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METHODIC OF SENIOR PUPILS' TRAINING TO THROWING MOVEMENTS ON THE BASES OF TECHNOLOGY OF COMPLEX IMPACT ON MOTOR AND INTELLECTUAL DEVELOPMENT

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Abstract
Purpose: to determine influence of technologies of integral cognitive and motor orientation on training of throwing technique in light athletic. *Material:* 2 groups of schoolgirls participated in the research: control (n = 22 – girls) and experimental (n = 21 – girls). *Results:* positive effect of authors' methodic application is ensured by adequate selection of exercises and expansion of theoretical aspect of training program. The program includes interdisciplinary connections and informational technologies for activation of associative perception of principles of rational movements' technique. Practical fulfillment of preliminary and main exercises is supplemented by theoretical studying of basic light athletic movements' bio-mechanical principles. At lessons on informatics, geometry, biology pupils watched educational film, in which there was shown analogy in rule of vectors' addition and laws of bio-mechanical forces' addition. *Conclusions:* We have shown validity and purposefulness of application of the methodic at light athletic trainings of senior forms pupils.
Keywords: abilities, skills, athletics, students, methods.

Introduction

In modern society there is acute problem of rising generation's health improvement with different mean of physical education and sport trainings, with higienic factors [1; 2; 3; 5; 6; 23]. In a set of health improvement means motor functioning is a determining one [12; 13; 14; 15; 16]. This problem is especially urgent for senior forms girls.

However, it is known [20; 21; 22; 25; 26; 29], that senior girl-pupils loose interest to compulsory lessons on physical education in school. One of the most difficult discipline in school physical education is light athletic [22; 24]. But exactly light athletic movements are the basic for a human being, because they facilitated survival of human being as species in evolutional process [4]. That is why at present time light athletic skills are principal for many kinds of sports as well as for many movements of everyday life. In this connection there appears a problem of increasing senior pupils' interest to light athletic trainings as well as increasing of effectiveness of light athletic trainings. Working out of appropriate means and methods will facilitate solution of the problem.

It is known [8; 9; 10; 11; 28; 31], that with increasing of mastering level of any skills wish to continue this kind of functioning also increases. It facilitates further perfection in this kind of activity.

In this connection especially difficult is to overcome psychological inertia, which hinders from regular practicing of some kind of motor functioning. Especially it is characteristic for light athletic, which is traditionally "difficult" kind of sports [17]. That is why working out of methodic for activation of intellectual component of light athletic exercises' mastering is an urgent and topical task. Its significance is actualized also by the fact that educational tasks are reduced to obtaining of necessary scope of knowledge by schoolchildren. After leaving school this knowledge will permit to use physical culture means independently and consciously during all life [27; 30; 32; 33; 34].

Purpose, tasks of the work, material and methods

The purpose of the work is to determine influence of technologies of integral cognitive and motor orientation on training of throwing technique in light athletic.

For determination of authors' methodic (implying training of senior girl-pupils' motor skills at academic and circle light athletic trainings) influence we conducted formation pedagogic experiment in period from September 2013 to May 2014. Control (n = 22) and experimental (n = 21) groups were composed of senior forms girl-pupils from Mu'tah, Al-Karak, Jordan.

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Results of the research

For training of light athletic basic movements we worked out methodic, based on practical fulfillment of preliminary and main exercises in combination with theoretical study of bio-mechanical principles of light athletic movements. With it we used interdisciplinary connections and informational technologies for activation of associative perception of principles of movements' rational technique (see fig.1.).

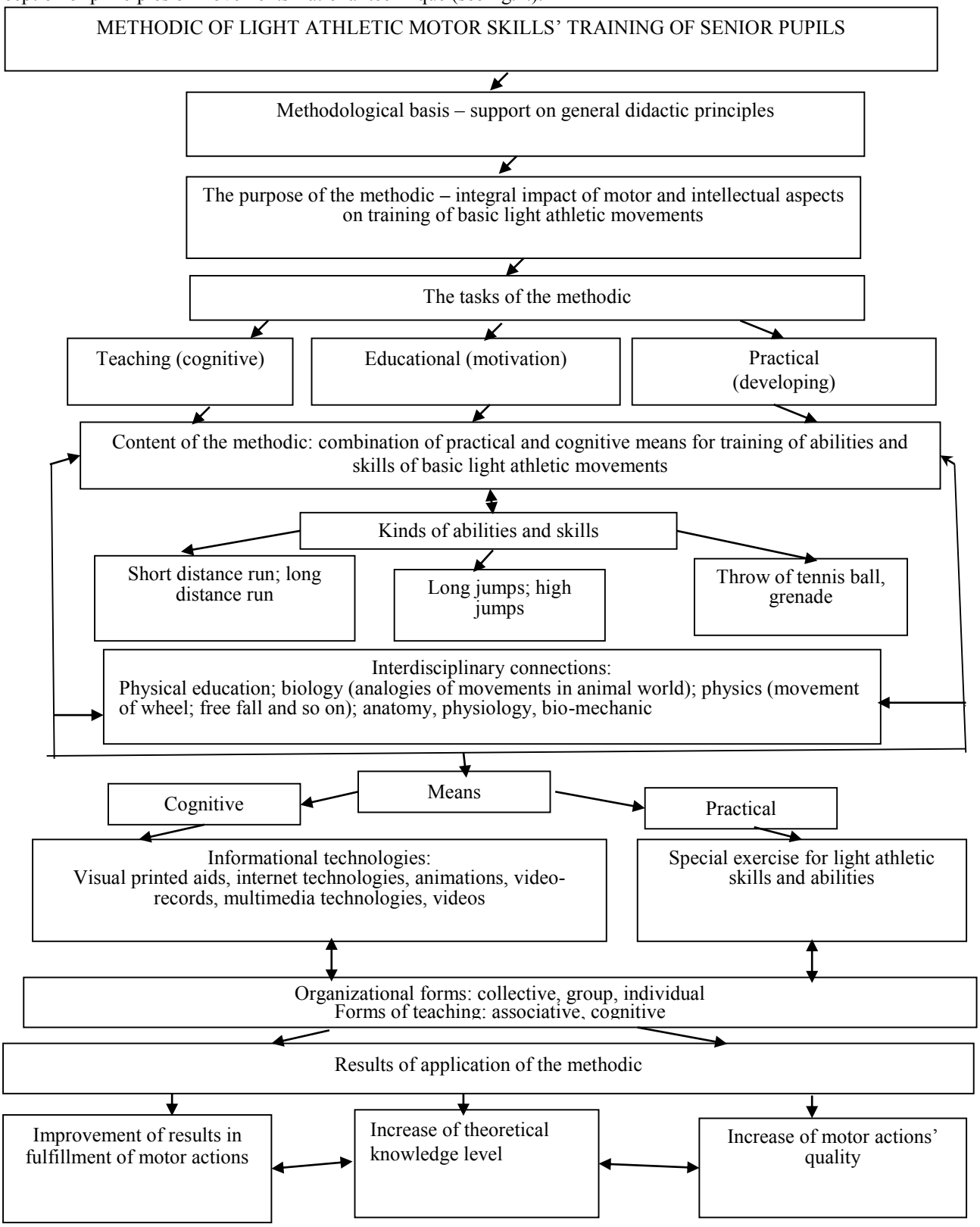

Fig.1. Model of authors' methodic of motor skills' and abilities' training for senior forms pupils at light athletic lessons

Training of throwing was a component of methodic of light athletic motor skills' training. Throws are characteristic for light athletic. Besides, throws are one of basic movements of man. Application of interdisciplinary connections in practical realization was the following: at lessons on informatics, geometry, biology pupils watched educational cartoon. In the film there was shown analogy in rules of vectors' addition and laws of bio-mechanical forcers' addition. As an example there were used passes of ball, interaction of forces of ants when they carry load, rules of forces addition in any collective unidirectional action [7].

The pupils are explained in detail the rule of forces addition by vectors. It is accompanied by examples of forces addition by vectors. For example, correct technique of ball pass in game kinds of sports was demonstrated. In the same way addition of forces by vectors takes place in light athletic throws. Thus, the pupils were shown how muscles shall "switch" in the movement correctly as well as how they create force, which facilitates accurate and strong throw in target (see fig. 2). This force is a result of addition of all forces' vectors, which ensure this movement. That is why, when passing ball and when throwing in light athletic all muscles shall work. It is important because the most frequent mistake of schoolchildren is stance of straightened legs, when throwing. With it correct usage of speed-power component of the movement is impossible, as well as proper accuracy of throw [7].

As an analogy from animated nature we supplied example of collective carrying of load by ants, when forces vectors of all ants' actions are added. From this point of view it is useful to bent legs with ball passing. With it the biggest legs' muscles "switch" in action. It ensures speed-power aspect for fulfillment of this technique. Also examples from epic literature were given as analogies of forces addition by vectors [7].

This material is presented as educational film (cartoon), in which materials of geometry, physics, biology and physical culture are combined. It facilitated correct understanding of material by pupils.

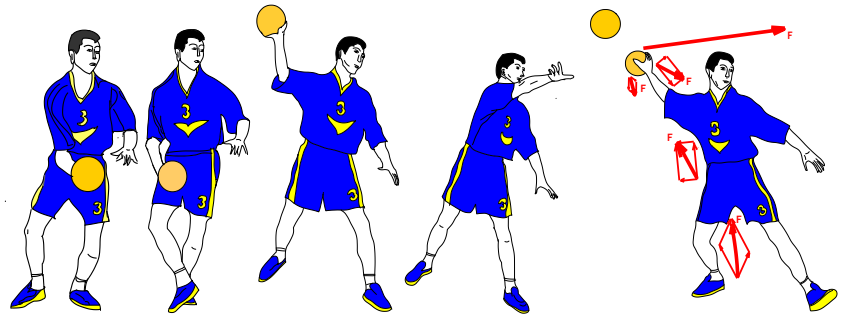

Fig.2. *Fragments of educational cartoon: rules of forces addition by vectors when throwing [7]*

As a result of experiment in experimental group we registered confident changes of testing indicators of motor fitness.

Table 1. Indicators of motor fitness of control (n=22) and experimental (n=21) groups before and after experiment (girls)

Indicators	Period of testing	Group	$\bar{x}$	S	m	p BE-AE	p CG-EG, BE	p CG-EG, AE
1	2	3	4	5	6	9	11	13
Throw of ball (m)	BE	EG	15,24	2,13	0,18	0,03	0,65	0,02
	AE		17,35	2,08	0,15			
	BE	CG	15,36	2,12	0,18	0,45		
	AE		15,39	2,16	0,16			
Experts' assessment of throw technique, points	BE	EG	2,87	0,56	0,22	0,02	0,19	0,01
	AE		4,21	0,58	0,21			
	BE	CG	2,77	0,49	0,17	0,47		
	AE		2,92	0,65	0,19			
Mark for theoretical testing, points	BE	EG	25,4	5,76	0,82	0,02	0,67	0,03
	AE		47,8	5,29	0,77			
	BE	CG	26,7	5,34	0,79	0,15		
	AE		27,1	6,73	0,76			

Notes: CG – control group; EG – experimental group; BE – before experiment; AE – after experiment.

Confident changes in girls' motor fitness indicators were registered in test "Throw of ball, m".

In control group such changes were not confident (see table 1).

Effectiveness of our methodic application is confirmed also by the fact that in experimental group level of motor skills increased. This level was determined by experts' assessment and theoretical knowledge (see table 1). In control group such changes were not confident (see table 1).

It should also be noted that control and experimental groups did not differ between each other confidently before experiment. After experiment the groups differed confidently by all tested parameters (see table 1). The received results show the validity and purposefulness of application of the worked out methodic. Thus, application of the worked out methodic of motor actions' training facilitates increasing of motor fitness indicators. It is an important aspect of schoolchildren's physical education. Positive effect of application of this methodic is ensured by adequate selection of exercises and expansion of theoretical aspect of training program. This program includes interdisciplinary connections and informational technologies.

Discussion

The received results confirm literature data about age peculiarities of senior school age children. G.L. Apanasenko [2]; Zh.L. Kozina [7], S.S. Iermakov [6], O.V. Antonov [1] showed demand in research of senior school age children's physical education. It permits to scientifically substantiate training programs and normative, concerning physical condition and physical fitness of schoolchildren. Presence of knowledge on these questions permits to form principle approaches to understanding of purposes, tasks and contents of physical culture school program показали необходимость исследования проблем физического состояния детей старшего школьного возраста. [18; 19].

One of the most important factors of child's growth and development is satisfaction of his (her) natural demand in motion. However, this natural demand is not sufficient. In our work we also confirm the results of authors [26; 27] that in puberty age demand in motion increases, though satisfaction of this increased demand is rather difficult in conditions of modern civilization. In this connection application of informational technologies with information about rational construction of movements permits to form children's proper attitude to training of motor skills [8; 9; 11]

Concerning application of informational technologies and interdisciplinary connections we confirmed the data of L.S. Dvorkin [5]. Our research also widens results of researches, conducted by Zh.L. Kozina [7] *and S. S. Iermakov* [6]. In these researches there was substantiation of working out and application of informational technologies for provisioning of trainings' visibility by different means of motor functioning. However, in works by Zh.L. Kozina [7; 8; 10] informational multimedia technologies for application in sport activity are stressed. Our work is devoted to working out of methodic of informational technologies' application of sphere of schoolchildren's physical education.

Our research expands the data of F.I. Sobianin [19], who elucidates different aspects of application of interdisciplinary connections in teaching process. The author shows effectiveness of interdisciplinary connections and information technologies' applicationв in training of movements.

Conclusions:

1. As a result of theoretical analysis and practical work we developed methodic of throws' training, which implied application of interdisciplinary connections and information technologies. At lessons on informatics, geometry, biology pupils watched educational film, in which analogy between forces vectors addition and laws of bio-mechanical addition of forces was shown.

2. As a result of the researches in experimental group we registered confident changes of testing indicators of motor fitness level. Level of mastering of motor skills also increased in experimental group that was registered by experts' assessments. In control group such changes were not confident.

The received results show validity and purposefulness of application of motor skills' training methodic with usage of interdisciplinary connections and information technologies on light athletic lessons of senior pupils.

The prospects of further researches imply perfection of methodic of skills' formation in schoolchildren with the help of integral impact of interdisciplinary connections and informational technologies.

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Conflict of interests

The authors declare that there is no conflict of interests.

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OBJECTIVE CRITERIA FOR DETERMINATION OF FUNCTIONAL-RESERVE POTENTIALS OF SECONDARY SCHOOL AGE PUPILS

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Abstract. *Purpose:* to substantiate criteria for determination of functional-reserve potentials of secondary school age pupils. *Material:* 1017 pupils of 5-9 forms from 16 schools were questioned. Besides, 200 physical culture teachers from 75 schools of 25 Ukrainian cities were questioned. 154 schoolchildren were tested/ Physical fitness and health levels were tested by index. Pupils fulfilled 4 simple test exercises. *Results:* we determined indicators of physical condition, psychic state, scopes of motor functioning. We substantiated criteria for determination of schoolchildren's functional-reserve potentials as well as values of boundary physical condition and physical fitness indicators, which guarantee strong health and optimal functional-reserve potentials of pupil's organism. *Conclusions:* Deviation of these indicators' complex from boundary values informs about pupils' potential belonging to group of risk. It requires correction of pupil's way of life and his (her) motor functioning.
Key words: pupils, fitness, physical condition, functional, reserve.

Introduction

Level of physical loads at physical culture lessons (PC) depends on pupil's functional-reserve potentials. Functional-reserve potentials are determined by medical workers, to whom a pupil was addressed by results of medical examination. At present, in Ukraine the main criterion for determination of pupil's health group is results of Ruffiet's test. But for persons younger than 17 years old this test is not informative. It is suitable for adults and does not consider natural increased heart beats rate of 6-16 years old children in rest state [8]. Its application results in mistaken addressing of healthy child to preparatory (PHG) and even to special health group (SHG) as well as in groundless decreasing of admissible physical loads at PC lessons. Scientifically adapted for children Ruffiet's test [8] is nearly unknown and is not used in practice.

Parents, if they wish, can fulfill adapted test in home conditions and determine independently workability of cardio-vascular system of their child. For this purpose they need certain skills and some equipment (stopwatch, metronome and so on).

Though for assessment of health and organism's functional-reserve potentials it is important to consider morphological, muscular, motor, cardio-respiratory and metabolic components [14]. While Ruffiet's test permits to assess workability of cardio-vascular system (indeed important but not the only in organism).

So we consider imperfect the existing criteria and means of determination of school age children's functional reserves: not informative, bulky, requiring special skills and equipment; not suitable for application in domestic conditions. That is why in practice individual level of optimal for every pupil load at PC lessons is determined by teacher, subjectively. Though, in conditions of integrated physical education (PE) of schoolchildren from different health groups it is important for teacher to have exact information about functional potentials of every pupil. For parents it would also be useful to know boundary indicators of physical condition (PCn) and physical fitness (PF) intrinsic to practically healthy children. Substantial deviation of indicators from boundaries of norm will permit to prognosticate probable worsening of health, to find "weak links" in functional state and take necessary measures in due time; for example to work out complex of exercises and choose methods of health strengthening.

Integrative PE of different health groups' children in Ukraine is accompanied by a number of unsolved problems, among which the most urgent (in opinion of PC teachers) is medical (91%) provisioning of this process. PC teachers' below average readiness for integrative lessons with different health groups' pupils also noticeably complicates this process. The existing criteria of pupils' distribution in health groups (by experts' assessments – 1.4, 1.6 points by 4 points' scale) also require perfection [1, 4, 13].

Pupils with health problems have some distinctions in a number of indicators of physical and mental condition, in PF [9, 10, 11, 19 et al.]. Local character of information about "corridors" of normal values of indicators of physical and mental condition, motor functioning (MF) and PF also hinder correct choosing of MF and PCn strategy. Deviations from their boundaries threaten with possible diseases and then passing to SHG.

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Purpose, tasks of the work, material and methods

The purpose of the research is to substantiate criteria for determination of functional-reserve potentials of secondary school age pupils.

Tasks: 1. Determination of social-psychological indicators, PCn, PF, scopes of MF suitable for secondary school age pupils with different functional reserve potentials.

2. Determine objective indicators of PCn and PF, ensuring optimal level of pupil's functional-reserve potentials.

3. Find out optimal values of registered indicators.

Experiment was approved by ethic committee of university. Children's participation in experiment was confirmed by written agreement of their parents.

The methods of the research: generalization of literature data, questioning of schoolchildren, pedagogic: testing, experiment with application of tool methodic, medical biological methods, methods of mathematical statistic (determination of mean arithmetic and its standard deviation, regressive and correlation analysis).

Questioning of three three health groups' children was conducted for determination of leisure kinds, which were of priority for them; preferable kinds of MF during lessons and out of lessons; different organizational forms of PE at schools; prevalence of harmful habits; their attitude to PC (their motive and interests: reasons of their negative attitude as well as missing of PC lessons) and passing tests for physical fitness. 1017 pupils of 5–9 forms from 16 schools participated in questioning. Among them there were 510 girls and 507 boys; 365 persons were from 5 forms; 342 – from 7 forms; 310 – from 9 forms. 631 pupils belonged to MHG, 327 – to PHG and 59 – to SHG.

The selected exercises were tested for authenticity. The testing witnessed that selected exercises had acceptable reliability (r_{tt}=0,81–0,90) and informative character (r_t=0,80–0,89) for assessment of physical skills in secondary school age.

For substantiation of logical (content) informative character we questioned PC teachers and experts in this field. 200 PC teachers from 75 schools of 22 Ukrainian cities were questioned. Experts (*n=19*) were 10 doctors of PE and sport sciences, 4 doctors of biological sciences, 5 candidates of PT and sport sciences, who worked in this field more than 20 years.

Tests' informative potential was determined empirically. As tests-criteria we used exercises with proved reliability. For this purpose we found correlation coefficient between results of passing of tests, constructed by us, and tests of previous testing.

For checking of tests for empiric reliability we involved 154 pupils of 5-9 forms (one form from every year). Initial testing we conducted in November – December. Main testing was conducted in January – February of the next calendar year. That is pupils had enough time for recreation of motor potentials. However this was insufficient for increasing of physical fitness. Conditions of testing, experimenters and contingent of the tested were the same in both cases. Main testing covered 1417 pupils of secondary school age школярів (10–16years old): 762 boys and 655girls.

Level of PF and health was determined by index, calculated with equation [2, 5] by results of passing of 4 simple test exercises: arms' bending and bending (with arms behind back, resting on bench) during 20 seconds; throws and catching of volleyball ball with two hands from wall during 30 sec.; right (left) torso bents, mm; torso rising in sitting position during 30 seconds. Stating pedagogic experiment (for obtaining of regression equations) was conducted with application of tools' methodic. Correlation coefficient (r=0,54) between integral indicators of functional state of health and PCn and health of pupils witnesses that obtained by us equations of multiple regressions permit to assess pupils level of health with moderate accuracy.

Conditions of tests" fulfillment:

Arms' bending and unbending (with arms behind back, resting on bench) during 20 seconds. Only complete arms' bending and unbending were considered. The exercise permits to assess arms' power endurance.

Throws and catching of volleyball ball with two hands from wall during 30 sec. Distance from the wall was 2 meters. Hitting of ball was not considered – only catching with hands. Two attempts with rest paused of 2 minutes were fulfilled and the best result was registered. For complex assessment of different forms of dexterity we recommend to draw a "target" of 1×1 m on the wall with center at pupils' eye level (distance from floor to bottom of target shall be 1 meter. Throws out of target shall not be registered. It is recommended for assessment of pupils' dexterity.

