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Adaptation of Ruffier's test for assessment of heart workability of students with health problems

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Abstract

Purpose: to check up experimentally adapted test for assessment of heart workability of students with health problems.

Material: in the research girl students and boy students of 18-20 years age (n=487) participated. The procedure of test was as follows: during 45 seconds students fulfilled torso rising from lying on back position. During this procedure pulse was measured three times. Total time of test fulfillment was 2 minutes. For working out the scale for the received results' interpretation we assessed new version of Ruffier's test for validity. For this purpose 487 absolutely healthy tested students fulfilled, first, adapted test. Then, after complete recreation (in 20 minutes) they fulfilled commonly accepted test with squatting.

Results: it was found that with the help of adapted test it is possible to objectively assess heart workability of students. Correlation analysis of the received results showed average correlation ($r=0.73$).

Conclusions: application of adapted Ruffier's test permits to assess heart workability of students with health problems.

Keywords: students, adapted, test, Ruffier, correlation analysis, heart workability.

Introduction

Modern health condition of future specialists is characterized as negative with tendency to worsening. Many studies of recent years have been registering increase of first year students' with health problems quantity. It is very noticeable in division of students for practical physical culture classes [16; 49, 68]. Annual analysis of applicants' health shows unfavorable dynamic of increasing first year students' with different disorders in cardio-vascular, digestive, urogenital, nervous and other organism's systems quantity. As per different data in special health groups (SHG – group of students with health problems) from 10.45% to 35.34% students were enlisted. In next years of study increment of these indicators is observed, which is characterized by progressing old diseases and emersion of new ones [8, 10, 13, 14]. The researches show that this quantity increases with every year. It results from emersion of new health problems and development of earlier registered [1, 3, 5, 15]. In 15.2-42.5% of students disorders in bone-muscular system were found.

Negative tendencies of students' health worsening require seeking new directions of these problems' solution. Among them there are:

- Increase of motivation component of sports practicing [25, 36] considering students' reactions to physical loads [46];
- Optimization of physical loads' volumes for students, considering their individual fitness [26, 40, 41, 65];
- Reduction of environmental and harmful habits' negative influence [50, 51];
- Application of modern and new training methods [61, 63];
- Organization of proper pedagogic control in trainings of students with different fitness [28, 47];
- Raising of health criteria, considering psychological

factors' influence [48, 52] and health culture formation [71];

- Implementation of physical education pedagogic technologies in the process of training of students with different nosologies [22, 54, 59, 62];
 - Application of health related students' trainings with sport competition elements [57];
 - Individual approach in choice of strategy, tactic and methodological provisioning of physical rehabilitation for students with pathologies [45, 67];
- Important criterion of the listed above approaches to students' health improvement is students' workability. Among approaches to increase students' workability we can name:
- Weakening of chronic fatigue under different loads [39, 43];
 - Determination of motor and sports rank places in students' leisure hierarchy [42];
 - Adaptation to physical loads [37].

With every passing years reduction of physical condition and functional fitness is observed in students. Generalization of medical examination results showed that many universities have own specific features: prevalence of bone-muscular system's diseases. It was found that in Sankt Petersburg universities such diseases are 43%; in Ryazan – more than 19%; in Homel – less than 17%; in Ulyanovsk it does not exceed 15% [20]. Some scientists found that osteoarthritis (OA) of knee joint cover 20% of world population [32, 33, 53].

Physical education of people with such problems has a number of distinctive features [23, 24, 30, 38]. It reflects in organization and fulfillment of practical classes in university conditions. As specialists note [27, 30, 31, 35] knee pain when ascending staircase or walking on even inclined surfaces is an evident factor, limiting physical activity with OA of knee joint. It is proved also be the data of other scientists [64, 69, 70]. The authors found that it is tiresome for people with lower limbs' OA to fulfill ordinary movements, because joint changes can

block transition of potential and kinetic energy of mass centers during walking. Some scientists resume that it is purposeful to develop methods of harmless physical loads for persons with Knee joint OA [34, 55, 56].

It means that additional studies, considering universities; specificities are required.

Hypothesis was built on assumption that adapted Ruffier's test with torso rising from lying position during 45 seconds will be valid in respect to commonly accepted squatting during 45 seconds. It will permit fro specialists to completely assess heart workability of students with lower limbs OA.

The purpose of the work is to check up experimentally adapted test for assessment of heart workability of students with lower limbs OA and substantiate it.

Material and methods

Participants: in the research girl students and boy students of 18-20 years age from main health group (without health problems) (n=487) participated. All participants were familiarized with "Helsinki declaration of world health protection organization" and gave written consent for participation in experiments [72].

Organization of the research: Ruffier's test is used for the following: assessment of heart workability before sport trainings; working out training programs; assessment of sport training programs' effectiveness; assessment of person's physical fitness by his/her cardiovascular system's reaction to physical load.

At present time several functional tests with squatting are known. Martinet's test implies 20 squatting during 30 sec.; Ruffier's test assesses heart functional reserves with 30 squatting during 45 seconds. All they imply bending and unbending of lower limbs. But such exercises are difficult for most of persons with lower limbs' OA. That is why adapted variant of Ruffier's test, especially for students with lower limbs OA, was worked out.

According to adapted Ruffier's test students shall be in lying position in relaxed state. His pulse is counted for 15 seconds (P1). Then student fulfills 30 torso risings from lying on back position. Arms are crossed on chest with hands on shoulders. Legs are fixed and bent in knees under angle 80-90°. When rising torso it is necessary to touch elbows by knees, when descending legs – lie on back completely. For exact dozing of rising frequency we used metronome with frequency 80 beat/min. Every torso movement corresponded to one strike of metronome. After test's finishing the tested took lying position and his pulse was measured during first 15 seconds (P2) and last 15 seconds (P3) in the first minute of rest.

Coefficient was calculated by the following formula:

$$C = \frac{4 \times (P1 + P2 + P3) - 200}{10}$$

For working out interpretation scale of the received results we assessed new variant of Ruffier's test for validity. For this purpose 487 absolutely healthy students fulfilled,

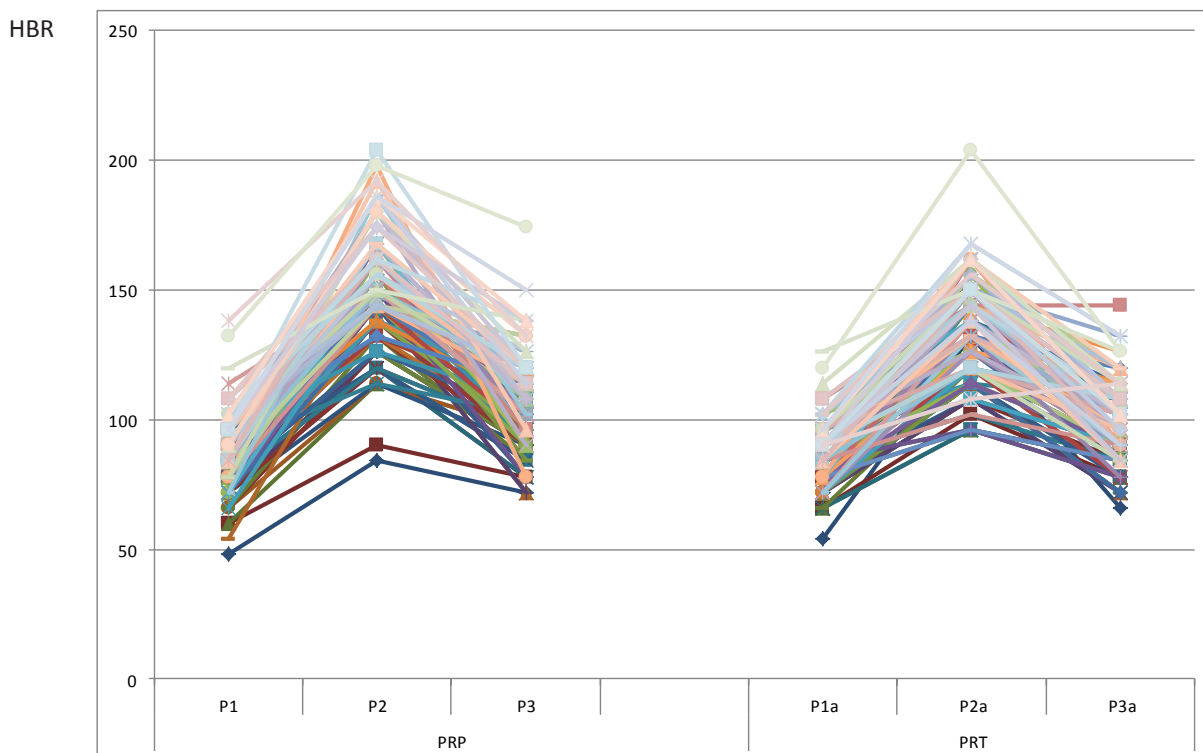


Fig.1. Results of heart beats rate registration (HBR) in Ruffier's test with squatting and torso rising from lying on back position: PRP – Ruffier's test with squatting; PRT - Ruffier's test with torso rising; P1, P2, P3 – HBR values in Ruffier's test; P1a, P2a, P3a – HBR in adapted Ruffier's test. .

first, adapted test. Then, after complete restoration (in 20 minutes) they fulfilled commonly accepted test with squatting.

Statistical analysis was fulfilled with the help of SPSS 22 program.

Results

For working out interpretation scale of the received results for students with lower limbs OA we fulfilled correlation analysis of the received data. These data were analyzed for finding statistical correlations in this sample. In fig. 1 there are presented the received results. Analysis of the obtained data shows regularity in heart beats rate distribution in both versions of Ruffier’s test. Alongside with it we formed correlation field (see fig.2). Analysis of this field showed direct positive correlation in the studied data. We found that with higher value of one attribute the value of other also increases. With reduction of one

attribute the other also decreases. Thus, we can note average correlation between two samples ($r=0.73$).

The received data permitted to develop the following interpretation scale for adapted Ruffier’s test results for persons with lower limbs OA:

The results are interpreted in the following way [18].

Less than 0 – athletic heart;

0.1-5 – “excellent” (very good heart);

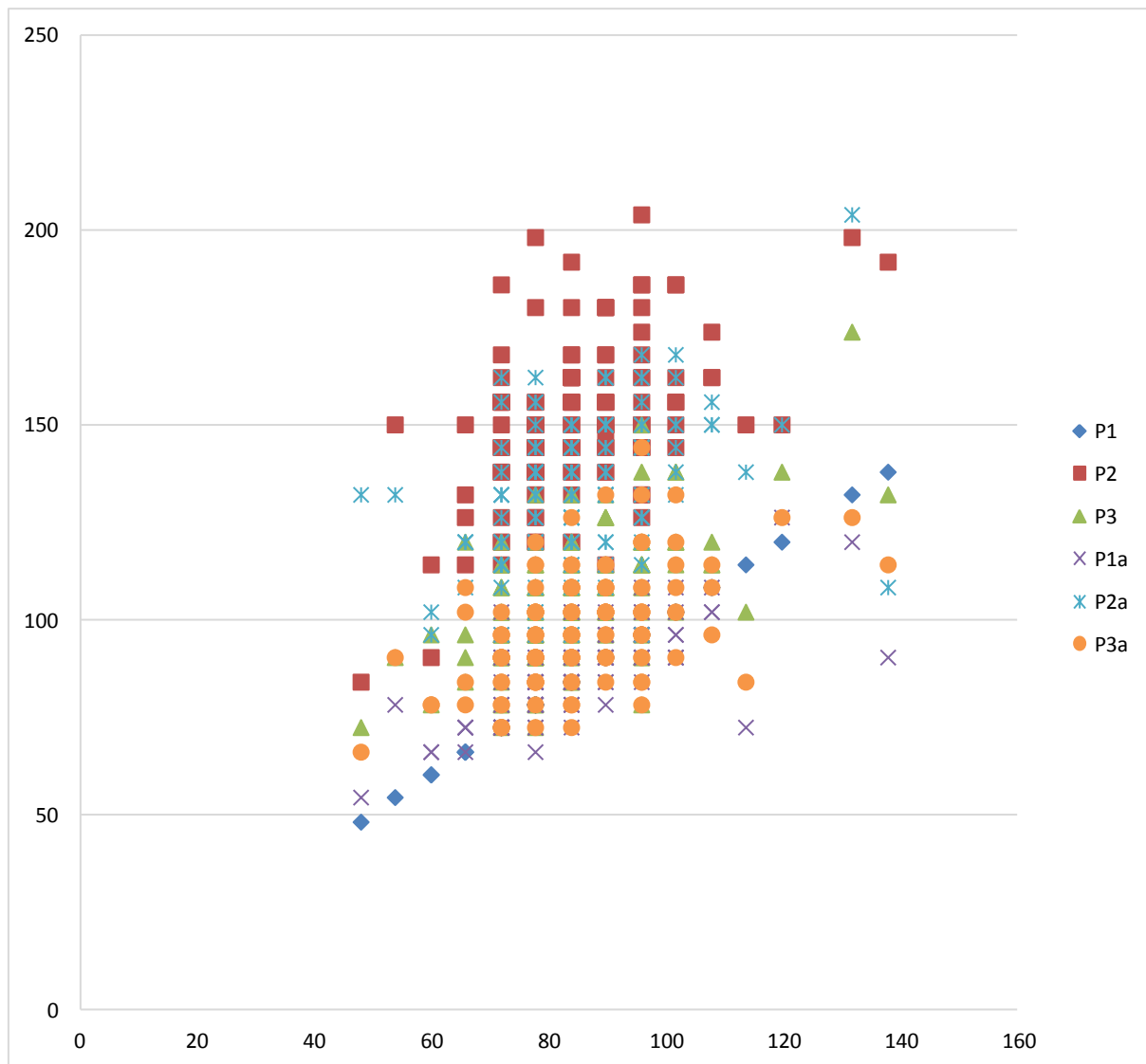
5.1-10 – “good” (good heart);

10.1-15.0 – “satisfactory” (moderate heart deficiency);

15.1-20 – “bad” (strong heart deficiency).

Finally, it should be noted that the fulfilled research of students hearts workability permitted to prove validity of the worked out adapted Ruffier’s test. The collected by that time empiric material proves that with the help of adapted Ruffier’s test specialists can objectively and with high quality assess heart workability of students with lower limbs OA.

HBR



HBR

Fig.2. Correlation field of heart beats rate registration results in commonly accepted Ruffier’s test P1, P2, P3) and in adapted version (P1a, P2a, P3a).

Discussion

Annual observations of physical education specialists find that there is significant quantity of students with chronic diseases of joint-ligament apparatus, in particular lower limbs OA [6, 17, 60, 66]. This category has a number of significant limitations in respect to physical loads and requirements to physical activity [7, 11, 12, 19]. Nevertheless, it is very important for these persons to sustain physical activity for ensuring normal functioning of organism's important systems. For this purpose it is necessary to develop special methodic and programs of physical education [9, 21, 58]. When choosing load it is necessary to know initial potentials and realize systemic control over them during long time [2, 4, 20, 44]. Widely used for this purpose Ruffier's test is intended for people with healthy lower limbs. Application of developed by us adapted version of Ruffier's test permits for specialists to assess at high quality heart workability of students with

lower limbs OA. Analysis of cardio-vascular workability of students with lower limbs OA permitted for us to prove validity of the worked out adapted Ruffier's test. The results permit to assume that application of this adapted test is possible for different age groups as well as for people without lower limbs OA.

Conclusions

The worked out by us adapted version of Ruffier's test has potentials for wide application by specialists in physical culture and sports. This variant of the test permits for physical culture pedagogues to completely assess heart workability of students with lower limbs OA, as well as of students without health problems.

Conflict of interests

The author declares that there is no conflict of interests.

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Special aspects of motor fitness influence on level of 11-13 years' age girls' physical exercises' mastering

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Abstract

Purpose: to find special aspects of motor fitness influence on level of 11-13 years' age girls' physical exercises' mastering.

Material: in the research 11 years' age girls (n=51), 12 years' age (n=54) and 13 years (n=63) participated.

Results: By physical condition indicators all girls statistically confidently differ ($p < 0.001$). We registered increase of body height indicators (by 12%), body mass (13%), vital capacity of lungs (by 12.8%), right hand strength (by 15%) and left hand strength (by 13.8%). In girls of 11-13 years' age we registered positive dynamic of physical condition, motor abilities and level of gymnastic exercises' mastering indicators. It was found that in total dispersion results' variation by 81.259%, 79.353%, 71,019% are determined by such factors: physical condition, motor abilities, level of physical exercises' mastering. In factorial structure level of physical exercises' mastering has weight 16.435% (11 years), 27.963% (12 years) and 17.010% (13 years).

