics in qualitative and quantitative approach make it possible to define the level of special preparation in categories: high, above average, average, below average, low.
The determination of model characteristics of pole vault jumpers aged 12–17 allowed defining specific trainings tasks and individualisation in programming and realization of training loads.

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Introduction

The popularity and importance of sport in the world is gradually rising. It can be exemplified by a rising number of countries participating in international competitions and new records broken by sportsmen of different sports disciplines. A dynamic development of professional sport depends on social, economic and political conditions and involves teams of scientists, prominent coaches and contestants with suitable psycho-physical predispositions in the above process [1, 2, 3, 4, 5].

At present practical training activity forces a coach to gain broad knowledge in the field of making decisions significant for this process. Coaches should be aware of the development possibilities of the athletes trained by them and know how to use different science fields whose aim is to optimize the training process. The process of sports preparation at particular stages of biological development is different and based on an individual adaptive response of the contestant's organism occurring under the influence of the training stimulus. Sozański [6], Ulatowski [7], Ważny [8], Klimczyk [9] and others draw attention to the fact that effective management of the training process is connected with a competent use of various model characteristics.

In science a model is a kind of mental design or a real (mathematical) system which reflects the object of research. The model can be used to conduct experiments which would be difficult to realize on the real object. Here, this term serves as a pattern according to which the phenomenon is described. The model can be an object of the research, but it can also be a research tool used to describe the real world phenomena. In this case we talk about the model experiment in which mathematical, physical, cybernetic and other models are used [10, 11, 12].

Platonov [3] points to three basic functions of models in sports theory and practice. The first one concerns the use of model characteristics to change the prototype and gain new information. The next function consists in applying the models to generalise empirical research and determine a correlation of various processes concerning sports activity. The third function consists in proving significant infiltration of the models obtained during experimental research to the practical sphere of sports activity.

Model characteristics used in sport are considered mainly in two fundamental groups:

- specific models for sports activity showing different types of the contestants' sports preparation, models concerning the morphological construction of the body, connected with the functioning of organs and systems ensuring the effectiveness of training;
- models presenting the dynamics and stability of sports mastery, the development of training effects and sports career; models of the basic organizational constructions of the sports training process where the subsequent stages and learning cycles are taken into account; models of the training plan where micro-, meso- and macro-cycles are included, models of training units and some of their parts, models of exercises [10, 13, 14, 15].

Platonov [3], Sozański [5], Ważny [8], Kochanowicz and Zaporożanow [13] draw attention to:

1. connecting the model process with current, operational and stage control tasks in order to optimize the training process in relation to competition requirements;
2. showing the number of parameters defining a specific model and their dependencies;
3. determining the time of functioning of particular models, their harness area and the possibility of their correction and change.

Models applied in the process of sports training and competition are divided in the following way: general, group and individual.

General models constitute the character of the analysed object or process. In this model research should involve a numerous group of athletes giving evidence of a significant level of sports preparation. Individuals of determined age, sex, level of proficiency in a particular discipline or a sports event take part in them. These are models expressing various aspects of participation in sports competition, models of macro-cycles or a construction of an annual training cycle. The models constitute guidelines to programming the training process and participating in sports competition in a particular sports discipline.

Group models are a result of the examination of the entirety of the group of contestants or team characterised by specific features within the selected sports discipline. The results of research

show that athletes achieving the best scores in other sports disciplines may belong, to the number of characteristic groups, depending on their specific features which have the crucial role in achieving a sports result (e.g. coordination, speed-power and others).

Individual models are created for particular contestants on the basis of long-term observations of organism's response to a training stimulus and participation in sports competitions. Various models result from the conducted research, among others sports preparation, particular training units, micro-cycles, direct sports preparation, particular aspects of the contestants' preparation [4, 8, 10, 14].

Basic indices forming the model structure of pole vault involve:

1. precision and the speed of execution of particular coordination tasks,
2. implementation of the tasks determining psycho-motor parameters included in special fitness attempts and showing the level of sports proficiency [9, 16].

Defining the model structures of the pole vault gives the possibility to determine features which should characterise talented sportsmen predisposed to achieving high scores at the international level.

The aim of the research was to define model characteristics of special fitness of pole vault jumpers of different age categories.

