

Adaptation of junior orienteers to loads, developing local-regional and special muscular endurance

Abzalilov R.Y.¹, Rybakov V.V.², Isaev A.P.², Erlikh V.V.²

¹Bashkir State Medical University, Russia

²South Ural State University, Russia

Abstract

Purpose: complex assessment of junior sport orientation athletes in conditions of concentrated training of local-regional muscular endurance and stroke loads (final part of preparation for competitions).

Material: in the research sport orientation athletes (n=34, age 13-16 years) participated. The athletes were divided into tested group (n=17) and group of comparison (n=17). In every group there were 17 boys and girls. The tested group consisted of volunteers, who practiced sport orientation. Comparison group included average distance and steeplechase runners.

Results: In system of junior orienteers' training we found: gender distinctions in carbohydrates and fats consumption (in the ranges of aerobic and anaerobic thresholds; substantial physiological changes in static-kinetic balance (tests with open and closed eyes. Dynamic coefficient of balance in main stance was better in sport orienteers, comparing with runners.

Conclusions: it is recommended to fulfill exercises in conditions of stretching, combined with motor actions of speed-power orientation and relaxation.

Keywords: sport orientation, control, adaptation, endurance, run.

Introduction

Modern sports with extreme loads require scientific substantiation and application of training technologies. It is especially important for sportsmen-adolescents. In such conditions diagnostic control is especially required. Unfortunately, by different reasons there appear negative after effects in all parts of physical culture and sports. Profound control is used for assessment of athletes' training [7, 9, 11].

Important stage of sport orientation training is control over athletes' physical and special training. Preparation of sport reserve requires creation of basic principles of physical and special endurance training. It is especially important on pre-competition and competition stages and in conditions of effective adaptation's preservation.

Adequacy of tests acquires great importance in control process [42]; creation of necessary conditions for testing [38, 48]. Avoiding of physical overloading of athletes' organism is possible at the account: optimization of physical loads and proper planning of training [33, 41]; consideration of athletes' individual features [37];

Bio-mechanical control includes angle and space-time characteristics of kind of sports' technique's mastering. Social-psychological control is connected with study of the following: features of sportsmen's personalities; their psychic state and fitness; general micro-climate; conditions of training and competition activity. These directions are used in natural integrity. It permits to select for control indicators, which are the basis of the found casual relations. Such relations reflect mechanisms of different indicators' interconnection. Physiological control envisages assessment of the following: psycho-physiological state and health; reserve potentials and characteristics of different physiological systems;

molecular manifestations of different organs and systems, which bear the main load in training and competition activity [14, 21].

Control over adolescents' fitness permitted to determine:

- Effectiveness of motor actions' program [34];
- Adequacy of usage of innovative pedagogic approaches [45];
- Adolescents' motivation for physical exercises' practicing [51];
- Distinctions in pedagogical principles of junior players' assessment [52];
- Moderate – intensive physical activity and self-determined children's motivation. The authors assume that consideration of distinctions in interaction of dominating elements in structure of lesson can permit higher level of physical activity. Such children will have better motivation in the lessons, based on models of tactical games [53].

Pedagogic indicators characterize the following: level of motor and technical tactic fitness; efficiency and stability of performances in competitions; structure and content of training process. Social-pedagogic indicators characterize: conditions of medium; strength and mobility of nervous processes and their ability for perception and processing information; the state of sensor integrations of analyzing functioning. Medical-biological characteristics includes: anatomic-morphological; genetic; physical; bio-chemical and immune indicators [15].

The used in control process indicators are divided into two groups. First group indicators characterize relatively stable, genetically conditioned, indicators, which change a little in the process of training. Adequate to such attributes indicators are used in stage-by-stage control. In such control the tasks of athletes' selection and choice of training directions are solved. The second group includes

indicators of stable attributes: body sizes; different fibers in skeletal muscles; type of nervous functioning; speed of some reflexes [17, 30]. Indicators of second group endure substantial pedagogic influence. They reflect: technical tactic fitness; level of different motor qualities; mobility and efficiency of organism's main life activity systems in different conditions of training [27, 40].