Conclusions: Analysis showed that in 11-13 years age girls motor abilities' training level is effective if it becomes a component of mastered motor skills.

Keywords: motor abilities, level of mastering, factorial analysis, girls.

Introduction

The problem of schoolchildren's physical education optimization was studied in works by I. Bondar [1], Iu.V. Vas'kov [2], T. Krucevich et al. [9]. The authors stress on demand in new approaches to integrative physical education of different health groups schoolchildren [1], to physical education's organization of comprehensive educational establishments' pupils [2], to planning physical culture trainings process in comprehensive educational establishments [9].

In schoolchildren's physical education directions of researches, which are connected with special aspects of motor abilities [5, 6, 7] and motor actions' training [17, 20, 28] are underlined. Specific features of children's and adolescents' functional, coordination and power fitness are determined [4, 11]. Dependence of power loads' training effects on regime of exercises' practicing and rest is found [18, 23]. The process of motor actions' training was studied from positions of interdisciplinary connections [12, 13], specificities of motor competence formation [14, 15], meta-cognitive behavior formation [16], verbal perception in the process of sport movements' mastering [19] and optimization of regimes of exercises' repetitions and rest intervals [20, 26, 28].

However, in available literature there are few data about wholeness of motor abilities training of children and adolescents [27, 29]. Thus, study of special aspects on level of physical exercises' mastering is rather relevant.

The purpose of the research is to find special aspects of motor fitness influence on level of 11-13 years' age girls' physical exercises' mastering.

Material and methods

Participants: in the research 11 years' age girls (n=51), 12 years' age (n=54) and 13 years (n=63) participated. Their parents gave written consent for the children's

participation in experiment.

Organization of the research: in the process of the research we registered: body height, body mass, vital capacity of lungs (VCL), hand dynamometry of right and left hands. We also registered results in the following tests: "Pressing ups in lying position, times", "Chin ups in lying position, times", "Legs' rising, hanging on wall bars, times"; "Angle on parallel bars, sec."; "Torso rising in sitting position from lying on back position during 1 minute"; "Forward torso bending from sitting position with legs apart, cm"; "Hanging on bent arms, sec."; "Torso rising from lying on abdomen position during 30 sec., times"; "Long jump from the spot, cm"; "Throw of filled ball (1 kg) from sitting position, cm"; "Shuttle run, 4x9 m, sec." [11].

Level of gymnastic exercises' mastering was registered with the following tests: "Forward roll", "Backward roll", "Horse vaults", "Climbing the rope, three times", "Bridge", "Stance on shoulder blades" [11].

Statistical analysis: was fulfilled with the help of standard program of statistical analysis IBM SPSS 20. We used factorial analysis (principle components analysis). Besides, we used access organization: varimax with Kaiser's normalization. For every variable we calculated the following: mean values, standard deviations, Student's t-test for independent samples. Level of mastering was determined as relation of successful attempts (m) to their total quantity (5): $p = (m/5) \times 100$.

Results

Results of the research are given in tables 1, 2. By physical condition indicators, 11-13 years age girls statistically confidently differ one from another ($p < 0.001$). We registered increase of body height indicators (by 12%), body mass (13%), vital capacity of lungs (by 12.8%), right hand strength (by 15%) and left hand strength (by 13.8%).

12 years' girls demonstrate confidently better results than 11 yrs girls in tests: "Pressing ups in lying position",

“Chin ups in lying position”, “Rising legs, hanging on wall bars”, “Angle on parallel bars”, “Forward torso bending from sitting position with legs apart”, “Hanging on bent arms”, “Torso rising from lying on abdomen position during 30 seconds”, “Long jump from the spot” and “Throw of filled ball (1 kg) from sitting position”.

13 yrs girls showed confidently better results than 12 yrs girls in the following tests: “Pressing ups in lying position”, “Chin ups in lying position”, “Rising legs, hanging on wall bars”, “Angle on parallel bars”, “Torso rising in sitting position from lying on back position”, “Throw of filled ball (1 kg) from sitting position” and “Shuttle run 4x9 m”.

Level of mastering of gymnastic exercises “Forward roll”, “Backward roll”, “Horse vault”, “Rope climbing, three times”, “Bridge” and “Stance on shoulder blades” with age confidently becomes better ($p < 0.001$) (see table 1).

Thus, in girls of 11-13 years’ age we registered positive dynamic of physical condition, motor abilities and level of gymnastic exercises’ mastering indicators.

For specifying motor fitness influence on physical exercises’ mastering by 11-13 yrs girls we fulfilled factorial analysis.

In the process of analysis we marked out in 11 yrs girls seven factors, which explain 81.259% of total dispersion (see table 2).

Factor 1 is the most influential (21.735%). The factor correlated with results of the following tests:

Angle on parallel bars – ,858.

Legs’ rising, hanging on wall bars – ,780.

Pressing ups in lying position – ,766.

This factor as called “relative strength”.

Factor 2 has weight 16.435% and correlated with the following tests’ results:

• Long jump from the spot – ,885.

• Forward roll, level of mastering – ,729.

• Backward roll, level of mastering – ,701.

• Horse vault, level of mastering – ,784.

The factor was called “Level of physical exercises’ mastering”.

Factor 3 contributes 11.303% and correlates with the following:

• Body height – ,912.

• Body mass – ,878.

The factor was called “Physical condition”.

Factor 4 contributes 8.978% and correlated with the following:

• Bridge, level of mastering – ,869.

• Torso rising from lying on abdomen position during 30 sec. – ,685.

Factor 5 has weight 8.958% and correlated with the following tests’ results:

• Chin ups in lying position – ,818.

• VCL – ,795.

• Stance on shoulder blades, level of mastering – ,585.

Factor 6 contributes 7.604% and correlates with the following:

• Torso forward bending from sitting position with legs apart – ,911.

Factor 7 contributes 6.246% and correlates with the following:

• Torso rising in sitting position from lying on back position during 1 minute – ,616.

Factors 4-7 specify the names of factors 1-3 and point at interconnection of level of exercises’ mastering with physical condition and motor fitness indicators of 11 yrs. girls.

Analysis of communalities showed that in motor fitness structure of 11 yrs girls the most influential were: “Body height – ,920; “Right hand dynamometry” – ,867; “Forward roll, level of mastering” – ,835; “Horse vault, level of mastering” – ,824.

In 12 yrs girls analysis showed six factors, which explain 79.353% of total indicators’ dispersion (see table 2). Factor 1 contributes the most (27.963%) and correlated with the following tests’ results:

• Forward roll, level of mastering – ,905.

• Horse vault, level of mastering – ,854.

• Rope climbing three times, level of mastering – ,853.

• Backward roll, level of mastering – ,838.

• Right hand dynamometry – ,754.

• The factor was called “Level of physical exercises’ mastering”.

Factor 2 contributes 16.777% and correlates with physical condition indicators:

• VCL – ,891.

• Body mass – ,781.

• Body height – ,763.

This factor was called “Physical condition”.

Factor 3 contributes 10.249% and correlates with the following results:

• Legs’ rising, hanging on wall bars – ,793.

• Shuttle run 4x9 m – ,657.

• Long jump from the spot – ,526.

This factor was called “relative strength of abdomen muscles”.

Factor 4 contributes 9.373% and correlates with the following results:

• Throw of filled ball (1 kg) from sitting position – ,860.

• Angle on parallel bars – ,723.

• Long jump from the spot – ,524.

This factor was called “Speed power”.

Factor 5 contributes 8.449% and correlates with the following results:

• Forward torso bending from sitting position with legs apart – ,750.

• Torso rising to sitting position from lying on back position during 1 minute – ,684.

• Torso rising from lying on abdomen position during 30 seconds – ,409.

Factor 6 contributes 6.541% and correlates with the following results:

• Bridge, level of mastering – ,821.

• Shuttle run 4x9 m – ,515.

Table 1. Testing results fo 11-13 yrs girls' motor fitness

Nº	Description of measurement	Age	N	X	m	t	P
1	Body height, cm	11	51	142,274	,932	-6,628*	<0,001
		12	54	150,629	,851	-6,796**	<0,001
		13	63	159,365	,939	-12,758***	<0,001
2	Body mass, kg	11	51	37,313	1,260	-3,883	<0,01
		12	54	43,018	,789	-4,354	<0,001
		13	63	48,920	1,056	-7,110	<0,001
3	VCL, cm ³	11	51	1733,333	44,692	-3,559	<0,01
		12	54	1933,333	34,669	-4,513	<0,001
		13	63	2223,809	51,635	-6,998	<0,001
4	Right hand dynamometry, kg	11	51	15,803	,679	-3,608	<0,01
		12	54	18,981	,566	-5,950	<0,001
		13	63	23,984	,608	-8,977	<0,001
5	Left hand dynamometry, kg	11	51	16,294	,589	-2,200	<0,05
		12	54	18,000	,507	-5,868	<0,001
		13	63	22,492	,559	-7,584	<0,001
6	Pressing ups in lying position, times	11	51	14,549	,764	-2,084	<0,05
		12	54	16,870	,806	-4,422	<0,001
		13	63	22,031	,830	-6,499	<0,001
7	Chin ups in lying position, q-ty of times	11	51	4,921	,355	-6,827	<0,001
		12	54	8,925	,460	-6,855	<0,001
		13	63	14,507	,641	-12,255	<0,001
8	Legs rising, hanging on wall bars, times	11	51	4,549	,405	-4,378	<0,001
		12	54	7,574	,551	-2,234	<0,05
		13	63	9,412	,597	-6,420	<0,001
9	Angle on parallel bars, sec.	11	51	,921	,197	3,859	<0,01
		12	54	,148	,055	-2,368	<0,05
		13	63	,492	,125	1,899	<0,06
10	Torso rising in sitting position from lying on back position during 1 minute, times	11	51	37,313	,611	-1,101	>0,05
		12	54	38,166	,482	-7,929	<0,001
		13	63	44,158	,563	-8,204	<0,001
11	Torso forward bending from sitting position with legs apart, cm	11	51	4,961	,395	-4,621	<0,001
		12	54	7,370	,342	5,789	<0,001
		13	63	4,857	,274	,221	>0,05
12	Hanging on bent arms, sec.	11	51	1,902	,314	-7,631	<0,001
		12	54	7,333	,624	-4,417	<0,001
		13	63	11,365	,653	-12,124	<0,001
13	Torso rising from lying on abdoment position during 30 sec., times	11	51	20,843	,369	-2,701	<0,05
		12	54	22,129	,303	-9,323	<0,001
		13	63	27,873	,507	-10,735	<0,001
14	Long jump from the spot, cm	11	51	131,471	1,900	-11,546	<0,001
		12	54	156,666	1,129	-,575	>0,05
		13	63	157,936	1,801	-10,049	<0,001
15	Throw of filled ball (1 kg) from sitting position, cm	11	51	208,137	3,539	-11,644	<0,001
		12	54	297,407	6,657	-3,734	<0,001
		13	63	329,365	5,499	-17,582	<0,001
16	Shuttle run 4x9 m, sec	11	51	11,316	,065	-,185	>0,05
		12	54	11,331	,048	6,896	<0,001
		13	63	10,703	,073	6,095	<0,001
17	Forward roll, level of mastering	11	51	83,137	1,970	-1,940	>0,05
		12	54	88,518	1,949	-3,898	<0,001
		13	63	97,142	1,185	-6,344	<0,001
18	Backward roll, level of mastering	11	51	71,764	2,577	-1,391	>0,05
		12	54	76,666	2,408	-6,509	<0,001
		13	63	95,555	1,720	-7,918	<0,001
19	Horse vault, level of mastering	11	51	72,156	2,446	-3,481	<0,001
		12	54	83,703	2,247	-4,982	<0,001
		13	63	96,507	1,397	-9,042	<0,001
20	Rope climbing three times, level of mastering	11	51	65,882	3,082	-2,013	<0,05
		12	54	74,074	2,676	-4,779	<0,001
		13	63	89,841	2,017	-6,719	<0,001
21	Bridge, level of mastering	11	51	99,607	,392	1,893	<0,06
		12	54	97,778	,863	-1,150	>0,05
		13	63	99,047	,705	,651	>0,05
22	Stance on shoulder blades, level of mastering	11	51	83,921	1,483	,509	>0,05
		12	54	82,592	2,117	-7,827	<0,001
		13	63	99,047	,705	-9,775	<0,001

* comparison of 11-12 years; ** comparison of 12-13 years; *** comparison of 11-13 years

Table 2. Matrix of factorial analysis results of 11-13 yrs girls' testing. Access organization: varimax with Kaizer's normalization

№	Description of measurement	Age	Components							h ²		
			1	2	3	4	5	6	7			
1	Body height, cm	11			,912						,920	
		12		,763	,335					x	,750	
		13	,483			,670		x	x		,696	
2	Body mass, kg	11			,878						,835	
		12		,781			,326			x	,775	
		13	,348			,728		x	x		,751	
3	VCL, cm ³	11				,795					,800	
		12		,891						x	,839	
		13			,387	,527	,329	x	x		,539	
4	Right hand dynamometry, kg	11	,512		,459			,424	,339		,867	
		12	,754	,379						x	,816	
		13	,517				,637	x	x		,846	
5	Left hand dynamometry, kg	11	,551		,524	,306					,788	
		12	,591	,398			,410			x	,800	
		13	,484				,693	x	x		,803	
6	Pressing ups in lying position, times	11	,766								,763	
		12	,588	,499	,474					x	,892	
		13	,590		,485				x	x	,646	
7	Chin ups in lying position, q-ty of times	11						,818			,847	
		12	,667	,490	,390					x	,887	
		13	,606		,492				x	x	,665	
8	Legs' rising, hanging on wall bars, times	11	,780								,775	
		12	,337		,793					x	,865	
		13	,882						x	x	,809	
9	Angle on parallel bars, sec.	11	,858								,856	
		12				,723				x	,628	
		13	,810						x	x	,716	
10	Torso rising in sitting position from lying on back position during 1 minute, times	11	,344	,463						,616	,800	
		12	,436				,684			x	,823	
		13	,782	,309					x	x	,711	
11	Torso forward bending from sitting position with legs apart, cm	11									,845	
		12										,793
		13										,405
12	Hanging on bent arms, sec.	11	,829								,810	
		12	,592	,629							x	,795
		13	,700							x	x	,623
13	Torso rising from lying on abdomen position during 30 sec., times	11	,525			,685					,795	
		12				,314	,409	,460	x		,601	
		13	,415	,370					x	x	,588	
14	Long jump from the spot, cm	11		,885							,832	
		12			,526						x	,731
		13	,521						x	x	,458	
15	Throw of filled ball (1 kg) from sitting position, cm	11	,582								,630	
		12										,839
		13									x	,495
16	Shuttle run 4x9 m, sec	11									,780	
		12										,742
		13										,731
17	Forward roll, level of mastering	11	,368	,729							,835	
		12	,905								,328	
		13		,750	,535						x	,890
18	Backward roll, level of mastering	11	,440	,701							,822	
		12	,838									,869
		13		,607	,671						x	,848
19	Horse vault, level of mastering	11		,784							,824	
		12	,854									,884
		13		,607	,645						x	,825
20	Rope climbing three times, level of mastering	11	,549	,323							,791	
		12	,853									,841
		13			,857						x	,771
21	Bridge, level of mastering	11									,832	
		12										,749
		13		,940							x	,910
22	Stance on shoulder blades, level of mastering	11		,546							,831	
		12	,709	,320								,649
		13		,940							x	,910
		11	21,735	16,435	11,303	8,978	8,958	7,604	6,246			
		12	27,963	16,777	10,249	9,373	8,449	6,541	x			
		13	21,792	17,010	13,865	10,812	7,540	x	x			

- Torso rising from lying on abdomen position during 30 second – ,460.

Factors 5-6 supplement each other and characterize flexibility.

Analysis of communalities showed that motor fitness of 12 yrs. girls is influenced most of all by: “Pressing ups in lying position” – ,892; “Chin ups in lying position” – ,887; “Horse vault, level of mastering” – ,884.

Analyzing 13 yrs. girls we marked out five factors, which explain 71.019% of total indicators’ dispersion (see table 2).

Factor 1 contributes 21.792%) and correlates with the following tests’ results:

- Legs’ rising, hanging on wall bars– ,882.
- Angle on parallel bars– ,810.
- Torso rising to sitting position from lying on back position during 1 minute – ,782.

The factor was called “strength of abdomen muscles”.

Factor2 contributes 17.010% and correlates with the following tests’ results:

- Stance on shoulder blades, level of mastering– ,940.
- Bridge, level of mastering– ,940.
- Forward roll, level of mastering– ,750.