Materials and Methods

Experimental research was conducted in between 2002 and 2009 involving 78 sportsmen doing pole vault in the sports club "Zawisza" Bydgoszcz, "Gwardia" Piła, "Śląsk" Wrocław, pole vault centre Gdańsk, TS "Olimpia" Poznań. Eighteen sportsmen aged 12, twenty-three aged 13, twelve aged 14, eight aged 15, seven aged 16 and nine aged 17 were examined. Most of the examined contestants had started their training process at the age of 12. Nine of them had taken up training at the age of 13, four at the age of 14 and three at the age of 16.

The participants aged 12, 13 and 14 underwent training at a sports club 3–4 times a week. The training unit was 60–90 minutes long. At school, they executed a Physical Education programme in the amount of 3-4 45-minute sessions a week with an emphasis on developing general physical fitness. The participants aged 15, 16 and 17 underwent training at a sports club 4–6 times a week. The training unit was 60-90 minutes long, while at school, similarly to their younger colleagues, they executed a Physical Education programme in the amount of 3–4 45-minute units a week with an emphasis on developing general physical fitness.

While examining the research problem the methods of pedagogical observation and individual case studies were used.

The research included an assessment of physical development, physical fitness and sports results, which was conducted prior to the competition and also during the competition phase.

The assessment of physical development was done on the basis of anthropometric measurements of the following indices of somatic composition:

1. body height (basis-vertex),
2. body mass,
3. torso length (suprasternale-symphysion),
4. lower limb length (basis-symphysion),
5. upper limb length (acromion-daktylion III),
6. shoulder width (acromion-acromion),
7. pelvis width (iliocristale-iriocristale),
8. thigh circumference,
9. shank circumference,
10. arm circumference,
11. volume of chest during inspiration,
12. volume of chest during exhalation,
13. chest breadth (the difference of the chest volume during inspiration and exhalation).

These were measured by the means of an anthropometer, bow compasses, a measuring tape and scales.

Physical fitness was assessed on the basis of 14 control attempts. They were selected according to the system of control indices suitable for the requirements of the sports event – pole vault [16]:

1. running speed at 30 m distance with a high start [s],
2. running speed at 15 m distance with a 20-m run-up [s],
3. running speed at 15 m distance with a 20-m run-up with a pole [s],
4. running speed at 15 m distance with a 20-m run-up with setting a pole [s],
5. strength – measured by long jump at state [cm],
6. explosive strength – measured by long jump with a 20-m run-up [cm],
7. strength of back muscles and shoulder girdle – measured by lifting feet to a horizontal bar from straight arm overhang [number],
8. strength of back muscles and shoulder girdle – measured by lifting feet to a horizontal bar from straight arm overhang 5 times in good time [number],
9. strength of shoulder girdle and shoulders muscles – measured by climbing a 3-m rope [s],
10. strength of shoulder girdle and shoulders muscles, horizontal pull-ups [number],
11. strength of shoulder girdle and shoulders muscles, 5 horizontal pull-ups in good time [s],
12. test of pole vault [cm],
13. coordination and explosive strength measured by “flying” over a crossbeam from back somersault through a handstand (from a mattress) [cm],
14. strength – measured by 4-kg shot put thrown back over the head [m].

Just before the planned attempts were made, the participants were instructed in detail on a way of their execution and then the 15-minute warm-up was conducted by a coach.

In order to perform an analysis of sports results, official competition protocols were used. The collected material was analysed statistically taking into account the minimum, maximum and mean values; the variance of the examined parameters, statistical distribution and Pearson correlation factors were considered as statistically important at $p<0.05$.

Results

The analysis of physical development of pole vault jumpers over a period of 7 years made it possible to carefully examine the changes occurring in its particular indices and to assess it with regard to the pace of development and differentiation in the group (Table 1). A development of all somatic build indices can be noticed. It is important to emphasise the biggest growth in the body height of pole vault jumpers aged 13–15. It reached the level of 8 cm. At this age also relatively the smallest increase in body weight was noticed, which is the evidence of the athletes’ greater slenderness. Age 16 is characterised by smaller dynamics of body height development and a greater growth in muscle mass and the shoulder width. Despite the smaller number of pole vault jumpers aged 15–17 (7–10 contestants) in comparison to the groups of younger contestants (aged 12–14), their a greater homogeneity with regard to somatic build can be observed. The evidence for that is a slight variance of the research results reaching the level of 0.77% in the index of pelvis width to 6.52% in the body mass index. For younger sportsmen the above indices were more dispersed and they reached from 19.7% to 9.49% respectively.