Right (left) torso bents. Initial position – standing vertically, hands in contact with hips: level of distal phalanx of middle finger of hand on hip shall be marked with choke. A pupils bends to the right and stops in this position for 2-3 sec. Second choke mark is made. Then the distance between two marks is measured (accuracy of 1 mm). To avoid bending forward the exercise shall be fulfilled by the wall with pupil's shoulder blades being in contact with the wall.

It is recommended for determination of backbone flexibility in frontal plane and possible asymmetry.

We recommend calculating index of backbone mobility by the following formula:

$$IBM = \frac{(L_1 - L_2) \times 0{,}5 - (L_2 + L_1)}{L_3} \quad (1)$$

Where IBM– index of backbone mobility;

L_1 – (lower) result of one side bending, mm;

L_2 – (higher) result of other side bending, mm;

L_3 – length of body, cm.

Torso rising in sitting position during 30 seconds from lying position with legs bent in knees under angle of 90°; feet are fixed and arms are crossed on chest. It is recommended for testing of abdomen muscles' power endurance.

Diagnostic of pupils' functional state was carried out with the help of program apparatus complex "Omega-M", produced by Company "Scientific-research laboratories "*Dinamika Technologies*"" (S-t Petersburg) [15]. Integral indicator of functional state of pupils' health was deduced on the base of systemic analysis of functional and biological reserves, assessment of pupil's psycho-physical and psycho-emotional state. 85 pupils (42boys and 43 girls) were tested. The researches were conducted in conditions of ordinary working day in academic year (3rd academic semester), after standard warming up before main part of PC lesson. Electric cardiogram was recorded during 5 minutes in sitting position. Electrodes were applied on limbs according to commonly accepted methodic in 1st standard lead.

The levels of functional state were in the following ranges of indicators (conv.un.): 0,81–0,100 – функціональний стан організму відповідав нормі; 0,65–0,80 – normal functional state; 0,40–0,64 – insignificant deviations from normal state and repeated examination is recommended; 0,20–0,39 – functional state is far from normal – consultation with doctor is recommended; 0–0,19 – pre-morbid state, signs of pathological changes; clinical examination is recommended.

For measuring of MF scope we used Framingham method [7]. It implies timing of day MF and its assessment with energy equivalents of MF level. Person's day functioning was divided into five levels: basic, immobile, little, average and high. Certain kinds of functioning correspond to each of them. We accumulated and processed indicators of 857 pupils.

Medical-biological methods of the research were used for determination of PCn indicators. Measurements were conducted in compliance with commonly accepted methodic.

Ketle's index was received with formula:

$$IK = M / L, \quad (2)$$

Where IK – Ketle's index, g/cm;

M – body mass, g;

L – body length, cm.

Slouch index was obtained by formula:

$$SI = SA / SW \times 100, \quad (3)$$

Where SI –slouch index;

SA – shoulder arc (arc distance between shoulder points - back side, cm).

SW – shoulder width (distance between shoulder points - front side, cm).

Skibinskiy's index was determined by formula:

$$SkI = (VCL / 100) \times T / HBR\ , \quad (4)$$

where SkI – Skibinskiy's index

VCL – vital capacity of lungs, ml;

T – time of breathing pause after inhale, sec.;

HBR – heart beats rate in relative rest, b.p.m.

Index of pupils' somatic health was determined by express-method of G.L. Apanasenko. Our modification of this express-method implied usage of adapted by I.P. Zanevskiy (2013) method for assessment of cardio-vascular system's condition and physical workability of children and adolescents (see table 1).

Table 1. *Gradation of levels of cardio-vascular system's functional reserve for secondary school age pupils (by [8])*

Level of cardio-vascular system's functional-reserve potentials	Offered model, considering age						Health groups for physical culture lessons
	10 years	11 years	12 years	13 years	14 years	15 years	
1 – low	≥ 21,4	≥ 19,4	≥18,2	≥ 17,0	≥ 15,7	≥ 15,1	special
2 – below average	15,4-21,3	13,7-19,3	12,7-18,1	11,6-16,9	10,6-15,6	10,0-15,0	
3 – average	11,8-15,3	10,3-13,6	9,3-12,6	8,4-11,5	7,4-10,5	7,0-9,9	preparatory
4 – above average	8,2-11,7	6,9-10,2	6,0-9,2	5,2-8,3	4,3-7,3	3,9-6,9	main
5 – high	≤ 8,1	≤ 6,8	≤ 5,9	≤ 5,1	≤4,2	≤ 3,8	

Organization of the research: at first stage we found social-psychological, Pcn, PF, MF indicators of secondary school age pupils with different functional reserve potentials (different health groups).

At second stage we accumulated objective (well known, simple in determination but, nevertheless, informative) indicators of PCn and PF, which ensure optimal level of pupil's functional reserve potentials. We considered informative such PCn indicators, which substantially (p<0,05-0,001) differed in main and special health groups. By results of all 11 offered by us test exercises we observed confident distinctions between pupils of different health groups. Results of 4 test exercises, which are the most closely connected with integral indicator of pupils' functional state, also were considered to be informative.

At next stage we found optimal boundaries of the accumulated indicators. Pupils' indicators, which were characterized by high level of functional-reserve potentials, the best compensation reserves, high and above average organism's adaptation, sufficient activity and appropriate psycho-emotional state were considered to be optimal.

Results of the research

We determined social-psychological, Pcn, PF indicators, scopes of MF for pupils with different functional-reserve potentials. Also we found that by great number of indicators distinctions of pupils from different health groups did not reach statistically confident significance. Their changes witness about existence of trend to changes of the mentioned indicators: in particular trend to worsening of pupils' attitude to MF (its different forms and means) with reduction of functional-reserve potentials.

We found indicators, by which secondary school age pupils with different functional-reserve potentials noticeably (p<0,05–0,001) differ between each other. We determined that pupils with low and below averageв functional reserve potentials noticeably (p<0,05–0,001) differ by a number of ***social-psychological indicators:*** they oftener watch TV; too rarely walk by foot and practice sports; have less sleep than representatives of other health groups. Among pupils with deviations in health there is bigger quantity of cigarette smokers and alcohol drinkers. Also they start smoking earlier that proves pupils' with health deviations bent to risky behavior as well as to de-valuation of basic existential values, domination of biological demands (demand in stimulation with psycho-active substances). Their attitude to physical education is extremely less (p<0,05–0,001) wish to pass tests for physical fitness and have differentiated mark on "Physical culture" discipline. Besides, they want to have less quantity of physical culture lessons in week [3, 6, 12].

We observed confident increase of quantity of pupils with low level of self-feeling and reduced functional-reserve potentials. Probably, it can be a result of weakening of their physical fitness. With increasing of deviations in health there appeared a trend to decreasing of subjective assessment of own functioning. It was proved by objective data about MF reduction with morbidity increase. Among DHG pupils there was confidently (p<0,05) higher quantity of persons with weak nervous system than among physically stronger pupils [16].

Analysis of the received data witnesses that total volume of ***MF*** and ***energy*** consumption (see table 2) of pupils during day do not differ between different health groups. It can be connected with equally low level of MF

independently on functional-reserve potentials. Though, volume of high level MF in SHG is significantly less than in other groups. It should be noted that pupils with reduced functional-reserve potential one-night sleep 1 hour 45 minutes less (p<0,05–0,01), than other. A little bit higher (p>0,05) was undefined time of these children, which is a reserve for increasing of their MF.

Table 2. Motor functioning of pupils (n=1017) of different health groups різних

Indicators	Health groups	Special (*n*=59)	Preparatory (*n*=327)	Main (*n*=631)
Energy consumption, k.cal.		2006,69 ±513,54	2212,93 ±490,56	2238,96 ±498,80
Motor functioning levels, %	high	**0,52**	**0,67^**	**1,38***
	average	3,44	4,07	4,83
	low	33,34	**34,77^**	31,84
	immobile	12,93	13,22	13,73
	basic	**31,45**	**38,10***	**38,37****
	undefined	18,31	9,17	9,85

Notes:

1. ^ – confidentiality of differences between indicators of 7th and 9th forms, PHG and MHG – p<0,05;
2. Levels of differences' confidence: * – *p*<0,05; ** – *p*<0,01.

In ***physical condition*** confident (*p*<0,05–0,001) distinctions between pupils with different functional-reserve potentials were registered by the following indicators: body mass, VCL; hand's power; a number of indices [slouch, resistance to hypoxia (Shtange), mass-height (Ketle), Skibinskiy]; index of somatic health; functional state and its components (organism's adaptation, vegetative and central regulation, psycho-emotional state). The most often we noticed distinctions in 13-14 years' age: in girls – oftener than in boys.

Analysis of integral indictor of ***health functional state*** of pupils (see table 3) resulted in determination that its level in MHG was above average. In PHG and SHG these indicators were lower (within "corridor" of mean values, characterized by insignificant deviations from norm. Though mean values of health condition in these both groups were assessed as satisfactory. Results of PHG were close to upper boundary of average level. SHG functional state indicators were close to lower boundary of average level. These indicators adjoined with abnormal values. So, pupils of different health groups demonstrated substantial (p<0,01-0,001) distinctions in indicators and levels of their health functional state.

As it was expected pupils with reduced functional-reserve potentials confidently lagged behind their peers from other health groups by level of ***all physical skills.***

The received results permitted to understand the borders of optimal values of chosen by us objective criteria for testing of pupils' functional-reserve potentials (see table 4). For determination of functional-reserve potentials' level it is necessary to compare PCn and PF (and MF) indicators with values, given in table 4. PCn and PF indicators in shown limits witness about high functional-reserve potentials of pupils. If there is substantial (±σ) deviation of one indicator or complex of them from boundary values, then scopes and intensity of pupil's MF require correction. It is necessary for prevention from possible worsening of health and pupil's potential belonging to SHG.

Discussion

In special literature there is quite a few data about distinctions of children's with different functional-reserve potentials indicators; in particular about distinctions between SHG and practically healthy children. The most often the object of scientific researches were children of certain age or of the whole period without differentiation by age. It made impossible to determine age dynamic of changes. In some scientific works there are results of examination of one sex children or only sick children of one nosology [9, 19]. It narrows the range of conclusions. There is nearly no data about specificities of leisure and place of children's motor functioning in it. Our data were received on sample of three health groups, of both sexes, of age groups 10-15 years old. These data are characterized by novelty, representative and informative character.

Table 3. Mean values of health functional state (conv.un.) of secondary school age pupils of different health groups

Health group	Indicators	Level of organism's adaptation	Indicator of vegetative regulation	Indicator of central regulation	Psycho-emotional state	Integral indicator of health condition	
Main (MHG) (*n*=22)	M	**0,75***phg**	0,78 **phg**	**0,70***phg**	**0,73*phg**	**0,74**phg**	AA
	SD	0,16	0,22	0,10	0,11	0,14	
Preparatory (PHG) (*n*=45)	M	**0,62***shg**	**0,65***shg**	**0,62*** shg**	**0,64** shg**	**0,63***	A
	SD	0,20	0,27	0,16	0,17	0,19	
Special (SHG) (*n*=18)	M	**0,43***mhg**	**0,39*** mhg**	**0,45*** mhg**	**0,48** mhg**	**0,44*** mhg**	A
	SD	0,24	0,26	0,20	0,20	0,22	

Notes:

1. AA – above average, A – average level of health functional state.
2. Levels of distinctions' confidence: * – $p<0,05$; ** – $p<0,01$; *** – $p<0,001$;
3. Little letters above wavy line denote groups of pupils between distinctions were registered.

Results of our researches supplement the data of other specialists [9, 10, 11, 19] about distinctions of children with deviations in health from healthy children. It was found that SHG pupils vary by a number of PCn, PF, MF indicators by psychic state from pupils with higher functional-reserve potentials. We confirmed that SHG pupils often have special social-psychological features. These features are characteristic for persons with health deviations: higher probability of harmful habits; increased demand in defense; separation from other children; increased anxiety; weakened self-assessment of own activity (proved by objective data). SHG pupils are group of increased risk of serious worsening of health owing to low level of some indicators. That is why they require increased attention of parents, pedagogues and medical workers. The found by us relatively less scopes of SHG pupils' day MF (probably) can result from low level of nervous cells' and nervous system in general workability.

Our researches confirmed [10, 11] the presence of confident distinctions between PCn indicators of secondary school age pupils. We confirmed that level of PHG pupils' lagging behind MHG pupils was less than between indicators of PHG and SHG. It was connected with less quantity and degree of confident differences. Application of progressive tool methods permitted for us to specify level of health functional state of SHG pupils (mean value is close to lower boundary of norm). It was confirmed [10] that condition of all physical skills of SHG pupils was substantially lower than indicators of practically healthy children. For the first time, for control during PC lessons we selected those exercises, results of which are connected with level of health functional sate of pupils.

Our researches proved that high probability of high functional-reserve potentials of 10-12 years old girls is prognosticated by the following: high indicators of power index; higher than average indicators of modified Ruffiet's test; mean values of life index and Robinson's index. In case of boys they are high indicators of power index. They are higher than mean indicators of modified Ruffiet's test, life index and Robinson's index.

Such levels of PCn indicators ensure higher than average level of somatic health. Somatic health level by modified by us express-methodic of G.L. Apanasenko, considering modified Ruffiet's test, shall be above average (12,4±2,2 conv.un.).

Slouch index shall be higher than 95,43±4,22 conv.un. independent on age of a child.

Index of PF and health shall be within 0,54-0,57 conv.un. that characterizes its level as average.

Table 4. Optimal values of physical condition, physical fitness and motor functioning (X±σ) of 10-12 years old pupils with high adaptive-functional potentials

Indicators	Sex, age	girls			boys		
		10 years	11 years	12 years	10 years	11 years	12 years
Physical condition							
Ketle's index		257,18 ±36,63	255,64 ±44,06	316,31 ±40,80	249,26 ±35,19	258,11 ±29,97	267,05 ±44,54
Life index, ml/kg		54,93 ±8,37	61,58 ±14,83	53,19 ±7,11	70,61 ±10,91	70,84 ±11,44	69,91 ±12,85
Shtange's test, sec.		40,65 ±9,49	38,53 ±8,17	37,55 ±9,61	42,95 ±5,14	42,32 ±7,34	40,28 ±9,48
Skibinskiy's index		10,56 ±4,36	11,16 ±3,68	12,13 ±3,47	15,14 ±3,84	15,97 ±4,87	16,81 ±6,86
Power index, kg		59,45 ±15,09	59,04 ±14,82	58,22 ±13,80	78,40 ±14,40	74,47 ±10,30	75,57 ±10,42
Somatic health index (by modified express-methodic of G.L. Apanasenko), conv.un.		12,4±2,2					
Slouch index, conv.un.		95,43±4,22					
Physical fitness							
Arms' bending and unbending (with arms behind back, resting on bench) during 20 seconds, times		21,22 ±3,75	21,03 ±4,47	20,32 ±7,83	20,63 ±5,02	20,89 ±5,90	20,69 ±6,15
Throws and catching of volleyball ball with two hands from wall during 30 sec., times		25,94 ±6,81	25,39 ±5,48	27,91 ±6,47	27,21 ±6,06	28,03 ±5,88	32,52 ±7,11
Mean result of left (right) bent, mm		220,09 ±45,46	218,20 ±42,62	214,17 ±46,99	182,08 ±53,49	192,88 ±50,07	201,37 ±47,89
Torso rising in sitting position during 30 seconds, times		20,06 ±5,53	19,44 ±5,46	21,45 ±8,33	19,89 ±4,90	21,78 ±5,81	21,48 ±6,28
Index of backbone mobility, conv.un.		5,78 ±1,62	5,79 ±1,81	4,12 ±0,99	4,73 ±1,89	4,64 ±1,45	4,38 ±1,27
Index of physical fitness and health, conv.un.		0,54– 0,57					
Motor functioning							
Motor functioning of high level, % of day duration		≥1,38					

Notes: methodic of indicators' determination is given in the text.

Motor functioning of high level includes specially organized physical education trainings, sports' practicing, and participation in sport competitions, dances, and intensive games, run and hiking. It shall be of not less than 1,38% of day duration (2 hours and 20 minutes).

So, the offered by us method permits for physical culture teacher [parents or scientist with the help of not difficult measurements and PF tests (instead of medical tests)] to determine compliance with norm of functional-reserve potentials and degree of deviations in indicators. It guarantees sound health and optimal level of organism's functional-reserve potentials.

Conclusions:

We have determined indicators of physical conditions, psychic state, physical fitness, scope of motor functioning of secondary school age pupils. These indicators are interconnected with levels of pupils' functional-reserve potentials. We substantiated objective criteria for determination of pupils' functional-reserve potentials. We found values of boundary indicators of physical condition and physical fitness, which guarantee strong health and optimal level of pupils' functional-reserve potentials. Deviation of these indicators from boundary ones informs about potential belonging to group of risk. It requires correction of pupil's way of life and motor functioning.

The prospects of further researches imply working out of criteria for determination of functional potentials for senior school age pupils.

Conflict of interests

The authors declare that there is no conflict of interests.

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IMPROVEMENT OF UPPER LIMB'S CONDITION OF WOMEN WITH POST MASTECTOMY SYNDROME WITH THE HELP OF PROBLEM-ORIENTED PROGRAM OF PHYSICAL REHABILITATION

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Abstract. *Purpose:* to determine effectiveness of problem-oriented program of women's physical rehabilitation with post mastectomy syndrome in improvement of upper limb's functional state. *Material:* 50 women with early symptoms of post mastectomy syndrome at stationary rehabilitation stage, who underwent radical mastectomy by Madden were involved in the research. Testing of movement amplitude in shoulder joint, swelling of upper limb and muscular strength of hand's flexors was conducted on 2nd day after surgery and at the end of stationary rehabilitation period (12-14th day). *Results:* Main means of the authors' program were: general and special physical exercises; static and dynamic breathing exercises; breathing through preloaded lips, controlled coughing, autogenic drainage, manual pressing, manual vibration; post-isometric relaxation; elements of labor therapy; lymphatic drainage massage and self massage; topical talks; consultations; auto training. The trainings were conducted individually 2-3 times a day; 20-30 minutes every session. The patients' independent trainings included: fulfillment of therapeutic positions, self-massage, relaxation exercises and auto-training. *Conclusions:* application of problem-oriented physical rehabilitation program facilitates improvement of upper limb's functional potentials of women with post mastectomy syndrome.
Key words: breast cancer, rehabilitation, shoulder joint, amplitude, swelling.

Introduction

Modern conception of breast cancer treatment is based on usage of complex impact, which includes radiation therapy, chemical therapy, hormone therapy, immune therapy. But the method of priority is still surgery [1, 2, 10, 12]. All these in total cause progressing of post mastectomy syndrome (PMS). PMS is expressed in such symptoms as lymphostasis, weakening of muscular strength, restriction of movements' amplitude in shoulder joint, disordering of sensitivity, vegetative trophy disorders of upper limb and negative psycho-emotional after-effects [2].

Advanced randomized researches prove purposefulness of early detection and constant monitoring of these disorders for timely overcoming of negative functional disorders and improvement of life quality of women of this nosology [4, 5, 8, 9, 13-24]. However, in most cases orientation on medical component of rehabilitation, working out of modern schemas of medicine provisioning, implementation of reconstructive plastic surgery, prevail. But physical rehabilitation of patients with PMS is not paid sufficient attention to.

The above said witness about significance of working out and realization of timely rehabilitation measures for timely correction of post mastectomy syndrome.

Purpose, tasks of the work, material and methods

The purpose of the research: is to determine effectiveness of problem-oriented program of women's physical rehabilitation with post mastectomy syndrome in improvement of upper limb's functional state.

Material and methods of the research: theoretical analysis of scientific-methodic literature data, Internet and empiric data; goniometry (assessment of shoulder joint's mobility); dynamometry (assessment of hand flexors' strength); anthropometry (assessment of difference between segment perimeters of upper limb at level of shoulder, forearm and hand for determination of swelling volume); methods of mathematical statistic.

The research was carried out on the base of Zaporozskiy regional cancer center. In experiment 50 women with early symptoms of post mastectomy syndrome participated. With method of random sampling we formed main group (MG) and group of comparison (CG) with 25 persons in every group. Mean age of the tested was accordingly 55,44±1,06 and 55,60±1,14 years. Testing of movement's amplitude in shoulder joint, swelling of upper limb and strength of hand flexors' muscles took place on 2nd day after surgery and at the end of rehabilitation stationary stage (12-14th day).

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Women of comparison group were treated by program of T.I, Grushina [1]. Main group was treated by authors' problem-oriented program. This program envisages reasonable choice of means, methods and forms of physical rehabilitation. All these concern: the process of post surgery period; age; characteristics of physical, functional and psycho-emotional status as well as presence of collateral pathology, type of attitude to disease and volume of surgery. For every patient of main group means, forms and methods of physical rehabilitation, which would reach the target in the most effective way, were selected individually. Main means were general and special physical exercises; static and dynamic breathing exercises; breathing through preloaded lips, controlled coughing, autogenic drainage, manual pressing, manual vibration; post-isometric relaxation; elements of labor therapy; lymphatic drainage massage and self massage; topical talks; consultations; auto training. The trainings were conducted individually 2-3 times a day; 20-30 minutes every session. The patients' independent trainings included: fulfillment of therapeutic positions, self-massage, relaxation exercises and auto-training.

Results of the researches

Analysis of the conducted experiment showed positive influence and purposefulness of application of the worked out problem-oriented physical rehabilitation program for improvement of movement's active amplitude in shoulder joint on operated side (see table 1).

