

**PEDAGOGICS
PSYCHOLOGY**

Medical-Biological
Problems of Physical
Training and Sports
№01/2019



Key title: Pedagogics, psychology, medical-biological problems of physical training and sports

Abbreviated key title: Pedagog. psychol. med.-biol. probl. phys. train. sports

ISSN 2308-7269 (English ed. online)

Founders: Iermakov Sergii Sidorovich (Ukraine); (doctor of pedagogical sciences, professor, Department of Physical Education, Kharkov National Pedagogical University).

Certificate to registration: KB 22063-11963P
16.05.2016.

Frequency – 6 numbers in a year.

Journal is ratified Ministry of Education

and Science of Ukraine:

pedagogical sciences, online (07.10.2016 №1222);

physical education and sport, online (13.03.2017 № 374)

Address of editorial office:

Box 11135, Kharkov-68, 61068, Ukraine,

Tel. 38 099 430 69 22

e-mail: sportart@gmail.com

<https://www.sportpedagogy.org.ua>

Journal is reflected in databases:

1) Web of Science Core Collection

[Emerging Sources Citation Index (ESCI)]

<http://ip-science.thomsonreuters.com/mjl>

DOAJ (Directory of Open Access Journals)

<http://www.doaj.org>

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Morphofunctional and motor characteristics of Baikal region's students (Russia) with overweight

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: to study the morphofunctional and motor characteristics of the organism of students with overweight and obesity. To compare these data with data of students with normal weight.

Material: it was examined students (females – n=1937; males – n=1302) of 17-21 year-olds. (Baikal region, Russia). It was performed an anthropometrical and physiometric examination of students. It was determined the content of muscle and fat mass in the component structure of a body. It was determined the motor qualities of students.

Results: the indicators of anthropometrical and physiometric characteristics, results of motor action tests, the content of muscle and fat mass in a body of students with overweight and obesity are lower in comparison with the indicators of females and males with normal body weight ($p < 0.05$). The integral criterion of physical fitness of students with overweight and obesity is lower in comparison with students with normal body weight ($p < 0.05$). It is defined the direct dependence between the decrease in the level of physical fitness and increase in body weight of males and females. It was obtained data concerning interrelation of anthropometrical and functional characteristics with motor qualities of males and females with different body weight.

Conclusions: Results of the research allow correcting physical training classes of youth. Such classes are focused on the differentiated decrease in fat mass content and increase in muscle mass in the component structure of students' bodies.

Keywords: students, anthropometrical, physiometric, motor qualities, overweight.

Introduction

According to World Health Organization (WHO) 39% of adult population of the world had overweight, and 13% had obesity in 2016 [1]. In European countries overweight had 50% of the population: among them 20% had obesity [2, 3]. There are a lot of people with overweight in a population of USA, Australia, Great Britain, China, South Korea, in the countries of Near East [4, 5]. WHO experts presuppose that the number of people in the world with obesity or overweight will double by 2025.

Overweight in youth strengths researchers to look for more effective ways to solve this problem:

- for New York students – consultations with healthcare providers [6];

- for Brazilian teenagers – control of obesity. It will allow decreasing the prevalence of hypertension in Northern region [7];

- for the youth of USA – it is the introduction of the monitoring system of risks behavior [8]. Six categories of health priority types among youth need the control: 1) behaviors that contribute to unintentional injuries and violence; 2) tobacco use; 3) alcohol and other drug use; 4) sexual behaviors related to unintended pregnancy and sexually transmitted infections (STIs), including human immunodeficiency virus (HIV) infection; 5) unhealthy dietary behaviors; and 6) physical inactivity [8];

- for Australian schoolchildren – it is the need to change habits concerning nutrition and to create healthy cultures in schools [9];

- for the youth of developing countries – the actions for obesity prevention which have to be innovative, concrete for the country and accepted from the cultural point of view [10];

- for Chinese youth – experts have to pay more attention to the prevalence of overweight and obesity in rural regions [11].

It is especially important to consider regional features in the prevention of obesity among youth. Such approach is in researches of regional features of Iran [12], Portugal [13], Sudan [14], Greece [15], Puerto Rico [16], Taiwan [17], Latin America [18], Ethiopia [19], Canada [20]; Republic of Belarus [21], Lithuania [22]. Authors confirm that the competence in the field of health care became an important part of the agenda in the field of healthcare and strengthening of health in recent years.

By results of a research (2012-2013) in 12 territorial subjects of Russian Federation, the prevalence of obesity among men was 26.9%, among women – 30.8% [23]. The annual growth of obesity cases in Russia is 0.4% in a year [2]. The overweight and obesity are widespread among students, especially after 20 year old [2]. Among students of the medical higher educational institution of Kemerovo (Russia), overweight have 10.7%, obesity have 4.8%, underweight have 9.7% [24]. In Tomsk (Russia) overweight have 18.6% of male-students [25].

Morphofunctional characteristics of the person are considered by researchers as information criteria of hormonal, growth and other metabolic processes; features of influence on the organism of climatic, ecological,

social and others factors [26, 27]. Therefore it is necessary to evaluate morphofunctional indicators of the population of different regions taking into consideration the regional anthropological features of persons.