The factor was called “level of acrobatic exercises’ mastering”.

Factor 3 contributes 13.865% and correlates with the following tests’ results:

- Climbing rope, three times, level of mastering– ,857.
- Backward roll, level of mastering – ,671.
- Horse vault, level of mastering – ,645.

The factor was called “level of gymnastic exercises’ mastering”.

Factor 4 contributes 13.865% and correlates with the following tests’ results:

- Body mass – ,728.
- Body height – ,670.
- Throw of filled ball (1 kg) from sitting position – ,598.

The factor was called “Physical condition”.

Factor 5 contributes 7.540% and correlates with the following tests’ results:

- Left hand dynamometry – ,693.
- Right hand dynamometry– ,637.
- Shuttle run 4x9 m– ,560.

This factor characterizes strength and general motor coordination.

Analysis of communalities showed that motor fitness of 13 yrs. girls is influenced most of all by: “Bridge, level of mastering” – ,910; “Stance on shoulder blades, level of mastering” – ,910 and “Forward roll, level of mastering” – ,878.

Discussion

In our study we researched the assumption about wholeness of motor abilities’ development and training , basing on systemic approach [3, 8]. It was found that results’ variation in total dispersion in 11-13 yrs. girls by 81.259%, 79.353%, 71.019% depends on the regarded factors. Level of physical exercises’ mastering in factorial structure has weight 16.435% (11 years), 27.963% (12 years) and 17.010% (13 years). Analysis of communalities showed that in 11-13 yrs girls motor abilities’ training is effective if it becomes a component of the mastered motor skills. The presented data supplement researches of Xu X., Ke F. [30], E. Repko et al. [10], O.M. Khudolii et al. [28].

The fulfilled factorial analysis permitted to regard motor training processes and training as holistic process. It supplements the data of Ivashchenko O. et al. [21, 22] about effectiveness of factorial analysis in physical education. Analysis of communalities in factorial analysis permits to find the role of separate indicator in factorial structure of the studied process. It points at need in application of mathematical statistic’s multi-dimensional methods for study the laws of children’s and adolescents’ physical education [24, 25].

Conclusions

In 11-13 yrs girls we registered positive dynamic of physical condition, motor abilities indicators as well as level of gymnastic exercises’ mastering.

It was found that results’ variation in total dispersion in 11-13 yrs. girls by 81.259%, 79.353%, 71.019% depends on the regarded factors: physical condition, motor abilities’ level and level of physical exercises’ mastering. In factorial structure level of physical exercises’ mastering contributes 16.435% (11 years), 27.963% (12 years) and 17.010% (13 years). Analysis of communalities showed that in 11-13 yrs girls motor abilities’ training is effective if it becomes a component of the mastered motor skills.

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Conflict of interests

The author declares that there is no conflict of interests.

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Cognitive functions and success in choreography skills' formation in secondary school age dancers

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Abstract

Purpose: to find connection between level of cognitive functions realization and successfulness of choreography functions formation in junior dancers.

Material: 32 dancers (16 pair) were tested. Sportsmen's age was 15-16 years; qualification – from first category to candidate master of sports of Ukraine.

Results: it was found that functional state of successful sportsmen is manifested in nervous system's high workability, emotional optimization and feeling of personal comfort. Success of junior dancers is conditioned by high cognitive functions: attention, quickness of visual perception, high operative and logic thinking, when processing verbal information. Besides, it is conditioned by quickness of responding to irritator in non-verbal cognitive test. Attention worsens in successful dancers at the account of increase of information processing quickness. It reflects in weakening of effectiveness and stability of test for non-verbal information processing fulfillment.

Conclusions: successfulness of technical skillfulness formation depends on cognitive functions and opportunities for their realization: high attention, quickness of visual perception and operative and logic thinking in processing of verbal (non-verbal) information and taking decisions.

Keywords: cognitive functions, attention, perception, thinking, successfulness, dancers.

Introduction

Sport dancing is rather a new kind of sports and many directions of training and competition activity have been still remaining unstudied. Scientists note that there is a problem of rather subjective moments in competitions assessments [1, 2, 6, 11]. Modern ball dance is a synthesis of art and sport. At present stage of sport dancing history ball dancing is more sport than art.

The process of elite sportsmen's training is realized at level of extreme physical and psychic forces. It conditions demand in profound study of scientific ideas about functional mechanisms of functional reserves' improvement in adaption to increasing physical loads [10, 12]. Rather important is the fact that in elite sportsmen's training results' improvement is observed under loads, oriented on maximal development of genetically determined features [3, 5, 16].

Sport dances' structure includes art, choreography and sport component. Sport dancing popularity is explained by aesthetic character of it and sportsmen's performing maximally difficult motor skills. As a kind of sports sport dances require high coordination skills. Such skills are demonstrated in conditions of musical accompaniment. That is why sport dances open different human abilities (including cognitive). Among psychological and physiological characteristics, ensuring sport dancing effectiveness, there are cognitive functions [13, 15]. They are responsible for training process and directly participate in sport activity formation and realization [20].

In evolution human organism formed nervous system's mechanisms, ensuring personality's optimal choice of functioning. They can include individual typological

features and cognitive functions, which, to large extent, are genetically inherited. Cognitive functions are under influence of phenotype factors (sport functioning) [8, 9, 17, 18].

In modern scientific literature there are practically no data, relating to the mentioned problem. This problem is closely connected with system of different irritators' perception in realization of sport dances successful results. Traditionally cognitive functions include characteristics of external information perception, attention, memory and thinking [4, 14]. In sport dances fulfillment of difficult elements, synchronizing with musical accompaniment and motor skills' realization require involvement of all cognitive sphere.

Recent years there have been appeared rather a lot of scientific works on organization of training process, physical training and sportsmanship in sport dancing. But there are practically no researches on connection between cognitive functions and successfulness of 15-16 years' age dancers [7].

Hypothesis: it is assumed that there is certain connection between cognitive functions' level and effectiveness of choreographic skills' formation in sport dancing.

The purpose of the works is to find connection between level of cognitive functions realization and successfulness of choreography functions formation in junior dancers. .

Material and methods

Participants: 32 qualified junior sportsmen – dancers participated in the research (16 pairs). The sportsmen's age was 15-16 years that corresponds to category "Juniors" in sport dancing. The sportsmen's qualification was from 1st category to candidate master of sports of Ukraine.

Every dancer was assessed by five criteria of

successfulness (10 points' system for each criterion) for further distribution in groups of more or less successful sportsmen.

The first group included dancers with the highest successfulness by special tests– 12 persons (>71points), the second group included sportsmen with less successfulness – 20 persons (< 70 points).

Organization of the research: testing was conducted in the first half of day without physical loads. Conditions for psycho-physiological resting net the following requirements: standardization of external conditions and testing procedure, creation of psychological climate and motivation of the tested. All sportsmen gave consent for testing and for usage of testing results in scientific purposes, in compliance with recommendations of ethic committee of bio-medical researches [19].

Five special criteria for high technical skillfulness composed of referees' criteria for dancers' performance skillfulness, determining successfulness of competition program. They are:

1. Temp and main rhythm (“musicality” – assessment of musicality of cadency) dancing in time means that every step is finished not before and not after but exactly at certain count. Observation of main rhythm mean that step is made during proper time (for example slowly or quickly) and correct correlation between quick and slow steps is observed.

2. Lines of bodies (correct elegant lines of pair, corresponding to the character of competition dance). Referee assesses: lines of arms, back; lines of shoulders, hips; lines of legs and neck; left and right side lines. Marks for every line are synonymous.

3. Movements (“dynamic” – fulfillment of figures; movement, corresponding to the character of dance). Referee shall determine the following: movement's

correspondence to the character of dance; lifting and descending, swing and balance of pair. Excessive swing brings to marks' improvement only if movements are controlled and balance is kept. In dances of Latin America it is necessary to assess plasticity of body work, which is characteristic for every dance.

4. Works of foot means “technique” – exact fulfillment of figures: direction of feet movements in respect to torso in different positions. Referee shall determine correctness of all foot area work (toes, heels, positions and movements; closeness of feet, expressiveness and control of legs' movements).

5. Presentation means showing of every dance character, behavior on parquet.

For cognitive functions study we used the following methodic approaches: test for perception of verbal irritators, which showed efficiency, quickness, accuracy and effectiveness of tasks; test “comparison of numbers” with indicators: effectiveness, latency of solution, accuracy and stability.

For determination of psychic condition of dancers with different successfulness we used color Luscher's test. It permits to determine sportsman's psychic state (by color preferred by the tested): workability, fatigue, anxiety, deviation from autogenic norm, eccentricity, concentricity, heteronomy, autonomy and vegetative coefficient.

Statistical analysis: the received data were processed with MS Excel and «Statistica 6.0» applied programs. As far as indicators were not subjected to the law of normal distribution, for determination of statistically significant difference between samples we used Wilcoxon signed rank sums test. For demonstration of data distribution we used inter-quartile range, which pointed at first (25% percentile) and third quartile (75%).

Table 1. Characteristics of psycho-physiological state by Luscher's test in dancers with different successfulness (median, top and bottom quartiles)

Indicators	More successful dancers (n=12)	Less successful dancers (n=20)
Workability, conv.un.	12.00 11.00;14.00	7.50* 6.50; 10.00
Fatigue, conv.un.	1.50 1.00; 2.00	3.00 2.00; 4.00
Anxiety, conv.un.	0.5 0;1.00	2.00* 1.00; 4.00
Deviation from autogenic norm, conv.un.	12.00 6.00; 12.00	17.00* 14.00; 22.00
Eccentricity, conv.un.	10.00 9.00; 11.00	6,00* 4.00; 10.00
Concentricity, conv.un.	7.00 6.00; 10.00	8.00 7.00; 10.00
Heteronomy, conv.un.	7.00 6.00; 9.00	6.00 5.00; 8.00
Autonomy, conv.un.	10.00 9.00; 12.00	9.50 8.00; 11.00
Vegetative coefficient,	16. 00 9.00; 17. 00	10. 50* 5. 00; 15. 00

Note: * - p<0.05, comparing with group of more successful dancers.

Results

The dancers’ psycho-physiological condition was determined by color Luscher’s test; results are presented in table 1.

The received data showed nervous system highest workability in group of successful dancers. At the same time we found confident reduction of anxiety indicator that witnessed about optimal emotional state. In group of less successful dancers’ anxiety state was noticed that witnessed about initial stage of stress.

Indicator of deviation from autogenic norm in less successful dancers’ group is confidently higher that points at subjective discomfort. In other group we observed full comfort. Eccentricity (indicator, reflecting wish to release energy) is confidently higher in group of successful dancers. It points at the highest level of nervous system’s strength, comparing with other group.

In group of successful dancers we observed confident increase of vegetative coefficient. It points at prevalence of nervous system’s sympathetic part over para-sympathetic, comparing with group of less successful sportsmen.

The conducted researches of psycho-physiological conditions of dancers with different successfulness showed that nervous system workability, emotional state, subjective comfort and strength of nervous system are better in group of more successful sportsmen. Besides there is prevalence of nervous system’s sympathetic part over para-sympathetic in more successful dancers.

In group of less successful dancers nervous system

workability is confidently lower; there is increased anxiety and subjective discomfort with para-sympathetic part of nervous system’s prevalence.

In table 2 we give results of cognitive test for verbal perception “recognition of regularities” by dancers with different successfulness.

Analysis of table 2 data shows that successful dancers have better indicators of accuracy and effectiveness in cognitive task’s fulfillment. Test “recognition of regularities” is characterized by verbal tasks on recognition of coded word. In this test’s fulfillment the main cognitive functions are: quickness of perception, operative and logic thinking, attention. Greater quantity of confidently higher absolute values of accuracy in group of more successful dancers points at higher attention and quickness of visual perception.

High effectiveness of successful dancers points at better logic and operative thinking under verbal irritators. Thus, sport dancing successfulness at junior level is conditioned by psychic functions of high attention, quickness of visual perception and increased operative and logic thinking, when processing verbal information in cognitive test.

In table 3 we present cognitive test results of processing non-verbal information “comparing numbers” by dancers with different successfulness.

Analysis of table 3 data shows confidently greater absolute indicators of effectiveness, latency and stability in less successful dancers. The received fact points at

Table 2. Indicators of cognitive test for verbal irritators “recognition of regularities” in dancers with different successfulness (median, top and bottom quartiles)

Indicators	More successful dancers (n=12)	Less successful dancers (n=20)
Efficiency, conv. un.	18.00; 16.00; 20.00	17.00 16.00; 20.00
Quickness, conv. un.	3.50 3.17; 4.36	3.58 3.00; 4.00
Accuracy, conv. un.	0.90 0.88; 0.96	0.87* 0.81; 0.91
Effectiveness, conv. un.	60.00 56.00; 66.95	49.29* 46.81; 66.96

Note: * - p<0.05, comparing with group of more successful dancers.

Table 3. Indicators of “comparing numbers” test of dancers with different successfulness (median, top and bottom quartiles)

Indicators	More successful dancers (n=12)	Less successful dancers (n=20)
Effectiveness, conv.un.	1104.60 1050.20; 1563.70	1324.50* 1119.10; 1463.200
Latency, msec.	1055.40 1035.50; 1514.80	1282.95* 1092.90; 1428.90
Accuracy, conv.un.	0.97 0.96; 0.97	0.98 0.95; 0.98
Stability, conv.un.	29.81 27.40; 37.54	33.81* 30.24; 41.72

Note: * - p<0.05, comparing with group of more successful dancers.

better quickness of information perception and processing in group of successful dancers.

At the same time quickness of visual information perception by successful dancers negatively influences on effectiveness and stability of non-verbal cognitive task's fulfillment.

Discussion

Modern development of sport dancing shows significant influence of nervous system's individual-typological features on possibility of high sport result [7, 11].

However, the quality of motor skills formation depends on individual-typological characteristics of supreme nervous functioning [4, 17]. It is known that nervous system's individual-typological properties are composed of neuro-dynamic and sensor-motor functions [8, 9, 16, 17]. Neuro-dynamic and sensor-motor functions are genetically determined characteristics of supreme nervous functioning. It conditions sportsmen's ability for high coordination [7, 18].

In our previous works we found importance of characteristics of supreme nervous functioning individual-typological features. It also concerns functional mobility of dancers' nervous processes and connection of dancing successfulness with neuro-dynamic characteristics [6, 7].

At the same time effectiveness of technical actions in sport dances depends on sensor-motor chain of functional system and on cognitive functions of information perception, analysis and processing [5, 6, 11, 20].

Comparison of successful and not successful dancers by their special technical skills permitted to find higher workability in group of successful dancers, together with weakening of emotional anxiety. It points at optimal emotional state. Less successful dancer have higher emotional anxiety that points at initial stage of stress. Alongside with high workability of successful dancers we found their subjective feeling of comfort and signs of strong nervous system. Successful dancers have prevalence of sympathetic nervous system.

Thus, high successfulness in special technical elements' fulfillment is connected with adaptation resources' mobilization that manifests as activation of organism's sympathetic adrenaline system [3, 16]. For optimization of junior dancers' training process it is necessary to consider the state and maximal level of their cognitive functions.

Basing on the above said we can conclude that successfulness in sport dances is conditioned by high activation of main cognitive functions: attention, perception and operative and logic thinking in processing

verbal visual information [1, 6, 7, 13]. As it is known in sport activity verbal intellect permits to consciously realize difficult motor skills. It acquires special importance in realization of dance programs [2, 13]. Verbal intellect permits to consciously perceive information from coach, directed at correction of technical elements' fulfillment.

Analysis of differences in non-verbal cognitive test results between groups of dancers with different successfulness showed quickness characteristics' prevalence in successful sportsmen. However, at the account of information processing quickness increase attention function of successful dancers worsens. It results in reduction of effectiveness and stability of test fulfillment. It is in agreement with previous researches [7]. Just concentration of attention gives additional mobilizing element for dancer's success in competition functioning.

In the process of the researches we proved that cognitive functions level of junior dancers influences on successfulness of special technical elements' realization. It is known that fulfillment of difficult technical elements in sport dances requires high coordination [2, 11, 12]. It is planned to concentrate further scientific researches on differentiation of technical training process, considering cognitive characteristics in sport dancing.

Conclusions:

In group of more successful dancers we found higher level of nervous system's physical, mental and psycho-emotional workability; optimization of motional state, subjective comfort and strong nervous system.

Junior dancers' successfulness is conditioned by high level of main cognitive functions' activation: attention, quickness of visual perception, operative and logic thinking in processing verbal visual information.