The analysis of the dynamics of the athletes’ physical development gave an opportunity to isolate significant moments of the process of the organism adaptation which occur as a result of the applied training stimulus.

Presented in Table 1 somatic build parameters of young pole vault jumpers may be considered as model characteristics in the method of selecting the candidates for training and in the process of managing the training at particular stages of advancement.

Tab. 1. Somatic build indices of pole vault jumpers aged 12–17

No	Examined parameters	Statistical values	Age					
			12 n-18	13 n-23	14 n-12	15 n-8	16 n-7	17 n-10
1	Body height [cm]	Average	155.67	158.98	166.08	174.88	180.71	183.45
		Min	144	149	157.5	165	178	174
		Max	172	178	180	182	185	190
		v %	7.13	6.97	7.01	6.15	2.69	4.8
2	Body weight [kg]	Average	40.81	43.07	48.42	56.81	67.29	70.87
		Min	31.7	32.1	37.5	48	62	60
		Max	66	71	73	65.5	78	76
		v %	7.8	7.65	9.49	6.52	5.31	4.73
	Rohrer index	x	1.08	1.07	1.06	1.06	1.14	1.15
3	Shoulder width [cm]	Average	32.85	34.43	35.28	36.44	37.7	40.13
		Min	26.7	29.4	33.1	34.5	36	36.7
		Max	36.9	37.9	39	38.5	39	43.9
		v %	2.44	2.41	1.97	1.43	0.95	2.28
	Index 1/3	Average	21.1	21.66	21.24	20.84	20.86	21.88
4	Pelvis width [cm]	Average	23.34	23.99	26.13	27.73	29.77	29.52
		Min	21.3	21.5	23.6	26.5	28	27.7
		Max	27.9	28.5	29.1	29.1	37.2	32.5
		v %	1.68	1.67	2.08	0.77	3.33	1.47
	Index 3/4	Average	70.05	69.68	74.06	76.1	78.97	73.56
5	Torso length [cm]	Average	43.44	43.9	45.2	50.1	53.2	55.13
		Min	38.7	40	42	44	50	53
		Max	46.8	47.6	50	53	55	57.1
		v %	2.4	2.55	2.7	4	1.57	1.62
	Index 4/5	Average	53.75	54.66	57.81	55.35	55.96	53.55

The analysis of the results of physical fitness tests in particular age groups showed their systematic growth. The highest values were recorded in attempts of speed character and strength character (with the exception of long jump at state and with a run-up). The standard deviation oscillated between 0.02 and 4.85, while the greatest dispersion of results was recorded in long jump with a run-up, which oscillated between 18.88 and 36.87 (Table 2).

A greater dispersion of the tests results in the attempts of general character, e.g. long jump at state or long jump with a run-up, is one of the characteristics of pole vault jumpers. The decreasing tendency of the dispersion of the examined parameters in indices specific for a run-up or moving the body over a crossbeam ("flying") is clearly marked. However, there are attempts (e.g. pole vault) in which we can observe their increase. Despite the greater content of special fitness indices with age and longer training, we can observe a greater diversity of sports results. At the age of 11 it reached 11.28% and at the age of 17 – 58.72%.

The biggest improvement in sports results in pole vault was recorded at the age of 15 (average about 90 cm). While the highest scores were achieved by the sportsmen aged 17.

The conducted analysis of the tests results revealsthat the sportsmen achieving the best results in the pole vault in the subsequent age categories achieved better results in particular physical fitness attempts than the average value in their group. The results achieved by them in some attempts reached the maximum values or they were very close to them or they significantly varied. It means that particular sportsmen have individual predispositions which together contribute to achieving the best score in pole vault. An example of the above is provided by one of the athletes, who at the age of 17, achieved the worst score in 5 pull-ups on a horizontal bar in good time and the run at 15-m distance without a pole in his age group, while the best score in a 4-kg shot put thrown back over the head. He achieved 95 cm (where the maximum score was 120 cm) in "flying" over a crossbeam from a back somersault through a handstand (from a mattress), and he was second in pole vault with the score of 470 cm.