Table 1. Change of goniometry indicators on operated side (M±m) of MG women in comparison with CG at rehabilitation stationary stage

Indicator	MG (n=25)			CG (n=25)		
	before	after	p	before	after	p
bending	40,52±2,42	113,80±3,15 **	<0,001	41,72±2,17	102,04±3,06	<0,001
unbending	25,20±1,59	45,36±1,77 ***	<0,001	25,44±1,49	31,44±1,45	<0,001
moving aside	37,00±1,68	110,08±3,27 ***	<0,001	39,08±1,69	78,84±5,26	<0,001
inside rotation	37,40±2,11	53,44±1,83 **	<0,001	35,48±1,97	45,28±2,26	<0,001
outside rotation	36,64±1,89	54,24±1,34 *	<0,001	37,44±1,65	49,88±1,69	<0,001

Notes: * – p<0,05, ** – p<0,01, *** – p<0,001 with comparing of final indicators of main group and comparison group.

Repeated measurement of movement's active amplitude in shoulder joint (see table 1) resulted in the following. MG patients demonstrated significant improvement of indicators: bending – by 73,28 degrees (p<0,001); unbending – by 20,16 degrees (p<0,001); moving aside – by 73,08 degrees (p<0,001); inside rotation- by 16,04 degrees (p<0,001); outside rotation – by 17,60 degrees (p<0,001).

Comparison of final indicators on operated side of main group and control groups' women showed confident distinctions by all directions of movements in shoulder joint. In MG indicator of bending was higher by 11,76 degrees (p<0,01); unbending – by 13,92 degrees (p<0,001); moving aside – by 31,24 degrees (p<0,001); outside rotation – by 8,16 degrees (p<0,01); inside rotation – by 4,36 degrees (p<0,05).

Results of changes of movements' active amplitude indicators in both groups in percents from norm are presented in fig.1. At the end of experiment bending indicators in MG were 63,22±1,75% from norm. Results of other indicators are as follows: unbending – 75,60±2,95%; moving aside – 61,15±1,81%; inside rotation– 76,34±2,62%; outside rotation– 66,96±1,65%. In comparison group they were accordingly: 56,68±1,70%, 52,40±2,49%, 43,80±2,92%, 64,68±3,23%, 55,42±1,88%.

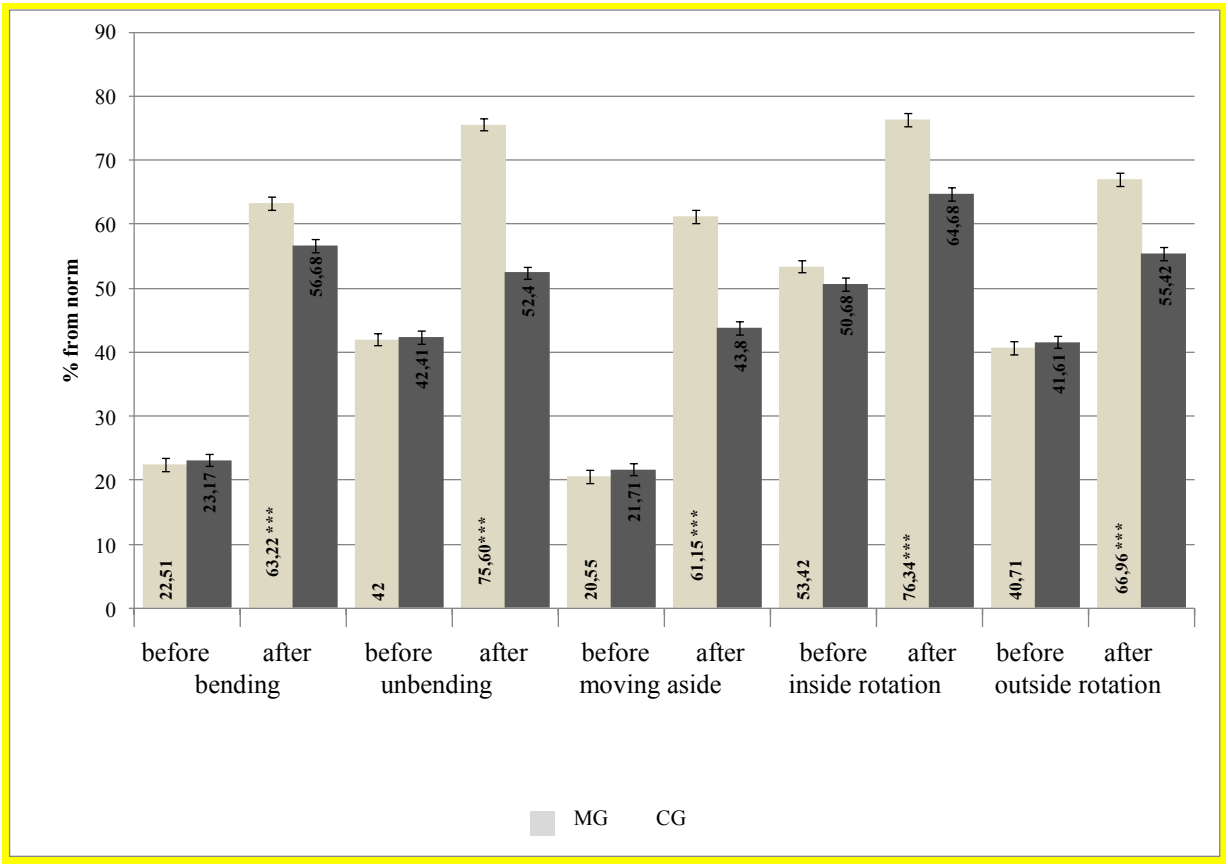

Fig.1. Change of goniometry indicators in MG, comparing with CG in % from norm under influence of rehabilitation, where: *** – p<0,001(comparison of MG initial and final indicators); ••• – p<0,001 (comparison of CG initial and final indicators).

Repeated testing of hand flexors' strength showed confident increase of these indicators on operated side of both groups' women: in MG – by 1,84 kg (p<0,001), in CG – by 0,68 kg (p<0,01). Difference of mean values of hand force index between operated and not operated sides was registered only in CG women and was – 3,49% (p<0,05). In table 2 we show results of changes of segments' perimeters of main and control groups women's upper limbs under influence of rehabilitation.

Table 2. Changes of segments' perimeters of upper limbs (M±m) in main group and comparison group at rehabilitation stationary stage, cm

Indicator	MG (n=25)			CG (n=25)		
	before	after	p	before	after	p
shoulder	2,40±0,20	0,68±0,12***	<0,001	2,44±0,15	1,88±0,16	<0,001
forearm	1,80±0,16	0,32±0,09***	<0,001	1,92±0,19	1,76±0,15	>0,05
hand	1,16±0,16	0,16±0,07***	<0,001	1,34±0,11	1,32±0,11	>0,05

Notes: *** – p<0,001 (comparison of final indicators of main and comparison groups).

In MG we observed reduction of swelling on operated side, comparing with initial data: in part of shoulder – by 1,72 cm (p<0,001); forearm – by 1,48 cm (p<0,001); hand – by 1,00 cm (p<0,001). In CG swelling on operated side confidently reduced in comparison with initial data only in part of shoulder – by 0,56 cm (p<0,001). At level of forearm and hand it had only tendency to reduction – by 0,16 and 0,02 cm (p>0,05).

Confident difference was found in final measurements of all segments' perimeters between tested groups. In particular, swelling in shoulder part was less in MG, comparing with CG – by 1,20 cm ($p<0,001$). In part of forearm – by 1,44 cm ($p<0,001$), in hand – by 1,16 cm ($p<0,001$). It confirms more positive impact of the worked out program on reduction of swelling.

Discussion

The received results confirm the data of R.T. Anderson, G.G. Kimmick, T.P. McCoy, 2012 [3], C. Arving, I. Thormodsen, G. Brekke et al., 2013 [4] about acute character of this problem and demand in early start of physical rehabilitation of patients with post mastectomy syndrome as well as opinion of researchers M.L. Martin, M.A. Hernndez, C. Avenda et al., 2011 [6],Y.H. Lin, P.J. Pan, 2012 [5] that usage of lymphatic drainage in combination with active exercises in post surgery period are effective means of swelling reduction on upper limb. The results of our work confirm opinion of specialists M.T. Pace do Amaral, M.M. Freire de Oliveira, O. Ferreira Nde, 2012 [7] about positive role of manual therapy elements in combination with physical exercises for increasing of movement's amplitude in shoulder joint on operated side. Thus, there appears important question of determination of lasting results of the worked out program for physical rehabilitation of women with PMS effectiveness.

Conclusions:

It was found that modern conception of breast cancer treatment facilitates increasing of quantity of patients, who are considered "healthy" due to formal absence of main disease's progressing though presence of complications through aggressive anticancer therapy increases. It requires active intervention of rehabilitation specialists. The worked out and tested problem-oriented physical rehabilitation program for women with post mastectomy syndrome facilitates surely better recreation of the following: movement's amplitude in shoulder joint; strength of hand flexors; as well as reduction of swelling in comparison with existing programs. All these are the key to prophylaxis of different later post mastectomy complications.

The prospects of further researches imply working out of physical rehabilitation program for women with post mastectomy syndrome after stationary stage and determination of its effectiveness.

Conflict of interests

The authors declare that there is no conflict of interests.

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SUBSTANTIATION AND WORKING OUT OF RECREATION HEALTH RELATED TECHNOLOGY ON THE BASIS OF HEALTH RELATED HIKING AND ORIENTEERING FOR JUNIOR SCHOOL AGE CHILDREN

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Abstract. *Purpose:* to study role of health related hiking and orienteering in improvement of children's physical conditions. *Material:* 163 children of 7 – 10 years old age participated in the research (82 boys and 81 girls). Tests for assessment of physical condition, physical health, adaptation reserve potentials and motor functioning of junior schoolchildren were used. *Results:* It was found that 46,01% of pupils can be considered healthy. Accordingly more than half (53,99%) have not infectious diseases. Among them nosologies of musculoskeletal apparatus prevail. In academic day with physical culture lesson average and high levels of motor functioning prevail (61,36%). Recreation health related technology on the basis of health related hiking and orienteering has been theoretically substantiated and worked out. Its structural components and content have been described. Realization of recreation health related technology is envisaged to be in three stages. Most of classes shall be in the open air. *Conclusions:* low level of adaptation reserve potentials and physical health of children have been determined that points at demand in health related measures in junior schoolchildren's physical education.
Key words: physical condition, physical education, junior schoolchildren, technology, health related hiking, orienteering.

Introduction

One of main tasks of physical education is health improvement of child's organism. But recent scientific researches witness about low effectiveness of modern physical education. It is noted that health level of rising generation causes justified anxiety [6]. Ukrainian physical education system does not meet today's requirements and needs qualitative renewal [7, 14, 15]. Organization of meaningful and active leisure is a source of different population strata's health improvement [1, 16, 17, 22]. Reconstruction of physical education system is possible at the account of working out of recreation health related technologies and their implementation in physical education system. Such technologies facilitate optimization of schoolchildren's motor functioning, rising of their physical and health condition levels, formation of firm motivation for recreation health related trainings, embedding of solid basis for healthy life style [1, 14, 15, 24, 25].

Recent years, in scientists' researches there have been observed some progress in solution of physical education effectiveness problem, concerning children of different age groups [1, 4, 10, 13, 19, 21]. Special attention is paid by scientists to physical education of junior school age children [8, 9, 14, 15, 23]. Exactly in this period foundation of physical condition and health is embedded [2, 8, 13]. Specialists prove that implementation of recreation health related technologies on the base of different motor functioning kinds and sport elements in physical education system give positive results [8, 14, 20]. Junior forms pupils have natural strive for cognition of environment. In combination with natural motor functioning means (walks and run) [1, 2, 15] it creates favorable conditions for formation of children's motivation for health related classes. Such harmonious combination is characteristic for health related hiking and orienteering.

In opinion of physical education specialists [4, 11, 12, 18] health related hiking is a versatile method with great potential for successful teaching, education and health improvement of rising generation. Orienteering is becoming more and more interesting for scientists as effective health related and recreation method [3, 5].

Analysis and generalization of special literature data permits to affirm that great number of scientists studied introduction of health related hiking and orienteering in physical culture lessons for junior school age children [8, 13, 14]. As well as regarded them as a kind of extra curriculum activity [3, 4]. With it a lot of questions about organization and conduct of optional classes still remain unsolved. Methods of health related hiking and orienteering as versatile tool of junior pupils' physical condition's improvement made their foundation.

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Purpose, tasks of the work, material and methods

The purpose of the research to theoretically substantiate and work out recreation health related technology on the base of hiking and orienteering means for improvement of junior school age children's physical condition.

The tasks of the research:

1. To analyze of literature sources devoted to physical condition of junior school age children.
2. To determine physical condition indicators of junior school age children.
3. To substantiate and work out recreation health related technology on the base of health related hiking and orienteering, directed on improvement of junior school age children's physical condition.

Material: in stating pedagogic experiment 2-4 forms' pupils of comprehensive school № 5 (Krolevets, Sumskaya region) participated (n=163).

The methods of the research: theoretical analysis and generalization of scientific-methodic literature, pedagogic observation, pedagogic experiment, anthropometry method, indices of Rorer, Robinson and Kerdo, express assessment of health condition by G.L. Apanasenko, methods of mathematical statistic.

Parents gave written consent for their children's participation in experiment. The research was approved by committee on ethic of university.

Results of the research

Analysis of scientific literature witnesses that most of researchers see way out from this problem situation in physical education at the account of modern technologies: health related physical culture, health protective, health related recreational.

Experiment permitted to detect that most of children demonstrated average level of physical condition: by indicators of body length – 72,39% (n=118), body mass– 71,17% (n=116), chest circumference– 78,53% (n=128). It corresponds to hygienic norms. Absolute compliance with hygienic norms was found in boys and girls. With it, it was determined that 74,23% (n=121) of children grow harmoniously, 21,47% (n=35) have disharmonious physical condition and 4,3% (n=7) of junior schoolchildren have acute disharmonious condition. Most of deviations from hygienic norm belongs to deficit of body mass that is a certain foundation of disharmonious physical growth (28,58% (n=12)).

Analysis of children's adaptation-reserve potentials on the basis of screening assessment showed that 85,89% (n=140) of junior forms pupils have moderate tension of regulatory mechanisms. It corresponds to pre-nosological state. Diagnostic of junior schoolchildren's health showed that 55,21% (n=90) of children have low physical health level (PHL), 34,97% (n=57) have PHL below average, 9,82% (n=16) have average PHL. With it there were no children with PHL above average and high. Analysis of presence of chronic diseases showed that 46,01% (n=75) of junior pupils were healthy. Accordingly more than half (53,99%, n=88) have not infectious diseases. Among them diseases of musculoskeletal apparatus prevail.

Thus, it was proved that great number of junior school age children was in group of risk, on the verge of nosology. That is why this age category of children requires more attention to their physical functioning. It was determined that without physical culture training in day off and academic day motion functioning is insufficient. In more than 50 – 56,82% it is at very low level. With it, in academic day with physical culture lesson average and high motor functioning levels prevail (61,36%).

Thus, problem of junior school age children's insufficient motor functioning can be solved at the account of creation and implementation of recreation health related technology in academic day, in which physical culture lesson is not stipulated as well as in day off as optional training. It can ensure optimal level of schoolchildren's motor functioning and become a solution of problem of physical condition's improvement.

Analysis of scientific-methodic literature, practical experience of specialists in field of physical culture, results of stating experiment permitted to work out recreation health related technology on the base of health related hiking and orienteering. Its purpose is improvement of junior school age children's physical condition. The offered recreation health related technology meets criteria of projecting of recreation activity system: scientific basis, systemic and structural character, controllability, economic, effectiveness and reproducibility [1].

Realization of recreation health related technology is envisaged in three stages:

Preparatory (setting a problem; determination of purpose and tasks, characterizing general conception of the technology; definition of technologies peculiarities);

Main stage (formation and choice of means, forms and methods as the basis of technology's model; creation of this model in the form of recreation health related program; assessment of children's physical condition and control over it);

Finalizing stage (analysis of expected results; determination of technology's effectiveness on the base of repeated assessment of schoolchildren's physical condition), (see fig.1).

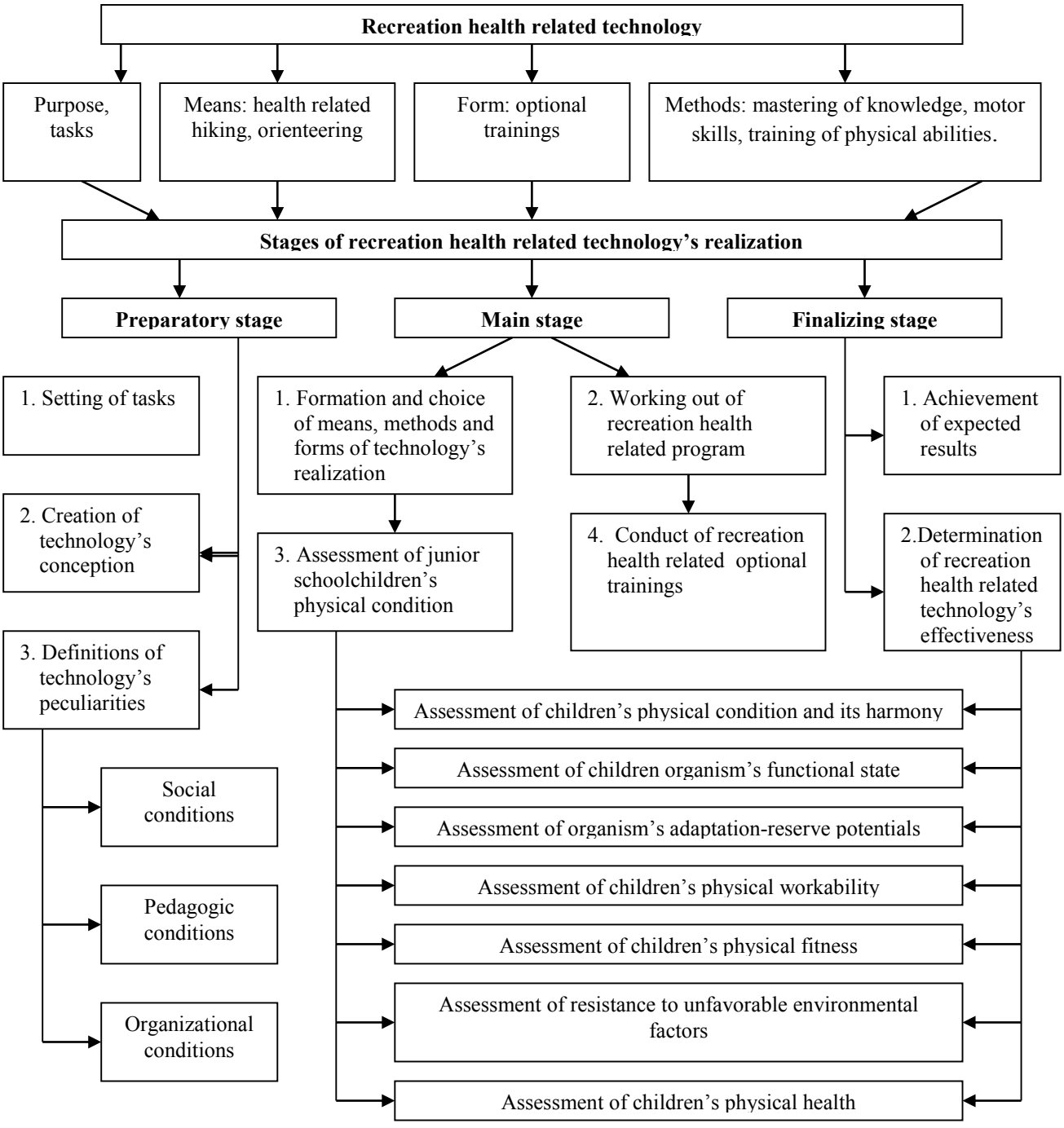

Fig.1. *Block diagram, of structure of recreation health related technology's realization*

At the main stage of technology's realization we worked out recreation health related program. The program is an optional course for pupils of 3rd and 4rth forms. When working out the program we considered content and volume of "School of active rest (recreation)". This component of physical culture program for comprehensive educational establishments (1-4 forms) was created by authors collective under guidance of T.YU. Krutsevych [10]. Our technology also considered content of academic disciplines "Me and Ukraine", "Principles of health", and "Study of Nature".

Optional recreation health related trainings are usually of practical character. Theoretical information is delivered mainly as talks as structural component of practical training.

The structure of the worked out program meets requirements of physical culture program for 1-4 forms. It consists of three components: informational (general knowledge in field of physical culture; knowledge of health, its protection and strengthening; knowledge of Nature and its protection, behavior in nature; knowledge of safety regulations un natural conditions, excursions, walks, competitions); operational-active (motor functioning of low, average and high level children; its orientation; consideration of individual features of schoolchildren's physical condition and their creative activity); motivation (participation in socially significant measures, satisfaction of personal demand in communication, motor functioning and creative activity; formation of orientation for healthy life style).

Interconnection of program's components is realized through objective approach to their mastering. Assessment of final result is fulfilled with the help of control over successfulness of special individual and collective tasks and exercises' fulfillment. This assessment is of verbal character. Most of trainings shall be in the open air.

The structure of recreation health related program consists of three periods: preparatory (diagnostic of children's physical condition; organism's adaptation to physical loads), main (improvement of physical condition; acquiring of motor skills; training of physical abilities), supporting (maintaining and support of the achieved physical condition's level).

Discussion

Analysis of scientific literature confirmed that level of modern children's physical condition is unsatisfactory [4, 7, 11]. Morbidity indicators are constantly increasing [6]. With it, conditions and regiment of teaching influence significantly on their health [2, 9, 14]. Scientists think that the root of this problem is children's insufficient motor functioning [2, 18, 20]. Physical culture lessons satisfy children's demand in motor functioning only by 25 – 30% from hygienic norm [10]. That is why intensification of motor functioning of different age groups' children is an urgent problem of physical education.

