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Strength exercise complex influence on strength parameters of humeral belt muscle power indexes for athletes of Ukraine paralympic ski and biathlon team during preparation stage of the season

Abstract. ***Purpose:*** *analyses of the strength parameters dynamics of paralympic athletes during preparation period followed by implementation in training process complexes of strengths exercise.* ***Material and Methods:*** *the study involved 12 highly qualified Ukraine paralympic ski and biathlon team members by 2 different nosology (body impairment and visually impairment). The age of athletes 17–28 (6 men, 6 ladies).* ***Results:*** *developed and justified the platform to improve strength possibilities of humeral belt muscle depends from stage of preparation period.* ***Conclusions:*** *on the basis of the study authors recommends involve strength exercise complexes to training process of paralympic athletes.*
Keywords: *power indexes, biathlon, cross-country, paralympic sport.*

Introduction. Competitive speeds which have an essential increase in Paralympic sport in the last years (cross-country skiing and biathlon), in many respects depend on ability of a sportsman in each in-transit cycle on skis to carry out pushing away by feet and hands (category LW10-12) with efforts, big by the size and time of performance. Ability of a skier to such actions depends on the level of high-speed and power preparation which, in turn, depends at most groups muscles that actively participate in realization of the main specific movements, and also from the level of intermuscular coordination [5; 8–11]. As a result of this there is a need to define means and methods of power training of Paralympic sportsmen on the basis of features of the competitive activity of different nosologies, and also abilities to carry out certain power exercises and sets of exercises of power character during different periods of an annual macrocycle.

The analysis of results of researches which were conducted with sportsmen-skiers, testifies that the level of sports results has a direct dependence on indicators of special endurance and high-speed and power opportunities [2; 4]. Scientific literature is very poor in information concerning Paralympic sport, especially in winter cyclic disciplines which are cross-country skiing and biathlon. Separate publications [1; 4; 5; 7], connected with training of swimmers, athletes, and also articles of rather general questions of Paralympic sport don't give the full chance for the analysis of training of Paralympic sportsmen who compete in cross-country skiing and biathlon. Despite the absence of information on the scientific researches conducted with Paralympic sportsmen, nevertheless, we allow identical dependence between indicators of force and endurance and sports result at healthy sportsmen and sportsmen with defeats of the musculoskeletal system and defects of sight. Generalizing results of researches which were conducted with skiers-racers, it is possible to draw a conclusion that the speed of reduction of muscles at pushing away, the increase in the characteristics connected with the power of these muscles conducts to growth of speed of a performance of movements, increases in length of a step, and, in general, to growth of remote speed of movement on skis [2–6; 8; 9–11]. All above-mentioned is components of specialized high-speed and power preparation.

Communication of the research with scientific programs, plans, subjects. The research was carried out according to the plan of the research work of the chair of winter sports, cycling and tourism of Kharkov state academy of physical culture of the Ministry of Education and Science of Ukraine, for 2011-2015 by the subject "Improvements of the training process in winter sports of sportsmen of different age and sports qualification, including with limited physical capacities" (number of the state registration is 0111U000190).

The objective of the research: the analysis of dynamics of power indicators of Paralympic sportsmen in the preparatory period of an annual macrocycle when using in training process of complexes of the power exercises aimed at the development of muscles of a humeral belt. Proceeding from the research objective, **the following tasks** consistently were solved:

1. To make complexes of power exercises for muscles of a humeral belt and to define a technique of their appendix during the preparatory period.
2. To define methods for testing of power indicators and to carry out the analysis of results of testing of power indicators of Paralympic sportsmen.

Material and methods of the research. The pedagogical supervision and the researches were conducted in the conditions of the educational and training process of sportsmen – members of a national Paralympic team of Ukraine from cross-country skiing and biathlon of two nosologies (defeat of the musculoskeletal device and defect of sight) in number of 12 sportsmen (6 men, 6 women). The age of sportsmen of 17-29 years old, sports qualification of CMS (2), MS (4), MSIC (3), HMS (3).

Results of the research and their discussion. Solving a task concerning the improvement of high-speed and power training of sportsmen with defeats of the musculoskeletal device and defects of sight (LW2-9 and B1-3 group), we made complexes of power exercises of high-speed and power character for muscles of a humeral belt which were used in the training process within 20 weeks in the preparatory period of an annual macrocycle of 2013.