Tab. 2. The results of physical fitness tests of pole vault jumpers aged 12-17

No	Examined parameters	Statistical values	Age					
			12	13	14	15	16	17
1	Run at 15 m with 20-m run-up [s]	Average Min Max v %	2.2 2 2.38 0.1	2.13 1.94 2.3 0.08	2.03 1.91 2.18 0.09	1.91 1.81 2.1 0.1	1.82 1.75 1.98 0.07	1.75 1.67 1.86 0.07
2	Run at 15 m with a pole with 20-m run-up [s]	Average Min Max v %	2.43 2.22 2.65 0.11	2.29 2.21 2.42 0.06	2.14 1.95 2.29 0.12	1.97 1.85 2.19 0.11	1.92 1.8 2.05 0.09	1.82 1.67 1.97 0.1
3	Run at 15 m with setting a pole with 20-m run-up [s]	Average Min Max v %	2.51 2.36 2.83 0.11	2.4 2.25 2.54 0.07	2.3 2.15 2.41 0.07	2.19 2.01 2.38 0.13	2.03 1.91 2.18 0.08	1.94 1.81 2.06 0.1
4	Long jump at state [cm]	Average Min Max v %	199.36 187 214 8.16	213.95 195 241 12.68	239.14 215 266 12.32	260.29 241 284 13.51	272.71 268 276 2.87	277.57 271 292 7.28
5	Long jump with run-up [cm]	Average Min Max v %	405.19 367 450 24.98	445.19 415 492 18.88	474.5 421 565 35.13	546.43 496 588 36.87	583.71 537 625 30.74	596.29 557 631 26.23
6	Lifting feet to a horizontal bar [5 times in good time [s]	Average Min Max v %				6.85 5.75 8.86 1.19	6.45 5.66 7.36 0.68	6.03 4.42 7.3 1.11
7	Lifting feet to a horizontal bar [quantity]	Average Min Max v %	5.57 1 12 3.2	6.29 2 12 2.26	7.21 4 11 2.22			
8	Climbing 3-m rope [s]	Average Min Max v %	14.6 10.6 18.4 2.15	12.36 8.2 15.8 2.24	9.76 6.02 14.6 2.88	7.22 4.37 9.27 1.88	5.88 3.31 8.02 1.57	5.66 4.01 7.16 1.02
9	Pull-ups on a horizontal bar [quantity]	Average Min Max v %	3.62 1 10 2.25	5.52 2 11 2.64	8.57 3 18 4.85	10.43 6 16 4.04	12 7 17 3.42	12.86 8 17 3.24
10	5 pull-ups on a horizontal bar in good time [s]	Average Min Max v %				7.25 6.16 8.69 0.96	6.5 5.02 7.54 0.96	5.69 4.22 7.06 1.03
11	Pole vault result [cm]	Average Min Max v %	205.48 190 225 11.28	233.81 205 270 16.42	265.36 215 380 49.32	352.86 310 390 32	375.86 330 420 36.1	411.43 350 480 58.72
12	"Flying" over the crossbeam from back somersault through a handstand (from a mattress) [cm]	Average Min Max v %				56.43 35 90 18.64	63.57 35 90 23.04	84 45 120 28.79

13	4-kg shot put thrown back over the head [m]	Average Min Max v %				12.72 11.32 13.29 0.66	14.34 12.89 16.25 1.09	15.43 14.65 16.24 0.56
14	30 m run [s]	Average Min Max v %				4.29 3.95 4.49 0.2	4.05 3.74 4.31 0.19	3.99 3.71 4.29 0.19

The conducted correlative analysis showed dependencies between particular indices of special fitness and the pole vault result (Table 3). A significant correlative dependence (at the level of 0.05) was recorded between speed-power indices and the sports result. The highest value was recorded in the attempt of climbing 3-m rope (0.7554) and lifting feet to a horizontal bar (quantity, 0.7554) and the speed of run with a pole (0.6259) and without a pole at 15-m distance with a 20-m run-up (0.6495). Interesting is the fact of a significantly lower correlation between the sports result and the run at 15-m distance with setting a pole (0.3307). Perhaps this is connected not only with the running speed necessary for a pole vault jumper during run-up, but an individual pace of the run-up resulting from the somatic build, physical fitness and psychological predispositions determining lifting one's own body on the pole to the highest possible height (adjusting the running speed to the further tasks).