The specialists of WHO emphasize the increase in a number of persons with overweight and obesity. It is especially widespread among city population. In this case process of urbanization is especially expressed, in comparison with rural population [1]. The Baikal region (Russia) is characterized by strongly continental climate. This region is also characterized by the adverse ecological situation connected with human impact [28]. Researchers point out regional features of body structure types of Baikal region's youth⁵. Authors determined incompleteness of body growth processes of Siberia youth (Russia) in comparison with students from the European part of Russia [29]. It is relevant the study of a regional feature of overweight and obesity prevalence among Baikal region's youth (Russia). The basis of such researches is made by motor action characteristics of students. These problems in this region haven't been studied yet.

The overweight and obesity promote the development of a serious noninfectious illness. It is diabetes of 2nd type, atherosclerosis, arterial hypertension, osteoarthritis, varicosity [30] violation of coronary and brain blood supply [31]. The risk of development of coronary heart disease in people with obesity increases in 2-3 times, strokes in 7 times [32]. People with the big body-weight index have violations of hormonal state [25]. Their working capacity [33, 34] and lifetime [35] decrease. The reason for an increase in the level of obesity is the availability of high-calorie foods against in a complex with a decrease in physical activity of population [36, 37].

The low physical activity has 39.8% of Russian population: 37.0% of men and 42.0% of women [23]. In researches of WHO [38] was emphasized the necessity to prevention and fight against obesity; normalization of population nutrition of various countries; to prevention addictions. The important role of people's physical activity is defined: increase in volumes and quality of physical training programs in educational institutions of different types [39, 40]; attraction to active sports activities and health-promoting activities [41, 42]; pedagogical control for physical loads [43, 44]. Training with students by a traditional technique (2-3 times a week) doesn't give the positive result concerning the decrease in body weight [40]. Therefore it is necessary to introduce the corrective classes in non-school hours [45].

The considerable decrease in overweight is promoted by application of health-promoting activities [46, 47, 48], physical exercises in a complex with a balanced diet and day regimen [49, 50]; corporal focused and dancing psychocorrection [51]; consideration of women's body features [52]; control of psychophysiological functions [53]. Other researches support the need of carrying out the fundamental and applied scientific researches in the field of primary population prevention of noninfectious diseases and formation of to a healthy lifestyle requirement [23] in population.

Hypothesis. The data concerning the interrelation of morphofunctional indicators with motor qualities of students with overweight and obesity will allow adding individual specific orientation of means and methods of carrying out physical training classes for university students.

Purpose: the comparative analysis of morphofunctional features and motor action characteristics of an organism of Baikal region's students (Russia) with overweight and obesity.

Materials and Methods

Participants

The university students (Irkutsk, Russia) were examined: females (n=1937), males (n=1302), 17-21 year-olds. All students belonged to the main medical group (have no deviations of health condition). The performed work doesn't violate the right and doesn't endanger the wellbeing of students in compliance with Ethical Principles for Medical Research Involving Human Subjects [54].

Design of a research.

It is carried out the anthropometrical and physiometric examination of females and males with an application of standard techniques [55]. It is calculated weight-for-height Quetelet index II ($BMI = \text{body mass/body height}^2$, kg/m^2) [56]. According to WHO classification (1991) [57] students are devoted into 4 groups: group "N" with normal body weight (BMI is in the range of 18.5-24.99 kg/m^2); group "OV" with overweight (BMI=25-30 kg/m^2); group "OB" with obesity (BMI>30 kg/m^2); group "U" with underweight (BMI<18.5 kg/m^2). It was measured for the characteristic of morphofunctional indicators:

- body height, cm;
- body weight, kg;
- chest circumference (CC), cm;
- circumference of body parts, cm;
- skinfold thickness (caliperometry), mm;
- heart rate (HR) before load, b/10 s;
- HR after 20 squats in 30 s, b/10 s;
- HR recovery time after 20 squats, min;
- systolic arterial blood pressure (ABPs), mmHg;
- diastolic arterial blood pressure (ABPd), mmHg;
- vital capacity lung (VCL), l;
- hand-held dynamometry, kg.

It was calculated: Rob_{index} [58] index ($\text{Rob}_{\text{index}} = \text{HRxABPs} \cdot 100$. c.u.); vital index ($\text{VI} = \text{VCL}/\text{body weight}$ [59], ml/kg); strong index ($\text{SI} = \text{muscle strength of hand}/\text{body weight} \times 100\%$) [60]. It was defined the average value of absolute and percentage content in students' bodies of fat and muscular tissue according to the formulas [61]. It was applied the control tests included in the European and American tests of physical fitness [62, 63] to evaluate the physical fitness of students (high-speed qualities, endurance, strength, flexibility, dexterity). For females: 20 m run (s); 10x5 m shuttle run (s); 5 min run (min); hang (s); sit-ups (quantity of times); trunk bending (cm); long jump from the spot (cm). For males: 100 m run (s); 1000 m run (min); 10x5 m shuttle run (s); hang (quantity of

times); sit-ups (quantity of times); inclinations of a trunk (cm); long jump from the spot (cm). Results of control tests were expressed in metric units.

Statistical analysis

It was applied Statistica 7.0 programs (Stat Soft inc., USA). It was determined the arithmetic average mean of indicators (M), a standard deviation (SD). The significance of distinctions of average means of independent samples was estimated by parametrical methods by means of Student t-test. The differences between means of indicators are considered statistically significant at the level $p < 0.05$.

Results

Distribution of all students according to the indicator mean of BMI is presented in fig. 1, 2. Students of group “U” with underweight didn’t participate in further research.