The exercise "bendings-extensions of hands in an emphasis lying were a part of a power complex No. 1" which were used in different variations of the dynamic and static modes of a performance of the exercise. The rest interval between repetitions made 60 seconds. The quantity of series equaled 2–3. The rest interval between series equaled to 5 minutes. The functional effect – is the development of power endurance of muscles of the top extremities and a trunk.

The exercises "A bar press lying were a part of a power complex No. 2 on a horizontal lava", "Thirst of a bar for a breast,

lying on a horizontal lava" that were used in the range of loading of 6-8 RM (repeated maximum). The rest interval between repetitions equaled 120 seconds. The quantity of series equaled 2–3, the rest interval between series of 10 minutes. The functional effect – is the development of explosive force of muscles of the top extremities and a trunk.

The exercise "Imitation of the simultaneous unmoved course" on the exercise machine «Ergoline» (made in Italy) was a part of a power complex No. 3 that was used in the range of loading of 10 RM (repeated maximum). The quantity of series equaled 3–5, the rest interval between series made 3 minutes. The functional effect – is the development of explosive force of muscles of the top extremities and a trunk. The structure of power complexes (RM range, duration of intervals of rest, quantity of series) changed individually for each sportsmen towards the increase in total loading after the stabilization reached at the previous stage of training.

Testing was held on the certified equipment (the exercise machine «Concept 2») (pic. 1) during educational and training meetings in Yevpatoria (the sports-rehabilitation center "Ukraine", 15.05.2013 and 10.10.2013), and also in the sports ski center of Vuokatti (Finland) 24.06.2013.

Pic. 1. Appearance of the exercise machine "Concept 2"

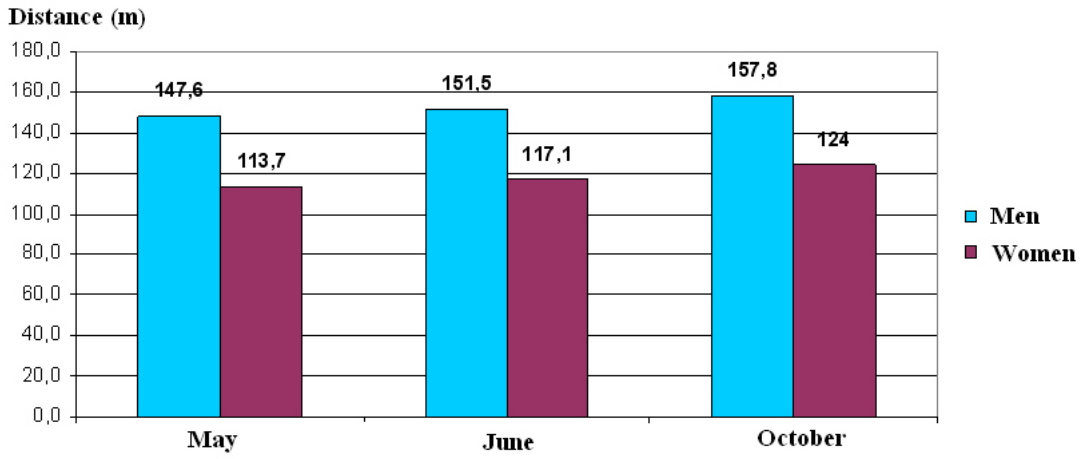
Carrying out the tests was elected in the first training day of a final microcycle (the first training). As parameters which were investigated by us:

1. A distance which was virtually overcome by the sportsman (it was registered on the monitor of the exercise machine "Concept 2") when performing the exercise "imitation of the simultaneous unstepped course" (the duration of a loading 30 s, the exercise performance power –is maximum).

2. The time (result) and average quantity of push-off in a minute (it was registered on the monitor of the exercise machine "Concept 2") when performing the exercise "imitation of the simultaneous unstepped course" (the length of a virtual distance of 500 m, the exercise performance power –is maximum).

Results of testing are reported in tables 1 and 2.