In successful dancer we found prevalence of quickness characteristics of responding to irritator in non-verbal cognitive test. But at the account of increasing of information processing quickness attention worsens, that results in reduction of effectiveness and stability of this test's fulfillment.

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Conflict of interests

The author declares that there is no conflict of interests.

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Control of psycho-physiological functions of students with ophthalmologic diseases in the process of physical education

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Abstract

Purpose: to analyze dynamic of special health group students' (having ophthalmologic diseases) psychological functions parameters in physical education process.

Material: in experiment 40 special health groups' students with ophthalmologic diseases participated. Psycho-physiological tests and tool methodic were used.

Results: numerical values of attention abilities at the beginning of the research witnessed about disharmony of information's processing, transformation and storing by students. We observed general tendency to increase of test results, which in most of experimental group students (63.4%) reached average level. Improvement of motor apparatus lability witnesses about adjustment of trophic and energetic processes as well as their vegetative regulation. Integrative indicator of attention stability was at average level (5 points) at the beginning of the research. During experiment this indicator increased 2.7 times (10-11 points). We determined the presence of correlation between quickness of task's fulfillment and efficiency coefficient ($r=0.655, p<0.05$).

Conclusions: the received information is a foundation for effective interaction of physical education subjects in the form of personality-oriented technology.

Keywords: students, special health group, psycho-physiological functions, ophthalmologic diseases, control.

Introduction

As on to day the quality of higher education is identified with quality of workable specialists' preparation. Students' health is one of the most relevant questions of the present time [2, 7, 10, 16]. Within these problems especially important is effectiveness of special health group (SHG) students' physical education.

It is considered that one of promising directions of progressing in SHG physical education is working out and practical realization of new, highly effective technologies of control and monitoring this process [6, 16, 22, 35]. In this context it is noted that high level of student's psycho-physiological sphere functional state ensures effective realization of his/her psycho-motor and intellectual potentials. It also ensures effectiveness of his/her educational and in the future professional functioning [12, 18, 19, 34].

Analysis of scientific-methodic literature shows that determination of physical education efficiency envisages study of psychological functions' state [4, 19, 22, 34, and 35]. Just these results are correlates of SHG students' psycho-physiological state. It is important in ensuring effective social re-integration and further students' functioning by specialty.

Specialists in this sphere attract attention to the fact that without consideration psycho-physiological potentials it is impossible to ensure physical education efficiency [5, 8, 22]. It is considered that assessment of SHG students' psycho-physiological state and monitoring its dynamic are leading factor for effectiveness of health related educational process control.

However, appealing to theoretical works witness significant scantiness of empiric material concerning psycho-physiological functions' studies in SHG. A number

of empiric researches proved purposefulness of control over students' with health problems psycho-physiological; state in SHG physical education [5, 14, 16]. Physical workability dependence on SHG students' psycho-physiological functions has been proved and substantiated [6, 16].

Nevertheless in scientific literature there is no proper substantiation and analysis of control over psycho-physiological functions of SHG students with disorder in some sensor systems (in particular ophthalmologic). In scientific practice there are some proofs on influence of psycho-physiological functions' disorders on visual sensor system [13, 40]. In a number of works influence of physical loads on organism's physiological systems is studied [16, 23, 39]. Influence of physical education on adolescents' (with eyesight problems) social-psychological adaptation has been experimentally proved [21]. Thus, the mentioned problems of control over psycho-physiological functions in students with ophthalmologic diseases has not been solved and experimentally tested. It significantly complicates determination of regular tendencies in this aspect.

Hypothesis: implementation of experimental control technology in SHG physical education envisages study of psycho-physiological functions' state. Its purposefulness is conditioned by significance of finding and studying plausible information at certain stage of students' studying. Close interconnection between visual sensor system's functional state and psycho-physiological mechanisms, ensuring students' professional workability can be used as an indicator of students' psycho-physiological state and criterion of workability.

The purpose of the research: is to analyze dynamic of special health group students' (having ophthalmologic diseases) psychological functions parameters in physical education process.

Material and methods

Participants: in experiment 40 special health groups' students with ophthalmologic diseases from NU "Lvivska politechnika" participated during three years' physical education course (boys and girl equal number). By results of medical examination the students of the tested sample were related to SHG. All students gave written consent for participation in experiment. Four groups (two - boys' and two - girls') control groups (CG) and experimental groups (EG) were formed as per principle of cluster analysis for sample's distribution into uniform groups. The latter were combined by mutual characteristic (nosological) providing satisfaction of requirements concerning sufficiency of sample's volume at confidence level $p < 0.05$.

The procedure: we fulfilled monitoring of psycho-physiological functions' parameters at the beginning and at the end of physical education course as per operational-procedure criterion (with control measurements and generalization of results). Standard, short, restricted in time psycho-physiological tests were used. Strength and mobility of nervous processes was studied by psycho-motor indicators with the help of short informative "Tapping test" [18]. Assessment of mental endurance, workability, cognitive functions and atenciony abilities (ability to distribute attention between several activities simultaneously) was fulfilled with a number of the most known methods. Methodic «Technique Munsterberg» is directed at determination of attention parameters [37]. Bourdon's correcting test (Benjamin B. Bourdon) letter variant) [32] serves for assessment of attention, psycho-motor functioning temp, workability and stability in conditions of monotonous functioning. Fulfillment of this test requires constant concentration of attention in conditions of long lasted visual analyzer's overloading. Test of Pieronne- Rouser is: indicators identify features of attention (concentration, stability, selectivity and quickness of re-switching; accuracy and reliability of information processing and workability level) [18].

The selected for empiric study test methods relate to diagnostic methods, which are permitted for application in educational establishments. They are multi-factorial, standardized; they do not set too much requirements and have high level of authenticity. These methods are suitable for application in our sample and do not require special conditions.

For testing simple motor-visual reaction and visual analyzer's lability we used an instrument for neuro-dynamic testing [41].

Statistical analysis: the received data were characterized with the help of descriptive statistic methods. The main one-dimensional values: mean arithmetic (X), standard deviation (S), median (Me), asymmetry coefficient (A_v), variation coefficient (V). Indicators' increment during experiment was determined by formula [9, 11, and 30] with application the data, taken at the beginning and at the end of the research. Statistical significance was determined with the help of inductive statistic methods (Student's t-criterion).

Statistical processing of the obtained material was carried out with the help of program «Statistica 8.0.», adapted to medical-biological researches.

Results

Results of monitoring at the beginning of EG and CG students' psycho-physiological functions' research did not confidently differ that was statistically proved (see table 1). So, the formed sample completely meets requirements of representativeness.

Neuro-physiological basis of individual difference between students of the same nosology are individual-typological properties of supreme nervous functioning [20]. Characteristic features of the latter are formed under influence of factors of available ophthalmologic problems. So, numerical values of atenciony abilities at the beginning of the research witnessed about disharmony in information's processing, transformation and storing by students of the tested groups.

For determination of experimental technology effect we formed the measure of the tested parameters' development, considering their dynamic (see table 2).

Nervous processes' strength is an indicator of nervous system's workability [18, 23]. Study of its dynamic gives main information about qualitative analysis of mental workability as indicator of organism's functional state. It was realized with the help of psycho-motor features express-diagnostic – "Tapping test".

The received coefficient of nervous system's mobility is an indicator of dynamic workability [12]. At the beginning of experiment 5.2% of students had the first degree; all the rest – second. No person with high degree was found in the sample. Reduction of quantity of points from square to square was observed in most of students. It witnessed about insufficient functional stability of nervous-muscular apparatus.

After finishing experiment in EG there were 89.6% persons, whose dynamic of coefficient of nervous system's mobility was registered as positive at average degree. We think that the received data are the results of strengthening of nervous system's temp potentials. They are conditioned by complex of central and periphery reconstructions in its state. As a result, under influence of morphological changes in students' organisms increase of nervous processes mobility happens. It basis is perfection of coordination. Visual analysis of rhythmic movements showed increase of sensor-motor workability in EG at the end of experiment.

Maximal frequency in "Tapping test" is one of indicators of psycho-motor activity's quickness; one of integral signs of its lability [14]. It determines development level of such synthesized parameter as quickness of central processing of information before taking decision (motor apparatus lability) [16, 20]. In students of the tested groups its indicators were below average (by 10-points scale) at the beginning of experiment). It witnessed exhaustion of plastic and strengthening of inert processes in central nervous system. Improvement of motor apparatus lability

Table 1. Indicators of psycho-physiological functions parameters of students with ophthalmologic diseases at the beginning of experiment

Description of parameters	EG (n=20)					CG (n=20)					P	
	X	S	As	Me	V	X	S	As	Me	V		
DE <i>conv.un.</i>	X	6.06	0.81	0.28	6.01	36.4	6,01	0.97	0.39	5.89	33.9	>0.05
	G	6.21	0.93	0.37	6.19	37.5	6,14	0.89	0.02	6.00	30.1	>0.05
LMA <i>conv.un.</i>	B	2.98	0.54	0.05	2.92	37.4	2,90	0.61	0.38	2.87	28.4	>0.05
	G	2.55	0.61	0.38	2.53	36.2	2,63	0.77	0.04	2.55	23.9	>0.05
CNSM,%	B	0.68	0.12	0.29	0.65	34.7	0,70	0.09	0.15	0.69	29.8	>0.05
	G	0.66	0.08	0.19	0.64	34.5	0,65	0.11	0.38	0.63	37.2	>0.05
Assessment "AcAc",points	B	8.55	0.86	0.12	8.39	39.0	8,65	1.11	0.26	8.55	31.2	>0.05
	G	8.01	1.05	0.40	7.98	40.4	8,99	0.95	0.43	8.77	33.4	>0.05
At, points	B	6.91	0.94	0.12	6.67	28.0	7,01	1.12	0.21	6.79	42.3	>0.05
	G	7.43	0.84	0.36	7.21	34.2	7,41	0.82	0.64	7.10	47.5	>0.05
At,%	B	70.23	2.11	0.23	69.80	22.2	71,54	3.15	0.04	69.3	47.8	>0.05
	G	74.18	3.09	0.01	73.01	24.5	72,76	4.11	0.42	70.02	45.7	>0.05
E	B	1290	82.8	0.36	1286	24.6	1291	108.2	0.18	1287	36.8	>0.05
	G	1353	105.2	0.19	1350	27.6	1341	103.6	0.47	1339	37.5	>0.05
C,%	B	38.18	5.9	0.41	37.69	27.9	37,66	5.6	0.18	36.11	37.4	>0.05
	G	42.64	5.3	0.25	41.33	45.7	41,03	6.2	0.08	40.33	36.2	>0.05
Pr,%	B	45.14	3.23	0.28	43.22	33.6	45,75	4.3	0.34	43.12	34.7	>0.05
	G	48.78	3.01	0.42	46.28	37.8	50,30	4.1	0.00	48.90	34.5	>0.05
AtS, <i>conv.un.</i>	B	55.90	4.04	0.25	54.12	39.0	53,42	5.8	0.18	50.32	39.0	>0.05
	G	60.34	5.15	0.15	60.01	27.9	59,15	4.1	0.06	58.67	40.4	>0.05
t, c	B	249.3	30.3	0.28	245.1	26.4	248,2	29.7	0.39	246.9	38.9	>0.05
	G	230.5	28.8	0.37	227.3	24.6	227,1	28.5	0.39	225.9	31.7	>0.05
CMW, <i>conv.un.</i>	B	0.65	0.11	0.05	0.64	35.4	0,67	0.09	0.38	0.63	35.1	>0.05
	G	0.63	0.07	0.38	0.63	29.8	0,65	0.05	0.24	0.63	29.7	>0.05
LP SVMR, <i>m.sec.</i>	B	339.3	10.4	0.29	334.3	37.2	327,6	11.5	0.15	325.7	43.4	>0.05
	G	321.5	9.3	0.19	319.0	31.2	317,6	11.8	0.58	315.3	39.1	>0.05
LVA, Hz	B	29.18	1.52	0.12	28.5	33.4	28,73	1.18	0.26	27.42	33.5	>0.05
	G	30.28	1.77	0.40	29.44	42.3	30,08	1.55	0.13	28.98	26.7	>0.05

Legend: DE– dynamic endurance; LMA – lability of motor apparatus; CNSM –coefficient of nervous system’s mobility; At – re-switching of attention; Ac – accuracy of attention; E – coefficient of mental workability;; C – concentration of attention; AtS – attention stability; Pr – effectiveness of work; t – selectiveness of sample; CMW – coefficient of mental workability; LP SVMR– latent period of simple visual-motor reaction; LVA – lability of visual analyzer; p – confidence of difference; B - boys; G - girls.

in EG at the end of experiment witnessed improvement of trophic and energetic processes and their vegetative regulation.

Analysis of motor system’s stability showed that boys’ results were confidently ($p < 0.001$) better than girls’ results. Tapping test’s results are substantiated in the aspect of available ophthalmologic disorders in students of the tested groups. At the same time we observed instability of attention and insufficiency of activity.

In general, positive changes in EG students by all parameters of “Tapping test” shows improvement of nervous-muscular apparatus and increase of balance

to the side of excitement. Accordingly, correlation of hits and misses in test’s results permits to speak about improvement of space coordination functional state in EG after experiment.

By integrative assessment of all tested parameters after experiment we observed general tendency to improvement of test results. Results of the most of EG students (63.4%) were at average level.

In systemic psycho-physiology attention is not regarded as independent psychic process. It is positioned as reflection of intra-systems’ relations of current functioning, which ensure effectiveness of this functioning

Table 2. Indicators of psycho-physiological functions parameters of students with ophthalmologic diseases after experiment

Description of parameters	EG (n=20)							CG (n=20)						
		Before		After		+	p	Before		After		+	p	
	X	S	X	S	X			S	X	S	X			S
DE conv. un.	B	6,06	0,81	4,85	0,95	19,9	<0,05	6,01	0,97	5,92	0,94	1,4	>0,05	
	G	6,21	0,93	5,05	0,91	18,6	<0,05	6,14	0,89	6,02	0,98	1,9	>0,05	
LMA conv.un.	B	2,98	0,54	3,91	0,63	30,2	<0,001	2,90	0,61	2,97	0,72	2,4	>0,05	
	G	2,55	0,61	3,34	0,58	31,3	<0,001	2,63	0,77	2,67	0,64	1,51	>0,05	
CNSM,%	B	0,68	0,12	0,88	0,07	29,4	<0,01	0,70	0,09	0,72	0,07	2,8	<0,05	
	G	0,66	0,08	0,81	0,09	22,7	<0,01	0,65	0,11	0,65	0,10	0	>0,05	
Assessment "AcAc", points	B	8,55	0,86	10,85	0,34	26,5	<0,01	8,65	1,11	8,81	1,03	2,1	>0,05	
	G	8,01	1,05	9,61	0,68	20,8	<0,05	8,99	0,95	8,08	0,84	1,2	>0,05	
At, points	B	6,91	0,94	9,12	1,15	28,5	<0,01	7,01	1,12	7,16	0,79	1,2	>0,05	
	G	7,43	0,84	10,05	1,01	31,6	<0,001	7,41	0,82	7,45	0,83	2,4	>0,05	
At,%	B	70,23	2,11	86,14	2,88	22,8	<0,05	71,54	3,15	75,62	2,28	5,6	<0,05	
	G	74,18	3,09	90,51	2,16	21,6	<0,05	72,76	4,11	77,33	3,01	6,8	<0,05	
E	B	1290	82,8	1598	91,8	23,4	<0,05	1291	108,2	1335	108,1	3,08	<0,05	
	G	1353	105,2	1702	102,6	25,8	<0,01	1341	103,6	1355	90,8	1,04	>0,05	
C,%	B	38,18	5,9	50,33	4,7	31,5	<0,001	37,66	5,6	38,91	6,2	2,6	>0,05	
	G	42,64	5,3	56,41	6,0	32,4	<0,001	41,03	6,2	43,15	5,3	2,8	<0,05	
Pr,%	B	45,14	3,23	54,72	4,71	20,8	<0,05	45,75	4,3	47,3	3,8	4,4	<0,05	
	G	48,78	3,01	60,11	5,74	25,1	<0,01	50,30	4,1	52,2	3,5	4,1	<0,05	
AtS, conv.un.	B	55,90	4,04	70,47	5,9	26,7	<0,01	53,42	5,8	55,4	5,6	3,7	<0,05	
	G	60,34	5,15	78,18	5,3	29,5	<0,001	59,15	4,1	61,1	4,2	3,3	<0,05	
t, c	B	249,3	30,3	167,4	32,9	32,1	<0,001	248,2	29,7	235,1	19,2	5,2	<0,05	
	G	230,5	28,8	156,1	28,3	33,0	<0,001	227,1	28,5	213,3	21,8	5,9	<0,05	
CMW, conv.un.	B	0,65	0,11	0,83	0,07	33,8	<0,001	0,67	0,09	0,71	0,06	6,5	<0,05	
	G	0,63	0,07	0,80	0,09	26,9	<0,001	0,65	0,05	0,68	0,08	4,6	<0,05	
LP SVMR, m.sec.	B	339,3	10,4	290,4	7,3	14,7	<0,05	327,6	11,5	326,2	9,9	0	>0,05	
	G	321,5	9,3	275,9	11,4	14,1	<0,05	317,6	11,8	318,6	10,3	0	>0,05	
LVA, Hz	B	29,18	1,52	39,93	1,23	30,2	<0,001	28,73	1,18	30,15	1,82	0,5	>0,05	
	G	30,28	1,77	40,56	1,67	30,7	<0,001	30,08	1,55	31,52	1,07	0,5	>0,05	

and mental workability [12, 18]. Indicator of task's fulfillment accuracy depends on functional state of nervous system, degree of stability and attention fatigue. Finally it determines the quality of fulfilled work [12]. Before the end of experiment qualitative values of this parameter in EG reach positive dynamic up to 30% ($p < 0.05$).