Intensification of junior school age children's motor functioning is possible with the help of recreation health related technologies [1, 10, 15]. Means of health related hiking and orienteering positively influence on indicators of schoolchildren's physical condition [4, 5, 11, 18, 20], including junior school age pupils [8, 13, 14].

The fulfilled research confirmed results of other authors about low level of physical condition indicators of junior school age children [4, 14, 15] With it, anthropometric indicators of most of children meet average level of physical condition [9, 11, 14, 15].

Besides, we expanded the data of domestic [4; 10; 14; 15] and foreign authors [2, 16, 17, 22, 23] about demand in optimization of junior schoolchildren's motor regiment. Optimization of motor functioning in extra curriculum time is one of ways to improvement of junior schoolchildren's physical condition [2, 4, 15]

Conclusions:

1. Analysis of scientific-methodic literature showed that physical education system is not effective and requires upgrading at the account of implementation of recreation health related technologies' implementation.

2. Health related hiking and orienteering have significant potential of health related means. It is a reserve of children's motor functioning in extra curriculum time.

3. Stating experiment showed low level of adaptation reserve potentials and physical health of junior school age children. This level corresponds to pre-nosological state that requires realization of health related measures.

4. The offered recreation health related technology on the basis of health related hiking and orienteering is directed at improvement of children's physical condition. It consists of purpose, tasks, means, forms and methods. The technology is realized in three stages: preparatory, main and finalizing.

The prospects of further researches imply analysis of the offered recreation health related technology's influence on physical condition components of junior forms pupils and testing of its effectiveness.

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Conflict of interests

The authors declare that there is no conflict of interests.

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SUBSTANTIATION OF HEALTH RELATED POWER LIFTING TRAINING METHODIC FOR UNIVERISTIES STUDENTS WITH MUSCULAR SKELETAL APPARATUSE AFFECTIONS

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Abstract. *Purpose:* substantiation of health related power lifting training methodic for universities students, who have disorders of muscular skeletal apparatus. *Material:* in experimental researches 126 students of 18-24 years' age, having disorders of muscular skeletal apparatus, participated. With the help of testing we registered changes of students' functional, physical and psycho-physiological fitness indicators. *Results:* optimal correlation of specific and non specific loads was found: 60% of specific and 40% of non specific. It is recommended to follow certain correlation of exercises in easy and complicated conditions: for first year students - 3:2; for second year students – 3:2; for third year – 2:3; for forth year – 2:3; for fifth year students – 1:3. Specific only for power lifting conditions and temps of students' (with muscular skeletal apparatus affections) functional, physical and psycho-physiological fitness improvement were determined. *Conclusions:* The requirements of the training methodic envisage correction of loads for bringing every indicator on proper level.
Key words: algorithm, health, purpose, methodic, power lifting, status, students, testing.

Introduction

World wide tendency to worsening of children's, adolescents' and youth's health did not pass away Ukrainian rising generation [1, 7, 9, 17]. As per the data of official statistic 70 – 80% of Ukrainian students have health problems [2, 3, 4, 11, 14, 16, 18]. Affections of muscular skeletal apparatus (MSA) are the most prevailing among the after effects of many diseases. Such affections are conditioned by traumas of spinal cord, polio, cerebral palsy and lower limbs' amputations [6, 12, 19–21]. Scientists found that significant improvement of youth's with health problem functional, physical and psycho-physical indicators is possible on the base of physical culture and sports' practicing (power lifting in particular) [2, 4].

Researches of problems of students' with MSA disorders have certain specific features:

1) Need in maximal attention to kind of disease, degree of MSA disorder, individual characteristics of physical loads' endurance [8].
2) Training program shall facilitate strengthening of students' motivation for receiving and mastering knowledge [22].
3) Need in increased attention to distinctions in psycho-physiological characteristics, indicators of psychic status and features of students' personalities, depending on power lifting experience [23].

Among researches, devoted to students' health strengthening with power lifting means it is necessary to pay attention to domestic works (I.N. Manko, [13]; M.Yu. Minov, 2010 [15]; A.V. Gorbunov, [5]; Ye.V. Kurmayeva, 2013 [10]) and works of foteing scientists (Trinkaus E., Rhoads M.L., 1999 [31]; Rossouw F., Krüger P.E., Rossouw J., 2000 [29]; Keogh J.W.L., Hume P.A., Pearson S.N., Mellow P., 2007 [26]; Jensen A.M., 2010 [25]; Hale B.D., Roth A.D., DeLong R.E., Briggs M.S., 2010 [24]; Kozub F.M., Brusseau T.A., 2012 [27]; Lewis C., 2015 [28]).

Analysis of researches [1, 6, 11, 12, 20] devoted to substantiation of health related methodic of pupils and students by means of different kinds of sports confirms that health related power lifting potentials for disabled students have not been practically studied yet.

Purpose, tasks of the work, material and methods

The purpose is substantiation of health related power lifting training methodic for universities students, who have disorders of muscular skeletal apparatus.

Material and methods of the research: in experimental researches 126 students of 18–24 years' age, having disorders of muscular skeletal apparatus, participated. The researches were conducted in period from 2011 to 2014 in four stages.

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Results of the researches

On the base of conducted complex researches we substantiated health related methodic of power lifting training for universities students with MSA disorders. The worked out methodic envisages algorithm of certain operations for teaching to special power lifting exercises (see fig.1). As we can see in fig.1 before power lifting trainings it is necessary to examine health of 1st year students as well as to test anthropometrical and functional indicators, to find degree of physical and psycho-physical fitness. After it, power lifters-beginners can start trainings by year program. This program includes 60% of specific and 40% of non specific loads. When familiarizing students with techniques of special and auxiliary exercises, the main task is to create students' pattern of trained movements. With it, it is necessary to observe correlation of exercises' practicing in easy and in complicated conditions 3:2. At the end of first year of trainings it is necessary to examine health condition, register changes of anthropometric and functional indicators; motor skills and psycho-physiological fitness of students.

On the base of the received information and considering the data of previous researches training program is composed. The program envisages fulfillment of special exercises in easy and complicated conditions in correlation 3:2. After two year of trainings it is necessary to carry out medical examination of students. If required it is necessary to treat the found diseases. Testing also helps to determine changes of students' functional, physical and psycho-physiological fitness indicators. Then these indicators are compared with appropriate normative for third year students. After it, training program for third year is composed. Mastering of special and auxiliary exercises envisages their fulfillment in easy and complicated conditions in proportion 2:3.

At the end of third year of trainings the described above testing procedures shall be varied out. Further, on their basis, considering parameters of previous researches, the program for the next forth year should be composed. It is recommended to plan fulfillment of specific exercises on the same conditions as in the third year (2:3).

In the same way, at the end of forth year it is necessary to register changes of the tested indicators. Further, with the help of previous researches' materials, it is necessary to correct training program for fifth year. With it, special and auxiliary exercises in easy and complicated conditions in proportion 1:3 shall be stipulated. As we can see in diagram (see fig.1) the offered methodic of motor skills', functional fitness improvement and training to special exercises, envisages conduct of students' profound medical examinations twice a year (before trainings and at the end of training period). In this methodic the basic pre-condition is well known postulate that physical load is the foundation of motor skills' formation and physical fitness improvement. Physical exercise is a structural unit of physical load. At first stage of physical exercises' influence implies excitation of appropriate afferent and motor centers, mobilization of skeletal muscles, blood circulation and respiratory functions. In combination, they create one functional system, responsible for realization of these motor responses. Effectiveness of these responses is insufficient for formation of steady adaptation. For achievement of the desired purpose multiple repetitions are required for gradual functional reconstruction of organism. For persons with MSA affections this process takes much more time. The reason is unsatisfactory condition of central and periphery nervous system, disorders of motor function and coordination. As per the data of specialists in adaptive physical education of disabled persons the most adequate are little volumes of loads. It should be noted that in our research we substantiated optimal parameters of loads for students. With it (see fig.1) we stipulated gradual increasing of special exercises' complexity: proportion of exercises in easy and complicated conditions for first year students – 3:2; for second year students – 3:2; for third year – 2:3; for forth year students – 2:3; for fifth year students – 1:3. This training methodic also envisages correction of loads for bringing every indicator (functional, physical, psycho-physiological fitness) for proper level.

Discussion

Results of our researches supplemented and confirmed the data of other authors [2, 4, 23–31) that systemic power lifting trainings facilitate improvement of functional mobility indicators and strength of nervous processes. Results of practical application of the worked out methodic confirmed principles, which are general for adaptation physical culture and sports for disabled [2, 6, 9, 12, 17, 21], about specificities of motor skills and physical abilities' formation.

It was found that the substantiated power lifting training methodic for universities' students with MSA affections ensures continuous perfection of motor abilities (confident increase of strength, quickness, speed-power and coordination indicators) and functional fitness; improvement of neuro-dynamic features of central nervous system. The results of the research permitted to determine specific only for power lifting conditions and rate of improvement of functional, physical and psycho-physical fitness of students with MSA affections.

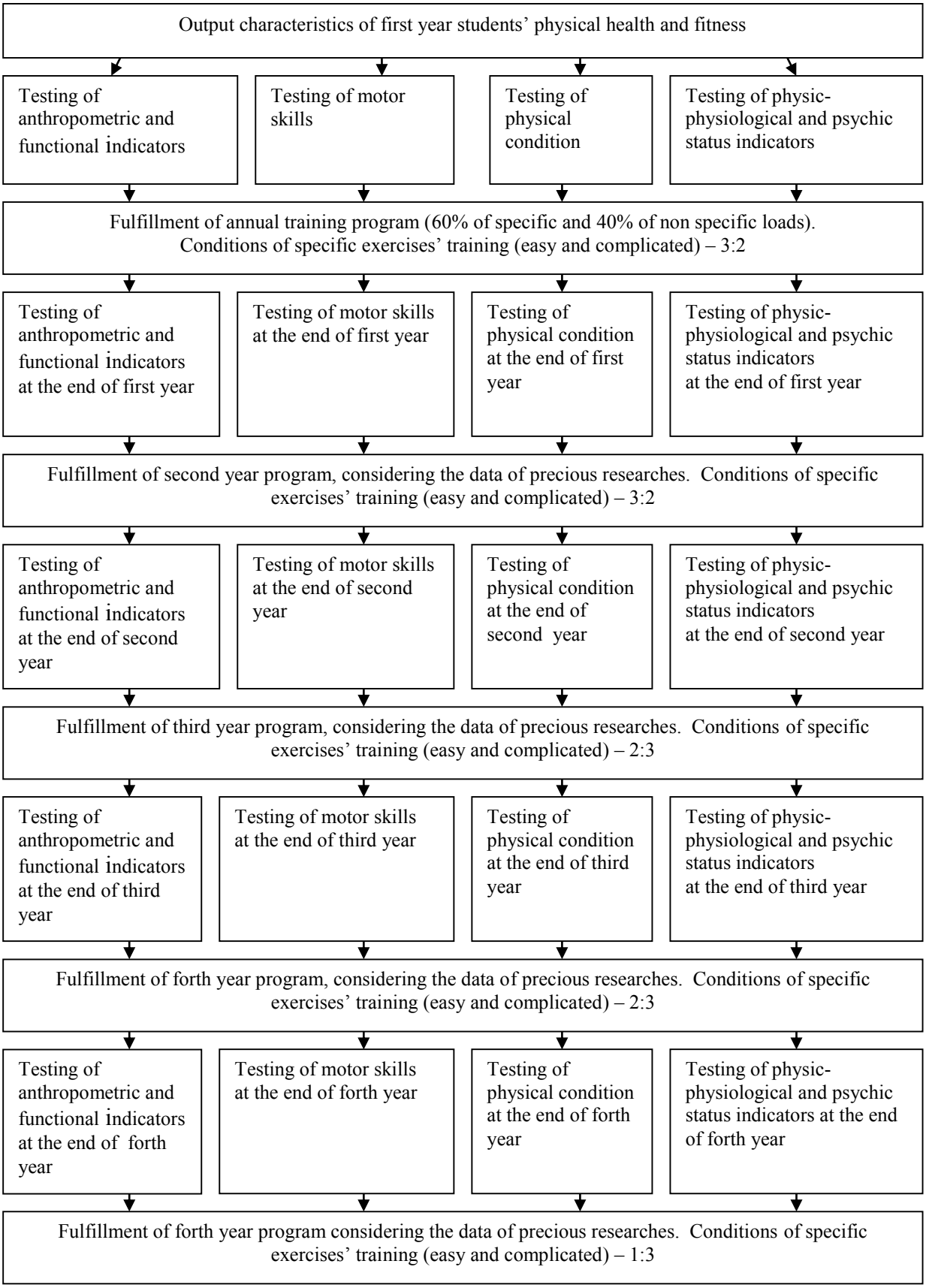

Fig.1. Diagram of application of health related power lifting methodic with students, who have MSA affections.

Conclusions

Effective health related power lifting training methodic for universities' students with MSA affections for extra-curriculum classes from first to fifth years has been experimentally substantiated:

− output diagnosis of anthropometrical, functional and psycho-physiological indicators; levels of physical health and psychological fitness; fulfillment of annual training program for first year students (which includes 60% of specific and 40% of non specific loads) in easy and complicated conditions in proportion 3:2;

− testing of anthropometrical, functional and psycho-physiological indicators; levels of physical health and psychological fitness; fulfillment of annual training program for second year students (considering the results of testing) in easy and complicated conditions in proportion 3:2;

− testing of the mentioned above indicators at the end of second year; fulfillment of program for third year students (composed, considering the conducted testing) in easy and complicated conditions in proportion 2:3;

− testing of the mentioned above indicators at the end of third year; fulfillment of program for forth year students (composed, considering the conducted testing) in easy and complicated conditions in proportion 2:3;

− testing of the mentioned above indicators at the end of forth year; fulfillment of program for fifth year students (composed, considering the conducted testing) in easy and complicated conditions in proportion 1:3;

The prospects of further researches can be connected with development of pedagogic control methods over physical loads of students-power lifters.

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Conflict of interests

The author declares that there is no conflict of interests.

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ANALYSIS OF WORLD BIATHLON LEADERS' PARTICIPATION IN BIATHLON WORLD CUP (ON EXAMPLE OF WOMEN'S BIATHLON)

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Abstract. *Purpose:* optimization of elite female biathlons' training, considering modern structure of international competitions. *Material:* we analyzed materials of three recent IBU Congresses and more than 3300 protocols of competitions of World cup stages, world championships, winter Olympic Games (women, sport seasons from 2005 to 2015). *Results:* it was found that, when preparing for winter Olympic Games 63.9% of sportsmen – prize winners missed 13.6% of stages of World Cup, when preparing for world championships 47.2% of prize-winners missed 9.5% of stages. Before the main start of the season in Europe prize winners missed in conditions of plain: 42.1% - 7.9% of World Cup stages; in midlands conditions 61.9% - 13.9%; in competitions with preliminary trans-meridian travel 54.2% of prize-winners missed 13.1% of stages. *Conclusions:* most of medals are won at world championships and Olympic Games by sportswomen, who are in top-10 of World Cup. The World Cup calendar of events forces sportsmen to miss some stages of World Cup, when they prepare to main start of season. Attitude of world biathlon leaders to missing of World Cup stages before main start of season depends on main character of main start of season. With it main condition for taking decision about missing of World Cup stages is rank of competitions and geographical characteristics of places of competitions.

Key words: biathlon, World Cup, individual, competition, calendar of events.

Introduction

Recent time there have been observed quick rise of biathlon popularity. Including of short-distance, spectacular races in competitions, well organized informational provisioning increased spectator audience (both on stadiums and before TV sets). It resulted in formation of international calendar of events' structure with a system of quotas and admittances [1, 2]. Rigid, multi-level structure of calendar of events was formed, which excluded weakly trained sportsmen's admittance to international competitions. Recent years commercial starts and different shows have been being admitted to international calendar of events. Leading biathlons have been started to be invited to such competitions. It resulted in significant expansion of calendar of events. In its turn it resulted in increasing of competition system's influence on strategy of biathlons' training. At modern stage such trend exists also in other kinds of sports [3, 4, 5].

At present, participation in competitions is used as effective mean of perfection of fitness's different sides. It is connected with the fact that many tasks can not be solved in ordinary trainings [6, 7, 8, 9]. It should also be added that in theory of sports it is not recommended to abuse competition practice. Besides, it is recommended to use competitions only in the scope, suitable for ensuring sportsmen's maximal readiness to main starts of season (MSS). On the other hand, there is another trend – insufficient sportsmen's adaptation to competitions factors. It results in unsuccessful performances owing to insufficient competition practice [10, 11, 12, 13, 14]. It is considered that distinctive feature of modern sports (biathlon inclusive) is trend to wider usage of competition practice. With every year commercialization embraces wider rages of modern sports. In this connection in biathlon there appeared specialists (coaches and sportsmen), who tray to combine solution of two main tasks: realization of maximal results at MSS (world championships, winter Olympic Games) and earning of maximally possible amount of prize money at commercial starts.

In opinion of sports' theoreticians it is possible in kinds of sports with low competitiveness among sportsmen. If so, biathlon, with its tight calendar of events, is exclusion [3]. In this case there is an interference of factor, which is usually omitted by sportsmen and coaches: weakening of sport form. It results in significant overloads and reduction of organism's adaptation potentials on the eve of MSS [11, 13, 14, 15]. Therefore, as on to day a question about rational quantity of starts for receiving optimal competition practice before MSS has become very topical. In scientific-research literature on biathlon [7, 8, 9, 16, 17, 18, 19] we could not fine recommendation on this question.

Winter Olympic Games (WOG) are the highest rank of competition structure in biathlon as well as every year world championships (WC). Their competition program is coordinated and structuralized in compliance with World Cup (WP) calendar of events on biathlon [2]. World Cup and Кубок IBU Cup on biathlon are considered commercial starts in Ukraine. Just at them quotas and admittances to world championships and winter Olympic Games are earned [1, 2].

Sport seasons of two recent Olympic cycles in biathlon (2006-2010 and 2010-2014) had 25-26 starts. These starts were included in general normative of WC (3-4 individual races, 10 sprinter races, 6-8 pursuits, 5 mass starts). From them 18-21 starts are included in national normative [20]. In total 33-34 starts in the frames of World Cup are fulfilled by the strongest sportsmen (they run in relay races and mixed relay races most often). It makes mean density of one start for 3.3

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– 3.5 days during competition period [20]. Besides, sportsmen participate in national championships and Cups, World Universiade, open championship of Europe, world championships for military officers and different shows. It significantly increases competition density in season. The conducted by us in previous work analysis of World Cup calendar of events [20] shows that construction of its blocks (trimesters) does not consider amount of days for organism's adaptation to heights' differences, to time zones. In this case constant starts take place in abnormally wasteful phase of organism's adaptation to mountain or time conditions. It significantly reduces sportsmen's functional potentials and results in weakening of sport form. It is especially inadmissible on the eve of MSS. Thus, successful performance at MSS is impossible without missing of certain WC stages [20].

Purpose, tasks of the work, material and methods

The purpose of the research was optimization of elite female biathlons' training, considering modern structure of international competitions.

The tasks of the research:

1. Analysis of scientific-methodic literature for studying of competitions rules' and structure's influence on results of performances in main start of season.

2. Analysis of world biathlon leaders' participation in competition program of World Cup on biathlon.

3. To determine influence of World Cup calendar of events on results of sportsmen's performances at MSS (world championships, Olympic Games), depending on main characteristic of MSS.

Analysis was carried out basing on materials of recent three IBU Congresses (2010, 2012, and 2014); more than 3300 protocols of World Cup stages' competitions among women, world championships and winter Olympic Games from 2005/2006 to 2014/2015).

Results of the researches

Analysis of changes in competition rules for biathlon (by materials of IBU congresses) clearly shows that at present situation in general and national standings in World Cup on biathlon significantly influence on application quotas, formation of applications by groups and receiving of more favorable start numbers at MSS. In this connection we analyzed the character of medals' distribution among leaders of world biathlon (women) at MSS. We analyzed individual kinds of competition program before and after MSS depending on rating in World Cup (see table 1). We also analyzed participation of general WC prize winners and all MSS champions and prize winners in individual kinds of competition program for women. We were interested in quantity of missed starts and stages of World Cup before MSS, general regularities of the missed stages depending on quantity of stages before MSS, rank of competitions, main geographic characteristics (height above sea level, latitude and longitude of stadium's location) (see tables 2, 3, 4).

Discussion

Analysis of sportswomen's performances in individual kinds of sports at WOG (Salt Lake City) and in season 2000-2001 and 2001-2002 on biathlon [3] permitted to say that most of WC 2002 leaders and winners could not win gold medals or become prize-winners at WOG 2002. Sportsmen, who were not leaders in their kinds of sports, became Olympic champions. These sportsmen participated in Cup competitions fragmentary, in "training" purposes and took part only in separate stages. In opinion of F.P. Suslov [3], one must not strive to achieve two purposes: to win WOG and WC.

We do not agree fully with him. In our opinion as on to day situation in biathlon has cardinally changed. The most quantity of medals at WOG ЗОИ-2006, 2010 and 2014, in individual kinds of program were won by sportswomen, who were on the top of biathlon WC rating. From 8-10 medal-winners at WOG 33,3 – 62,5% were in rating WC before MSS in first ten; 66,7 – 75% were in first fifteen sportswomen (see table 1).