The males have overweight in 1.7 times more often, and have obesity in 2.5 times more often than females, who have underweight in 36,1% times more often (in 1, 8 times).

The females of group “OV” and “OB” have increase in indicator mean of BMI (in 15.8%; in 29.8%) in comparison with group “N”. The majority of physiometrics are higher in students with a normal weight (tab. 1), than in females with overweight and obesity ($p < 0.05$).

The females of group “OV” and “OB” (tab. 2) had

lower indicators means of all motor tests (except test “20 m run”), than females of group “N” ($p < 0.05$). It was determined the difference in quantitative content of muscular (MM) and fat (FM) body mass in females of different groups (fig. 3).

The females of group “OV” had: the content of muscle mass in component structure of a body in 9.7% less and fat mass in 12.2% more, than females of group “N”. Females of group “OB” had: less content of muscle mass in component structure of body in 22.1% and more in 25.2% of fat mass, than females of group “N”.

The males of groups “OV” and “OB” had higher means of BMI (in 16.58%; in 30.7%) in comparison with group “N”. The majority of cardiovascular system indicators and all indexes in males of group “N” (tab. 3) were higher, than in males with overweight and obesity ($p < 0.05$).

The males of groups “OV” and “OB” had the lowest indicators in five of seven motor tests (shuttle run, 100 m run, 1000 m run, pull-ups, long jump), in comparison with males of group “N”.

According to the results of a research was determined the difference in quantitative content of muscular (MM) and fat (FM) body mass in males of different groups (fig. 4).

The males of group “OV” had the content of muscle mass in 13, 7% less and the fat mass in 17.1% more, than in males of group “N”. The males of group “OB” had

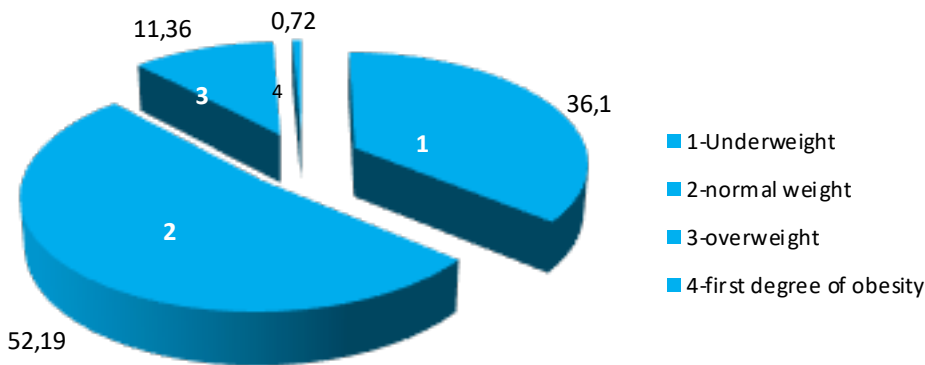


Fig. 1. Distribution of females according to BMI (in % to quantity of examined persons)

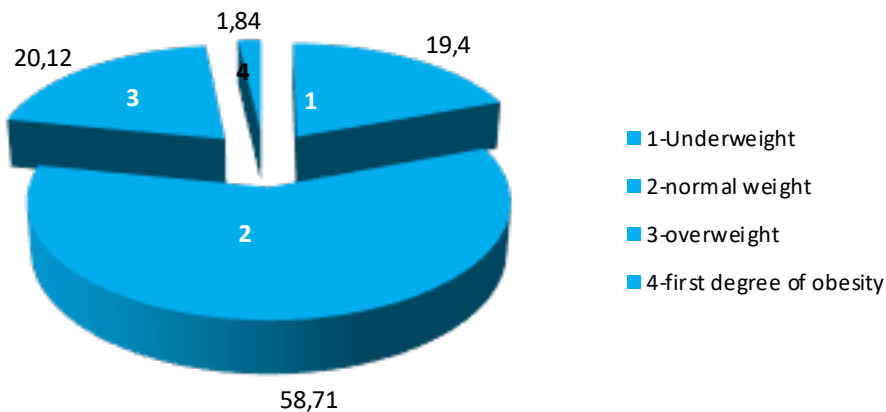


Fig. 2. Distribution of males according to BMI (in % to quantity of examined persons)

Table 1. The morphofunctional characteristics of females with different means of BMI (M±SD)

Indicators	Group «N» (n=1011)	Group «OV» (n=220)	Group «OB» (n=14)
<i>Somatometrics</i>			
Body height, cm	164.7±0.17	165.0±0.34	156.7±1.54* #
Body weight, kg	56.9±0.14	68.5±0.35*	73.4 ±1.74* #
Chest circumference, cm	87.3±0.12	90.8±0.33*	96.8±1.93* #
<i>Physiometrics</i>			
VCL, ml	2701.0±14.0	2712.0±30.0	2691.0±123.0
RHR, b/10 s	11.71±0.02	11.76±0.05	12.07±0.13* #
HR after 20 squats in 30 s, b/10 s	21.0±0.08	21.1±0.18	19.78±0.42
HR recovery time after 20 squats in 30 s, min	1.42±0.01	1.48±0.04	2.14±0.18* #
ABPs, mmHg	105.6±0.30	109.7±0.79*	116.0±1.92* #
ABPd, mmHg	69.12±0.17	69.4±0.39	70.2±0.39
Dynamometry of left hand, kg	23.1±0.17	23.2±0.41	22.7±0.86
Dynamometry of right hand, kg	24.1±0.17	23.5±0.44	23.1±1.64
<i>Indexes</i>			
Body weight index, kg/m ²	21.2±0.13	25.2±0.43*	30.2±1.88* #
Robinson index, c.u.	74.13±0.21	77.4±0.40*	84.0±0.65* #
Vital index, ml/kg	47.4±0.11	39.5±0.37*	36.6±2.14*
Strong index of left hand,%	40.5±0.09	33.8±0.27*	30.9±1.70*
Strong index of right hand,%	42.3±0.10	34.3±0.29*	31.4±1.96*