Indicator of work efficiency characterizes quickness of perception and thinking. It depends on nervous processes mobility [13]. Reaching of nervous system excitation's utmost under influence of trainings created favorable conditions for increase of attention's efficiency in EG. Integrative indicator of attention stability at the beginning of the research was at average level (5 points). During experiment this indicator increased 2.7 times (10–11 points). At the same time we found the presence of correlation between quickness of task's fulfillment and coefficient of efficiency ($r = 0.655$, $p < 0.05$).

Implementation of experimental technology in EG educational process conditioned substantial improvement

of atenciony abilities' indicators. The latter condition success in any professional functioning. They take leading place in its psycho-physiological structure [12]. Integrative indicator of atenciony abilities increased in EG in average up to 33% ($p < 0.05$). Numerical values of concentration, stability, re-switching and selectivity of attention reached average and good levels. All these are the main factor of work's and mental workability's high effectiveness [16].

Physiological base of attention is brain activation, connected with reticular formation's functioning [13]. In a number of cases indicator of the tested number of abilities is lower than possible because of health problems, asthenic state or fatigue. Thus, we can observe influence of ophthalmologic diseases on atenciony abilities. At the beginning of the research their level was low. Improvement of qualitative values up to average level is, to some extent, an evidence of improvement of morphological state in EG.

Attention concentration was low and rigid nearly in all students of the tested sample at the beginning of experiment. It is explained by increased load on visual analyzer and possible Gnostic disorders. The reason of attention concentration's weakening is also bad eyesight. It is considered that concentration of attention is trained rather easily [12, 20]. After experiment it increased to good level – 87.8% in EG. Such data are the results of improvement of general brain activation under influence of trainings.

Indicators of attention re-switching [20] were low in the tested groups at the beginning of experiment. After its' finishing their confident increment was observed as well as reaching of average level in EG. It resulted from optimal activation of reticular system that ensured such dynamic. Level of confidence of the changes in the tested parameters in EG was rather high.

In systemic psycho-physiology mental workability is conditioned by level of cognitive functions and atenciony abilities [16, 18]. Together they reflect such intra-systems relations of psycho-physiological functions, which ensure effectiveness of functioning. Development of mental workability goes as per general ontogeny laws. But the structure and complexity of its formation require correction psycho-physiological mechanisms of its progressing through physical culture. Besides, mental workability indicators have complex indirect dependence on indicators of physical workability [23]. As a result of our research in EG coefficient of mental workability reached to single values. Between average values of mental workability coefficients of EG boys and girls we found no confident differences during experiment ($p>0.05$).

In mental functioning visual analyzer endures the main load [16]. In this aspect we considered purposeful to study the following: the functions, connected with visual perception of information and functional state of central nervous system. Determination of sensor-motor reaction's indicators was conditioned by demand in consideration functional mobility of nervous processes. The latter ensure effectiveness of professional activity.

By results of simple visual-motor reaction we judged about effectiveness of visual information's processing. Before experiment latent period was low in all students. We assumed that it as explained by influence of ophthalmologic diseases on physiological responses of students' organisms to the offered stimuli of reactions. The received results are completely substantiated from the point of physiology. Quickness of sensor-motor responding to large extent determines functional state of central nervous system [1]. It manifested as regress of quickness and accuracy of responding to external signal. It elongated the time of reaction. We do not exclude also influence of active formation of brain informational processes' bases on reduction of students' responding time. It is characteristic for such age period [16].

Indicator of visual analyzer's lability is integrative assessment of central nervous system's lability and changes of its functional state. It ensures the function

of information scanning in real time [35]. Before the research indicator of light blinking discreteness in EG was at level 1–2 points (≤ 30 Hz). After experiment, in control group the most typical changes in emotional lability were gradual dynamic increase of its criterion indicators. We observed confident ($p<0.001$) improvement of nervous processes' mobility indicators. Their positive dynamic was within up to 30%. In points it was 7 points.

In study of psycho-physiological functions' neuro-dynamic block we found a number of differences between measures of reactions by signs of gender dimorphism. All tested indicators of girls confidently were higher than boys' at significance level ($p>0.001$). Nosological distribution of reaction time has positive asymmetry.

Especially different are qualitative results of neuro-dynamic block parameters' testing in the tested groups. It manifested as quickness and accuracy regress in responding to external signal (elongation of reaction time). Evidently, it is conditioned by their physiological characteristics and disorders of visual sensor system's functional components. Accordingly, substantial positive dynamic of the tested parameters is conditioned by improvement of this system's state; changes in motor component's organization; reduction of deviations in visual analyzer.

The study of psycho-physiological functions permitted to determine that change of the tested parameters in CG is characterized by absence of positive tendency both in boys and girls. Some indicators manifested positive tendency in the process of training. However, at finalizing stage they, in general, did not confidently differ ($p>0.05$) from the beginning stage. The mentioned above shows weakening of energetic and regulatory processes in central nervous system. It objectively manifests in regress of psycho-physiological functions' parameters. Absence of positive dynamic in indicators of visual analyzer's lability witnesses about asthenia. Mental workability coefficient in CG students insignificantly but confidently reduces during the whole period of training ($p<0.001$).

Discussion

We completely support scientific approaches of scientists, who deal with optimization of control in physical education [2, 6, 16, 19, 24]. In this aspect, the state of psycho-physiological functions is one of important criteria of mental workability. The latter is limited by organism's reserves, pathological changes in visual sensor system [12, 16, 35]. Numerical scientific data [8, 13, 16, 34] witness that studies of psycho-physiological functions gives additional information about functional state of students' organisms.

We expanded and supplemented information [2, 6, 7, 35] about studies of important parameters of SHG students' psycho-physiological functions' parameters. There are many evidences that they are determining factors of students' psych-physiological readiness for future professional functioning. In contrast to previous researches of SHG we fulfilled experiment in compliance with addressed nosology.

In the base of test selection were results of well known scientists' works. It was determined by the fact that formation of professional skillfulness is conditioned by individual's cognitive, regulatory and sensor-motor sphere. It is limited by state of sensor integration in processes of perception and memory. Actually it conditions success in any professional activity [12-20, 33, 34]. Their state is regarded as criterion of physical education effectiveness in removal of evident health problems [6, 21, 35].

At present, searches of mechanism of mental workability control of SHG students with ophthalmological diseases with application of definite motor functioning forms are still fragmentary, insufficient and not substantiated. By scientific data [12, 18, 20, 23] such situation is conditioned by central nervous system's state as well as the senses. We used scientific data about tests' application for diagnostic. It is limited by organism's reserves and available pathological deviations in visual system [5, 16, 19]. Positive dynamic of mental workability in EG is a proof of it.

We proved that psycho-physiological functions' state depends on sex [12, 13, 18]. In indicators of the tested parameters the most significant differences were determined by sex dimorphism. In boys of EG improvement of mental workability and endurance was confidently ($p < 0.05$) better than in girls. The EG girls' better changes (confident at $p < 0.05$) were in attention abilities. Such tendency is quite logical, considering sex aspects of individual ontogeny. The latter are characterized by certain intensity of physiological systems functions' development. They also determine quantitative changes of certain parameters: gender properties of attention and so on. As specialists [12, 16, 18, 20] think it does not concern mental workability. It is proved by results of experiment. We found no confident differences between mental workability coefficient of EG boys and girls during experiment ($p > 0.05$).

According to scientific data [1, 16, 20, 23] ophthalmological diseases condition organism's physiological reactivity. The received by us results prove that such pathologies determine low level of students' psycho-physiological functions. As a result the time of simple visual-motor reaction becomes longer. It proves the presence of permanent psycho-physiological functions interconnection with organism's morphological functional state [12, 16, 18, and 23]. Indicator of task's fulfillment accuracy depends on nervous system's functional state, degree of attention stability and fatigue. In total, it determines the quality of fulfilled work. This important principle of pathogenesis is conditioned by

leading role of central nervous system and influence of visual sensor system's available diseases. They disorder its normal functioning [1, 23]. Assessment results of main nervous processes' mobility in visual analyzer prove conclusions of scientists that in students with eyesight problems the process of information processing differs by regress of quickness and dynamic of information receiving [1, 23, 35].

The received results supplement our own researches [4-6, 14] on realization of experimental control technology in SHG. The predicted effect of the conducted experiment was efficiency of implemented technology. It was proved by positive dynamic of the tested parameters.

We proved numerical scientific data [2, 7, 19, 22] about low effectiveness of acting physical education system in SHG of higher educational establishments.

Conclusions

The purposefulness of psycho-physiological functions diagnostic in the conducted experiment is conditioned by the fact that such functions ensure success in any professional functioning. Consideration of individual psycho motor abilities permits to find the level of professional fitness.

Generalized statistic analysis of testing results of SHG students' psycho-physiological functions permits to conclude that it is necessary to implement the worked out technology in physical education. We witnessed increase of mental workability and positive dynamic of cognitive functions against the background of visual sensor system's improvement. We stated their diachronic coincidence in CG (at level $p > 0.05$) before and after experiment. With it there is diachronic difference (at level $p < 0.05$) in EG before and after experiment. Before and after experiment between EG and CG there is synchronic difference. With it confidence of differences of the tested students was at level $p < 0.05$.

Systemizing and generalization of all tested parameters' final results witness in favor of implemented technology. Experience of EG trainings permits to state positive effect of targeted correction impacts in the course of physical education. It is witnessed by absolute values of psycho-physiological functions' parameters at finalizing stage. The received information is the base for effective interaction of physical education subjects in the form of personality-oriented anthropic technology.

Conflict of interests

The authors declare that there is no conflict of interests.

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Traumatism in training process of students – volleyball players

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Abstract

Purpose: to analyze traumas in training process of students-volleyball players.

Material: 42 students participated in the research. Students' medical records were analyzed in the research.

Results: with every year of study in university the quantity of traumas decreased. In 1st year students we found 10 traumas, in 4th year – 5. Ligament sprains are the most frequent kinds of traumas. In total we found 33.3%. Their main part covers ankle joint traumas. The reasons of them are bursts, stops, changes of movements' direction. Rather frequents (30%) are maims of knee and elbow joints, caused by falling down. The degree of joints' injury is, as usually, negligible. The highest quantity of moderate and heavy traumas was among 1st year students (9 from 10) and 2nd year students (8 from 8).

Conclusions: prophylaxis complex for prevention of volleyball traumas has been offered. Volleyball traumas' prevention implies improvement methodic and technique of students-volleyball players' training. The main reasons of traumatism are the following: non observation of sports training principles; poor organizational and logistical support of training process.

Keywords: traumas, volleyball, students, sportsmen, volleyball players.

Introduction

With every year quantity of students, practicing volleyball has been increasing [1, 8, 10]. In this connection requirements to sportsmen's organism have been rising. So, risk of traumas increases [6, 13, 17]. That is why, it is necessary to concentrate the highest attention to prophylaxis and correct treatment sport traumas [10, 14]. Understanding of mechanism of traumas' emersion, as well as their localization permits to realize more effective prophylaxis measures. For this purpose it is necessary to combine the efforts of scientists, coaches, medical workers, dealing with sport traumatism [2, 4, 7].

The problems of children, youth and sport traumatism were the subject of different authors' studies [1, 3, 5]. It was found that the most frequent were inflammatory and degenerative changes in muscular-skeletal apparatus. They appear as a result of endured and insufficiently cured traumas, repeated micro-traumas and physical overloads [8, 16, 20]. In other works it was noted that children suffer more from traumas than from other diseases [2, 9, 19].

The problems of traumas emersion and prophylaxis were analyzed in different kinds of sports and directions:

- Direct proportion of social –philosophical and spiritual values, person's social orientation and his/her general culture level with physical health and traumas' presence or absence in sport practicing has been determined [18];
- Influence of tourists' training program for skiing, considering traumatism prophylaxis in conditions of limited time has been shown [27];
- Application of preliminary fatigue principles permits to reduce loads volume and traumatism [25];
- Application of health related technologies in secondary school age girls' football trainings reduces traumatism [26];
- Positive influence of psychological support for recreation sportsmen of game kinds of sports after

lower limbs traumas has been shown. The authors notes importance of the mentioned approaches in practicing physical exercises [28];

- Importance of educational programs for rising sportsmen's knowledge about traumatizing at competitions and about first aid measures has been noted [11];
- Possibilities of more effective sportsmen's recreation in different kinds of sports (football, volleyball, run. weight lifting) have been shown [12];
- It is noted that it is necessary to observe safety measures in volleyball training that facilitates reduction of traumatism [24, 29].

That is why in physical education important role is played by complex of prophylaxis measures, directed at prevention from accidents and traumas [6, 13, 17]. It is necessary to build educational-training and sport process in higher educational establishment so that risk of traumas would be completely eliminated.

The purpose of the research is to analyze traumas in training process of students-volleyball players and find the reasons of their emersion, as well as to offer the complex of prophylaxis measures, directed at traumas' prevention.

Material and methods

Participants: in the research 1st-4th year students participated (in total – 42 sportsmen).

Organization of the research: for analyzing traumas students' medical records were studied in the research. We analyzed the main reasons of traumatism, traumas' character and heaviness.

Statistical analysis: the results were calculated with the help of SPSS 22 program.

Results

The following traumas are the most characteristic for volleyball players: upper and lower limbs' maims; ligament strain as well as strain of legs, arms and torso

muscles; dislocation of shoulder, ankle joints (in less quantity of cases – elbow, wrist and knee elbows); feet blister, muscles’ twitching (as a rule shin and hip muscles). Muscles and ligaments’ breakages are comparatively rare. As per some data in volleyball players sub-dermal injures of muscles (bursting) are only 0.23% of all pathologies, ligament breakages (quadriceps muscle of thigh, fingers’ extensors, Achilles tendon) - 3.51% of all pathologies [5, 15, 23].

Main reasons of traumatism

Reasons of methodic character: violations of sport training principles (continuity, cycle character, gradualness of loads rising; training in fatigue condition; fulfillment of back-breaking, unfamiliar, difficult exercises; training without arming up; absence of sportsmen’s concentration) [16, 22].

Reasons of organizational character: coach’s qualification; groups’ completing without consideration of sex, age and physical fitness; absence of support; fulfillment of exercises “strong against weak” and etc.; excessive quantity of students in sport groups; trainings without coach; training at too cold temperature; sportsmen admittance to trainings without previous medical examination; too early training after disease or traumas; violation of body, arms hygiene; violation of training places maintenance regulations (poor illumination and ventilation; bad quality of site surface;

wrong location of inventory and so on); violation of sport discipline and regime; not optimal competition calendar, without considering recreation time of volleyball players’ organism, change of climate and hour zones [3, 9, 21].

Considering the absence of data about volleyball players’ traumas and injures we fulfilled analysis of characteristic traumas and their quantity in students for the period of their study in universities.

The results of the researches permit to find the character and heaviness of students-volleyball players’ traumas and injures. Total quantity of traumas in the years of studying is shown in fig. 1.

The graph shows that with every training year quantity of students-volleyball-players’ traumas reduces. In first year they were ten and by the forth year they reduced twice (5).

The reasons of such results can be quite different. Some students practiced volleyball before entering university. Some students had weal physical and special fitness at the beginning of study in university. As a result there is great quantity of traumas in the 1st year.