Practically all WOG medal-winners stood on the podium at WC stages. Exclusion was only Helena Khrustaliova, who won medal at WOG 2010 года медаль. On one of WC stages she earned only 23rd place. But before WOG the sportswoman did not miss any start at WC stages. It can be assumed that this sportswoman performed at WC with training purposes, but evidently not "fragmentary" and she did not restrict her participation in WC.

Sportswomen with the highest quantity of medals, won at WOG, won in the same season general standings in WC (Kati Wilhelm, 2006; Magdalena Neuner, 2010). From 9 winners and prize-winners of WC in three recent Olympic seasons only two sportswomen were without medals at WOG. It was Helena Jonsson – 10th best place at WOG (2010). Also Kaisa Makarainen, who won World Cup of season 2013-2014 (at WOG 2014 she could earn only sixth place).

Season 2013-2014 differs by counting of WC scores from other sport seasons by the fact that MSS was not set off as WC (though at three previous Olympic Games scores of Olympic disciplines were taken in account when counting WC scores). If to re-count WC 2013-2014 considering starts at WOG 2014, then WC in season 2013-2014 should have been won by Darya Domracheva (1005 scores) (three gold medals at WOG 2014), the second - Tora Berger (993), and the third - Kaisa Makarainen (973).

Table 1. Medals' distribution among world biathlon leaders at main starts of season in individual kinds of competition program

№	Year	Quantity of sportswomen-medal winners	% of medals, won by sportswomen, who took position in top-10		Quantity of sportswomen, who won medals, and entered "top" WC before MSS (in brackets % from general quantity of medal winners)			Quantity of sportswomen, who won medals, and entered "top" of final of general WC standings (in brackets % from general quantity of medal winners)		
			Before MSS	In WC final	Top - 6	Top - 10	Top -15	Top - 6	Top - 10	Top - 15
					Winter Olympic Games					
1.	2006	8	66,7	75,0	4 (66,6)	5 (62,5)	6 (75,0)	5 (83,3)	6 (75,0)	6 (75,0)
2.	2010	9	41,7	58,3	2 (33,3)	3 (33,3)	6 (66,7)	3 (50,0)	5 (55,6)	6 (66,7)
3.	2014	10	58,3	66,7	3 (50,0)	5 (50,0)	7 (70,0)	5 (83,3)	6 (60,0)	8 (80,0)
					Every year world championships					
4.	2007	8	91,7	91,7	5 (83,3)	7 (87,5)	7 (87,5)	6 (100)	7 (87,5)	7 (87,5)
5.	2008	7	66,7	66,7	3 (50,0)	5 (71,4)	5 (71,4)	4 (66,7)	5 (71,4)	5 (71,4)
6.	2009	7	50,0	83,3	3 (50,0)	3 (42,9)	4 (57,1)	4 (66,7)	5 (71,4)	5 (71,4)
7.	2011	8	75,0	83,3	5 (83,3)	5 (62,5)	6 (75,0)	5 (83,3)	6 (75,0)	7 (87,5)
8.	2012	8	75,0	83,3	5 (83,3)	6 (75,0)	7 (87,5)	5 (83,3)	6 (75,0)	8 (100)
9.	2013	8	66,7	75,0	3 (50,0)	4 (50,0)	6 (75,0)	3 (50,0)	5 (62,5)	6 (75,0)
10.	2015	9	41,7	50,0	2 (33,3)	4 (44,4)	7 (77,8)	3 (50,0)	5 (55,6)	8 (88,9)

Table 2. Statistic of missed by leaders of women world biathlon leaders World Cup stages before MSS (champions and prize-winners of WCh, WOG in individual disciplines of competition program in sport seasons from 2006 to 2015)

№	Main start of season (WC stages to MSS)	Missed stages of World Cup								Total man\stages	Analyzed sample (persons)	% of participation in missing of WC stages	% of missed stages from total quantity
		World Cup stages											
		1	2	3	4	5	6	7	8				
1	Before WOG 2006 Cesana San Sicario (6)	1		1	2	1	2			7	8	75,0	14,6
2	Before WCh 2007 Anterselva (6)			1		2	3			6	8	50,0	12,5
3	Before WCh 2008 Östersund (6)			1	1	1				3	7	50,0	7,1
4	Before WCh 2009 Pyeong Chang (6)	1		3	2	1				7	7	71,4	16,7
5	Before WOG 2010 Vancouver (6)	1		1	3	1	2			8	9	55,6	14,8
6	Before WCh 2011 Khanty-Mansiysk (8)	1					1	2	2	6	8	37,5	9,4
7	Before WCh 2012 Ruhpolding (8)							1		1	8	12,5	1,6
8	Before WCh 2013 Nové Mesto (6)		1	2			1			4	8	50,0	8,3
9	Before WOG 2014 Sochi (6)	2		1	3		1			7	10	60,0	11,7
10	Before WCh 2015 Kontiolahti (8)	2	2		2			3		9	9	62,5	12,5
11	In total before MSS from 2006 to 2015	8	3	10	13	6	10	6	2	58	82		

Notes: character of missed WC stage see in table 3 (more specifically – in article of Ye.M. Pidgrushna)[20];

- missing of WC stages by three sportswomen (Albina Akhatova (2008), Anastasiya Kuzmina (2009), Ekaterina Yurlova (2015)) was not taken in account because it was connected with sportswomen's entering team or winning quotas but not with solution of strategic tasks of

Table 3. Geographic conditions of WCh and WOG on biathlon in 2006 – 2015sport seasons [20]

№	Place of MSS	Years of MSS	Height above sea level, m (difference of ski distances' heights)	UTC	North latitude (N)	East longitude (E), west longitude (W)
1.	Cesana San Sicario Torino (ITA)	2006	1680	+ 1	44°57′29″ N	6°48′22″ E
2.	Anterselva (ITA)	2007	1634 (1626-1673)	+ 1	46°47′0″ N	12°3′0″ E
3.	Östersund (SWE)	2008	355 (350-392)	+ 1	63°11′0″ N	14°40′0″ E
4.	Pyeong chang (KOR)	2009	850 (830-900)	+ 9	37°22′0″ N	28°24′0″ E
5.	Vancouver (CAN) (парк Whistler)	2010	860 (850-910)	– 8	50°7′15″ N	122°57′16″ W
6.	Khanty-Mansiysk (RUS)	2011	83 (63-114)	+ 6	60°59′2″ N	69°1′34″ E
7.	Ruhpolding (GER)	2012	710 (701-733)	+ 1	47°42′52″ N	12°38′51″ E
8.	Nové Mesto (CZE)	2013	625 (620-665)	+ 1	49°33′51″ N	16°4′35″ E
9.	Sochi (RUS)	2014	1441 (1414-1471)	+ 4	43°40′43″ N	40°12′19″ E
10.	Kontiolahti (FIN)	2015	120 (88-128)	+ 2	62°46′0″ N	29°51′0″ E

Table 4. Summary table of characteristics of missed by leaders of women world biathlon World Cup stages before MSS (champions and prize-winners of WCh, WOG in individual disciplines of competition program in sport seasons from 2006 to 2015)

№	Main characteristic	Missed stages of World Cup									Analyzed sample (persons)	% of participation in missing of WC stages	Quantity of characteristic's repetitions	% of missed stages from total quantity
		World Cup stages								Total man\stages				
		1			4	5	6	7	8					
1.	Before WOG	4	-	3	8	2	5			22	29	63,0	3	13,6
2.	Before WCh	4	3	7	5	4	5	6	2	36	56	47,2	7	9,5
3.	Before WCh after 6 WC	1	1	7	3	4	4			20	30	55,2	4	11,1
4.	Before WCh after 8 WC	3	2	-	2	-	1	6	2	16	26	37,5	3	8,0
5.	Before MSS on plains	3	3	3	3	1	2	6	2	23	41	42,1	5	7,9
6.	Before MSS in mountains	5	-	7	10	5	8	-	-	35	44	61,9	5	13,9
7.	Before trans-meridian MSS	3	-	4	5	2	3	2	2	21	26	54,2	3	13,1

The same situation is in not Olympic seasons. Sportswomen with gold medals, won at WCh, won in the same season WC: Andrea Henkel (2007), Magdalena Neuner (2008), Helena Jonsson (2009), Kaisa Makarainen (2011), Magdalena Neuner (2012), Tora Berger (2013). Only in season 2014-2015 WC winner Darya Domracheva remained without medals at WCh -2015. It can be regarded as accident but not as logical result.

The highest quantity of medals at WCh 2007-2015 was won by sportswomen, who were on top of WC biathlon rating. On seven WCh of 2007 – 2015 period leaders were distributed in the following way: three sportswomen (from 21 for the passed period) could not win medals in individual disciplines: Sandrine Bailly (WCh 2008) with two 5th places; Andrea Henkel (WCh 2011) with forth place; Darya Domracheva (WCh 2015) with 4th and 7th places. The places, taken by these sportswomen, are not unsuccessful. In average from 7-8 medal-winners of WCh only 1-2 sportswomen can not enter the ten of the strongest WC before MSS.

Analysis of biathlon world leading sportswomen's participation in main starts of season and four years' period as well as in WC permitted to highlight two starting points in competition structure. The first is sportswomen's rating in WC before MSS. It was noted in our previous works: position in rating influences significantly on application in best start group and on getting in race from mass start [1, 2, 21]. The second is struggle for "Crystal globe", which implies final results of WC at the end of sport season. Recent years there appear a trend that leaders stopped "fear" to loose score in struggle for "Crystal globe". They began to miss stages of WC before MSS (see tables 2 and 4). In characters of missed WC stages there is no unified pattern. Sportswomen miss WC stage on plain and WC stages in mountains. Probably it is connected with different models of training ("mountain" and "plain"). Though the made by us analysis showed that "mountain" stages are missed most frequent. For example, from 58 analyzed by us cases of WC stages' missing by leading sportswomen – 35 relate to "mountain" stages. It makes 60,34% of all cases (see tables 2 and 4).

Depending on main characteristic of MSS (rank of competitions – WOG or WCh; geographical conditions and time zone; position of MSS in calendar of WC events) attitude of world biathlon leaders to missing of WC stages before MSS is different (see table 4). The minimum quantity of missing before WCh in Europe (plain conditions): only 42,1% of prize-winners miss 7,9% of stages with density 4,6 man\stages of competitions. In Ruhpolding (GER) it was 12,5% sportsmen with 1,6% of missed stages; in Östersund (SWE) – 50,0% with 7,1; Nové Mesto (CZE) – 50,0% with 8,3%. By geographical characteristics all these places are optimal for both: sportswomen from Europe and sportswomen from Ukraine/ Unexpectedly many sportsman\stages were missed before "plain" Kontiolahti (FIN) – 62,5% with 12,5%. However this percentage was ensured only by two sportswomen, who missed 3 stages each.

We observed more responsible attitude to WOG (63,0% of sportswomen with missing 13,6% of WC stages) than to WCh (47,2% with 9,5%). However, the highest quantity of WC stages' missing was observed before MSS in unfavorable conditions; in "mountain" conditions 61,9% with 13,9; in trans-meridian conditions 54,2% with 13,1%. Worsening of WCh and WOG prize-winners' rating after MSS was noticed only in those sportswomen, who stop perform in WC after MSS. As a rule this is the way of behavior of sportswomen of post-soviet space. They do not pretend to get in top-10. Sportswomen from west perform at WC stages after MSS without missing.

Conclusions:

1. As on to day it is not true that in biathlon Olympic champions become: not leaders of WC; sportsmen, who participated in Cup competitions fragmentary, with "training" purposes and restricted by participation in separate stages [3]. Most of medals at WCh and WOG in individual kinds of program is won by sportswomen, members of top-10 WC. The rest win from 12,5 до 28,6% of medals.

2. Innovations in competitions' rules force leading biathlons of the world to strive to get in top-10 and top-15 of current WC before MSS. It is conditioned by solution of strategic tasks at MSS.

3. Leaders stopped "fear" to loose score in struggle for "Crystal globe". They began to miss stages of WC before MSS. In average they miss one WC stage with three starts. But there are examples of missing of 2-6 starts (Andrea Henkel, 2007; Magdalena Neuner, 2010).

4. Attitude of world biathlon leaders to missing of WC stages before MSS is different. It depends on main characteristic of MSS. Less of all missing were before WCh, conducted in Europe in conditions of "plain". When preparing to WOG there is much more missing of WC stages (13,6%), than when preparing for WCh (9,5%). However, main condition for taking decision about missing of WC stages before MSS is rank of competitions and geographical characteristics of places of competitions. For example, before MSS in "mountain" conditions 13,9% of sportsmen miss. 13,1% of sportsmen miss starts, requiring preliminary trans-meridian travels.

5. Sportswomen (with rare exclusion) do not miss WC stages before MCC in places, which, by their geographical characteristics, are optima for sportsmen of Central Europe and Ukraine. (Ruhpolding, GER; Nové Mesto, CZE).

6. Worsening of WCh and WOG prize-winners' rating in WC after MSS concerns only those sportswomen, who can not pretend on high rating in WC final and stop performing in WC. As a rule this is the way of behavior of sportswomen of post-soviet space. Sportswomen from west perform at WC stages after MSS without missing.

The prospects of further researches in this direction we see in creation of optimal individual calendar of events for effective preparation for main start of season (WCh, WOG).

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Conflict of interests

The authors declare that there is no conflict of interests.

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DIFFERENTIATED CORRECTION OF JUNIOR SCHOOL AGE CHILDREN'S POSTURE AT PHYSICAL CULTURE TRAININGS

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Abstract. *Purpose:* to show peculiarities of differentiated correction of junior school age children's posture, considering tonic vibration reflex. *Material:* the research was conducted with participation of 62 junior school age children (7-10 years old boys and girls). All children have no sport training experience. All children were preliminary examined by qualified medical doctors. Tonic vibration reflex of lumbar spine was registered. Children fulfilled test exercises, which characterized power endurance of abdomen muscles, side of torso and back muscles. *Results:* external signs of posture disorders were absent in frontal plane. In 35 persons (65.8%) we registered one-side increased reflex excitability of nervous centers: from right side of backbone – in 28 children (72%); from the left side in 17 children (28%). Correction of posture with the help of correcting exercises can give steady effect only with simultaneous formation of correct posture habit. For this purpose it is necessary to create muscular-joint sense of separate body parts' position. *Conclusions:* for determination of functional potentials of in-born muscular corset it is recommended to fulfill special test exercises. For local influence on lumbar spine muscles it is recommended to use exercise of asymmetric character.
Key words: correction of posture, tonic, vibration, reflex, scoliosis, schoolchildren.

Introduction

Problems of control, diagnostic and accounting of pathologies with scoliosis deformations have acquired great importance. Rehabilitation treatment of schoolchildren is of not less importance. All these witness about society's and state demand in prophylaxis of posture abnormalities and scoliosis; their diagnosing and treatment.

The researches of V.K. Veltchenko [1, pg. 85] showed importance of early diagnosing of posture disorders. It will permit to recover them in due time. The author notes that selection of correcting exercises shall be determined individually, considering the character of posture disorders. In this case shape of back is the only sign of scoliosis. It permits to determine correctness of means and methods of trainings. However, visible signs of backbone deformation signal about posture disorders. That is why for effective prophylaxis of posture disorders it is necessary to have method, which could ensure exact detection of first signs of muscular functioning imbalance at early stages.

Different authors conducted researches in this aspect. For example, A.A. Potapchuk and M.D. Didur [3, pg. 98] outlined requirements to methodic of children's medical examinations for posture disorders:

1. Determination of minimal symptoms of posture disorders and physical condition (early diagnosing);
2. Determination of the weakest links in organism's systems, responsible for formation and support of posture that permits to work out individual correction program (general assessment and individual approach); systemic assessment of health related measures' effectiveness and correction of program (operative and integrative control).

Among other publications results of domestic [8, 12, 13, 15-20, 22, 25, 31] and foreign [9, 23, 27-30] authors attract attention. Most authors agree that this pathology takes place in every population and does not depend on race and geographical location. For ensuring of early diagnostic and organization of correcting preventive measures it is necessary to practice constant monitoring of physical condition, physical fitness and physical potentials of children. The authors note that it is necessary to implement complex preventive programs, facilitating more effective correction of body space organization's disorders and permitting to neutralize negative influence of school risk factors. Besides, they note that for improvement of children's lungs and cardio-respiratory systems' functional state it is necessary to use exercises with breathing pauses.

The mentioned researches do not solve completely the problem of scoliosis prophylaxis and treatment by means of physical education. That is why it is required to continue researches in the mentioned above aspect because it is an urgent problem for school age children.

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Purpose, tasks of the work, material and methods

The purpose of the work Мета дослідження – is to show peculiarities of differentiated correction of junior school age children's posture, considering tonic vibration reflex.

The research was approved by ethic committee of Chernigov National Pedagogical University, named after T.G. Shevchenko. We received written consents of parents for their children's participation in experiment.

The research was conducted with participation of 62 junior school age children (7-10 years old boys and girls). Before experiment, for control over posture of experimental groups' children we examined them for presence or absence of visible signs of posture disorders. The examination was fulfilled by qualified medical doctors. From 62 examined junior school age children in 48 there were found no visible disorders of posture. In this group of children we conducted registration of tonic vibration reflex of lumbar spine. On the base of initial measurements we formed groups: control 912 persons) and experimental (12 persons). All children had no visible signs of posture disorders in frontal plane.

Medical examination was carried out twice: at the beginning of pedagogic experiment (September) and at the end of experiment (May).

Results of the researches

Medical examination showed that in 35 persons (65.8%) we registered one-side increased reflex excitability of nervous centers: from right side of backbone – in 28 children (72%); from the left side in 17 children (28%). With the help of registration of tonic vibration reflex (TVR) of lumbar spine symmetric muscles we found increased reflex excitability of right or left torso sides. As results of our researches showed confident information about early signs of imbalance of skeletal muscles' functional state is carried by indicators of appropriate nervous centers' reflex excitability. These indicators can be received in registration of tonic vibration reflex. We assumed that usage of TVR data for current control would permit to increase effectiveness of preventive measures by means of physical exercises of correcting orientation.

It is known that if formation of schoolchildren's correct posture natural "muscular corset" participates. To large extent it determines stability of posture, ability to keep certain position during long time [2, pg.52]). For determination of "muscular corset" functional potentials control and experimental groups' children were offered to fulfill test exercises for power endurance of abdomen muscles, torso sides and back strength.

Comparative analysis of results of back power endurance testing determined insufficient level of power endurance of the mentioned muscles (see table 1).

Table1. Comparative analysis of power endurance indicators of control and experimental groups' children's torso muscles before pedagogic experiment (by methodic of I.D. Loveyko and M.F. Fonariov)

Testing	Norm	Control group	Experimental group
Power endurance of back muscles, sec.	60-120	41.6±1.6	39.2±2.2
Power endurance of torso side muscles, sec.	60-90	59.2±2.6	57.5±2.1
Power endurance of abdomen muscles, quantity of times	15-20	16.8±0.9	15.7±0.9

Statistic processing of results of torso side power endurance testing permitted to find the presence of asymmetry in static power endurance of torso right and left sides in most of the tested children. In average, in this test children of control group showed result 59.24 ± 2.6 seconds; experimental group's children – 57. 5 ± 2.1 seconds. Distinctions by level of torso sides' muscles between groups were not confident ($p > 0.05$). Comparative analysis of the received data (comparison with norms) (60-90 seconds: 2, pg. 54) also showed insufficient level of static endurance of torso side muscles' static endurance (see table 1).

Testing of abdomen muscles' power endurance showed that practically all tested coped with this test. Exclusion was only two children from experimental and 1 child from control groups. Mean quantitative indicators in

control group were 16.8 ± 0.9 times and in experimental – 15.7 ± 0.9 times. Distinctions were not confident разів. (p> 0.05). Normally, children of this age group shall fulfill this exercise 15-20 times [2, pg. 54].

Examination of functional potentials of back, abdomen and torso side's muscles permitted to observe dynamic of power endurance development during all pedagogic experiment. The examinations were used for determination of load parameters of correcting exercises for them to be adequate to children of control and experimental groups.

During year health related trainings, oriented on prevention from posture disorders in frontal plane were conducted by known methodic [2, pg. 54] with control and experimental groups' children. These trainings were practiced thrice a week with duration of f 30 minutes each. Main part of health related trainings of control and experimental groups' children consisted of correcting exercises (55-75% from total time of training), relaxation exercises (5-10%), general developing exercises (GDE) (10-15%), breathing exercises (BE) (10%) and mobile games (10-15%).

Distinctions in methodic of health related trainings in the tested groups were as follows. In control group correcting exercises were oriented on prevention from posture disorders, without consideration of detected one side increased reflex excitability of appropriate nervous centers. Instructor practiced traditional symmetric training of muscles (natural "muscular corset") with accent on training of strength and power endurance. In experimental group trainings were built on the basis of the received data of TVR of lumbar spine. With it indicators of one-side increased reflex excitability of motor centers were considered. For local influence on lumbar spine muscles we used asymmetric loads. These loads selectively strengthen and stretch muscles on the side of reduced reflex excitability and relax muscles on the side of increased reflex excitability. We assumed that such methodic approach would permit to reduce difference of impulse flow from periphery (muscles) from right or left torso sides to central nervous system (CNS). Besides, it could prevent from asymmetry of muscular tonus in the future.

To avoid wrong application of asymmetric exercises in group form of trainings their quantity is restricted [7 pg.52]. In this connection fulfillment of correcting asymmetric exercises was controlled by pedagogue. This control was conducted on the base of preliminary fulfilled measures on revelation of imbalance of lumbar spine motor centers' reflex excitability. To ensure visual character of exercises and increase of children's understanding of correcting exercises we put bright band on one of lower limbs of a child. The band pointed at localization of increased reflex excitability of appropriate nervous centers.