Note –* significant differences between indicators of groups: “N”, “OV” and “OB” (P<0,05); – # significant differences between indicators of groups “OV” and “OB” (P<0,05).

Table 2. the results of motor tests of females with different means of BMI (M±SD)

Tests	Group «N» (n=1011)	Group «OV» (n=220)	Group «OB» (n=14)
20 m run, s	3.98±0.05	3.94±0.09	3.93±0.34
10x5 m shuttle run, s	21.25±0.06	22.43±0.15*	23.55±0.39* #
5 min run, m	890.2±6.33	820.0±14.1*	762. 7±22.67* #
Hang, s	9.37±0.16	8.35±0.36*	5.19±1.36* #
Sit-ups, reps	23.5±0.22	21.3±0.37*	16.3±0.72* #
Trunk bending, cm	15.38±0.21	14.8±0.38	11.0±0.9* #
Long jump from the spot, cm	150.93±0.52	143.0±1.22*	131.0±4.51#
Integral criterion (points)	3.02±0.01	2.86±0.03*	2.18±0.09* #

Note –* significant differences between indicators of groups “N”, “OV” and “OB” (P<0,05); – # significant differences between indicators of groups “OV” and “OB” (P<0,05).

Table 3. The morphofunctional characteristics of males with different means of BMI (M±SD)

Indicators	Group «N» (n=765)	Group «OV» (n=262)	Group «OB» (n=24)
1	2	3	4
<i>Somatometrics</i>			
Body height, cm	177.9±0.22	177.3±0.38	174.5±2.08
Body weight, kg	67.0±0.19	79.9±0.39*	93.2±2.0* #
Chest circumference, cm	93.81±0.19	98.54±0.36*	106.2±1.9* #
<i>Physiometrics</i>			
VCL, ml	4180.0±19.3	4207.5±32.2	4200.0±130.0
RHR, b/10 s	12.04±0.03	12.19±0.05*	12.57±0.25*

1	2	3	4
HR after 20 squats in 30 s, b/10 s	19.02±0.05	19.18±0.10	19.34± 0.49
HR recovery time after 20 squats in 30 s, min	0.93±0.01	1.04±0.01*	1.89 ± 0.06* #
ABPs, mmHg	114.0±0.27	115.5±0.40	116.8±1.5
ABPd, mmHg	72.9±0.24	74.0±0.41	74.5±1.12
Dynamometry of left hand, kg	43.0±0.12	43.8±0.21	42.8±1.34
Dynamometry of right hand, kg	44.9±0.23	44.8±0.28	43.3±1.45
Indexes			
Body weight index, kg/m ²	21.2±0.06	25.4±0.18*	30.6±0.75* #
Robinson index, c.u.	82.3±0.27	84.4±0.64*	88.8±1.32* #
Vital index, ml/kg	62.3±0.18	52.6±0.32*	45.1±1.56* #
Strong index of left hand,%	64.2±0.19	54.8±0.41*	45.9±1.58* #
Strong index of right hand,%	67.8±0.20	56.1±0.44*	46.4±1.62* #

Note –* significant differences between indicators of groups: “N”, “OV” and “OB” (P<0,05); – # significant differences between indicators of groups “OV” and “OB” (P<0,05).

Table 4. The results of motor tests of males with different BMI means (M±SD)

Tests	Group «N» (n=765)	Group «OV» (n=262)	Group «OB» (n=24)
10x5 m shuttle run, s	16.04±0.04	16.34±0.08*	16.58±0.28#
100 m run, s	13.84±0.35	15.23±0.08*	16.6±0.28* #
1000 m run, min	3:51.85±0:00.8	3:56.65±0:01.5#	4:05.69±0:06.7* #
Pull-ups, reps	11.08±0.15	9.92±0.27*	7.34±0.88#
Sit-ups, reps	29.3±0.20	29.5±0.28	29.1±0.76
Forward bend, cm	16.9±0.26	17.12±0.43	15.2±1.59
Long jump, cm	238.5±0.58	232.8±1.07*	216.6±3.88* #
Integral criterion (points)	3.23±0.01	2.92±0.02*	2.71±0.07* #

Note –* significant differences between indicators of groups: “N”, “OV” and “OB” (P<0,05); – # significant differences between indicators of groups “OV” and “OB” (P<0,05).