Taking into account statistical distribution (example Fig. 1), results of the correlative analysis allowed defining special fitness indices in a uniform grading scale.

The above grading scale allows assessing the level of development of particular skills (indices) in a normalized grading scale. It also gives a chance to compare the level of development of particular indices with each other taking into account the changes which occur because of the training influence (Table 4).

Tab. 3. The results of a correlative analysis of physical fitness with the pole vault result of jumpers aged 14

No	Special fitness test	Pole vault result
1	Run at 15 m with a 20-m run-up [s]	-0.6495
2	Run at 15 m with a pole with a 20-m run-up [s]	-0.6259
3	Run at 15 m with setting a pole with a 20-m run-up [s]	-0.3074
4	Long jump at state [cm]	-0.4733
5	Long jump with run-up [cm]	0.3307
6	Lifting feet to the horizontal bar [quantity]	0.7554
7	Climbing 3-m rope [s]	-0.7934
8.	Pull-ups on a horizontal bar [quantity]	0.5791

A detailed analysis of particular indices of pole vault jumpers' special preparation including statistical distribution allowed presenting their values in a uniform 10-point grading scale (e.g. to gain 1 point a contestant should run a 15-m distance with 20-m run-up in 2.36 seconds and with a pole in 2.65 seconds; in long jump at state he should achieve the result of 187 cm and with run-up 367 cm, etc.; cf. Table 4, Fig. 1). The above approach gives a chance to define the dynamics of development of particular special fitness indices in a uniform normalized grading scale, to determine dominant features and to compare the achieved results of physical preparation of pole vault jumpers in particular age categories.

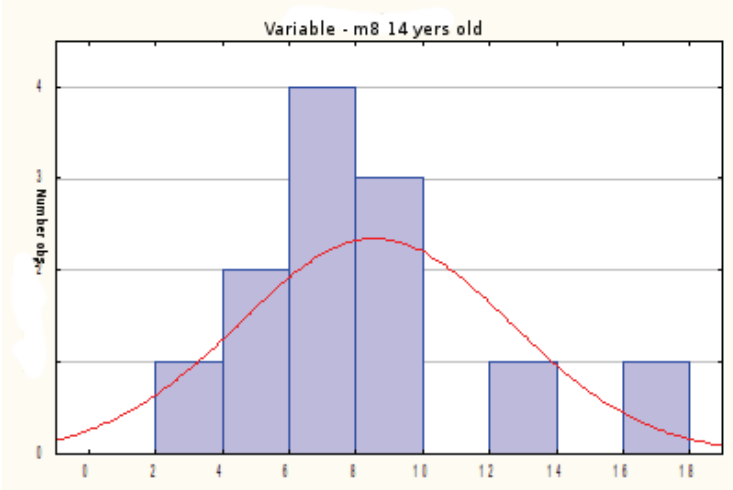


Fig. 1. A sample character of statistical distribution in pull-ups on a horizontal bar in pole vault jumpers aged 14

Tab. 4. Grading scale of special preparation of 12-17-year-old pole vault jumpers

No	Special dexterity indices	Point values of special preparation									
		1	2	3	4	5	6	7	8	9	10
1	W1 – run at 15 m with 20-m run-up [s]	2.36	2.26	2.22	2.17	2.04	2	1.96	1.88	1.81	1.67
2	W2 – run at 15 m with a pole with 20-m run-up [s]	2.65	2.48	2.34	2.26	2.2	2.11	2.02	1.94	1.85	1.69
3	W3 – run at 15 m with setting a pole with 20-m run-up [s]	2.83	2.65	2.59	2.41	2.32	2.26	2.19	2.11	1.98	1.81
4	W4 – long jump at state [cm]	187	196	205	218	229	241	248	256	273	292
5	W5 – long jump with run-up [cm]	367	398	423	459	475	523	541	556	589	631
6	W6 – climbing 3-m rope [s]	18.4	15.2	13.87	12.1	10.77	9.03	7.91	5.26	4.32	3.31
7	W7 – pull-ups on a horizontal bar [quantity] 1	1	3	4	5	7	8	10	12	15	18
8	W8 – pole vault result [cm]	190	219	245	272	302	331	349	368	405	480

In every physical fitness attempt W1, W2....W8 a contestant can gain a maximum of 10 points, which in total allows achieving 80 points.