Technology of experimental group children's posture disorders' prevention was as follows. Registration and further computer analysis of electric myogram (EMG) permitted to determine the character of reflex excitability of child's motor centers. In its turn, it permitted to find out on what side from backbone reflex activity of skeletal muscles is increased. Accordingly, this side was selectively additionally loaded with stretching and relaxation exercises. On the side of weakened excitability of motor centers we added strengthening exercises. Thus, instructor's actions were directed at balancing of reflex excitability of nervous centers. For this purpose asymmetric loads were applied.

Alongside with asymmetric exercises we widely used symmetric correcting exercises. As S.B. Sharmanova [6, pg. 164] notes with defects of posture in frontal plane main role is played by symmetric exercises. They ensure balancing of muscular force and elimination of muscular tonus asymmetry.

Series of experiments resulted in finding that health related effectiveness of symmetric correcting exercises, used by children with one-side increased reflex excitability, is restricted due to weak muscles on one side of torso [5, pg.124]. Weakness of muscular groups on one side of backbone results in their quick fatigue as well as in unconscious deviation of backbone when fulfilling symmetric correcting exercises. In this case it is necessary to stop correcting exercise. It reduces the volume of the fulfilled work.

For junior school age children the most important element of health related methodic is choice of physical load level. Insufficient physical load will not result in expressed health related effect through insufficient mobilization of physiological functions. Excessive physical load can bring to unfavorable after effects in muscular skeletal apparatus and result in loss of children's interest to trainings.

In order to determine optimal load limits it is necessary to have clear knowledge of children's maximal potentials. This information can be obtained from control execution of main exercises. In compliance with it correcting exercises were dozed on the base of control testing of strength and power endurance of muscular corset. In complexes of correcting exercises we used power exercises of dynamic and static character. Static exercises were preceded by dynamic power exercises. Dynamic power exercises took approximately 95-85% from total quantity of correcting exercises. Static exercises took 5-15%. When fulfilling static exercises their dozing made 50-70% from maximal result of control testing.

With regular repetition of the same exercises the process of active adaptation to them takes certain period of time. It gives training effect. After it external influences stop being active irritators and their training role also stops. Further intensive growth of physical abilities does not take place. That is why with growing of strength and power endurance of muscles quantity of repetitions of every exercise also increases.

Quantity of repetitions and rest interval between exercises depended on functional potentials of tested children and was regulated by heart beats rate (HBR). According to recommendations of I.D. Loveyko and M.I. Fonariov [2, pg. 58], when fulfilling correcting exercises, pulse shall be in the range of 120-160 bpm. Restoration of pulse up to 110-120 bpm pointed at children's readiness for next series of exercises. We considered peculiarities of children's condition [7, pg. 69] in fulfillment of static correcting exercises. For example, time of passive rest was two times greater than the period of exercise's fulfillment.

With growing of strength and power endurance we used exercises with combination of different modes of muscles' functioning. Power exercises were combined with stretching and relaxation of actively working muscles.

For a child to master voluntary relaxation of muscles is rather difficult task. It requires certain motor experience and ability to control muscular tonus. Relaxation exercises ensured maximally possible reduction of tonic tension of muscles. They used in final part of training or in main part in rest intervals (after power exercises).

Most of specialists think that it is compulsory to include breathing exercises in health related complexes (L.A. Golobina, Yu.A. Kopylov, N.V. Skovorodnikova, A.P. Shkliarenko, A.P. Matveyev et al.). It is explained by the fact that the most often respiratory failure is combined with expressed somatic weakness of a child, functional failure of muscular-ligament apparatus against the background of relative circulatory failure. That is why in experimental group special attention was paid to formation of rational breathing skills during fulfillment of physical exercises. Children's conscious attitude to breathing exercises was formed. It was achieved through constant explanations of importance of correct "full" breathing fro effective muscular work and the whole organism. When fulfilling static exercises children's attention was concentrated on impossibility of breathing pauses in static positions. For this purpose we used methodic technique, offered by M.V. Kuzmenko (2002). The author offers pronouncing of different sounds at exhaling.

Posture's correction with the help of correcting exercises can result in steady effect only with simultaneous formation of correct posture skill. For this purpose it is necessary to create muscular-joint sense of separate body parts' position (S.M. Popov, R.F. Valeyev). Formation of posture on the base of pro-prioceptive sense envisages observation of certain organizational-methodic requirements. These requirements imply presence of smooth wall without plinth. It permits for a child to stand with back in contact with the wall and take correct posture. Children shall feel five points of contact: the back of the head, shoulder blades, buttocks, shin muscles and heels. That is child feels correct position of own body in space. It creates pro-prioceptive sense, which, with multiple repetitions, is fixed in CNS.

At the end of academic year, after experiment we carried out experts' examination of children's posture in control and experimental groups and summarizing registration of TVR.

Table 2. Summarizing TVR of control and experimental groups' children after experiment

Group	Quantity of children with one-side increased reflex excitability				Quantity of children with posture disorders			
	At the beginning of pedagogic experiment		At the end of pedagogic experiment		At the beginning of pedagogic experiment		At the end of pedagogic experiment	
	n	%	n	%	n	%	n	%
Control	12	100	7	58.3	0	0.0	3	25.0
Experimental	12	100	4	3.3	0	0.0	0	0.0

Discussion

Results of our research confirmed the data of other authors about complex control of children's posture (M.V. Kuzmenko, 2002; I.D. Loveyko, M.I. Fonariov, 1988; S. Sharmanova, A. Fedorova, G. Kalugina, 1999; A.P. Shkliarenko, V.A. Petkov, 2001; Sobera M., Siedlecka B., Syczewska M., 2011; Hagner W., Bąk D., Hagner-Derengowska M., 2011; Dockrell S. та інш., 2012; Czaprowski D. та інш., 2014; McKay S.M., Wu J., Angulo-Barroso R.M., 2014; Żukowska Hanna та інш., 2014; Tamozhanskaya A.V., 2015).

Approaches to building of methodic, oriented on consideration of children's individual potentials can be considered to be novelty. This methodic permit to achieve greater effectiveness in prevention from posture disorders of junior school age children.

Cultivation of correct posture shall be realized through imaginary and visual picture about it. Imaginary picture was formed with instructor's explanations about ideal positions of body parts in space (head, shoulders, torso and legs). Visual picture was created by direct example of instructor himself. At all trainings children should have seen correct beautiful posture of their instructor, who demonstrated it during all training session.

The content of health related trainings in control and experimental groups was practically identical. Peculiarities of experimental group's trainings implied that correcting exercises were selected for every child, considering one-side reflex excitability of appropriate nervous centers. We assumed that such methodic approach can permit for us to increase effectiveness of health related trainings for prevention from posture disorders in frontal plane.

Conclusions

We think that the results, received by us, confirm one more the effectiveness of methodic of early diagnostic. This methodic is based on registration of tonic vibration reflex (TVR) for prophylaxis of posture disorders in frontal plane. It permits to obtain confident information about character of nervous centers' excitability that reflects functional activity of interconnected muscular groups. The methodic permits to practice current control of prevention measures' effectiveness by means of physical culture and introduce, is it is required, operative changes.

The prospects of further researches imply substantiation of practical recommendations for application of early diagnostic methodic in cases of children's posture disorders in conditions of comprehensive educational establishments.

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INFLUENCE OF CYCLIC MODERATE INTENSITY WORK ON FUNCTIONAL FITNESS OF 17–21 YEARS OLD STUDENTS WITH "HIGH" CONTENT OF FAT COMPONENT

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Abstract. *Purpose:* determination of run loads purposefulness in aerobic energy supply mode for increasing of functional fitness of 17–21 years old boys with high content of fat component. *Material:* 17 boys of 17–21 years' age, who did not practice sports, participated in the researches. By their health all boys were belonged to main health group. During 24 weeks training cycle, at different stages of the research (in 8, 16 and 24 weeks from the beginning of training) we registered indicators of aerobic performance and component composition of body mass. *Results:* with trainings' periodicity of 3 times a week energy losses for one training did not exceed maximal admissible value and exceeded minimal one. Minimal value was not less than 44% from maximal admissible energy losses (energy losses of one training were approximately 50% from maximal admissible). *Conclusions:* run loads in aerobic energy supply mode confidently increase boys' aerobic potentials after 16 weeks of trainings. With it they do not influence on anaerobic performance. It was found that under influence of such trainings fat component of body mass and visceral fat reduce; muscular component increases. Alongside with it body mass index and main metabolism did not change for 24 weeks of trainings.

Key words: boys, run loads, aerobic performance, anaerobic performance, component composition of body mass.

Introduction

It is known that studying at HEE is accompanied by emotional and mental over-tension, wrong regime of work and rest, ineffective organization of physical education. Considering all listed students' observation healthy life style becomes especially important. Sufficient motor functioning is an integral component of healthy life style [1, 7]. That is why there appears a problem of creation and application of new health related physical culture technologies in physical education of higher educational establishments' students [2, 5, 7, 8, 14]. Effectiveness of health related trainings to large extent depend on improvement of organism's adaptation mechanisms. One of factors, influencing on this process is individual growth of organism, connected with age period of ontogeny [14].

Also dependence between ability to adapt to physical aerobic and anaerobic loads and body mass has been found [3, 15, 16]. For example, with increasing of fat component in organism, indicators of aerobic and anaerobic performance reduce. That is why, application of physical exercises for correction of body mass component composition permits to purposefully improve functional fitness [2, 4, 5, 7, 8, 9, 12, 14]. Alongside with it variable character of physical loads' influence on functional fitness of persons with different content of fat component has not been researched yet.

Considering the above said creation of new forms of physical education programs and studying of their effectiveness, considering fat content of 17–21 years old boys, condition the urgency of the present research.

Purpose, tasks of the work, material and methods

The purpose of the work is determination of run loads purposefulness in aerobic energy supply mode for increasing of functional fitness of 17–21 years old boys with high content of fat component.

The tasks of the research: to study effectiveness of run loads influence in aerobic energy supply mode on indicators of aerobic and anaerobic performance and on component composition of 17–21 years old students' body mass.

The methods and organization of the research: in our previous works it was found that aerobic and anaerobic performance of 17–21 years old boys depend on component composition of body mass (with increasing of fat component indicators of both aerobic and anaerobic performance reduce) [3, 15, 16]. We studied possibility of cyclic exercises' application in aerobic energy supply mode for influencing on functional fitness of boys with "high" content of fat component. At the beginning of experiment we formed group of students (17 persons) with "high" fact component content. For improvement of these students' functional fitness we used run loads in aerobic energy sully mode. For prevention from these trainings' negative influence on muscular-skeletal apparatus we took in consideration body mass index (BMI), which exceeded norm in our researches. During 24 weeks (thrice a week) the tested fulfilled run loads. At every training energy losses were 50% from maximal admissible value. In running each

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student used moniutor of heart beats rate and observed fixed pulse regime – 150 bpm^{-1}. It corresponded the planned intensity of work, which was 60% from maximal oxigen consumption ($VO_{2\ max}$).

Effectiveness of trainings' influence on students' functional fitness was assessed by physical workability (PWC_{170}) and maximal oxygen consumption ($VO_{2\ max}$) [6], threshold of anaerobic metabolism – TAM) [13], power of anaerobic a-lactate (Wingate anaerobic test for 10 seconds – $WAnT_{10}$) and lactate (Wingate anaerobic test for 30 seconds – $WAnT_{30}$) energy supply processes, by maximum quantity of mechanical work for 1 minute– MQMK) [13, 18], and component composition of body mass [20].

Quantitative content of fat component in boys' organism was assessed by criteria of Gallagher D., McCarthy H. D. and Omron Healthcare [17, 19, 20]. Aerobic performance was assessed by relative value of maximal oxygen consumption. For it we used criteria of Ya.P. Piarnat [11]. By criteria of G.L. Apanasenko we estimated levels of physical health: "safe" level for boys corresponded to relative value of $VO_{2\ max}$ not lower than 42 $ml \cdot min^{-1} \cdot kg^{-1}$. Before experiment level of physical health of the tested students corresponded to level; "below average" by mean value of $Vo_{2\ max\ rel.}$ It was lower than "safe" health level. Research results were registered after 8, 16 and 24 weeks from the beginning of experiment.

Effectiveness of run trainings depends on their periodicity and loads of every training, which shall not exceed maximal admissible energy loss (E_{max}) and exceed minimal (E_{min}). For calculation of minimal (E_{min}) and maximal admissible (E_{max}) values, as well as for determination of run duration with such energy losses we used indicator $VO_{2\ max}$ [12].

For prompt calculation of individual indicators of aerobic performance, energy losses in run at certain heart beats rate, for assessment of students' organism aerobic performance we used author's computer program "Health calculation". Using the inserted data the program gives results of calculation of absolute and relative indicators of organism's aerobic performance (PWC_{170} i $VO_{2\ max}$); level of organism's aerobic performance (by criteria of Ya.P. Piarnat) [11]; maximal admissible (E_{max}) and minimal (E_{min}) energy losses values; heart beats rate (HBR). Intensity of run work is calculated by formula of O.A. Pyrogova [10], considering the planned one training energy losses, maximal admissible (t_{max}) and minimal (t_{min}) duration of rum.

Statistic processing of the data of the research was conducted with the help of mathematical statistic methods. We determined mean arithmetic value (x), mean square deviation (σ) and error of mean arithmetic (±S). T criterion of Student was used for determination of confidence of results' difference.

The materials of this work comply with legal and ethic standards of researches that is confirmed by bio-ethic committee of *Vinnitsa* State *Pedagogical University (minutes* №1 dt. October 8 2015). Besides, we received written consents of parents for testing of students.

Results of the researches

Under influence of trainings the tested boys' absolute and relative indicators of aerobic performance increased (see table 1). After 24 weeks of trainings absolute value PWC_{170} confidently increased by 15.16% ($p<0.01$). Relative indicators PWC_{170} confidently increased after 16 weeks by 10.6%, ($p<0.01$) and after 24 weeks – by 16.79% ($p<0.001$).

Under influence of trainings, absolute indicator $Vo_{2\ max}$ increased by 9.27% ($p<0.01$) after 24 weeks. In contrast to absolute indicator, relative indicator$Vo_{2\ max}$ increased by 6.9 % ($p<0.001$) after 16 weeks and by 10.9% ($p<0.001$) after 24 weeks.

Confident increase of absolute and relative indicators TAM of the tested persons was registered only after 24 weeks of trainings. TAM_{abs} increased by 13.18% ($p<0.001$). Relative indicators TAM increased, in average, by 14.86% ($p<0.001$).

In spite of absolute and relative values of indicators PWC_{170}, $Vo_{2\ max}$ and TAM confident increasing. level of physical health (by Ya.P. Piarnat and G.L. Apanasenko) did not change confidently.

Training during 24 weeks did not change significantly anaerobic performance by indicators of maximal external mechanical work during 1 minute (MQMK), power of a-lactate processes ($WAnT_{10}$) and power of anaerobic lactate energy supply processes ($WAnT_{30}$).

Table1. Influence of run loads program of aerobic orientation on indicators of aerobic and anaerobic performance of 17–21 years old boys

Indicator	**Mean values, x±S**			
	Before trainings	**After 8 weeks**	**After 16 weeks**	**After 24 weeks**
PWC_{170}, kgm·min^{-1}	975.08	1015.03	1073.34	1149.31
	±41.51	±33.77	±37.53	±45.07**
PWC_{170}, kgm·min^{-1}·kg^{-1}	11.55	12.14	12.92	13.88
	±0.34	±0.25	±0.29**	±0.38***
$VO_{2\,max}$, ml·min^{-1}	2897.63	2965.55	3064.67	3193.83
	±70.58	±57.47	±63.7	±76.61**
$VO_{2\,max}$, ml·min^{-1}	34.42	35.53	36.97	38.63
·kg^{-1}	±0.49	±0.36	±0.31***	±0.47***
TAM, W	178.24	187.06	188.82	205.29
	±6.87	±6.27	±5.57	±4.87***
TAM, W·kg^{-1}	2.12	2.25	2.28	2.49
	±0.06	±0.08	±0.09	±0.08***
MQMK, kgm.min^{-1}	2372.12	2465.14	2457.01	2529.95
	±79.39	±77.30	±72.98	±75.07
MQMK, kgm·min^{-1}	28.42	29.54	29.63	30.59
·kg^{-1}	±1.05	±1.03	±0.99	±1.04
$WAnT_{10}$ kgm·min^{-1}	4814.58	4904.21	4974.6	4992.55
	±119.78	±177.97	±177.97	±179.00
$WAnT_{10}$ kgm·min^{-1}	57.53	58.59	58.82	60.18
·kg^{-1}	±1.88	±1.88	±1.88	±1.67
$WAnT_{30}$ kgm·min^{-1}	3405.51	3434.91	3505.21	3602.99
	±138.51	±132.03	±139.21	±135.31
$WAnT_{30}$ kgm·min^{-1}·kg^{-1}	40.76	41.12	42.24	43.53
	±2.44	±2.37	±2.23	±2.09

Notes: Confidence of differences in indicators of output data: * – p<0.05; ** – p<0.01; *** – p<0.001.

Table 2. Influence of run loads program of aerobic orientation on component composition of 17–21 years old boys' body mass

Indicator	Mean values, x±S			
	Before trainings	After 8 weeks	After 16 weeks	After 24 weeks
Body mass, kg	83,83	83,48	82,92	82,71
	±1,11	±1,08	±1,10	±1,11
BMI	24,65	24,55	24,38	24,32
	±0,09	±0,17	±0,16	±0,14
Fat content,%	23,35	22,78	21,93	21,88
	±0,40	±0,31	±0,42*	±0,42*
Skeletal muscles, %	38,43	38,85	39,28	39,33
	±0,19	±0,26	±0,26*	±0,25*
Visceral fat content	7,71	7,12	6,94	6,53
	±0,28	±0,21	±0,28	±0,28*
Main metabolism, kcal	1854,12	1836,18	1817,47	1805,12
	±17,34	±19,99	±15,32	±18,31

Note. Confidence of differences in indicators of output data: – p<0,05.

Characterizing of changes' dynamic in component composition of body mass in the process of trainings (see table 2) we found that percentage of fat mass in students' organism reduced by 6.08% ($p<0.05$) after 16 weeks of trainings and by 6.3% ($p<0.05$) after 24 weeks. With it content of muscular component of body mass increased by 2.16% after 16 weeks and by 2.3% after 24 weeks of trainings. After 24 weeks, under influence of trainings, level of visceral fat reduced by 15.3%, $p<0.05$). However we did not register confident changes of body mass, BMI and main metabolism.

Discussion

So, run loads in aerobic energy supply mode can be used for improvement of 17-21 years old boys' functional fitness. Considering dependence of functional fitness of such age boys on fat content (with increasing of fat content functional fitness worsens) the purposefulness of such trainings of boys with excessive fat component becomes obvious.

Correction of functional fitness shall be realized through improvement of aerobic metabolic processes, which determine effectiveness of muscular work. Effectiveness of such work is conditioned by chosen means of physical education, by periodicity of trainings and volume of loads. For improvement of boys' functional fitness we chose run of moderate intensity in aerobic energy supply mode. With trainings' periodicity of 3 times a week energy losses at one training did not exceed maximal admissible level and exceeded minimal one. Minimal admissible level was 44% from maximal admissible energy losses (energy losses at one training were 50% from maximal admissible). There is information that effectiveness of trainings in aerobic mode can be ensured by less periodicity and less energy losses [10]. Results of our researches do not confirm this opinion [12, 14]. Our training program facilitates increase of 17–21 years old boys' aerobic potentials by indicators $VO_{2\,max}$ and TAM. They do not influence on anaerobic performance. This performance was assessed by power of anaerobic a-lactate and lactate energy supply processes as well as by capacity of lactate energy supply processes. Under influence of such trainings fat component of the tested reduced. It is a risk factor, meaning reduction of organism's functional potentials.

Conclusions

Run loads in aerobic energy supply mode of 50 % from maximal admissible energy losses value with periodicity of 3 times a week confidently increase aerobic potentials of boys with "high" fat content, videlicet: power of aerobic energy supply processes by indicator $Vo_{2\,max}$, after 16 weeks of trainings and later (after 24 weeks of trainings) – capacity of aerobic energy supply processes by indicator TAM, with it not influencing on anaerobic performance.

Under influence of such trainings fat component content decreased after 16 weeks of trainings and level of visceral fat reduced after 24 weeks of trainings. With it muscular content of 17–21 years old boys increased. However, BMI and main metabolism did not change after trainings cycle.

The further researches: it is planned to study influence of trainings in mixed energy supply mode on functional fitness of students with "high" content of fat component.

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Conflict of interests

The authors declare that there is no conflict of interests.

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HEART BEATS RATE INDICATORS AND STRUCTURE OF ELITE FOOTBALL REFEREES' AND THEIR ASSISTANTS' MOTOR FUNCTIONING IN COMPETITION PERIOD

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Abstract. *Purpose:* to analyze structure of motor functioning and heart beats rate indicators in elite football referees' and their assistants' competition activity. *Material:* in the research 15 referees and referees' assistants of Ukrainian Prime League, 30 referees and referees' assistants of first and second professional leagues of Ukraine participated. Observations over referees' movements in 21 professional matches of Ukrainian professional leagues were fulfilled. Distance, passed by a referee in one match was determined. *Results:* It was found that during one match referee (depending on his functions – referee or referee's assistant) passes distance from 6000 to 12 000 meters. This scope of motor functioning depends also on motor activity of players and qualification level of teams-participants in the match. Motor actions of referees' assistants change every 5 seconds during a match. During one match referee's assistants fulfill about 20 sprints and 74 accelerations. A high temp of match total distance makes 1.2 km. *Conclusions:* Referees' and referee assistants' motor functioning and heart beats rate indicators can vary from aerobic-restoration to anaerobic-glycolytic zone. This fact shall be considered when planning program on special physical training. It should be noted that with heart beats rate of more than 180 bpm concentration of attention significantly weakens as well as ability to take prompt and correct decisions. In such cases probability of mistakes significantly increases.
Key words: referee, motor functioning, heart beats rate, competition functioning.