Special attention is paid to reasons of traumas’ emersion and their prophylaxis. Students’ outlook at volleyball traumatism expanded. Besides, as a result of well planned training process, volleyball-players’ physical and technical fitness rose. May be just because of these reasons the quantity of forth year students-volleyball

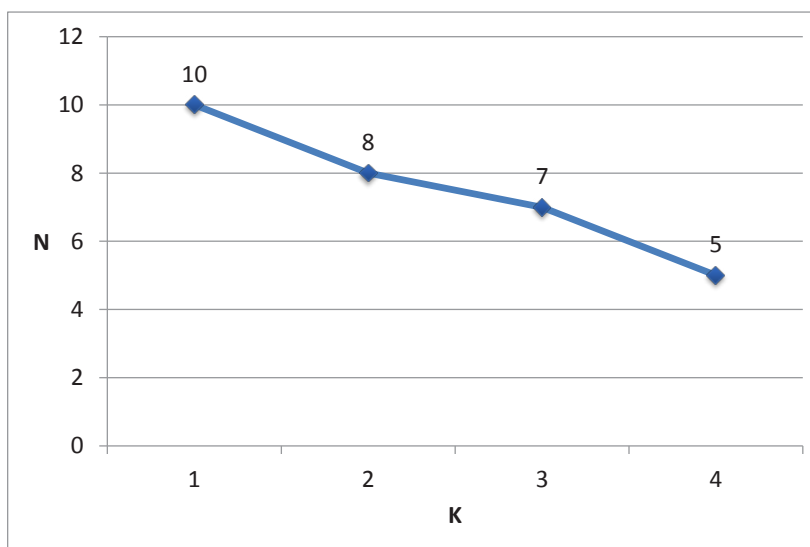


Fig. 1. Dynamic of students-volleyball-players’ traumatism for four years of study

Table 1. Characteristic of volleyball players’ traumas by the character of damages (quantity)

Traumas	Year of study				Total
	1	2	3	4	
Maims	1	1	5	2	9
Fractures	1	–	–	–	1
Dislocations	1	1	–	–	2
Strains	3	4	1	2	10
Bursts	3	1	1	1	6
Breakages	1	1	–	–	2
Total	10	8	7	5	30

players' traumas becomes significantly less (see table 1).

Indicators of traumas and sport damages were reduced to percents (see table 2).

As we can see in table 2 strains are the most frequent in students-volleyball players. In total we found 33.3%. The main part of them relates to traumas of ankle joint. The reasons of them are bursts, stops, changes of movements' direction as well as poor quality of volleyball players' footwear (see fig. 2).

Maims are rather frequent (30%): mainly of knee and elbow joints. Such traumas are caused, in general, as a result of falling down. The degree of joint damage is rather negligible with it. The quantity of dislocation is not high and they are localized in wrist joints. The reasons of such traumas are the same as with strains.

Ligaments burst and breakages were 20 and 6.7% (accordingly) for four years with localization in ankle and knee joints. During four years only one fracture occurred. It is 3.3% from total quantity of traumas.

Analysis of traumas by the character of damages permitted to determine their heaviness and impact on

organism. Results of the research are given in table 3.

From table 3 we see that the highest quantity of moderate and heavy traumas was in the first year (9 from 10) and in the second year (8 from 8). From diagram (see fig. 3) we can see which (by heaviness of impact on organism) prevail in sportsmen.

The diagram shows that 50% are moderate traumas, 37% - heavy. The least quantity of traumas is light ones (13%). So little quantity of light traumas is connected with the fact that they were not paid proper attention and they were not officially registered.

Discussion

The fulfilled work proves and supplements numerous results [4, 14, 19] of special literature: the higher level of students' physical and special fitness, the lower percentage of traumas received in training process. Our results prove the data of other studies [7, 20, 23]: solution of volleyball traumas prophylaxis problem implies perfection of technique and training methodic of students-volleyball players.

Table 2. Characteristic of traumas by the character of damage (%)

Traumas	Total for 4 роки (%)
Maims	30.0
Fractures	3.3
Dislocations	6.7
Strains	33.3
Bursts	20.0
Breakages	6.7

Table 3. Characteristic of traumas by heaviness of their impact on organism (quantity)

Traumas	Year of study				Total	Total in %
	1	2	3	4		
Light	1	–	2	1	4	13
Moderate	5	5	4	1	15	50
Heavy	4	3	1	3	11	37

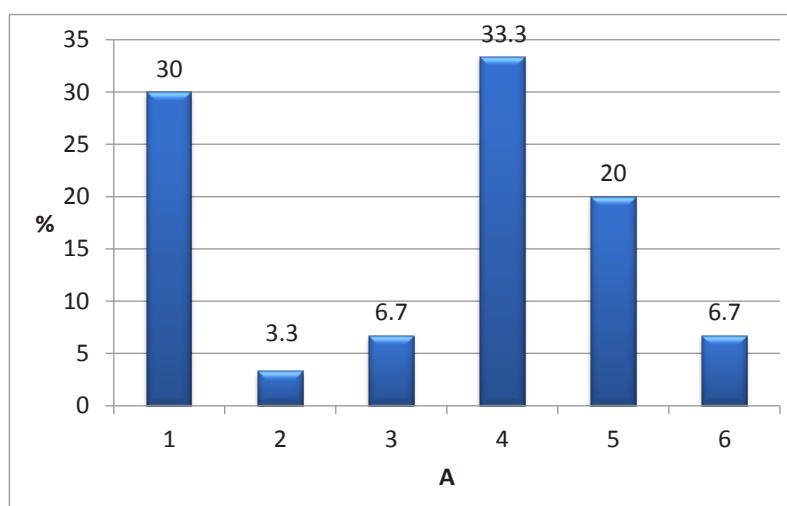


Fig. 2. Characteristic of traumas by the character of damage (%). A – Kinds of traumas: 1 –maims; 2 –fractures; 3 – dislocation; 4 – strains; 5 – bursts; 6 – breakages.

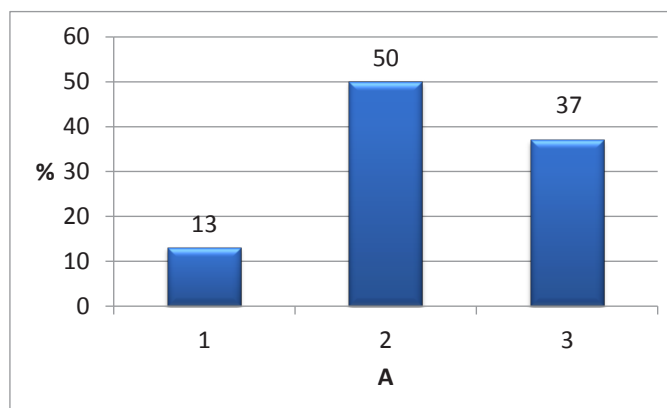


Fig. 3. Characteristic of traumas by heaviness of their impact on organism (%). A – Kinds of traumas: 1 – light traumas; 2 – moderate traumas; 3 – heavy traumas.

Our results also prove the data of the researches [15, 21 22]: traumas resulting from physical exercises' practicing are rather frequent; their after effects prevent from physical perfection of person. When determining the frequency and localization of traumas it was found that dislocations, strains, deformations and traumas of joints' and muscles ligaments prevail.

Generalization of our research's results proved [1] existence of clear dependence between physical exercises and sport traumas. We supplemented the following: the first year students-volleyball players will have more traumas and sport injures; with years of students' study the quantity of traumas reduces. It is worth to study prophylaxis of traumatism among students-volleyball

players in future researches.

Conclusions

In our work we proved hypothesis that first year students-volleyball players have more traumas and sport injures and with years of study the traumas' quantity reduces.

The main reasons of traumatism are: violation of sport training principles; level of organizational and logistic support of training process.

Conflict of interests

The author declares that there is no conflict of interests.

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Pedagogic control of schoolchildren fitness in skiing training with the help of posturography methods

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Abstract

Purpose: Pedagogic control of schoolchildren's fitness in skiing training with the help of posturography bio-mechanical methods is regarded. To show effectiveness of posturography methods for determination schoolchildren's fitness in skiing training.

Material: in the research schoolchildren participated (n=90, age 16 years). For determination schoolchildren's fitness we used the following tests: stance on left (right) foot, test for balance.

Results: by results of first bio-mechanical researches we determined: formed models of technique's bio-mechanical structure in skiing; registered schoolchildren's fitness; worked out methodic of schoolchildren's motor skill formation in skiing. This methodic is based on application of bio-mechanical indicators, psychological components of motor actions' control. We also found quantitative indicators of speed acceleration, pushing efforts and sliding. It permits for schoolchildren to show better result at finish.

Conclusions: for current determination of schoolchildren's fitness it is recommended to use bio-mechanical methods of posturography.

Keywords: bio-mechanical, posturography, ski training, schoolchildren, pedagogic, control.

Introduction

In Ukraine, physical education of children and youth is one of important links of preparation for integration in society [3, 4, 20, 29]). It is directed at improvement their physical and psychic health, perfection of readiness for active life, creative professional functioning [10, 12, 22, 23]. In school physical education formation of motor technique is of great importance [8; 9, 18, 30].

By importance for health, physical condition and physical fitness of schoolchildren one of leading places is engaged by ski training [7, 13]. In the process of ski training schoolchildren receive knowledge of skiing technique. They receive information about skiing hygiene, familiarize with accessories and its maintaining; they pass control tests [5]. Of not less importance is children's training to vitally significant motor skills. In such training application of posturography methods have its advantages [1, 2, 32]. Basing on individual bio-mechanical models it is possible to correct schoolchildren's and elite sportsmen's technique [6, 15].

Application of posturography methods permits to solve the following sport-pedagogic tasks:

– Test static-dynamic stability of sportsman's body or system of bodies; assess quantitatively and qualitatively; supplement knowledge about exercises' sport technique [11, 32];

– provide quality control of exercises' training, connected with complex motor skill of body balance [21, 28, 31, 34];

– determine the level and dynamic of motor skills' formation [17, 19, 24, 26].

Great importance is acquired by methods of schoolchildren's pedagogic control [25, 27, 33, 35]. Posturography methods were used for determination of additional qualities and skills of students in light athletics [16], choreography [14], swimming [2], volleyball

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[17], outdoors games [1]. Posturography methods were also used in research of different age biathlon girls' movements in out of school establishments [15]. But we have not found study of schoolchildren's movements in skiing with the help of posturography methods.

The purpose of the research is to show effectiveness of posturography methods for determination schoolchildren's fitness in skiing training.

The tasks of the research:

1. Analysis of literature sources devoted to this topic.

2. Working out of methodic of schoolchildren's motor skills' formation in skiing with the help of bio-mechanical control methods.

3. To show effectiveness of posturography methods for determination schoolchildren's fitness in skiing training.

Material and methods

Participants: in the research schoolchildren of 16 years age participated (n=90). Schoolchildren with higher results formed model group (MG, n=30). Schoolchildren with worse results formed general group (GG, n=60). GG was divided into two groups (30 persons in each): control group, which was trained by traditional methodic; experimental group (EG), which was trained by the author's methodic.

Organization of the research: the work was fulfilling during 2012-2014:

– In bio-mechanical laboratory of Chernigov National Pedagogical University, named after T.G. Shevchenko,

– In two out-of-school establishments (Chernigov specialized children-junior Olympic reserve skiing school and Chernigov regional children-junior sport school for children-orphans "Olymp"),

– In Chernigov municipal comprehensive school of 1st-3rd grade № 3,

– In Chernigov municipal information-technological

- lyceum № 16,
- Khalyavinska comprehensive school of 1st-3rd grade (Chernigov district).

For determination of schoolchildren’s skills condition in skiing training we conducted stating experiment with 3 methods of posturography: “Stance on left foot”, “Stance on right foot”, tests for stability. Parents gave consent for their children’s participation in the research.

Statistical analysis was fulfilled with the help of Excel program.

Results

By results of correlation analysis we constructed models of oscillations of general mass center (GMC) of schoolchildren’s bio-mechanical structure (see Fig.1).

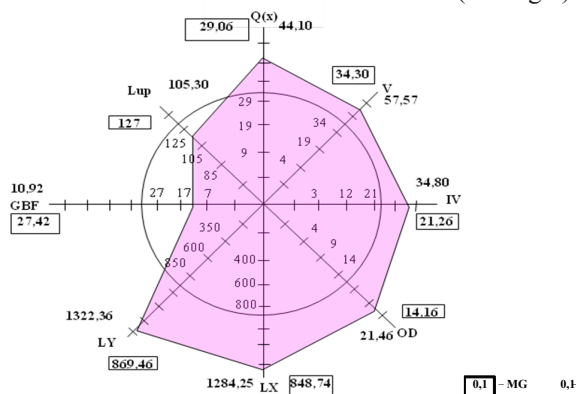


Fig. 1. Graph-analytic model of bio-mechanical structure of test “For stability”: MG – model group; GG – general group; Q(x) – dispersion by frontal axis, mm; V – velocity of general mass center (GMC) traveling, mm/sec; IV – mean-amplitude value of velocity, mm/sec; AM – assessment of movement; LX – length of GMC trajectory by frontal axis, mm; LY – length of GMC trajectory by sagittal axis, mm; QBF – quality of balance function, %;

Lup – forward deviation, mm.

In test “For stability” we see the difference by results of GG and MG indicators: GG – dispersion by frontal axis is 44.10±2.14 mm; MG – 29.06±1.46 mm. Increase of Q(x) indicators means reduction of schoolchildren’s stability in corresponding plane. Mean velocity of general mass center (GMC) traveling, is the following: GG – V=57.57±5.21 mm/sec; MG - V=34.30±2.89 mm/sec. This indicator determines mean-amplitude value of GMC traveling velocity during testing. High velocity illustrates active processes of keeping vertical posture, connected with disorder of one or several organism’s systems (for example vestibular function). The highest velocity means timely compensation of appearing body deviations-normal work of systems, sustaining vertical posture.

Mean-amplitude value of velocity, (IV) was: GG – 34.80±2.97; MG – 21.26±1.69.

Assessment of movement (AM) was: GG – 21.46±1.10; MG – 14.16±0.96.

Next indicator is relation of static-kinesiograms to average dispersion, related to the time of research. Its increase says about stability worsening and decrease – about improvement. The length of GMC trajectory by frontal axis (LX) was: GG – 1284.25±93.28 mm; MG – 848.74±65.23 mm.

The length of GMC trajectory by sagittal axis (LY) was: GG – 1322.36±95.61 mm; MG – 869.46±66.22 mm.

The quality of balance function (QBF) was: GG – 10.92±0.85%; MG – 27.42±2.11%.

Forward deviation was: GG – 105.30±6.63 mm; MG – 127.00±4.45 mm.

QBF indicator assesses minimal velocity of movement center (MC). The higher QBF is the better schoolchild’s body stability in both planes; the better schoolchild keeps balance.

The author’s methodic is built on objective bio-

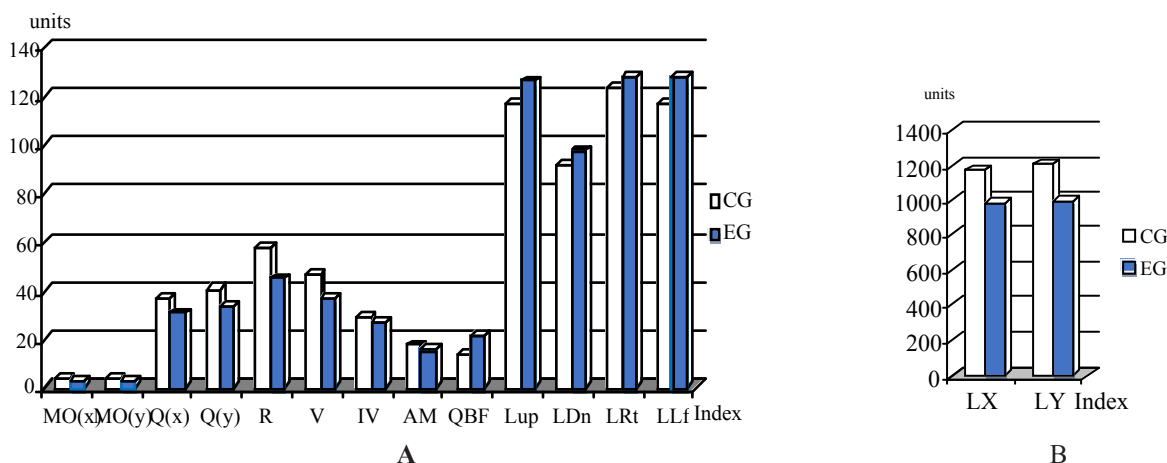


Fig.2. Bio-mechanical indicators of schoolchildren’s static-dynamic stability (groups CG and EG) by results of test “For stability”: Units – conventional units; Index – indicators; MO(x) – mean traveling by frontal axis, mm; MO(y) – mean traveling by sagittal axis, mm; Q(x) – dispersion by frontal axis, mm; Q(y) – dispersion by sagittal axis, mm; R – average dispersion, mm; V – velocity of general mass center (GMC) traveling, mm/sec; IV – mean amplitude velocity value, mm/sec; AM – assessment of movement; QBF – quality of balance function, %; Lup – forward deviation, mm; LDn – backward deviation, mm; LRT – right deviation, mm; LLf – left deviation, mm; LX – length of GMC trajectory by frontal axis, mm; LY – length of GMC trajectory by sagittal axis, mm.