In other works authors provide arguments in favor of working out, testing and assessment of new methods, which can be used for optimization of young people's training [35]. Authors affirm that new innovative models can be useful tools of training. However, they can not replace reasonable and comprehensive physical education program, based on practice models [43]. Alternative training models are regarded as more suitable approaches to ensuring physical education at high quality. The authors note influence of physical education program on professional activity of future pedagogues [54].

The relevance of the research is conditioned by the fact that up to the present time the problem of physiological substantiation of effective adaptation and technology of sports reserve training in the field of sport orientation has been remained insufficiently worked out. Great number of adolescents has to stop sports practicing due to muscular overloads and disorder of functions. Depending on the used means and methods, control can be of pedagogic, bio-mechanical, social-psychological or physiological character. In the process of pedagogic control the following is assessed: technical-tactic and motor fitness; performances at competitions; dynamic of sport results; structure and content of training process; tolerance to loads.

Hypothesis: it is assumed that consideration of complex control indicators in sport orientation training process facilitates health preservation and improvement of sport efficiency

The purpose of the research is complex assessment of junior sport orientation athletes in conditions of concentrated training of local-regional muscular endurance and stroke loads (final part of preparation for competitions).

Material and methods

Participants: in the research sport orientation athletes (n=34, age 13-16 years) participated. The athletes were

divided into tested group (n=17) and group of comparison (n=17). In every group there were 17 boys and girls. The tested group consisted of volunteers, who practiced sport orientation. Comparison group included average distance and steeplechase runners [31]. The parents of all athletes gave their consent for their children's participation in experiment. .

Organization of the research: athletes of the tested group were trained in conditions of concentrated development of local-regional muscular endurance (sport circles of sport orientation). Experimental group fulfilled exercises during 25 seconds each of them (60 second was the rest after every exercise). Quantity of series varied from 6 to 10.

In control group trainings were conducted by traditional schema, which included 50% of general and 50% of special exercises (with further reduction to 40%). They fulfilled jumps, multiple jumps, imitations of jumps, exercises on simulators) in block of basic training, at first stage exercises took 50%, on second - 40%. At the end of this part athletes practiced stretching and relaxation. Trainings were conducted 5 times a week. Comparison group was trained by programs of SCJSOR [2]. In both groups the volume of loads was the same.

Spiro-metric data (cardio-ling test) were assessed on device «SCHILLER» (Switzerland) [28] with analysis of indicators by Wasserman. Control was fulfilled in period of final training for competitions with interval loads. Ergo-spiro-metric load was increasing with every step: duration – 3 minute; progressively increasing power - 60, 120, 180, 240 W and 60 rpm.

Statistical analysis: was conducted in program «Statistika 10.0». We determined mean values, errors of mean values, criteria of confidence of distinctions by Manna-Whitney.

Results

Testing was fulfilled in basic period of training (see table 1). The tests were passed before and after concentrated development of local-regional muscular endurance (LRME). The tests were combined with crosses, power exercises, stretching and work with map.

As it is shown in table 1, special motor abilities and power endurance confidently increased and corresponded to requirements of sport qualification [29]. Our data are

Table 1. Physical fitness of athletes-orientees

Tests	Examination I examination (n=17)		II examination (n=17)		P
	M	m	M	m	
3000 m cross on uneven terrain	10 min 45 sec	27 sec	9 min 55 sec	24 sec	<0,05
Power endurance, pressing ups (times)	36,24	1,42	43,36	1,67	<0,05
Quantity of squatting with partner of own weight (times)	9,32	0,98	13,64	1,02	<0,01
Speed of orienteering, m/sec	5,18	0,26	4,90	0,24	<0,001

Notes: M – mean square deviation; m – error of mean value; p – confidence.

in agreement with other work [5] by vector of changes. Critical periods in development of orienteers' endurance is observed between 15 and 15 yrs age; quickness – between 13-14 yrs.; power abilities – between 15-16 yrs. age. It points at need in individual approach to training and perfection of these abilities (accented stimulation) [1, 12, 29].

Orienteering is a durable run on uneven terrain with variable intensity, which is, in average, below anaerobic threshold (AnT). Duration of run depends on the length of distance. The distance depends on the scale of competitions, kind of program and character of terrain.