Introduction

Referees' activity takes place in the eyes of millions of spectators. Popularity of football pre-conditions high responsibility of referees: sport and show sides of every match to large extent depend on their qualification and authority [9]. Modern football match can be conducted by referee only under condition of his high motor functioning. Otherwise he simple would lag behind the temp of game. It can result in a lot of mistaken decisions [1-3, 12, 15].

Referee's high motor functioning in football match and during all season facilitate higher quality of his work as well as ability to cope with constantly increasing competition load [2, 7, 8, 14, 18].

Referees' and referee assistants' actions show that fulfillment of their duties is connected with significant motor activity and high indicators of heart beats rate (HBR). It is conditioned by exclusively dynamic character of the game itself [1, 18]. These indicators depend on intensity of movements, means of movements (sprints, acceleration, slow or moderate run speed and etc.) different movements of arms (illustrating the character of noticed violations; pointing at kinds of penalties).

Specialists in football refereeing, such as A.N. Spirin (2003), A.D. Budogoskiy (2008), A.B. Abdula (2013), T.G. Chopilko (2014) note that modern football match is characterized by great number of technical-tactic actions and high intensity of football players' movements as well as by quick change of game situations, which can cause referee's wrong decisions.

Thus, the structure of referees' motor functioning in competition period has much in common with motor functioning of football players. The most significant qualities of referees' special physical fitness include special endurance and quickness (first of all quickness of motion) to less extent referees have to demonstrate strength, dexterity and flexibility [1, 3, 7, 19].

Purpose, tasks of the work, material of the research

The purpose of the work is to analyze structure of motor functioning and heart beats rate (HBR) indicators in elite football referees' and their assistants' competition activity.

For solution of our tasks we used the following *methods and organization of the research:*

1. Pedagogic: studying, analysis and generalization of scientific-methodic literature, pedagogic observations, photographing and video recording of different game situations, questioning;

2. Medical-biological methods: registration of heart beats rate (HBR bpm^{-1}). HBR was registered with the help of transmitter «Polar T31» («Polar Electro Oy», Finland0) with telemetric transmission of data;

3. Statistical analysis of results.

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Results of the research

Observations over referees' movements in 21 professional matches of Ukrainian professional leagues were fulfilled. It was found that during one match referee (depending on his functions – referee or referee's assistant) passes distance from 6000 to 12 000 meters. This scope of motor functioning depends also on motor activity of players and qualification level of teams-participants in the match.

The researches permitted to quantitatively characterize total scope of referees' motor functioning. We found that in refereeing of competitions of not the highest level (matches of second professional league of Ukraine) referees pass distance of 6-8 km during one match. Referee assistants pass from 2 to 6 km. It is directly connected with intensity of game itself and qualification level of the participants.

Motor actions of referee's assistants change every 5 seconds during one match. In one match they fulfill about 20 sprints and 74 accelerations. Total distance is 1.2 km in match of high temp. Main means of motion are: ordinary run of different intensity and side step run. Referee's assistant passes distance of 1.2-2.0 km with side step (in average 1.5 km) see table 1).

The presented in table data show that referee fulfills work of anaerobic character: walk, slow run and average rate run. It should be noted that referee uses more quick accelerations and less quick sprints. Backwards running permits for referee to control players' actions with ball depending on their location on field. But these indicators are insignificant in relation to total volume of fulfilled work [2, 10].

Referees' and referee assistants' motor functioning takes place with variable power of work and reflects in change of HBR during match. This assumption was experimentally tested by registration of HBR of referees and referee assistants. First of all, the fact, that with increasing of competition level HBR of all referees rises, attracts attention. Scope of motor functioning of second professional league of Ukraine referee assistants mainly consists of walk and slow side step run. HBR is within the range of 91-120 bpm (62.4% of playing time). During matches of the same level referees' motor functioning also consists of walk and slow run. Their HBR is within 111-140 bpm (60.5-73.5 % of playing time). игрового времени).

Scope of motor functioning of first professional league of Ukraine referees mainly consists of slow run, average speed run and run with accelerations. HBR was within 121-150 bpm (46.2-55.7 % of playing time).

Concerning referees of Prime league (some of them have qualification "referee of FIFA" HBR in competition period is in the range of 150-170 bpm. Maximal indicators of HBR were 184 bpm. These data witness that referees fulfill work with rather high HBR. Mean HBR indicators were 162 bpm. These indicators practically do not change in first and second times. Mean values of percent relation of working time in different pulse ranges [4-6], are given in table 2.

Mean HBR indicators of referee assistants of Prime league are 137 bpm. Indicators lower than 130bpm. are 33%. HBR indicators within 130-150 bpm are 38% of total time; indicators 150-170 bpm - 23% ; indicators higher than 170 bpm. - 6%.

Discussion

Observations over referees' actions during matches show that their fulfillment of duties is connected with significant motor activity. Such activity is conditioned by exclusively dynamic character of the game itself [20]. This motor activity manifests as constant movement of referees at different distances. All actions of referees take place on rectangular of football field (90-120 m – length and 45-90 m – width). It is a distinctive feature of refereeing in modern football [1-5]. Referees' motor functioning takes place with variable power and reflects in changes of heart beats rate during game [16].

This assumption was experimentally tested by registration of HBR of referees and referee assistants, who work on matches of Prime league, in first and second professional leagues of Ukraine. It was found that structure of referees' motor functioning has a lot in common with football players' motor functioning17].

The most significant physical qualities of referees include: special endurance, quickness (first of all quickness of motion). It is necessary to distinguish start and distance speed, which are interconnected. Strength, dexterity and flexibility are demonstrated by referees to less extent [9, 18].

Table 1. Structure and scope of motor functioning of elite referees and referee assistants depending on level of competitions

Соревнования	Specialization	Scope of motor functioning, m	Kind of motor functioning, m					
			Walk	Slow run	Side step and backwards run	Run at average speed	Accelerations	Run with maximal speed (sprint)
Вторая профессиональная лига Украины	Referee (n=5)	6155 ±527	2067 **±245**	1745 ±164	68 ±16	1245 ±108	1030 ±93	
	Referee assistant (n=10)	2120 ±256	738 ±85	532 ±61	624 ±78	108 ±14	118 ±22	
Первая профессиональная лига Украины	Referee (n=5)	8476 ±1564	2236 ±211	**2418 ±198**	54 ±23	1846 ±171	1820 ±167	102 ±28
	Referee assistant (n=10)	3304 ±427	**862 ±93**	766 ±88	802 ±94	274 ±27	540 ±49	60 ±12
Премьер-лига Украины	Referee (n=5)	8896 ±1264	2056 ±213	2233 ±244	63 ±28	**2456 ±197**	1904 ±108	184 ±22
	Referee assistant (n=10)	3682 ±383	798 ±57	845 ±86	**1023 ±101**	340 ±46	598 ±37	78 ±24

Table 2. Mean values of heart beats rate (HBR0 in % from total time of elite referees' and referee assistants' work depending on level of competition

Competitions	Specialization	HBR (bpm) of different pulse intervals in % from total working time											
		70-80	81-90	91-100	101-110	111-120	121-130	131-140	141-150	151-160	161-170	171-180	181-190
Вторая профессиональная лига Украины	Referee (n=5)		1.2 ±0.9	1.9 ±1.6	9.7 ±2.8	22.7 ±5.6	31.2 ±4.3	19.6 ±5.8	10.9 ±4.7	3.0 ±1.2			
	Referee assistant (n=10)	5,.5 ±2.7	15.0 ±3.2	22.4 ±4.4	23.1 ±3.8	16.9 ±2.9	10.3 ±3.6	5.1 ±2.9	1.7 ±1.1				
Первая профессиональная лига Украины	Referee (n=5)	1.5 ±1.1	4.0 ±2.8	6.8 ±3.1	7.1 ±2.7	12.2 ±4.5	15.1 ±3.4	20.3 ±2.9	20.3 ±3.2	9.8 ±2.2	2.9 ±1.1		
	Referee assistant (n=10)	0.6 ±0.3	9.0 ±3.3	12.3 ±3.8	11.7 ±3.4	23.0 ±2.4	27.3 ±2.9	10.2 ±3.3	3.9 ±2.7	2.0 ±1.6			
Премьер-лига Украины	Referee (n=5)	1.5 ±1.1	3.0 ±2.4	2.8 ±2.6	5.7 ±1.9	3.0 ±1.3	11.6 ±1.4	11.7 ±2.2	20.4 ±2.9	21.7 ±3.6	10.3 ±3.1	7..0 ±2.8	1.3 ±0.7
	Referee assistant (n=10)	2.4 ±1.6	3.1 ±1.8	6.3 ±2.3	7.9 ±2.2	15.0 ±3.2	15.2 ±3.6	8.1 ±3.6	12.9 ±2.8	10.2 ±2.8	5.1 ±1.9	3.8 ±2.1	

Conclusions

The results of our researches permit to conclude that in competition functioning of elite referees and referee assistants amount of motor functioning and HBR indicators depend on level of competitions. They can vary from aerobic-restoration to anaerobic glycolytic zones. It shall be considered when planning program on special physical training. Knowledge of these factors permits to sufficiently accurately determine main parameters of training load: scope and intensity.

It is noted that with HBR more than 180 bpm, concentration of attention as well as ability to take prompt and correct decisions significantly weaken. In such cases probability of mistake significantly increases.

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Conflict of interests

The authors declare that there is no conflict of interests.

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BODY COMPOSITION OF YOUNG PEOPLE AGED 17–18 YEARS, PRACTICING AND NOT PRACTICING SWIMMING, WITH THE USE OF THE BIOELECTRICAL IMPEDANCE METHOD.

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Abstract. *Purpose:* Body composition evaluation of youth aged 17–18 of a different physical activity with the help of bioelectric impedance method. *Material and Methods:* 18 boys practicing swimming and 19 boys not practicing it took part in the study, making up a control group. Height, weight, BMI, lean body mass, the content of fat and water, Rohr factor were evaluated. Non-parametric Mann-Whitney test has been used to evaluate the differences in the range of the tissue components between the two groups. *Results:* Statistically significant differences were found on the $p<0,05$ level in % fat content. Mean body weight in experimental group was 71.5 kg, while in control group it was 69.4 kg. Minimum and maximum weight in group of swimming-practicing persons was: 56.6–92.2 kg. Increased body weight in the group of swimmers can result from greater amount of active tissue in this group compared with persons of low physical activity. Proportionally, it amounted to 64.3 kg and 61.3 kg. In the tested groups, minimal and maximal values of amount of active tissue proportionately amounted to: 54.1–78 and 49.5–72,3 kg. *Conclusions:* Physical activity modifies body composition. Active lifestyle is one of the methods for prevention of overweight and obesity.
Key words: body composition, physical activity, obesity, bioelectric impedance.

Introduction

Recent years, in Poland and in many other countries studies have been conducted on problem of overweight and obesity. Obesity is perceived as a health problem and treated as "Epidemic of XXI century". In medical concept, obesity is treated as a systemic chronic metabolic disease resulting from a disorder of the balance between energy collecting and spending [1]. Obesity is connected with an excessive fat body growth. The period of puberty is a critical period for general fatness development and in terms of body for fat location in the organism [13].

Hirschler V. et al. [8], Anoop M. et al. [1] suggest that there is a correlation between abdominal obesity and late appearance of the metabolic syndrome (ZM). De Ferranti A. et al. [5] state that obesity is a clinical concept of related metabolic disorders, to which belong the following among others: abdominal obesity, hypertension, increased glucose concentration, insulin resistance, lipid economy. In case of children obesity should be treated as a multi-systemic disease [7].

According to Sikorska-Wiśniewska G. [18], main obesity causes are: inappropriate eating habits, low physical activity, emotional problems, pregnant women's inappropriate nutrition, genetic factors. The author says that during childhood, environmental impact is very crucial, due to formation of eating habits. Besides, parents have also a significant influence on the children's way of their free time spending. They can offer different forms of physical activity to the child. Significance of a physical activity increases, especially in the prevention of civilizational diseases. Physical activity positively affects our health, emotional and social development. Systematic, long-lasting physical exercises induce changes in organs, systems, cells. These changes affect body composition (lean body mass participation, fat body) [17]. Chabros E. and Chrzanowska J. [4] state that obesity and overweight are frequently the result of an inappropriate diet and low physical activity. It has been found that following an appropriate diet together with a regular physical activity constitutes an effective method in the fight against obesity. Regular participation in sports reduces amount of fat body and increases lean body mass. Physical activity leads to reduction of fat body mass size, and also improves its sensitivity to insulin effect. An adequate level of physical activity leads also to regulation of metabolic disorders, which occur with obesity. Białkowska M. [2] claims that physical activity is effective for secondary and primary obesity prevention, while reduced physical fitness can lead to increased risk of premature death.

Body mass and composition measurements are good tools to evaluate metabolism disorders, in diagnostics of malnutrition, overweight and obesity.

Anthropometric methods evaluating overweight and obesity include: bioelectric impedance method, percentile grid, waist-hip rate (WHR), waist circuit (WC), BMI rate (body mass index). Bioelectric impedance method

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is a non-invasive, simple method. Besides, thanks to this method, evaluation of body composition mass can be made. Woodrow G. [20], Birch K., et al. [3] state that bioelectric impedance is connected with electrical conductivity of lean, hydrated and anhydrous body fat. The most frequently used weight-height factor is BMI factor.

Material and methods

Ethics

The study was conducted in accordance with the Helsinki Charter of Human Rights and was approved by Ethics Committee of State Higher Vocational School in Raciborz. Each participant was willing to participate in the study voluntarily and confirmed that with a written agreement.

Participants and controls

Tests were conducted in 2013 on a group of young people at age of 17–18 in the morning hours (8.00 – 10.00). The participants were divided into two groups differing by level of physical activity. One group consisted of persons with high level of physical activity, training swimming (18 boys). The second tested group – were the persons not training (19 people), attending only PE lessons (3 times a week).

The subjects were instructed to avoid physical activity, maintain current food intake, with no alcohol and caffeine 48 hours before testing. On test day, the athletes were with empty stomach. The subjects stayed in standard study conditions (temperature 20–22^{o} C – thermo neutral conditions), following the basic procedures of sports metrology.

As a research tool, analyzer of body composition TANITA TBF-300 type has been used, measuring participation of particular body components (Bioelectric analysis of the impedance – BIA). This method uses resistance measurement of electric current in human body. As a result of such research, the following values have been obtained: body mass [kg], BMI – Body Mass Index (weight – height factor of body mass), FAT % – percentage of body fat, FAT MASS –content of body fat in [kg], FFM –content of lean body mass [kg], TBW – total water content in organism [kg].

The results were processed and subjected to the statistical calculations (mean, standard deviation (SD, ±), min., max.) in Microsoft Open Office Excel 2007 software. Significance level of differences between tested groups was calculated with Statistica 10 program. Calculations were made with the use of non-parametric U Mann-Whitney test to compare two independent groups. The level of significance was $p<0,05$.

Results

Table 1. Somatic evaluation of tested groups of young people aged 17–18.

Parameters	**Swimmers (group I) N=18 Mean value of standard deviation.± (min. max)**	**Tested group (II) Mean value of the standard deviation..± (min. max)**	**Significance level p<0,05**
Age	17,4±0,50 (17–18)	17,7±0,46 (17–18)	0,218448
Body height [cm]	180,0±6,36 (168–192)	179,6±6,06 (167–192)	0,963645
Mass [kg]	71,5±8,23 (56,6–92,2)	69,4±8,84 (53,3–92,5)	0,681643
BMI [kg/m^2]	22,1±1,92 (18,9–26,9)	21,5±2,48 (16,2–28,5)	0,370033
FAT %	8,4±3,41 (2,7–15,4)	11,2±3,70 (2,8–21,8)	0,030970
FAT MASS [kg]	6,2±3,12 (1,7–14,2)	8,1±3,65 (1,5–20,2)	0,055574
FFM [kg]	64,3±6,10 (54,1–78)	61,3±5,90 (49,5–72,3)	0,260881
TBW [kg]	47,0±4,51 (39,6–57,1)	44,9±4,32 (36,2–52,9)	0,254493
TBW [%]	66,0±4,74 (49,4–71,2)	65±2,72 (57,2–71,2)	0,104015
Rohrer factor	1,2±0,11 (1,1–1,5) athletic type	1,20±0,15 (0,9–1,6) athletic type	0,637644

*significance level p<0,05

The study involved young people aged 17–18 years, practicing and not practicing swimming. The measurement of body composition with the help of bioelectrical impedance analysis was carried out in two groups of adolescents with different levels of physical activity. In addition to the basic somatic parameters, i.e. body weight [kg] and height [cm], body composition assessment was done, in which lean body mass [FFM kg], adipose tissue [FAT] expressed in kilograms and as percentages as well as the water content expressed in kilograms and as percentages, were specified.

Mean body weight in experimental group was 71.5 kg (± 8.23), while in control group it was 69.4 kg (± 8.84). Minimum and maximum weight in group of swimming-practicing persons was: 56.6–92.2 kg. Increased body weight in the group of swimmers can result from greater amount of active tissue in this group compared with persons of low physical activity. Proportionally, it amounted to 64.3 kg (± 6.10) and 61.3 kg (± 5.90). In the tested groups, minimal and maximal values of amount of active tissue proportionately amounted to: 54.1–78 and 49.5–72,3 kg. Greater volume of active tissue in group with high physical activity has also an effect on BMI. This indicator respectively took values: 22.1 (± 1.92) [kg / m2] and 21.5 (2.48) [kg / m2]. Minimum and maximum values were: 18.9–26.9 [kg/m^2] and 16.2–28.5 [kg/m^2]. Amount of active tissue, body weight, BMI in group of young people practicing swimming, were not significantly statistically higher, compared with control group. Water content [TBW] expressed in percents and in kilograms, in group practicing swimming, was not significantly higher, compared with control group. These indicators respectively took values: in experimental group: 66.0 (± 4.74), maximum and minimum values: 49.4–71.2 [%], whereas in control group: 65 (± 2.72), minimum and maximum values: 57.2–71.2 [%].

The study and analysis of the results have shown that there were significant statistical differences in body fat expressed in percents. In the group of people practicing swimming, these values amounted to 8.4 (± 3.41), minimum and maximum values were: (2.7–15.4) [%]. Accordingly, in control group, body fat, expressed in [%], took values of 11.2 (± 3.70) 2.8–21.8 [%]. Body fat percentage, expressed in kilograms, was 6.2 (± 3.12) in experimental group, minimum and maximum values were: 1.7–14.2 [kg], while in reference group they were: 8.1 (± 3.65), minimum and maximum values: 1.5–20.2 [kg]. Body fat percentage expressed in kilograms, approached level of significance 0 <0.05.

Discussion

Łaska-Mierzejewska T. [11] states that in non-training population, BMI shows rather high correlation with different measures of fatness. People, who train sports, have different composition of body tissues. BMI of contestants may be considered as an active tissue measurement. Jaskólski A. [10] writes that BMI factor is not the best obesity factor for trained people. People with of high physical activity and having mass musculature can have higher BMI value, which may indicate overweight or obesity. In the swimming-training group, high BMI factor can result from a large amount of muscles. Based on the presented opinions, BMI factor should not be compared when people, who differ in the level of physical activity, are examined. In group of the individuals, who practice swimming, in comparison with group II, BMI factor has shown insignificantly higher value. Nazar K. and Kaciuba-Uściłko H. [14] write that BMI factor can increase under the influence of increased physical activity. In group of contestants, body mass was insignificantly higher in comparison with the tested group. Beneficial effects of sports training are visible along with the evaluation of changes in proportions of active tissue and body fat. It can be observed in our studies, where body fat percentage was significantly lower in the contestants' group. It is confirmed by the opinion of Dietz W. H. [6] who claims that long-lasting physical activity promotes fat body reduction. Besides, in the author's opinion, systematic physical activity raises body efficiency and affects psyche positively. A similar conclusion was drawn by Janiszewska R. [9] who investigated students differing in the level of the physical activity. Based on the conducted studies, it can be assumed that intensive sports training affects body composition. In tested group I, amount of lean body tissue was insignificantly higher relative to group II. Our results are consistent with previous results, obtained by Stanula A., et al. [19]. Having investigated 12-year old swimmers with a 3-year training experience, the authors have shown that physical training significantly affects body composition. Janiszewska R. [9] states that systematic, increased physical activity leads to protein body mass increase, LBM increase, reduction of the subcutaneous body fat and visceral, and maintenance of BMI factor within normal range. On the basis of the studies, Orkwiszewska A. et al. [15], while assessing the degree of fatness and tissue composition in the training and non-training boys, suggest, that appropriately dosed physical exercises affect the process of physical development in a modifying way, leading to changes in somatic construction and tissue system.

According to Nazar K. and Kaciuba-Uściłko H. [14], the changes in body composition, connected with physical activity, are important argument in obesity therapy. Besides, the authors state that there are differences in sensitivity of cells, located in various parts of body, to the physical exercises. Moreover, according to Dietz W. H. [6], systematic physical activity not only raises body's efficiency, but also affects psyche positively. Radochońska A. and Perenc L. [16] state that studies on fatness play important role in the obesity treatment and prevention.