Results of testing (pic. 2) testify to growth of indicators during the entire period of researches with the increase of dynamics at the end of the period: $\Delta_1=X_2-X_1=2,6\%$, $\Delta_3=X_3-X_2=4,1\%$, $\Delta_2=X_3-X_1=6,9\%$



Pic. 2. Dynamics of high-speed and power indicators (the length of the overcome virtual distance for 30 s) members of a Paralympic national team of Ukraine in the preparatory period of 2013

Table 1

Results of testing of high-speed and power indicators of sportsmen of a Paralympic national team of Ukraine (the exercise machine "Concept 2", when performing the exercise "imitation of the simultaneous unstepped course")

№	S.N	Test 1 (15.05.2013) Distance (m) за 30 s, $\bar{X}_1$	Test 2 (24.06.2013) Distance (m) for 30 s, $\bar{X}_2$	Test 3 (10.10.2013) Distance (m) for 30 s, $\bar{X}_3$	Dynamic of indicators (m), $\Delta 1=X_2-X_1$	Dynamic of indicators (m), $\Delta 2=X_3-X_1$	Dynamic of indicators (m), $\Delta 3=X_3-X_2$
Men							
1	Sh. D.	**154,5**	**159,0**	**167,0**	**4,5**	**12,5**	**8,0**
2	U. Y.	**154,0**	**158,0**	**165,0**	**4,0**	**11,0**	**7,0**
3	K. V.	**146,5**	**148,0**	**159,5**	**1,5**	**13,5**	**11,5**
4	M. V.	**141,5**	**146,0**	**149,5**	**4,5**	**8,0**	**3,5**
5	V. G.	**138,5**	**140,5**	**148,0**	**2,0**	**9,5**	**7,5**
6	R. I.	**150,5**	**155,0**	**157,5**	**4,5**	**7,0**	**2,5**
Average meanings		**147,6**	**151,5**	**157,8**	**3,5**	**10,3**	**6,7**
Women							
7	N. L.	**112,0**	**113,5**	**122,5**	**1,5**	**10,5**	**9,0**
8	S. V.	**124,0**	**127,0**	**129,0**	**3,0**	**5,0**	**2,0**
9	L. L.	**111,0**	**117,5**	**123,5**	**6,5**	**12,5**	**6,0**
10	K. A.	**110,0**	**115,0**	**124,0**	**4,0**	**14,0**	**9,0**
11	B. I.	**107,0**	**110,0**	**114,5**	**3,0**	**7,5**	**4,5**
12	Sh. O.	**118,0**	**119, 0**	**130,5**	**1,0**	**12,5**	**11,5**
Average meanings		**113,7**	**117,1**	**124,0**	**3,2**	**10,3**	**7,0**

Note. *The duration of loading 30 s, the exercise performance power – is maximum.*

Table 2

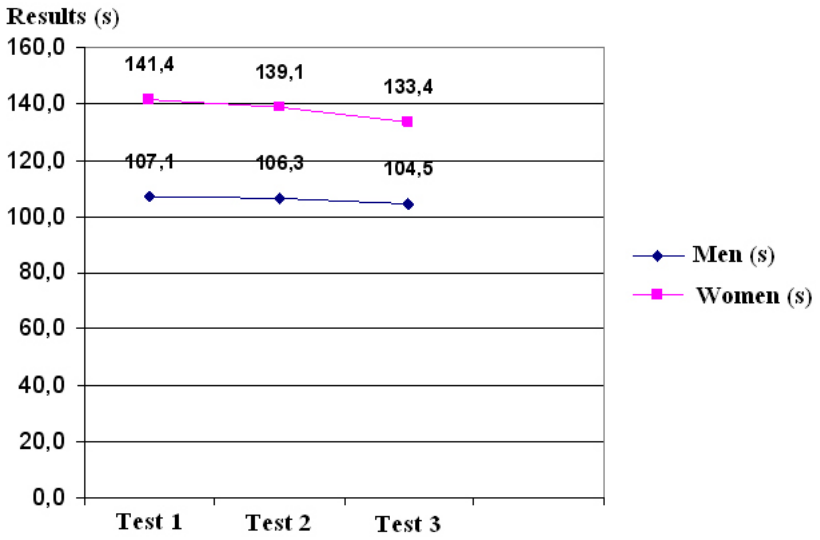
Result of testing of high-speed and power indicators of sportsmen of a Paralympic national team of Ukraine (the exercise machine "Concept 2", when performing the exercise "imitation of the simultaneous unstepped course"