According to Rules of competitions on orientation, duration of long distances' run (earlier called "classic") is from 60 to 100 minutes; on middle distances (earlier – short) – from 30 to 40 minutes; on sprinter distances of park orientation – from 15 to 20 minutes. On very long distances (marathon) it can be 120-150 and more minutes [5].

Results of the research are given in table 2.

As we can see in table 2 confident distinctions in heart beats rate (HBR) were observed with increase of loads' power. By gender attribute significant differences were in AT (aerobic threshold) ($P<0.01$) and AnT (anaerobic threshold) ($P<0.05$) conditions. Girls reached such values earlier than boys. Volume of oxygen consumption confidently differed with achievement of thresholds. Energetic value of equal by volume and different by intensity loads significantly differed ($P<0.05-0.01$).

Confident differences were in carbohydrate consumption ($P<0.05-0.01$) and fats ($P<0.05$). Recreation of indicators took place in heterochronic way. HBR recreated quicker. Other indicators recreated depending on contribution to realization of loads, developing special endurance and tolerance. These indicators permit to control loads in different structures of training process, starting from separate trainings and up to many years training process.

Sport orientation is a situational kind, which imply: change of general center of pressure; keeping balance with visual control and without it. The following indicators are marked out: functional stability; balance index; dynamic coefficient of balance; Romberg's coefficient (see table 3).

As it follows from the received data, Romberg's coefficient is 226.22 ± 9.82 . This value exceeded the same coefficient in 13-14 yrs, adolescents ($P<0.01$). Mean square deviation (MSD) in main stance also confidently exceeded the same indicators of adolescents ($P<0.05$). The differences were registered with head turns in visual tests: especially with closed eyes (EC) ($P<0.01$). In sagittal plane MSD values also confidently differed in favor of adolescents ($P<0.01$). Differences were also registered in indicators of main stance with open eyes (EO, GCP speed) ($P<0.05-0.01$). In sagittal plane confident differences were registered with right head turn in tests EO and EC ($P<0.05$). Confidently differed indicators of ellipse length to its width in all positions ($P<0.05$). Relation of static kinesigram length (SKG) to its area significantly differed in EO positions ($P<0.03$); in left turn of head in

Table 2. Ergo-spiro-metry of sport orienteering (n=17 –boys; n=17 –girls)

Indicators	Unit of measurement	Standard M±m	Sex	In rest state M±m	In conditions of aerobic threshold AT	In conditions of anaerobic threshold AnT	Relation of AnT to standard %	Relation of AT to reference %	Recreation 3 min
Heart beats rate	bpm	180,3±0,76	B	66,00±1,04	160,24 ±1,44	178,24±1,98	101,17	112,54	115,89±1,34
		172,3±0,58	G	68,13±1,35	168,92±1,86	174,96±1,52	97,73	101,20	116,32±1,46
Power of load	W	216,0±0,74	B	-	210,66±4,69	260,00±5,42	83,88	128,38	-
		179,7±4,25	G	-	186,32±4,98	190,72±4,12	106,13	103,68	-
Volume of oxygen consumption	l/min	2,92 ±0,16	B	0,34 ±0,04	2,68 ±0,17	3,42 ±0,60	117,12	91,79	119 ±0,06
		2,60 ±0,10	G	0,39 ±0,05	1,76 ±0,09	1,94 ±0,07	134,02	74,62	0,79 ±0,05
Equivalent of oxygen	Conv. un	-	B	19,13±0,56	21,13 ±0,64	29,07 ±0,81	-	-	36,13 ±0,90
		-	G	21,26±0,47	25,16 ±0,32	25,72 ±0,34	-	-	34,37 ±0,89
Energetic value	k.cal/h	-	B	121,0±2,74	772,44±8,45	1134,7 ±12,44	-	-	374,22±12,56
		-	G	115,1±3,42	517,72±8,76	598,20 ±0,98	-	-	248,92±8,47
Consumption of carbohydrates	k.cal/h	-	B	126,7±1,89	779,62±11,18	1820,7 ±58,44	-	-	746,00±18,40
		-	G	116,9±5,62	595,38±11,39	723,22 ±19,17	-	-	535,83±15,20

Notes: B- boys; G – girls; M – mean square deviation; m – error of mean value; p – confidence.