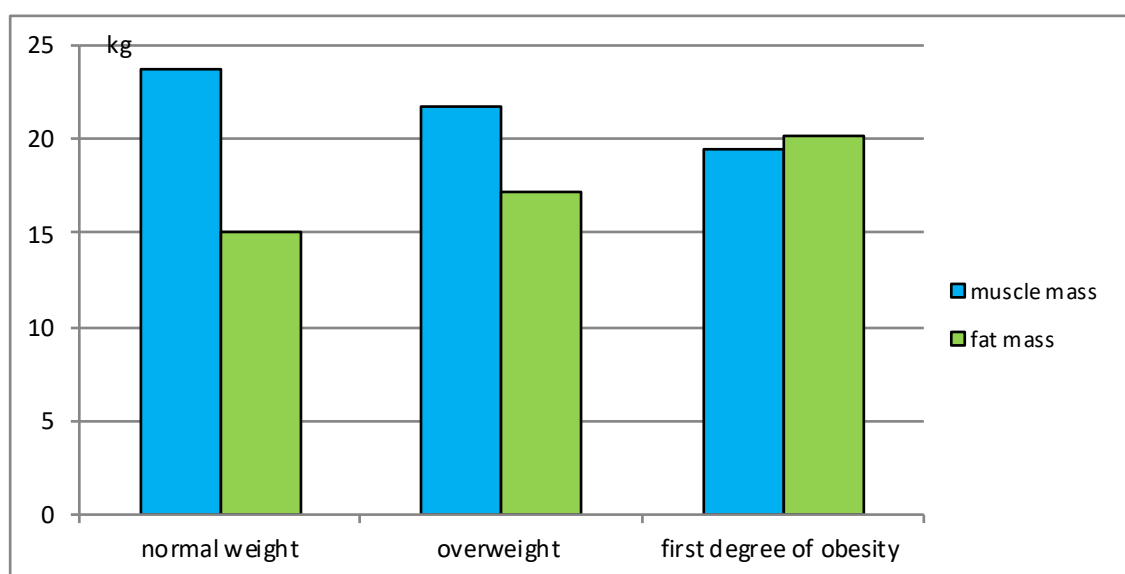


Fig. 3. Muscular and fat content of body (kg) of females with different BMI means

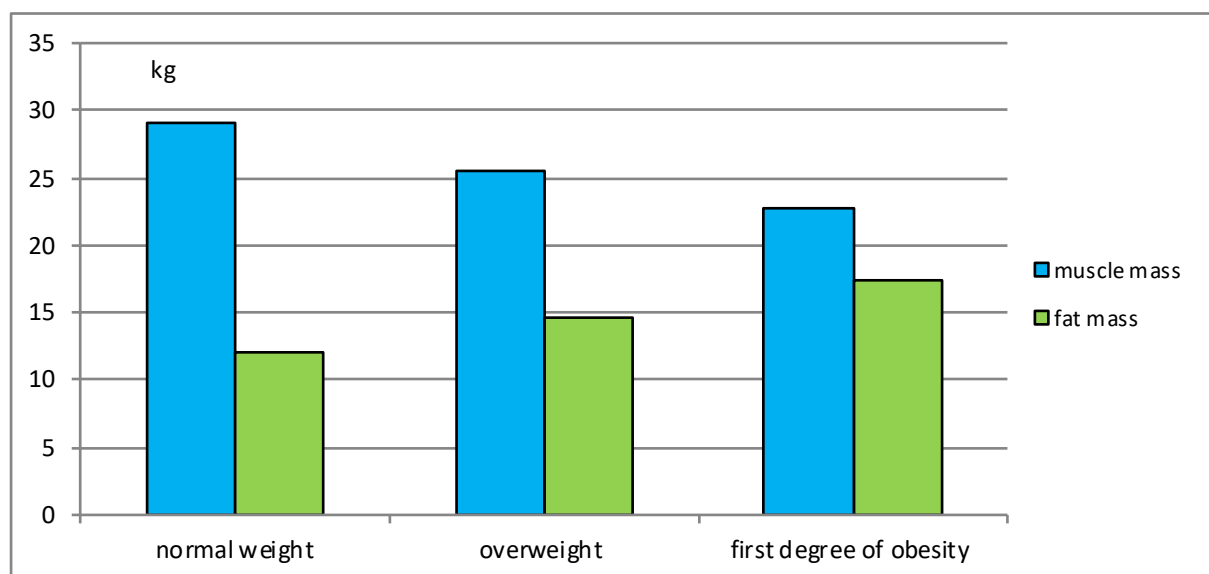


Fig. 4. Muscular and fat structure of body (kg) of males with different BMI means

the content of muscle mass in 27.6% less and fat mass in 30.4% more, than in group “N”.

Discussion

The overweight and obesity are risk factors for noninfectious diseases of human [33]. One of the reasons for such phenomenon is the inactive way of lifestyle of population [64, 65]. On a global scale, the physical activities are the fourth important factor, decreasing the risk of human death [25]. In Russian Federation, about 30% of the population suffers from overweight [51]. According to our data males from Baikal region have overweight and obesity more often than females. It will be coordinated with results of researches in other regions of Russia [66, 67]. Females are more motivated on asthenic constitution [68]. It is confirmed by the questioning of Romania students concerning the index of dissatisfaction with a constitution on The Beck Depression Inventory [69]. More than 41% of female students answered that it is possible to improve a body figure [69] by physical training and adhere healthy lifestyle. The analysis of results of the conducted research demonstrated the essential difference between anthropometrical and physiometric indicators in females and at the males with different BMI.