Table 1. Methodic of 16 years age schoolchildren’s motor skills formation in skiing training (fragment)

Task	Training method	Content of training	Dozing	Control indicators	
1	2	3	4	5	6
	<i>Training 1</i>			Q(x) mm	3.37±0.18
	Control of static-dynamic stability indicators in schoolchildren			V mm	30.02±1.49
				R mm	4.19±0.21
1. To form the feeling of skis cohesion with snow	In gym: (preparatory part)	1.Theory.	5 minutes		
	Explanations	2. Warming up. General (GE).	3 minutes	60 m run,	10.20±0.67
	Demonstrations	3. Special power exercises (SPE) on simulator “Belts with rings”.	3 minutes	sec.	8.2±0.74
2. To master coordination of arms, torso, legs movements; balance	Practical	4. Exercises for mastering forms of arms, torso and legs movements (imitation of skiing).	1 minute.	Shuttle run 4x9 m,	9.20±1.05
	On snow (main part)				
3. To master movements of legs, arms and torso in ski stepping and sliding	Explanations	Jumping on skis on the spot:		3 km run,	
	Demonstrations	1. Alternating legs with the help and without ski sticks with GMC transfer.	30 seconds for every exercise	minutes	
	Practical	2. On both skis with and without help of sticks, with turning skis to the right and to the left.			
4. Mastering of motor skills: endurance, flexibility, dexterity, quickness and strength.	Leading up exercises:	3. On one right or left ski with and without sticks with turning skis to the left or to the right.		Skiing by skate style,	14.20±1.11
	Demonstration	Demonstration of ski stepping with and without sticks	Training circle – 200 meters	5 km, minutes.	9.10±0.66
5. Home task: imitate skiing, motion on skis by classic alternate steps with and without sticks; power exercises.	Uniform	1. Slow ski stepping and sliding with and without sticks	One circle for every exercise individually.	Skiing by classic style,	22.8±1.33
	Uniform	2. Slow sliding on one ski with and without sticks.	60 minutes.	3 km, minutes.	
	In gym (finalizing part)	3. Skiing with alternative classic style with sticks and without them.		Chin ups, quantity of times.	2.70±0.21
	Circular Encouragement	1. Chin ups, rising of legs, pressing ups on simulator “Parallel bars-horizontal bar”.	3 times with 100% efforts	Long jump from the spot, m.	
		2. Squatting on one leg	3 times for every leg with 100% efforts		
		3. Special power exercises (SPE) on simulator “Belts with rings”.	5 minutes.		

mechanical analysis and modeling. The methodic has exact tasks with preparatory and special power exercises, required trainings methods, load dozing, biomechanical control indicators in the basis (see table 1).

In one year after the author’s methodic application we determined effectiveness of the offered methodic, resulted from formation experiment by the same 3 methods of posturography (see Fig.2).

It was proved that in EG, comparing with CG schoolchildren there were confident changes and results improved in tests “Stance on left foot” – by 20.54 %; “Stance on right foot – by 18.18 %. It proves effectiveness of posturography methods in determination of schoolchildren’s skills in ski training.

Discussion

Analysis of scientific-methodic literature and

own practical experience shows that the problem of development and implementation bio-mechanical control methods in pedagogic process (meaning control over schoolchildren’s skills formation at ski training) has been still insufficiently studied.

Students’ motor fitness was determined with the help of biomechanical control methods in light athletics, choreography, swimming, volleyball, outdoors games [1, 2, 14, 17]. In biathlon motor fitness of schoolgirls was determined [15]. In all cases the methods of bio-mechanical control were applied. All results proved effectiveness of bio-mechanical methods.

On the base of the received by us data we constructed bio-dynamic parameters’ models of schoolchildren’s supporting reactions in skiing. Besides, we found difference between control, experimental and model groups.

The author's methodic of schoolchildren skills' formation in ski training process is an integrated system of motor skills formation. It is based on application of bio-mechanical indicators and psychological components of motor control. Earlier we conducted theoretical studies with the help of posturography tests [5, 6, 15], in the base of which calculated data were. In the present work we received actual characteristics of posturography parameters, which were used in ski training. Such approach to formation of motor skills significantly increases skiing technique. The methodic considers psycho-emotional state of schoolchild. Pedagogue helps schoolchild to choose optimal skiing speed, considering quantitative indicators of acceleration, pushes and sliding. It permits for the schoolchild to achieve higher results at finish.

Conclusions

For the first time methodic of schoolchildren's skiing

motor skills has been worked out and implemented in practice.

Effectiveness of posturography methods in determination of schoolchildren's fitness in ski training has been proved.

For determination of fitness level it is necessary to select bio-mechanical control methods, according to age.

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Conflict of interests

The author declares that there is no conflict of interests.

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Correction of elderly age people's psycho-physiological condition by recreation motor activity

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Abstract

Purpose: to work out program of elderly age people's psycho-physiological condition correction by recreation-motor activity and test its effectiveness.

Material: psycho-physiological condition and life quality of 50-65 years' age 155 teachers were analyzed with the help of two questionnaires. 50 teachers with low level of recreation activity were selected and divided into control and experimental group (25 persons in each).

Results: main problems in organization of physical recreation have been determined. It became a base for working out and substantiation measures for intensification recreation activity of elderly age teachers. The basic principles of the worked out program are as follows: all year round physical exercises in natural geographic-climatic conditions; teachers' distribution by groups of recreation activity and level of motor activity.

Conclusions: we have proved effectiveness of the offered measures, in respect of elderly age teachers' sleep and psycho-physiological state improvement.

Keywords: teacher, psycho-physiological state, sleep, recreation activity, elderly age.

Introduction

Demographic researches' data [3, 5, 9] witness about constant increase of working elderly people in general structure of population. As on to day it is rather complex sociological and medical-psychological problem. That is why there appears a demand in comprehensive study of ageing processes [1, 12, 13, 22] and physical recreation means [8, 11, 19], permitting to sustain proper level of psycho-physiological condition (PPC). Intensification of recreation activity (RA) is the base of such level.

In some works [1, 2, 3, 16, 21] it is proved that in higher educational establishments there is deficit of RA. Especially it concerns elderly age teachers (EAT). Such situation formed as a result of low competence and motivation, i.e.: absence of creeds about need in supporting own PPC at high level; ignoring the most effective health related recreation means [4, 7, 14].

The existing approaches to health related measures' realization at higher educational establishments (HEE) are rather ineffective [5, 7]. As a result it weakens interest to physical culture and makes impossible prioritizing of recreation motor activity [11, 14, 19].

The works by H.W. Robert et al. [23] proved that most people in 50-65 years age have certain syndromes of chronic fatigue with expressed signs of sleep disorders. In system of recreation measures sleep is considered as basic rest [14, 20, 22]. Without proper sleep recreation motor measures can result in adaptation mechanisms' failure and symptoms of diseases [17, 18, 19].

Theoretical study of the mentioned problem proves that in to-day's conditions physical recreation is based on well grounded, legal support. It is oriented on solution of the following tasks: organization of leisure; recreation of psycho-physical workability; compensation of motor

deficit, conditioned by professional specifics; preservation of organism's functional reserves (as the base of somatic health); satisfaction of demand in health related way of life [7, 15].

Recent years there have been appeared a lot of scientific works [1, 2, 13, 15, 16], devoted to PPC strengthening by means of physical culture. However, influence of RA on psycho-physiological condition of persons, engaged in teaching at HEEs has not been elucidated sufficiently in scientific literature. So it requires further studies.

Hypothesis: it is assumed that recreation of motor activity influences positively on quality of basic rest (sleep) and psycho-physiological state of elderly teachers, having low recreation activity level.

The purpose of the work is to work out program of elderly age people's psycho-physiological condition correction by recreation-motor activity and test its effectiveness.

Material and methods

Participants: the study was conducted in HEE (Ivano-Frankovsk) in the period from 2012 to 2015. In the research 155 persons participated (women n=71; men n=84; age 50-65years). From them we selected 50 teachers with low RA. They were divided into control (CG, n=25) and experimental (EG, n=25) groups.

Organization of the research: in the research we used test-questionnaire for assessment of self-feeling, activity and mood by G.L. Apanasenko's methodic [6]. We analyzed somatic health level also by methodic of G.L. Apanasenko [10]. Besides, questionnaires for determination of sleep subjective character was used (questionnaires "If you have insomnia" and "Healthy sleep"). For objective assessment we used EEG "Tredex" (Ukraine). Spectral analysis of heart rhythm variability (CardioLab+) was fulfilled. Besides, we determined

quantitative and qualitative characteristics of motor activity by Framingham methodic.

For assessment of teachers' readiness for RA intensification we worked out diagnostic methodic for finding different components by the following formula:

$$PC_{(RA)} = CC + EMC + WC + BC,$$

where $PC_{(RKA)}$ – personal competence concerning RA; CC – cognitive component; EMC – emotional-motivation component; WC – will component; BC – behavioral component.

Each indicator was assessed by criteria of presence and expression by scale: from 1 to 3 points – low level; 4-6 points – average level; 7-9 points – high RA level.

In CG recreational measures were realized in free time as non-organized leisure as per own potentials and wishes.

In EG measures on RA intensification were realized as per worked out program. The program realization required one calendar year, divided in four stages: preparatory-adaptive, training, supporting and finalizing.

Preparatory-adaptive stage took 6 weeks and was realized at threshold of physical loads' intensity. The main tasks implied the following: formation teachers' personal competence in RA intensification; adaptation of heart-vascular and respiratory systems to physical loads; reduction of psychological tension and creation optimistic attitude and belief in own potentials; organism's hardening.

The second (training) stage took five months. It corresponded to physical loads of average intensity. The tasks of this stage were: strengthening of organism's physiological systems functioning; improvement of psycho-emotional state; improvement of organism's adaptation potentials.

The third, supporting, stage took five months. The trainings ere conducted with moderate intensity. The main tasks of this stage were: further expansion of recreation-motor activity and preservation of the achieved physical and mental workability level; strengthening of general endurance; correction of psycho-emotional state; improvement of sleep quality.

The forth finalizing stage took 2 weeks. This stage measures were realized in sport-health recreational camp in conditions of middle altitude. The main tasks of this stage were: preservation of the achieved level of recreation motor activity and sleep quality improvement. For improvement of night sleep quality characteristics in finalizing stage the teachers were offered to take oxygen cocktail with different phyto-fillers (day norm – 2 portions; one of them shall be taken 20-30 minute before sleep; other - by wish, during day).

Load control by indicators of maximal, peak and threshold heart beats rate (HBR) was realized with the following formulas:

$$\begin{aligned} HBR_{max} &= 220 - \text{age (in years)}; \\ HBR \text{ bottom limit} &= 220 - \text{age} \times 0.6; \\ HBR \text{ top limit} &= 220 - \text{age} \times 0.75. \end{aligned}$$

The program stipulates:

- Morning exercises (correcting, different kinds of general gymnastic exercises; in motion, with objects, in pairs, in circle, on stimulators, jumps, walk, run, breathing exercises). Morning exercises are fulfilled independently, during 10-15 minutes;
- Hardening (cold shower, rubbing, walk barefoot, sun and air baths). The procedures are fulfilled independently, during 15-25 minutes;
- Outdoor games for motor abilities (with elements of run, jumps, throws; overcoming resistance, coordination, attention, memory and moral-will qualities). They shall be fulfilled independently or under supervision of specialists during 1-2 hours;
- Health related, recreation swimming shall be fulfilled independently or under supervision of specialist: 1-2 times a week, during 15-20 minutes;
- Health-run (jogging with compulsory shin muscles' warming; duration – 30-45 minutes. To be fulfilled independently or under supervision of specialist;
- Training in sport circles (adapted for age – mini football, volleyball, basketball, ping-pong, badminton). To be fulfilled independently or under supervision of specialist, duration 45-90 minutes;
- Hiking, excursions and walks (independent or under supervision of specialists with different outdoor games in he nature) shall take from 1 to 3 hours, during 1-2 days;
- Dancing exercises: shall be fulfilled independently or under supervision of specialist 1-3 time a week and take 45-60 minutes. Load intensity shall be 90-110 bpm, depending on kind of training.

Effectiveness of the offered program was tested by repeated assessment of EG and CG teachers' recreation activity and psycho-physiological state.

Statistical analysis implied data processing with the help of parametric and non-parametric methods of statistic.

Results

The fulfilled study showed that with age portion of teachers, who are not satisfied with own psycho-physiological state, increases ($r_s = -0.38$; $p < 0.05$). Life quality is negatively influenced by the following factors: watching TV for long time ($r_s = 0.38$; $p < 0.05$); low readiness for recreation motor activity ($r_s = 0.42$; $p < 0.05$); chronic diseases ($\chi^2 = 25.5$; $p < 0.01$); hobby, requiring immobile means of realization ($r_s = 0.44$; $p < 0.05$); loneliness and domestic conditions ($\chi^2 = 29.4$; $p < 0.01$). Among the most negative factors of life quality the following should be noted: low motor activity – 37.6±6.24%; irrational eating – 29.8±3.12%; taking alcohol – 50.4±4.36% and tobacco smoking – 19.5±1.83%.

It was found that most (84.8±2.55%) of teachers want to receive recreational services in the form of group and individual trainings under supervision of instructor or with the help of trade union functionaries or sport clubs. It points at demand in application of scientifically substantiated, accessible physical recreation system for

teachers through the mentioned public organizations.

It was found that 63.2% of teachers do not practice physical recreation at all, 22.7% practice it from time to time. Own RA level is assessed as “low” nearly by two third of the questioned (74.8%).

Analysis of teachers’ readiness for RA intensification showed its low level (48.4%). In 52.3% of teachers it closely correlates with low PPC level. It demands application of health related recreation measures.

Assessment of stating experiment results shows that 57.4% of respondents had low and below average levels of personal competence in RA. It was found that no teacher had high RA competence. Nearly 90.0% of day time they are in static position. Only 2.9% teachers had high motor activity level. Such situation is a result of the following: low readiness for RA ($r=0.87$); excessive body weight (in 78.9% of men and in 89.3% of women). It is witnessed by indicators of body weight (higher than 30.0).

We also found great quantity of persons (95.8%) with sleep disorders of different character and expressiveness. As Ye.N. Prystupa points [14] sleep ensures basic rest and facilitates adaptation to psycho-emotional stresses at low cost. Sleep plays important role in mechanisms of psychological defense in professional functioning [18].

The main EEG signs of sleep disorders are the following: periodic delay of background activity and main rhythm; simple partial attacks with motor symptoms; quick delta oscillations with high amplitude like outburst of slow activity in frontal lobe. The found electric neuro-graphic changes can serve as objective base for assessment of recreational programs’ effectiveness for elderly people.

The conducted complex research of PPC and physical recreation’s organization among teachers permitted to determine the main problems and work out programs of RA optimization and PPC correction by physical recreation means.

This program contains new and improved functional-structural elements.

In the offered program *the objects of control* is the process of physical recreation and *the subject of control* – psycho-physiological state of 50-65 years’ persons. *Block of informational provisioning* ensured formation of teachers’ with low RA register, who require physical recreation.

The main tasks of the offered program implementation is improvement of recreation servicing of HEE teachers staff (integration and coordination of work between higher educational establishments’ administration, their trade unions and sport clubs as well as centers of population’s social support; improvement of physical recreation measures; study of low RA reasons; finding of persons, requiring physical recreation).

By results of formation experiment, in EG we registered confidently ($p<0.05$) higher RA and all its components. With it, high RA level was achieved by 73.3% persons, average – by 26.7%. In no teacher we found low level.

Teachers’ participation in program of RA correction resulted in confident ($p<0.05$) improvement of personal

attitude to PPC, which corresponded to high level in $54.0\pm 5.12\%$ of teachers. By $65.2\pm 7.44\%$ indicator of ability to plan personal RA increased. At the same time, quantity of persons with high and average day motor activity raised (accordingly by 5.0% and 13.1%). It positively influenced on index of day physical activity (37.5 points, $p<0.05$).