Table 3. Stabilometric indicators of athletes-orienteers (boys; n=17, M±m)

Indicators	MS. EO	Left turn of head, EO	Right turn of head, EO	MS. EO	Left turn of head, EC	Right turn of head, EC
Mean square deviation by frontal plane, mm	12,02±2,16	18,14±1,28	11,03±0,79	22,09±3,14	21,06±1,52	31,62±4,52
Mean square deviation of GCP, mm	12,05±2,78	16,06±1,27	17,29±2,24	21,24±2,45	8,01±2,07	21,07±2,76
GCP speed, mm/sec.	11,08±0,37	11,22±0,54	12,09±0,76	17,93±0,78	17,06±0,99	21,94±1,39
Level 60 % of spectrum power by frontal plane, Hz	0,62±0,03	0,78±0,14	0,45±0,08	0,44±0,05	0,36±0,09	0,39±0,12
Level 60 % of spectrum power by sagittal plane, Hz	0,28±0,08	0,38±0,08	0,49±0,09	0,56±0,09	0,36±0,07	0,52±0,03
Area of static-kinesiogram, 90, mm ²	85,64±3,58	116,42±7,87	88,32±6,54	143,12±6,9	158,32±9,14	169,53±27,14
Relation of ellipse length to its width, conv.un.	1,26±0,10	1,23±0,09	1,33±0,10	1,26±0,09	1,20±0,08	1,56±0,32
Realtion of static kinesiogram to its area, conv. un. 1 mm	4,82±0,34	3,50±0,30	4,60±0,26	0,82±0,48	3,70±0,24	3,20±0,40
Level 60 % of power by vertical component, Hz	5,60±0,12	5,80±0,14	5,82±0,12	5,72±0,14	6,10±0,17	6,12±0,16
Indicator of functional stability (IFS) %	94,02±0,41	93,04±0,37	93,50±0,42	92,78±0,49	92,02±0,42	88,32±0,92
Stability index, conv.un.	35,75±1,26	29,96±1,28	29,89±1,86	22,98±1,24	23,88±1,20	19,89±1,24
Dynamic component, %	64,96±1,34	70,94±1,28	66,78±1,72	77,94±1,20	76,98±1,18	79,82±1,19
Mean position of GCP in horizontal plane, mm	2,69±0,54	2,85±0,98	0,60±1,01	2,35±1,19	2,37±1,20	2,18±1,32
Mean position of GCP in sagittal plane, mm	16,33±2,78	15,96±2,32	14,09±2,79	16,92±2,97	19,58±2,57	19,86±2,43

Notes: MS –main stance, EO –eyes open, EC –eyes closed; GCP – general center of pressure; M – mean square deviation; m – error of mean value; p – confidence.

EO - ($P<0.01$); in right turn of head EO - ($P<0.05$). Level of spectrum power by vertical component confidently differed: in positions MS, EO ($P<0.05$); right head turn with EC ($P<0.05$); indicators of functional stability with right head turn (EO) ($P<0.01$); in all positions with EC ($P<0.05-0.01$). Index of stability statistically significantly changed in all positions ($P<0.05-0.01$) with open and closed eyes.

Comparing of age and gender stabilometric indicators (in conditions of special training) of 13-14 yrs and 15-16 yrs athletes showed effective adaptive changes and substantial distinctions in the following values: Romberg's coefficient ($P<0.01$); mean square deviation in main stance ($P<0.05$); in tests with head turns with open and closed eyes ($P<0.01$); levels 60% of power in position with OE in frontal plane and in sagittal plane (with EO and EC ($P<0.05$); in relations of ellipse length to its width in all positions ($P<0.05$); static kinesiogram length to its area in all positions ($P<0.01-0.05$). We observed distinctions

in levels of spectrum density by vertical component in all positions ($P<0,05$). Head turns caused substantial changes of functional stability and index of balance (EO, EC, $P<0.05-0.01$). Indicators of stabilometry in orienteers and elite runners were different in positions with head turn in main stance with closed eyes; head turns ($P<0.05$) [11]. Even greater differences were registered in respect to elite runners ($P<0.01$). In main stance, dynamic coefficient significantly differed with deprivation ($P<0.01$) with orienteers' priority.