Anthropometrical indicators (body weight, CC) and physiometric characteristics [HR_{rest} and time of HR recovery after 20 squats; systolic arterial blood pressure (except males); Robinson index; vital and strong indexes] were better in group “N”, than all students in groups “OV” and “OB” ($p < 0.05$). The lowest results of anthropometry and physiometry are revealed in males and females of group “OB” ($p < 0.05$). The similar dependence of anthropometrical indicators of the person and overweight and obesity is noted by others researches [49, 70].

It is determined that the females of group “OV” and “OB” have high means of indicators of systolic arterial blood pressure, in comparison with females of group “N”. Results of our researches are confirmed by scientific

works in which were defined the interrelation between overweight, obesity and arterial hypertension [32, 33]. It can lead to heart attacks and brain strokes.

According to our data students with overweight and obesity have significant low indicators of cardiovascular system condition (HR_{rest} and HR recovery time after 20 squats), than students with normal body weight ($p < 0.05$). It is confirmed with results of research devoted to the cardiorespiratory system in women of the first mature age in Ukraine [71].

The indicator of cardiovascular system activity is Robinson index. According to our data males and females of group “N” have a low mean of this index. The students of group “OV” and “OB” have significantly high Robinson index than students of groups “N”. It demonstrates the decrease in activity of cardiovascular system in students with overweight and obesity. However, our data differ from results of examination of females with overweight in the Tyva Republic (Russia) [72]. Authors determined low means of Robinson index and great reserve opportunities of an organism for physical activity.

According to our data, the physical fitness of females and males with overweight and obesity is much lower in comparison with results of testing of students with a normal weight. It is confirmed by researches of other authors [45, 73]. It was determined (tab. 2, 4) that females with overweight have significantly low results in five of seven motor tests. The males with overweight and obesity have low results in five tests ($p < 0.05$). In comparison with students with normal weight, males and females (groups “OV” and “OB”) have the decrease in results in motor tests. It is confirmed by the integrated criterion of motor qualities tests (fig. 5).

The mean grade of integrated criterion of physical fitness (fig. 5) of females of group “OV” (with overweight) and females of group “OB” (with obesity of the I degree) was 2.86 ± 0.03 and 2.18 ± 0.09 points respectively. It was in 5, 3% and 27.8% lower than mean grade of female

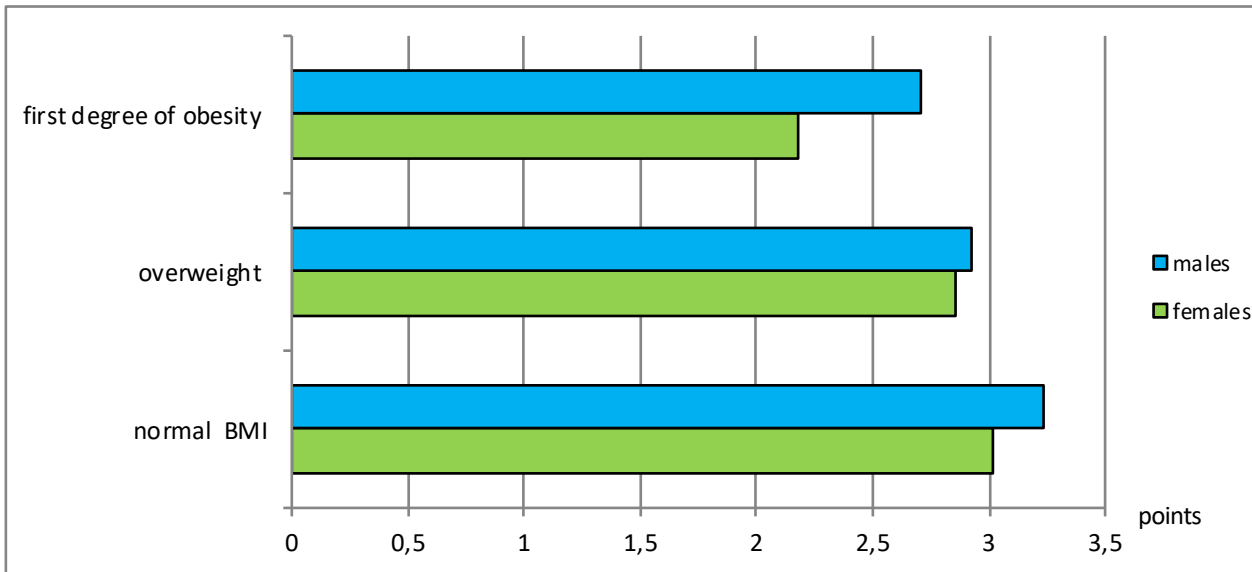


Fig. 5. Integrated criterion of physical fitness level of females and males with different BMI means.

students with a normal weight ($p < 0.05$). The mean grade of integrated criterion of physical fitness (fig. 5) of males of group “OV” (with overweight) and males of group “OB” (with first-degree obesity) was 2.92 ± 0.02 and 2.81 ± 0.07 points respectively. It was in 9.6% and 16.1% is lower than a mean grade of students with a normal weight ($p < 0.05$). Low characteristics of motor qualities of males and females with overweight and obesity are caused by: weak heart function, insufficient content of muscular tissue, overage of fat tissue in component structure of body. The obtained data (fig. 3, 4) confirm the low content of muscle mass and considerable overage of fat mass in component structure of students bodies (with overweight and obesity) in comparison with students of group “N” ($p < 0.05$). These data conform with researches of others authors [73, 74] and our previous researches⁷⁵.