№	S.N.	Test 1 (16.05.2013)		Test 2 (25.06.2013)		Test 3 (10.10.2013)		Dynamics of indicators					
		T1 (s)	N1	T2 (s)	N2	T3 (s)	N3	Δ1= t2–t1	Δ1–1= n2–n1	Δ2= t3–t1	Δ2–2= n3–n1	Δ3= t3–t2	Δ3–3= N3–n2
1	Sh. D.	110,2	74	107,9	57	101,0	61	2,3	–15	9,2	13	6,9	+4
2	U. Y.	102,2	81	103,0	74	102,7	76	–0,8	–7	–0,5	–5	0,3	+2
3	K. V.	106,0	69	106,5	71	101,7	68	1,5	+2	4,3	–1	2,8	–3
4	M. V.	109,6	63	108.1	66	105,9	70	1,5	+3	3,7	+7	2,2	+4
5	V. G.	111,5	70	112.0	66	115,2	62	–0,5	–4	3,7	–8	–3,2	–4
6	R. I.	103,2	89	102,6	80	100,4	73	0,6	–9	2,8	–16	2,2	–7
Average meanings		**107,1**	**74,3**	**106,3**	**69,0**	**104,5**	**68,3**						
7	N. L.	148,0	75	74	66	136,0	56	5,0	–9	12,0	–19	7,0	-10
8	S. V.	131,7	69	71	70	131,7	73	–0,6	+1	0,0	+4	0,6	+3
9	L. L.	163,3	74	66	72	151,0	70	3,3	–2	12,3	–4	9,0	–2
10	K. A.	142.7	72	66	75	128,5	77	6,7	+3	14,2	+5	7,5	+2
11	B. I.	125,3	64	80	64	123,9	66	0,3	0	1,4	+2	1,1	+2
12	Sh. O.	137,2	76	138,1	78	129,2	86	–0,9	+8	8,0	+10	8,0	+10
Average meanings		**141,4**	**71,7**	**139,1**	**70,8**	**133,4**	**71,3**						

Note. *The length of a virtual distance of 500 m, the exercise performance power – is maximum; T – the exercise*

The greatest gain has an indicator Δ2 that characterizes the considerable positive dynamics of power qualities at the end of the preparatory period.

The presented results in the table 2 testify to positive dynamics of speed of overcoming of standard exercise what is displayed in an indicator **Δ2=t3–t1** (pic. 3) Results concerning an indicator of N which characterizes the quantity of pushing away in a minute, have no identical tendency and depend on specific features of sportsmen and the chosen rate of overcoming of a distance.



Pic. 3. Dynamics of high-speed and power indicators (the time of overcoming of a virtual distance 500 m long and the rate of movements at simultaneous pushing away) members of a Paralympic national team of Ukraine at testing stages in the preparatory period of 2013

Conclusions:

1. The creation of the training process of Paralympic sportsmen who specialize in cross-country skiing and biathlon, answers the standard principles of sports training in cyclic sports.

2. The developed complexes of power exercises provide the application at stages of the preparatory period their different connection and gradation of the general loading: at the all-preparatory stage use of the complexes No. 1 No. 2 together twice for a microcycle, the complex No. 3 three times for a microcycle is expedient; on the specially preparatory stage – the complex No. 1 twice for a microcycle, the complex No. 2 once for a microcycle and the complex No. 3 four times for a microcycle.

3. The dynamics of indicators of high-speed and power preparation is defined during the preparatory period of Paralympic sportsmen. The highest results in both nosologies are received at the end of the preparatory period (testing 10.10.2013) which characterizes a high basic level of special power preparation and possibility of effective transfer on the primary activity – a movement on skis.

Thus, it is possible to assume that the positive dynamics of power indicators recorded in tests can be a basis for the subsequent growth of the level of functional training of Paralympic sportsmen and the highest sports results.

Prospects of the subsequent researches. In a competitive season in 2015-2016 it is planned to carry out the correlation analysis of indicators of high-speed and power qualities with results at control and official starts on skis and roller skis. It is planned to pay a special attention to dispensing of training loads depending on dynamics of power indicators and periods of preparation.

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