Specific postural characteristics of orienteers and runners were found in comparison of indicators in stance (EO, EC) and head turns ($P<0.01$). We do not present runners' indicators but show only results of confident distinctions' comparison. Runners' results were analyzed in works by V.V. Erlikh [32].

Dynamic coefficient of balance in main stance with closed eyes was better in orienteers ($P<0.01$).

Discussion

In our research we found specific influences of kind of sports on postural characteristics in SKB (static-kinetic balance). With it, important role is played by bio-mechanical motor parameters and reflex of stretching [36, 47]. In motor actions, SKB is regulated by many links' regulation system. Total body sizes, age, sex, kind of sports influence greatly on athlete's balance: in main stance; in overcoming obstacles of ascents and descents [44, 46]. In main stance thigh flexors and extensors work simultaneously and it conditions balance when wiggling in sagittal plane (forward-backward in respect to legs). It coincides with received by us postural characteristics. In literature the question of sport efficiency provisioning is still discussible, i.e. about adaptation strategies [36]; role of elastic-viscose properties of muscles; role of breathing muscles [47]. The controlled range of signals' reacting and convergence correlate regulation's sensitivity. Somatic sensor cortex controls general levels of sensitivity of stimulated organs (receptors of muscles', ligaments and joints' stretching, which are in post central cingulated) [6, 16]. Direct and short signals regulate sensitivity level of sensor input. Posture sustaining in different relieves of terrain results in tension of SKB. Constant differentiation of sensor signals of somatic and other systems is required [31]. V.S. Gurfinkel assumed that main task of vertical posture's regulation system is sustaining of body mass center's projection inside of supporting contour of feet (ankle strategy).

It is confirmed by research of D.V. Skvortsov [26]. The work of Nashner L.M. [46] is devoted to studying of Romberg's posture. The author found postural characteristics of body regulation. The received by us results are of priority, comparing with indicators of control [26]. Finding of individual characteristics

of morphological functional state permits to predict potentials of reacting to muscular impacts [50].

Finally, it should be noted that in literature we did not find the researches of such kind (except devoted to physical fitness). Comparison was with runners of the same age and sex: results have been presented in the work. Our results of physical fitness assessment coincide with other authors' works [11, 5, 1]. The problem of junior athletes' adaptation characterizes integrative functioning of organism, considering physical fitness, special endurance, bio-energetic potentials and stabilometric indicators. It permits to analyze bio-mechanical parameters of junior athletes' activity in sport training system. Our data permitted to deepen knowledge about static/kinetic balance of athletes in the regarded kind of sports.

Conclusions

1. Integrative assessment of combined characteristics for development of local/regional and special muscular endurance showed effective adaptation of junior orienteers. It is recommended to fulfill stretching exercises in combination with speed power and relaxation exercises.

2. In system of junior orienteers' sport training we found the following: gender distinctions in carbohydrates and fats consumption ($P < 0.05-0.01$) in the ranges of aerobic and anaerobic thresholds; substantial physiological changes in static/kinetic balance (tests with open and closed eyes) all these shall be considered in athletes' training.

Conflict of interests

The author declares that there is no conflict of interests.

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Information about the authors:

Abzalilov R.Y.; <http://orcid.org/0000-0002-5441-7480>; abzalil.r@mail.ru; Bashkir State Medical University; Lenin str. 3, Ufa, 450000, Bashkortostan Republic, Russia.

Rybakov V.V.; <http://orcid.org/0000-0003-2640-0240>; julyaa-74@yandex.ru; South Ural State University; 60 Soni Krivoy st., Chelyabinsk, 454080, , Russia.

Isaev A.P.; <http://orcid.org/0000-0002-8136-9656>; isaevap@susu.ru; South Ural State University; 60 Soni Krivoy st., Chelyabinsk, 454080, , Russia.

Erlikh V.V.; <http://orcid.org/0000-0003-2640-0240>; julyaa-74@yandex.ru; South Ural State University; 60 Soni Krivoy st., Chelyabinsk, 454080, Russia.

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