The analysis in a uniform grading scale creates the basis for a generalised assessment of special preparation of pole vault jumpers, presentation of their individual model and programming further development.

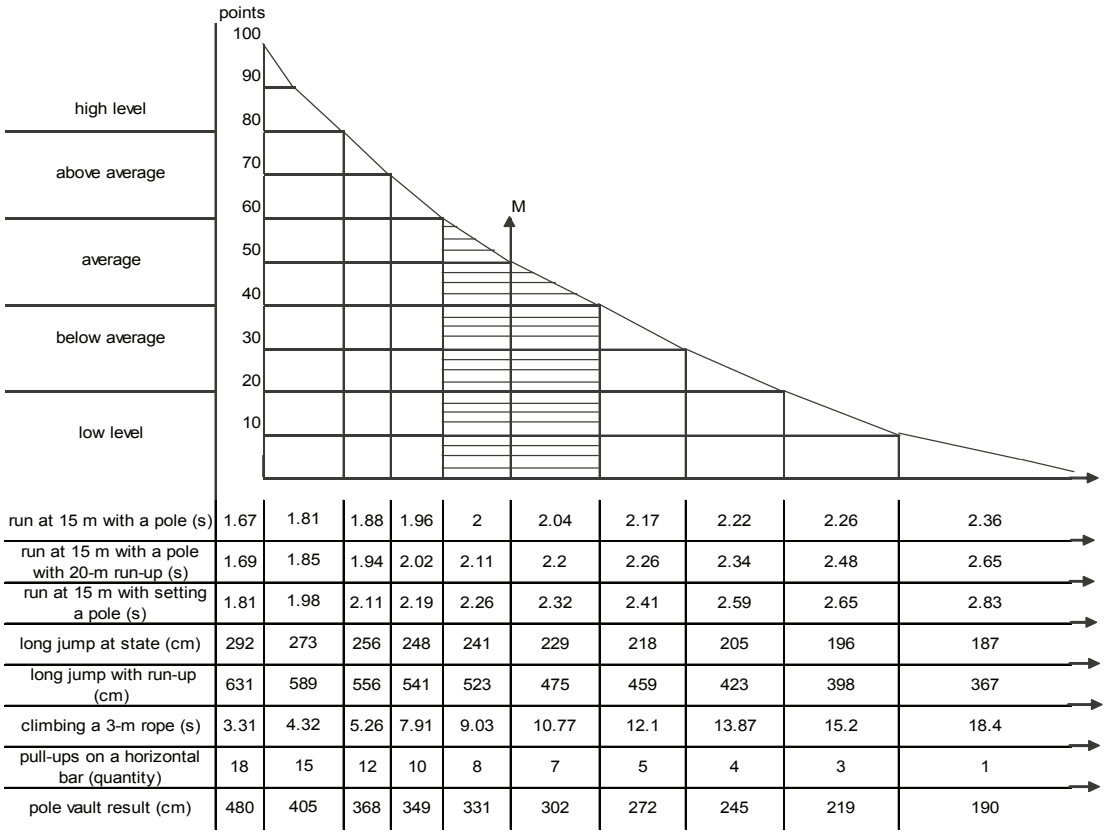
The generalised assessment of special preparation of pole vault jumpers aged 12–17 is calculated by summing up the indices of attempts same for each age control.

The indices of quantitative assessment of special fitness of pole vault jumpers present as follows:

$$WS = \frac{W1 + W2 + W3 + W4 \ldots W8}{8}$$

where: **WS** – the index of special fitness,

W1 .. W8 – the number of points gained on the tests (Tab. 5 and Fig. 2).



run at 15 m with a pole (s)	1.67	1.81	1.88	1.96	2	2.04	2.17	2.22	2.26	2.36
run at 15 m with a pole with 20-m run-up (s)	1.69	1.85	1.94	2.02	2.11	2.2	2.26	2.34	2.48	2.65
run at 15 m with setting a pole (s)	1.81	1.98	2.11	2.19	2.26	2.32	2.41	2.59	2.65	2.83
long jump at state (cm)	292	273	256	248	241	229	218	205	196	187
long jump with run-up (cm)	631	589	556	541	523	475	459	423	398	367
climbing a 3-m rope (s)	3.31	4.32	5.26	7.91	9.03	10.77	12.1	13.87	15.2	18.4
pull-ups on a horizontal bar (quantity)	18	15	12	10	8	7	5	4	3	1
pole vault result (cm)	480	405	368	349	331	302	272	245	219	190

Fig. 2. Grading scale of special fitness of pole vault jumpers aged 12–17

Generalised characteristics in qualitative and quantitative approach give a chance to define the level of special preparation in the following categories: high, above average, average, below average, low (Table 5).