Overweight doesn't allow to develop speed and flexibility of students. The lack of a muscular component in all students' bodies (group “OV” and “OB”) decrease in results of motor tests for manifestation of strength, high-speed and general endurance. Characteristics of these motor qualities were lower, than in students with normal weight (group “N”, $p < 0.05$).

We agree with ideas of other authors [76] concerning decrease in body weight and improvement of motor abilities of the person. It is recommended to apply moderated and long (more than 30 min) aerobic motor exercises for decrease in fat component in a body and

improvement of cardiovascular system activity. It is necessary to apply high-intensity physical activities which allow to intensify synthesis of protein in organism [77] for increase in muscle mass of a body.

Conclusion

1. Female and male of 17-21-year-olds with overweight and obesity have lower anthropometrical and functional characteristics of organism and motor qualities, than students with a normal weight. Such students have less content of muscle mass in component structure of body, than students with normal weight. Also the content of fat mass is more, than in students with normal weight ($p < 0.05$). It is determined the dependence between the quantity of body fat mass of males and females with the level of their physical fitness.

2. The obtained data concerning features and interrelation of anthropometrical, functional characteristics and motor qualities of females and males (with different body weight) allow to correct educational process of physical training of youth. The basis of such process is made by physical exercises which promote decrease in content of fat mass and to increase in muscle mass in component structure of students' bodies.

Conflict of interest

The authors declare no conflict of interest.

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Cite this article as:

Kolokoltsev MM, Iermakov SS. Morphofunctional and motor characteristics of Baikal region's students (Russia) with overweight. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):4–13. <https://doi.org/10.15561/18189172.2019.0101>

The electronic version of this article is the complete one and can be found online at: <https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 15.01.2019

Accepted: 10.02.2019; Published: 27.02.2019

The impact of variability and distribution of practice on student's learning of basketball throw skill

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: The practice organization is an important factor in sports environment and education. This study aimed to investigate the impact of variability and distribution of practice on basketball throw skill learning among female elementary school students.

Material: Based on the pre-test scores of 15 attempts (5 throw from any distances of 3, 3.5, and 4 meters), 90 volunteer participants were distributed in 6 homogeneous groups of 15 participants (three massed practice groups and three distributed practice groups with blocked, increasing, and decreasing practice arrangements). In acquisition stage, the participants practiced for 9 sessions. After 72 hours, all participants conducted the retention test. Changing the angle at a distance of 3.5 meters, the transfer test was conducted at the same day.

Results: The findings showed that the variability and distribution of practice did not impact on participants' performance in acquisition, retention, and transfer stages.

Conclusions: For development of contextual interference effect, the variability in parameters of a motor program is not enough.

Keywords: massed practice, distributed practice, variable practice, constant practice.

Introduction

The motor skills constitute a large part of human life. It is for many years that scientists and trainers try to identify factors affecting the skills performance and skillful movements. All those who train motor skills know that the learning of these skills is not possible without practice. The people train skills to increase their potential to perform the skills in future. The practice aims to achieve skillful performance features. There are four characteristics which define skillful performance: improvement, consistency, stability, and persistence. In different situations, there are different training methods to improve them. The variability of practice is one of the features which increase the likelihood of success in achieving skillful performance. There are several studies which support the impact of practice variability on optimization of practice's beneficial effects. The main challenge in this feature is this question: which aspect of skill should be changed and how this variability should be provided in exercise sets [1]?

The practice organization is one of the important factors in sports environment, rehabilitation process, and education. The teacher, therapist, or coach should decide who to distribute the practice time of a skill? It seems that two things are important in this process: first, the length and frequency of exercise sessions per week and second, the rest time between practice sets [1]. Some coaches increase practice time, instead of increasing the effectiveness of training. However, it seems the practice time is not the most important factor in planning and the quality of practice should also be considered. Therefore, it is very important to organize practice to increase its effectiveness [2]. The distribution and organization of practice in the

form of practice program may provide a proper context for deeper and more meaningful processing of motor and cognitive concepts and better acquisition of motor skills [1]. In response planning stage, the individuals may use scheme to estimate parameter value in attempts. This process will be led to a movement which is based on past experience in using this program. Some evidence suggests that variable practice impacts on creating schemas [3].

The contextual interference effect is one of the practice variability theories; it was proposed by William Battig [4]. According to Battig, there are two important sources for this interference. First, the order of performing different skills; if a skill is repeated frequently, only one skill will be maintained in working memory and as a result, the activity of working memory and the need for attention will be reduced. While, if various skills are periodically practiced, the created interference will be high. Second, the nature of skills; if the skills have similar nature, the interference will be lower [4]. Battig suggested that the contextual interference effect is applicable for motor and verbal areas [5]. Shea and Morgan were pioneers in testing Battig claims and for the first time, they applied the contextual interference for motor skills. The result of this test showed the effects of contextual interference [6]. According to Magill [1], on the other hand, the interference of practicing several skills in one session may led to improved learning. In this method, the need to focus on skill and problem solving will lead to more effective learning [7]. Also, the dynamic system approach emphasizes on the need to expand the perceptual-motor space and discover better methods to overcome the problems of skills' degrees of freedom [8].