Conclusions

1. Based on the results, it can be concluded that in group of individuals, who practice swimming, body fat proportion, expressed in %, was significantly lower compared with the control group.

2. In group of contestants there were no statistically significant tendencies for lean tissue growth [kg] compared with the control group.
3. In tested groups, BMI was normal. Based on these results, it can be concluded that non-significantly higher rate in group with increased physical activity was associated with content of lean tissues.
4. In group of swimmers, water content was not significantly higher, compared with control group.

Conflict of interests

The authors declare that they have no competing interests.

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ACHIEVEMENT GOALS AND INTENSIVITY OF PHYSICAL ACTIVITY DURING FREE PLAY IN CHILDREN: THE MODERATING ROLE OF PERCEIVED SPORT CONFIDENCE

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Abstract. *Purpose:* to examine the moderating role of sport confidence and resultant the achievement goal profile with physical activity intensity during free play. *Material:* participants were 28 children participating in an after-school program. The 28 children completed measures of task and ego goal orientations and sport confidence two weeks prior to having their heart rate monitored during a free play session. *Results:* indicated that children with high sport confidence were characterized ($p < .05$; Cohen's ds > 1.10) by higher task and ego orientations and average heart rate over the course of the free play session when compared to the low sport confidence children. The moderate sport confidence children were not significantly different than the other groups expect for ego orientation though effect sizes indicated this group tended towards being more similar to the high sport confidence group. The results were confounded as all children in the low sport confidence condition were girls. *Conclusions:* Sport confidence moderates physical activity intensity during free play in children and is characterized by a higher ego orientation and generally higher task orientation. But given all of the low confident children were females, intervention work is needed at early ages with girls to build sport confidence and motivations for both goal orientations to hopefully increase physical activity intensity during free play.
Keywords: goal orientations, exercise intensity, physical activity, confidence.

Introduction

In all developed nations, daily physical activity participation of sufficient intensity and duration for health benefits for children and youth are alarmingly low. Across all health organizations (i.e. World Health Organization, Centers for Disease Control and Prevention), children and youth are strongly recommended to engage in at least 60 minutes of moderate to vigorous physical activity daily. The benefits of physical activity across one's lifespan have been known for decades such as reduction in the risk of hypertension, coronary heart disease, diabetes, depression and some forms of cancer. Children who are active are more likely to be active adults, and thus, they will reap the benefits of lifelong physical activity. For instance, a fairly recent research [1] reported that after 50 years of being initially surveyed, the number one predictor of later-life physical activity in an initially healthy sample who were surveyed as children in the 1940's was participation in a high school varsity sport.

Unfortunately, children and youths are insufficiently active, especially girls, thereby setting up another generation of inactive adults. Certainly, we must encourage children's activity levels so they might be interested and talented enough to even participate in high school athletics because currently physical activity participation rates are very across today's youth. For instance in the United States, only 17.7% of female and 36.6% of male high school students surveyed in 2013 indicated that they were active at least 60 minutes a day for the surveyed 7-day period [2]. In Spain, a recent survey found that only 37% of boys and 26% of girls between the ages of six and seven were engaging in at least five hours of physical activity per week [3]. In short, children and adolescent are overwhelmingly physical inactive. The disparity between boys and girls is also a major concern. Understanding determinants of physical activity is one key to increasing physical activity participation. Researchers have examined physical activity through the lens of a number of motivational theories, one through Achievement Goal Theory (AGT) frameworks [4–7] that is the focus of the current investigation.

Since the late 1970's, competency thoughts have been investigated within the achievement goal frameworks [8]. The most studied achievement goal framework is the dichotomous framework. In the sport context alone, at least 236 published reports with the two most used task and ego goal orientation measures exist [9]. In this framework, there are two orientations by which personal competency are judged [8]. Individuals endorsing a task orientation are primarily motivated by personal mastery or improvement. Because of their personal mastery orientation, these individuals reflect a self-referenced standard of personal achievement to gauge their personal competency for a desired behavior. In contrast, an ego oriented person strives to attain high normative standards of ability which is typically

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defined by winning or beating intended others. Ego-oriented individuals evaluate their success and failure and thus personal competence on other-referenced standards.

A critical variable within the dichotomous framework is that of perceived competence [10]. Perceived competence is theorized moderate the relationship between the ego orientation and outcomes in that an individual endorsing the ego goal orientation with high perceived ability should engage in more adaptive achievement behaviors and thoughts than one with low perceived ability and a high ego goal orientation [10]. The relationship between an ego orientation and adaptive achievement behaviors though is at times complex [11, 12]. Though theorized with perceived competence to lead to adaptive achievement behaviors, an ego orientation by itself is correlated with less desirable achievement strategies such as a positive attitude concerning doping in sports [11]. Though when combined with perceived sport confidence, it seems the absence of the ego orientation with high perceived competence is associated with high regard for sportspersonship [12].

In the physical education context, research has verified the theorized moderation of adaptive achievement behaviors, perceived competence, and the ego orientation [13]. Important to the present investigation, perceived competence has been shown to be a very most important determinant of physical activity [4, 14]. For instance, within the AGT [4] in a sample (N = 611) of university females, perceived competence was the most important predictor of stage of exercise participation above that of the task or ego goal orientation. In addition, very recent research in a large sample (N = 1,552) of 3rd to 12th graders, reported that perceived competence referenced towards games and sport play directly predicted physical activity in school and away from school [14]. To date, examination of AGT within children and objectively measured physical activity is nonexistent as the measure of physical activity participation has been self-reported [4, 12]. Hence, the purpose of the present investigation was to examine AGT and objectively measured physical activity intensity in children during free play through the lens of perceived competence.

Purpose, materials and methods

The purpose of the research was to examine whether sport confidence moderated children's objectively measured physical activity intensity over the course of an hour of free play while taking into account the children's goal orientation profiles. The purpose was achieved by the following materials and methods. Participants were initially 38 elementary students in either 4th (n = 20) or 5th (n = 18) grade, participating in an after-school program at their elementary school a part of a large United States of America Department of Education funded grant. Of the initial 38 students, 28 were in attendance the day heart rate was recorded during the free play session. All of the children on average were of an optimal body mass index (BMI) or even slightly underweight (BMI mean = 18.36 $\pm$ 2.97). All participants are enrolled at an elementary school comprised of nearly 100% eligible for subsidized food programs. An appropriate human subject participation form for the children was signed by the children's parent or guardian for participation in the after-school program along with many other programs. The after-school program consent allows for measurement and evaluation of physical activity participation and motivations. The majority of the children were Hispanic or African-American.

Concerning the measures taken, achievement goals were measured by the Perceptions of Success Questionnaire (POSQ) [15]. When completing the questionnaire, the participants were asked to respond to "What does success in sport mean to you? There are no right or wrong answers. We ask you to X out the letter that best indicates how you feel. When playing sport, I feel most successful when:" All questions were answered using a 5-point scale ranging from A "Strongly Agree" to E "Strongly Disagree". The POSQ has an equal number of items assessing both goal orientations. An example task orientation question is, "I really improve." An example ego orientation question is, "I show other people I am the best."

Sport competence was measured by an adapted version of the Perceived Competence Scale (PCS) [16]. The PCS is a 4-item questionnaire with high face validity. As with the POSQ, all questions were answered using a 5-point scale ranging from A "Strongly Agree" to E "Strongly Disagree" if reference to the following instructions: "Over the course of the after school program, we will play a number of sports. How confident are you in your ability to play a number of sports well? There are no right or wrong answers. We ask you to X out the letter that best indicates how you feel." An example question is "I feel confident in my ability to play many sports well."

Last, heart rate was measured in real time by use of © Polar Electro 2015 [17] group solution product. This product allows for simultaneous group collection of heart rate data. The children were provided a sensor and strap. They were instructed on the proper placement of the sensor. All sensors were checked as to their transmission to the iPad prior to the start of the free play session for any adjustments required.

Informed consent was obtained from all of the children's parents or guardians at the beginning of the school year (i.e. August 2015). The children completed the measures in a group setting two weeks prior to the free play

session. The first author read the questions aloud and asked for any questions from the children. In addition, several of the after-school staff assisted children who might have had a question. Free play is a common activity in the after school program. The children were allowed to play for an hour with 58 minutes being recorded. A variety of sport equipment was provided as always and the children are also allowed to play on the playground equipment.

Results of the research

To examine the moderating role of sport competence, three groups were formed by a one-third split. The high confidence group (n = 11, 9 boys, 2 girls) was certainly a naturally formed group as scored a mean of 5.00 $\pm$ .00 on the scale with the next another (n = 8, 7 boys, 1 girl) with a mean of 4.62 + .13 and the low sport confidence group (n = 9, 9 girls) with a mean of 3.30 $\pm$ .65. The univariate F-test was highly significant, $F(2, 25) = 52.36$, $p < .000$. All Cohen's *d* values (> 2.68) indicated the large meaningful difference between the sport confidence mean values. BMI was checked again across the three sport confidence groups. All means were nearly equal hovering around the entire group average reported in the participant section.

Table 1 contains the descriptive data and Table 2 contains Cohen's *d* for the study variables in reference to the higher sport confident group in each calculation (i.e. high sport confidence – medium sport confidence; high sport confidence – low sport confidence; and medium sport confidence – low sport confidence). To test the main purpose of this investigation, a multivariate analysis of variance (MANOVA) was conducted with sport competence groups as the independent variable and task orientation, ego orientation, and average heart rate as the dependent variables. Significant univariate F-tests were followed up with the Ryan-Einot-Gabriel-Welsch (R-E-G-W) Range post hoc test. Cohen's *d* was calculated to determine meaningfulness of differences with interpretation of d as large (> .80), medium (.50), and small (.20) [18]. To this end, the MANOVA results revealed a significant multivariate effect for sport competence groupings, Wilk's $\lambda = 0.43$; $F(6, 46) = 3.99$, $p = .003$. All three of the follow-up univariate *F*-tests were significant, task orientation, $F(2, 25) = 4.15$, $p = .028$; ego orientation, $F(2, 25) = 5.91$, $p = .008$; and heart rate, $F(2, 25) = 5.63$, $p = .010$.

Table 1. Descriptive data by sport confidence (SC) grouping for study variables

	Measure		
Group	**Task Orientation**	**Ego Orientation**	**Heart Rate (bpm)**
High SC			
Mean	4.39	4.39	149.45
Standard deviation	.64	.56	12.64
95% confidence interval	4.06, 4.72	4.01, 4.77	143.12, 155.78
Medium SC			
Mean	4.16	4.33	144.50
Standard deviation	.43	.25	5.20
95% confidence interval	3.77, 4.55	3.88, 4.77	137.08, 151.91
Low SC			
Mean	3.70	3.51	134.22
Standard deviation	.46	.84	10.03
95% confidence interval	3.33, 4.07	3.09, 3.93	127.22, 141.21

For task orientation and mean heart rate, the R-E-G-W Range post hoc test indicated that the high sport confidence group was significantly higher than the low sport confident group. For ego orientation, the R-E-G-W Range post hoc test revealed both of the higher sport confident groups significantly differed compared to the low sport confident group. All variable differences when compared to the low confident group were very meaningfully with all Cohen's *d*s > 1.0 (see Table 2). The Cohen's *d* values between the highest and medium sport confident group where medium to small in meaningfulness. Thus, the top two sport confident groups tended to be more similar than different.

Table 2. Effect size value comparisons for the goal orientations and heart rate

Comparison	Task Orientation	Ego Orientation	Heart Rate (bpm)
HSC to MSC	0.41	0.14	0.48
HSC to LSC	1.22	1.26	1.31
MSC to LSC	1.03	1.28	1.26

Discussion

Sport confidence moderated physical activity intensity during free play the children who participated in this very unique field investigation. No data exist in the AGT literature with measured heart rate in children during play prior to this study. It is important to highlight that all of the groups on average were sufficiently engaged in free play. For instance, even the lower confident group was within the lower to middle range of moderate intensity physical activity in the free play time with the 95% confidence intervals from approximately 60 to 67% of maximum age predicted heart rate. But, certainly the two higher sport confident groups' physical activity intensities were greater and at the upper end of the 95% confidence intervals were at least 72% of age predicted heart rate maximum or moderate intensity physical activity. These two higher confident groups were highly engaged during the free play session. The two higher sport confidence groups compared to the low sport confidence group were characterized by a higher ego orientation and generally higher task orientation. The higher ego orientation scores present a conundrum of sorts in that yes we wish children to be very active and in these data the most active children were characterized by an ego orientation. But, the endorsement of the ego goal orientation is associated directly with typically viewed upon undesirable sport beliefs [11, 12]. The children in this study, across all of the groups, the children were of optimal weight or even slightly underweight. It does seem that the sample is unique given the worldwide obesity epidemic and could have contributed to the findings that all groups were sufficiently active during the free play session.

Of great concern was the finding that all of the low confident children were all females. Though past research [19] and even meta-analytic [20] work exists on this topic, it is still very concerning that only girls comprised the low confident group. Past research would certainly not have predicted that all of the low confident group would have been girls. The differences in worldwide statistics concerning girls being consistently lower than boys in daily activity could be due partly in nature to lower sport confidence as strongly suggested by this investigation's results. Certainly, with the exception of structured physical education and sport practices, children spend the majority of their time in free play. If in fact, girls with low sport confidence shy away from higher intensity play, future intervention research is needed at early ages with girls to build sport confidence and motivations for both goal orientations to hopefully increase physical activity intensity during free play. In addition, future research should determine if the differences in sport confidence could be minimalized with more structure to free play sessions especially in an organized after-school program where areas of the playground could contain a greater variety of sport equipment allowing for choice of activities and or placing the children on "activity teams" that mix high and low sport confident children. It might be that by placing children with low sport confidence with higher sport confident children that they will be active at higher physical activity intensities.

Conclusions

1. Sport confidence is very important when studying objectively measured physical activity.
2. The ego orientation might come at a price in sport contexts as it certainly was a characteristic of children in the higher level of sport confidence that engaged on average in higher intensity activity. It is possible that during free play, these children engaged in unsportspersonship like behaviors.
3. Future research needs to play close attention enhancing sport confidence in girls.
4. AGT especially when considered with a measure of sport confidence has an important place in combating the physical inactivity epidemic in developed countries worldwide.

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THE LEVEL OF SELF-ESTEEM IN 14–16-YEAR – OLD FEMALE TENNIS PLAYERS

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Annotation. *Purpose:* The level of self esteem in 14–16-year–old female tennis players. *Material:* The main aim of the study was to determine the level of self-esteem among 14–16-year–old girls practising tennis in comparison to their peers not engaged in sport on a regular basis. The study involved two groups of girls: those practising tennis competitively (n=30) and those not training sports systematically (n=30). The subjects' age was in the range of 14–16 years old and their training experience 3–6 years. The level of self-esteem was determined by means of Morris Rosenberg's questionnaire in the Polish modification. *Results:* As a result of the conducted study significant differences in the level of self-esteem between the tested groups and a correlation with their training experience were found. As a result of the conducted study, it was found that both groups of girls represented the level of self-esteem defined as average (tennis players – 29.9 points; non-training girls – 26.4 points). However, these differences were statistically significant ($p \leq 0.05$) to the advantage of tennis players. *Conclusions:* Statistically significant differences were found between the level of self-esteem among girls training tennis and their peers not practising sports regularly (to the advantage of the former ones). Far more (almost twice as many) tennis players achieved a high level of self-esteem in comparison to girls who do not systematically practise sports. None of the examined tennis players represented a low level of self-esteem. The length of training experience has a statistically significant, positive correlation with the level of tennis players' self-esteem.
Keywords: tennis, self-esteem, girls, training.

Introduction

Positive self-esteem in all its aspects is a very important factor in a favourable adjustment of an individual to the environment and a criterion of self-satisfaction. In the course of one's life a human being learns about and evaluates the surrounding world and collects experience of one's own person. These experiences accumulate during the individual's development since the first years of life. They are becoming gradually sorted out, which in turn leads to forming certain ideas about oneself [1].

Sports activity, in addition to shaping the physical development, also affects the shaping of personality, the development of the skill of an actual assessment of one's own abilities. With age, practising sport contributes to accepting more and more difficult and demanding aims and to increasing one's abilities and expectations [3, 17].

These issues are particularly important in tennis. Therefore, the main aim of the study was to determine the level of self-esteem in 14–16-year–old girls practising tennis in comparison to their peers not engaged in sport on a regular basis. Thus clarified purpose implies answering the following research questions:

1) What level of self-esteem do the studied tennis players represent?

2) Are there statistically significant differences in self-esteem between the tennis players and girls of the same age who do not train sport competitively?

3) Is there a correlation between the training experience and the tennis players' self-esteem level?

Material and methods

To define the level of self-esteem, Morris Rosenberg's questionnaire in the Polish modification was used [10]. The questionnaire contains 10 diagnostic statements, and responses are evaluated on a scale of 1–4. The measured self-esteem has a global character and is treated as a constant trait rather than a temporary condition. Questions 1, 2, 4, 6 and 7 were scored as follows: the answer "definitely agree" – 4 points, "I agree" – 3 points, "I do not agree" – 2 points, "I definitely do not I agree" – 1 point. In turn, questions 3, 5, 8, 9 and 10 had the inverse point value for answers to questions. The following ranges of self-esteem were adopted: low (0–20 points), average (21–30 points), high (31–40 points).

The study involved 30 girls aged 14–16 years (15.2±0.8) regularly training tennis. Their training experience ranged between 3–6 years (4.6±1.1). The comparative group comprised 30 girls aged 14–16 years (15.1±0.8) attending Tricity middle schools who did not train sports regularly.

The study was carried out in March 2015. The non-training girls filled in the questionnaire individually before a Physical Education lesson, while the training persons – before a training session.

Results

As a result of the conducted study, it was found that both groups of girls represented the level of self-esteem defined as average (tennis players – 29.9 points; non-training girls – 26.4 points). However, these differences were statistically significant ($p \leq 0.05$) to the advantage of tennis players.

The greatest difference regarded the statement: "I believe that I am a valuable person at least to the same extent as others" (23 pts. in favour of girls training tennis – the difference in the sum of points obtained for the

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statement for the entire sample). Persons not training sports regularly gained a slight advantage (9 pts. – the difference in the sum of the points for the statement for the entire sample) only in one statement: "Generally, I'm tempted to believe that I'm not successful".

Sixteen persons in each group obtained an average level of self-esteem (Fig. 1). Fourteen tennis players and eight non-training girls had a high level of self-esteem and only girls not practising sports regularly represented a low level.

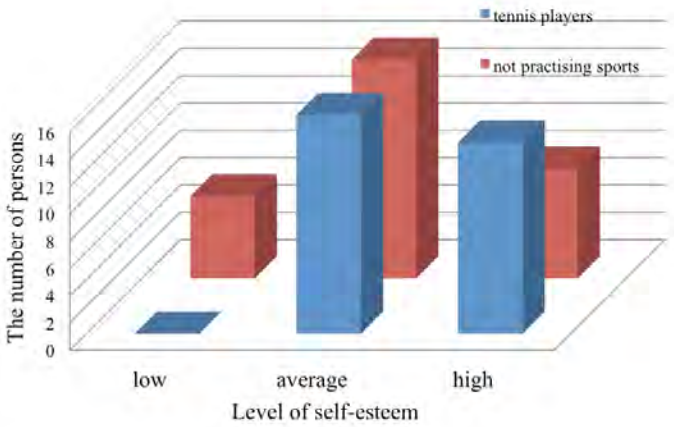

Figure 1. Distribution of the level of self-esteem among tennis players and girls not practising sports (n-30, n=30, respectively).

In addition, the study proved a statistically significant relationship, at a high level, between the level of self-esteem and the length of training experience (r=0.72).

Discussion

Numerous studies confirm that physical activity has an impact on the increase in the level of self-esteem [2, 6, 8, 15, 19]. Some papers are related to the level of adolescents' self-esteem with reference to e.g.: BMI, the parents' wealth [7], satisfaction with physical appearance [16], eating disorders and habits [12], depression and social anxiety [18].

A type of self-esteem is important for many aspects of sports life. The most desirable is high self-esteem, but at the same time stable and adequate [9, 13, 14].

This study has revealed higher self-esteem, at a statistically significant level, among girls practising tennis. Sports-active girls have higher self-esteem and thus have an advantage in interpersonal skills, and they can find themselves better in difficult situations [5]. Self-esteem in which "the ideal I" is close to "the real I" is not easy to achieve, but the conducted study shows that training tennis contributes to self-acceptance, motivates to action and encourages to accepting increasingly difficult challenges, having regard to one's real potential. Self-esteem largely refers to what an individual feels about himself or herself [20].

A person practising tennis must properly assess his/her own level of training, choose appropriate objectives and select appropriate ways to achieve them [11]. A person with a high level of self-esteem expects to have an ability to perform a difficult task. He or she believes that what he or she is doing is close to ideal. Such individuals are characterized by boldness, self-confidence, establishing social contacts easier. In the peer group they start discussions on their own initiative and actively participate in them [17].

Self-acceptance means a positive attitude to oneself and definitely a conscious contact with everything that is and what manifests itself in own emotions, thoughts, deeds and desires. The self-acceptance in question does not eliminate noticing one's own mistakes and flaws; it does not mean uncritical looking at the self either [4].

Conclusions

As a result of the conducted study, the following conclusions can be drawn:

1) Statistically significant differences were found between the level of self-esteem among girls training tennis and their peers not practising sports regularly (to the advantage of the former ones).

2) Far more (almost twice as many) tennis players achieved a high level of self-esteem in comparison to girls who do not systematically practise sports. None of the examined tennis players represented a low level of self-esteem.

3) The length of training experience has a statistically significant, positive correlation with the level of tennis players' self-esteem.

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