Tab. 5. Generalised qualitative and quantitative assessment of sports preparation of the pole vault jumpers aged 12–17

Age	Level of preparation in points				
	high	above average	average	below average	low
12	38 and more	37–34	33–26	25–22	21 and less
13	42 and more	41–37	36–30	29–24	23 and less
14	53 and more	52–44	43–36	35–27	26 and less
15	64 and more	63–52	51–42	41–30	29 and less
16	70 and more	69–58	57–46	45–36	35 and less
17	75 and more	74–62	61–50	49–39	38 and less

Discussion

In modern professional sport the effectiveness of athletes' training, starting from the stage of comprehensive training, is based on selection of methods and means suitable for their individual psycho-physical features [1, 7, 14, 15, 19].

It is well known that sport results in different sports disciplines and sports events require suitable predispositions with regard to somatic build, condition, coordination and psychological

skills. Therefore, these are considered as important indices of special fitness in a particular sports discipline [3, 5, 17, 18].

Objective quantitative and qualitative information about the level of special sports preparation allows defining model characteristics in particular sports disciplines [9, 10, 12, 14]. Comparing the achieved results of physical fitness or physical development of particular sportsmen with the achievements of the best ones leads to optimization of the training process.

Determination of model characteristics for sportsmen doing pole vault at the age of 12–17 allowed defining specific training tasks and individualisation in programming and realization of training loads.

A thorough analysis of the athletes' physical development proved a systematic development of the examined indices. The biggest growth in the body height was recorded at the age of 13–15 and a relatively small one in the body weight. The visible growth in muscle mass and shoulder width was recorded at the age of 16–17. With age we can observe a smaller diversity in the somatic build among the pole vault jumpers. The above observations in the field of anthropometric indices may be used as model characteristics for the selection of the candidates for sports training and in the process of managing the training at particular stages of pole vault.

The results of physical fitness tests also showed a systematic development of its particular indices and sustaining diversity between the contestants of different age categories. A greater dispersion of the tests results was recorded in the attempts of general character and a smaller one in special fitness indices. It was noted that the examined sportsmen are characterised by individual profiles of somatic build and physical fitness, which in a significant way correlate with the sports result. This was also proved by our and other authors' previous research presented in the first part of the paper. It needs to be emphasised that with age an increasing diversity of sports results of the pole vault jumpers was recorded. This diversity at the age of 12 reached 11% (where the average score of the group was at the level of 205 cm), and at the age of 17 it increased to 58%, while the average score of the group was at the level of 411 cm. It is worth noticing that since the beginning of the study there was a leader who systematically improved his sports results from 225 cm at the age of 12 to 480 cm at the age of 17. The biggest improvement in the results of this athlete, similarly to the examined groups, was recorded between the age of 13–14 and 16–17. It is interesting that this contestant was the weakest in some of the speed-power attempts (the run at 15-m distance without a pole, pull-ups on a horizontal bar in good time) and he was the best in other ones (4kg shot put thrown back over the head).

The above study proves a need for further analysis whose aim would be to optimise the training process on the basis of athletes' individual psycho-physical predispositions.

Conclusions

The conducted analysis of the tests results allowed reaching the following conclusions:

1. With age a smaller diversity of somatic build can be observed among 12–17-year-old pole vault jumpers.
2. Significant dependencies between the level of development of speed-power skills and the sports result of pole vault were recorded among the examined athletes.
3. The sportsmen have individual characteristics resulting from somatic build, motor predispositions and the level of motor skills, which together contribute to the achievement of the best results in pole vault.
4. A quantitative and qualitative assessment of special fitness of the pole vault jumpers allows defining their individual profiles of development.

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