Correlation analysis permitted to determine direct dependence between RA and somatic health (SH). High SH level was found in 9.1% of men and in 4.3% of women in EG. Besides, confidently higher was portion of persons with average and above average levels (accordingly in 23.1% and 12.9% cases, $p<0.05$). RA level increased by 53.4%; integral coefficient of physical recreation effectiveness raised up to 59.7%; teachers’ knowledge about use of physical exercises in the nature increased 2.8 times ($p<0.05$). It should be noted that before pedagogic experiment teachers had average level of different components of readiness for recreation-motor activity (see table 1).

Table 1. Integral assessment of 55-60 age teachers’ psycho-physiological condition before and after application of health related recreation program (n=50, points)

Indicators	CG	EG
Emotional readiness	3.9±0.24	4.5±0.25*
Psycho-motor readiness	3.7±0.12	4.8±0.14*
Regulatory readiness	3.7±0.35	4.4±0.26*

Note:* – $p<0.05$ comparing with CG.

Implementation of health-related recreational program resulted in confident ($p<0.05$) increase of psycho-motor readiness indicators – by 26.3%, emotional – by 18.4% and regulatory – by 18.9% (see table 1). In the course of pedagogic experiment PPC increased in 42.1% of men and 45.2% of women. Body weight index dropped by 34.2% in men and by 28.9% in women. Stress resistance increased (accordingly by 54.6% and 49.8%). Questionnaire “Healthy sleep” and EEG indicators showed normalization of sleep.

It is illustrated by renewal of main waves’ amplitude-frequency characteristics (in $45.2\pm 2.44\%$ cases) and sleep stabilization (in $64.1\pm 2.19\%$ cases).

Discussion

We can state that the problem of psycho-physiological condition correction by physical recreation means has been remaining unstudied and requires further theoretical studying, scientific analysis and appropriate organizational methodic provisioning [3, 5, 6]. Results of our research are proved by the data of other authors [7, 8, 12, 16, 19]. With it, high interest of teachers to physical recreation is observed [13, 15]. Alongside with it, accessible means of its realization have relatively low effectiveness [12, 20] and day regime organization is irrational. It conditions psycho-physiological condition’s worsening [9].

Our results are in agreement with the data of many authors [1, 2, 3] and point that most of teachers in 50-65 age have different symptoms of chronic fatigue with sleep disorders. Researches [9, 10] proved that in system of recreation measures sleep is regarded as basic rest. Without full-fledged sleep recreation measures can result in adaptation mechanisms' failure and weakening of organism's psycho-physiological reserves [12].

For the first time, we worked out and realized correction system for personal competence and readiness for RA intensification. It included purpose, tasks and the following sub-systems: components of physical recreation personal competence; program and stages of its realization; methods and methodic techniques; principles, criteria and results of assessment.

The worked out structural-logic model of program permitted to test assessment and its criteria for different levels of teachers' readiness for recreation activity's intensification. The model permitted to experimentally check the program effectiveness. Such program is directed at formation of personality's competences in respect of recreation-motor activity and sleep correction as a component of psycho-physiological condition of elderly age teachers. Implementation of such program significantly increases recreation activity; improves teachers' attitude to own psycho-physiological condition. The program permits to plan own functioning in intensification of recreation activity, facilitates somatic health improvement.

Conclusions

1. It was found that teachers' life quality is influenced

by the following factors: age; motor activity; stress situations, connected with professional activity; recreation-motor activity in leisure time; chronic diseases. Social factors, influencing negatively on life quality, are: loneliness; absence of regular health related recreation measures; psycho-emotional overloads, conditioned by professional activity.

2. Positive changes took place in somatic health (in particular, quantity of teachers with average and above average somatic health level) and motor activity: quantity of persons with average and above average levels increased 2.1 times; confidently increased indicators of day physical activity index. Besides, indicators of body weight index reduced in 30.2% teachers.

3. Activation of physical recreation permitted to improve psycho-physiological condition in 42.1% men and 45.2% women. It is subjectively proved by the data of repeated questioning by complex of questions "Healthy sleep". This fact is registered objectively by the following: improvement of recreation coefficient (by the data of electro-cardio-intervalography); positive changes in main waves' amplitude-frequency characteristics (in 45.2% cases); sleep stabilization in 64.1% persons (by EEG data).

Further researches can be directed at improvement physical education system in conditions of industrial collectives for recreation activity's improvement.

Conflict of interests

The author declares that there is no conflict of interests.

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Peculiar aspects of qualified wrestlers' special workability and supreme nervous system functioning at special training stage of preparatory period

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Abstract

Purpose: to determine peculiar aspects of qualified wrestlers' special workability and supreme nervous system functioning in special training stage of preparatory period.

Material: 18 qualified wrestlers if 17-20 yrs age were tested. We used testing of special workability and psycho-physiological testing.

Results: it was found that sportsmen's special workability was at rather high level. Though, recreation coefficient witnesses about some accumulation of fatigue. Besides, we registered reduction of central nervous system's functional potentials. It is proved by latent periods of simple and complex visual reactions (at low and below average levels). We found correlations between sportsmen's special endurance, level of complex visual-motor reaction and nervous processes' functional mobility. Besides, sportsmen with stronger nervous processes recreate quicker after standard loads.

Conclusions: it was found that alongside with high special workability sportsmen accumulate fatigue and have absence of recreation. It is proved by weakening of central nervous system's functional potentials. We supplemented the data about correlation between special workability and sportsmen's psycho-physiological condition. It was assumed that persistent influence on supreme nervous system will permit to sustain special workability at high level and prevent from over-training.

Keywords: fatigue, psycho-physiological indicators, special workability, recreation coefficient.

Introduction

Modern tendency of training process intensification in sport wrestling is connected with desire of international wrestling federation to raise show character of duels. For this purpose duration of competition duels and tournaments was shortened. Referee's practice was oriented on simulation wrestlers' activity together with increase of wrestling techniques' quantity [11, 26, 29].

In this connection, nowadays wrestling duel of qualified wrestlers has become a highly intensive kind of competition functioning [6, 17, 31]. By level of requirements and organism's potentials wrestling duel approaches to similar by duration kinds of cyclic sports competitions with intensive power component [18, 20, 21, 22].

Accordingly, it results in re-construction of training methodic and increase of requirements to wrestler's physical qualities [6, 16, 25, 30]. It was shown that special endurance substantially influences on duel result [2, 28]. Special attention is paid to special workability training in special-training stage of preparatory period. In this stage modeling of different competition situations with maximal physical loads is used for effective training. Such loads give the main training effect. At the same time application of such loads without proper control can result in over tension and over training [12, 13, 14, 15].

A number of scientists [3, 7, 9, 11] proved that wrestler's special workability is the main factor of influence on competition result. Though, in scientific literature there are no data about recreation processes in organism in special training stage of preparatory period,

especially after significant training loads, oriented on special workability in "advanced" micro-cycles.

Besides, it is necessary to consider conditions of duel in wrestling, situations, which change during duel. With it supreme nervous system's functioning plays very important role. It should also be noted that with possibility of over training and high special workability, psycho-physiological indicators can be the first markers of adaptation failure [8]. So, for obtaining more complete picture of wrestlers' fitness and organism's recreation special workability and psycho-physiological indicators shall be studied. A number of works is devoted to sportsmen's psycho-emotional and psycho-physiological states in different kinds of sports at different stages of training [8, 23, 24]. Though there are no data about correlation of wrestlers' special workability indicators and psycho-physiological indicators in special training stage of preparatory period. That is why we fulfilled correlation analysis between the mentioned indicators.

Hypothesis: it was assumed that in special training stage in qualified wrestlers weakening of supreme nervous system's functioning can be observed alongside with high special workability. Besides, we assumed that there are correlations between some special workability indicators and psycho-physiological indicators.

The purpose of the research is to determine peculiar aspects of qualified wrestlers' special workability and supreme nervous system functioning in special training stage of preparatory period.

Material and methods

Participants: 18 qualified wrestlers if 17-20 yrs age were tested (free style wrestling; they were candidate

masters of sports and masters of sport, among whom there were prize winners of Ukrainian championships). All participants gave written consent for participation in experiment.

Organization of the research: the research was fulfilled during “advanced” micro-cycle of special-training stage of preparatory period. Micro-cycle took 7 days and was directed at perfection of technical-tactic actions and training of sportsmen’s special workability. Sportsmen’s functional fitness was assessed by results of pedagogic tests: shuttle run 4×9 m, test for special endurance, test for recreation [4].

Psycho-physiological indicators were registered with the help of computer program “Psycho-diagnostic” [1]. Such program is designed for determination of supreme nervous system’s individual characteristics, connected with visual information of different complexity processing by methodic of N.V. Makarenko and V.S. Lyzogub [10]. The testing was conducted in two modes: optimal and feedback communication. We registered simple and complex visual-motor reactions as well as nervous processes’ functional mobility (NPFM) and nervous processes’ strength (NPS).

The research was planned so that the day before testing was free from training loads. First we fulfilled psycho-physiological diagnostic and then pedagogic testing.

Statistical analysis: statistical processing of the received results was fulfilled with the help of GraphPad Prism version 5.0 for Windows programs [19]. We determined the following: mean arithmetic (\bar{x}), standard

errors (m). For finding of correlations between indicators we fulfilled correlation analysis: calculation of Spearman’s rank correlation coefficients. Degree of correlation was determined by correlation coefficient (r). Value $p \leq 0.05$ was regarded as statistically confident [5].

Results

From the received data (see table 1) we can see that the time of shuttle run distance covering corresponds to high values; special endurance coefficient (SEC) and quantity of repetitions in this test were above average; recreation coefficient (RC) was below average values, intrinsic to this specialization [4]. It witnesses about high quickness, dexterity and special workability. Though, recreational processes were slower after testing loads.

Wrestling is a kind of sport activity, in which situations constantly change and sportsman has to response to opponent’s actions. That is why nervous system’s functioning assessment is of great importance for determination of wrestler’s fitness. For this purpose program “Psycho-diagnostic” was used [1]. As we can see in table 2 latent period of simple visual motor reaction (SVMR) is below average. Latent period of reaction to choice of one from three (RC 1-3) corresponds to low level. Latent period of reaction to choice of two from three (RC 2-3) also was at low level. The time of passing to minimal exposition, when finding functional mobility, corresponded to below average level [10]. Thus, we observed weakening of central nervous system’s functional potentials. Alongside with referent values of

Table 1. Indicators of qualified wrestlers’ pedagogic testing in special training stage of preparatory period ($\bar{x} \pm m$; n=18)

Indicator	\bar{x}	m
Shuttle run 4x9 m, sec.	8.26	0.05
Coefficient of special endurance	0.9211	0.009
Quantity of repetitions in test for special endurance	104.6	1.687
Recreation coefficient	0.8121	0.0111
Quantity of “fireman’s carry takedowns” in tests for RC	23.17	0.5378
Maximal heart beats rate (HBR) after test for recreation	170.7	2.879

Table 2. Psycho-physiological indicators of qualified wrestlers in special training stage of preparatory period ($\bar{x} \pm m$; n=18)

Description of indicator	\bar{x}	m
SVMR, time of latent period, msec.	306.1	8.604
RC 1-3 time of latent period, msec.	476.3	12.37
RC 2-3 time of latent period, msec.	538.9	10.14
NPFM (feedback) time of latent period, msec.	448.4	10.97
NPFM (feedback) minimal time of signal’s exposition, msec.	424.4	18.33
NPFM (feedback) total time of test fulfillment, sec.	99.89	1.964
NPFM (feedback) time of passing to minimal exposition, sec.	74.89	4.547
NPS (feedback) time of latent period, msec.	405.3	5.994
NPS (feedback) quantity of mistakes	134.1	2.237
NPS (feedback) minimal time of signal’s exposition, msec.	360.0	8.402
NPS (feedback) time of passing to minimal exposition, sec.	133.7	16.63

Table 3. Correlations between pedagogic testing results and wrestlers’ psycho-physiological indicators

	Description of indicators	r	p
0.50<r>0.69	SVMR (latent period) and special endurance coefficient	0.5126	0.0296
	RC 1-3 (latent period) and quantity of repetitions in test for SEC	-0.5732	0.0129
	NPFM (feedback, latent period) and quantity of repetitions in test for SEC	-0.5680	0.0139
	NPFM , the forced rhythms (% of mistakes at 5 th stage) and SEC	-0.5438	0.0197
	NPFM , the forced rhythms (% of mistakes at 3 rd stage) and shuttle run	-0.5748	0.0126
	NPFM , the forced rhythms (% of mistakes at 4 th stage) and shuttle run	-0.5622	0.0152
	NPFM , the forced rhythms (% of mistakes at 5 th stage) and shuttle run	-0.5006	0.0343
0.30<r>0.49	NPS (feedback) quantity of mistakes and recreation coefficient	0.4823	0.0427
	NPFM , the forced rhythms (% of mistakes at 2 nd stage) and shuttle run	-0.4843	0.0417

bio-chemical indicators it can be the marker of possible overtraining and adaptation failure [8, 23, 24].

The presented above indicators are only separate components, by which wrestlers’ fitness can be characterized. That is why it would be purposeful to study correlation between in order to receive more objective information (see table 3).

The presence of average correlation between latent period of simple visual motor reaction and special endurance coefficient ($r=0.51$; $p=0.0296$) illustrates that wrestlers with better simple reaction have lower special endurance.

In contrast to it we can observe feedback correlation between latent reaction of choice of one from three irritators and quantity of repetitions in test for special endurance ($r=-0.57$; $p=0.0129$). Total quantity of repetitions in SEC test also is and indicator of special endurance level. That is why we can say that wrestler’s special endurance depends on level of complex visual motor reaction.

Wrestler’s special endurance also depends on functional mobility of nervous processes that is proved by reverse correlation between NPFM latent period and quantity of repetitions in SEC test ($r=-0.57$; $p=0.0139$).

It is interesting that there is reverse correlation between time of covering shuttle run distance and percentage of mistakes in third, fourth and fifth stages of NPFM determination with forced rhythm ($r=-0.57$; $p=0.0126$; $r=-0.56$; $p=0.0152$; $r=-0.50$; $p=0.0343$ accordingly). May be it is conditioned by prevalence of excitation processes over inhibition ones in wrestlers with higher quickness. Accordingly, the quantity of mistakes, made by such wrestlers in NPFM determination (with forced rhythm) is higher.

We found direct correlation between recreation coefficient and quantity of mistakes, made in determination of nervous processes’ strength in feedback mode ($r=0.48$; $p=0.0427$). It is possible to assume that wrestlers with stronger nervous processes recreate after loads quicker. That is why optimization of recreation processes in qualified wrestlers’ organisms at the account of supreme nervous system’s functioning is logical and purposeful.

Discussion

It was found that in special training stage of preparatory

period special workability of qualified wrestlers is rather high. It coincides with results of other researches [3, 7, 9]. Though the received by us data in test for recreation after standard work witness that recreation is not complete. It can be conditioned by great scope of special work in this training stage and fatigue’s accumulation.

In wrestling, significant role in duel’s efficiency is played by high special workability and supreme nervous system’s functioning [8, 23, 24]. That is why we carried out psycho-physiological diagnostic with the help of program “Psycho-diagnostic”. When determining individual characteristics of supreme nervous system in processing visual information of different complexity we found weakening of central nervous system’s functional potentials. It is witnessed by the data of simple visual motor reaction to choice of one from three and two from three (they were at low level and below average) [10]. Such psycho-physiological indicators and high special workability can be markers of possible overtraining [8]. That is why we can state that in special training stage of preparatory period it is necessary to provide more careful observations over sportsmen’s organisms from the side of coach, medical workers and scientists. For this purpose it is necessary to apply pedagogic, psycho-physiological and bio-chemical methods.

Correlation analysis showed that wrestler’s special endurance depends on level of complex visual motor reaction and on nervous processes’ mobility. It was found that wrestlers with stronger nervous processes recreate quicker after standard loads. That is why we can assume that persistent correction of wrestler’s psycho-physiological state by training and out-of-training means in this stage will facilitate prevention from over-fatigue and overtraining and sustain high special endurance.

Conclusions:

1. It has been found that in special training stage of qualified wrestlers’ preparatory period, alongside with rather high special workability recreation coefficients witness about insufficient recreation and fatigue’s accumulation.

2. The data of psycho-physiological; testing in this training stage show weakening of central nervous system’s functional potentials that can point at possible overtraining.

3. The data about wrestlers' special workability correlation with psycho-physiological state in special training stage of preparatory period have been supplemented. Assumption that persistent influence on supreme nervous functioning of wrestlers in this training

stage permits to sustain high special workability and prevent from overtraining, has been made.

Conflict of interests

The author declares that there is no conflict of interests.

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