Travlos observed the contextual interference effect in volleyball service skill acquisition and retention stages

and stated that the special practice improves athletic performance in both stages [9]. Also, Rahavi, Shojaei, Estiri, and Naghizadeh compared the performance of blocked, random, and serial groups in basketball skills. Investigating the effect of contextual interference on motor programs learning, they found significant difference in retention stage; the random practice group performed better than other groups [10]. Pauwelz, Vancleef, Swinnen, and Beets also reported that the contextual interference impacts on computer visual-motor task learning among young and elderly people [11]. Correa, Walter, Torriani-Pasin, Barros, and Tani did not find contextual interference in a serial task and found that the practice amount had no effect on it [12]. Lotfi, Khalaji, Bahram, and Farrokhi did not report any significant difference between blocked, serial, and random groups in acquisition and transfer stages of basketball throw skill and stated that the creation of contextual interference effect requires more training [13]. Mokhtari Dinani, Farrokhi, Lotfi, and Nazarian investigated a bimanual coordination task and found that the variability of practice impacts only on parameters learning [14].

In their theory, Guadagnoli and Lee suggested that the cognitive processing level during practice depends on practice challenging level [15]. The nature of practice, practice situation, and learner's level interact to determine the challenge in practice attempts. Due to difference in tasks types, skill level of participants, acquisition attempts, and limitation of attempts to duration of research project, there is rarely an overall result for practice arrangement and sometimes, conflicting results are reported [15]. Fromer stated that the contextual interference effect emerges by interacting with individual characteristics and the people who have higher intelligence benefit more from contextual interference [16]. Guadagnoli and Lee believed that the regular challenges during exercise will lead to optimal learning environment for learners [15]. According to challenge hypothesis, the more the people get skilled during practice, the less will be functional task difficulty and the nominal task difficulty will be constant. This means that by changing skill levels, the practice difficulty levels will also change. When the learner achieves higher levels of skills, these challenges will be increasingly more difficult. A gradual increase in contextual interference may be one of ways to prepare learner for appropriate challenge level and eventually, learn a task. The systematic increasing contextual interference is one of practice arrangements which have recently been proposed in motor learning literature and refers to the gradual increase of contextual interference during practice [17]. Pasand, Fooladiyanzadeh, and Nazemzadegan investigated the volleyball skills and reported that in acquisition stage, the blocked group had a better performance and in retention and transfer stages, the random and gradual contextual interference increase groups had better performance than blocked group [18].

On the other hand, Garcia, Moreno, Reina, Menayo, and Fuentes compared the effects of intensive and distributed practice on acquisition and retention of single

and continuous skills. They reported that at the end of practice, the distributed practice group had better outcome. In delayed retention stage, the intensive practice group performed the single and continuous skills significantly better than other groups [19]. Leite, Ugrinovitch, Carvalho, and Benda reported that although the massed practice impacts on elderly people and weakens their learning, it has no impact on task learning of young people [20]. Also, Dail and Christina considered the golf swing as a single task and found that those who perform distributed practice have better performance than those who performed intense practice; in retention stage, there was no significant difference between two groups [21]. Given the multiplicity of factors affecting the incidence of contextual interference effect and variability of practice and the possibility of interaction between this effect and results of intervention in distribution of practice, this study aims to investigate the impact of variability and distribution of practice on acquisition, transfer, and retention stages of basketball throw skill learning among female elementary school students and introduce the most appropriate method of practice distribution and tasks arrangement in every training session to improve the learning process of similar skills.

Material and Methods

Participants: From among volunteers who were right-handed female students aged 12-10 years, 90 participants were selected; they completed consent forms. Based on the pre-test scores of 15 attempts (5 throw from a distance of 3, 3.5, and 4 meters), they were distributed in 6 homogeneous groups of 15 participants (three massed practice groups and three distributed practice groups with blocked, increasing, and decreasing practice arrangements).

Research Design: In acquisition stage, the participants practiced for 3 weeks, 3 sessions per week, and 3 sets with 15 repetitions in each session. In distributed practice groups, the participants rested for 30 seconds after each throw and 3 minutes after each set. In massed practice groups, the participants thrown 15 times in each set and rested for 3 minutes after each set. During the training period at the end of each session, the average performance of participants in each group was recorded. After resting for 72 hours, all participants conducted the retention test, like the pre-test. Changing the angle at a distance of 3.5 meters, the transfer test was conducted at the same day.

A demographic questionnaire and AAHPERD's basketball throw modified test were used as research tool. In this test, if the ball falls directly into the basket has 5 points, if the ball hit the ring but does not fall the basket has 3 points, if the ball hit the board and ring and does not fall in basket has 2 points, and if the ball hit the boards has 1 point. The balls which go out without hitting the board and ring have zero point.

After filling out the consent form and demographic questionnaire, a total of 90 female right-handed eligible beginners were selected and participated in a preparatory training session. Then, all participants performed

AAHPERD's basketball passing pre-test which consisted of 15 attempts (5 throw from any distance); all throws were scored and recorded separately. The mean of 15 attempts was considered as pre-test score. Based on pre-test scores, the sample distributed homogeneously in 6 groups: 1) Massed increasing group, 2) Massed decreasing group, 3) Massed blocked group, 4) Distributed increasing group, 5) Distributed decreasing group, and 6) Distributed blocked group. In acquisition stage, the participants practiced for 3 weeks, 3 sessions per week, and 3 sets with 15 repetitions in each session. In distributed practice groups, the participants rested for 30 seconds after each throw and 3 minutes after each set. In massed practice groups, the participants thrown 15 times in each set and rested for 3 minutes after each set. At the end of last session after 10 minutes of rest, all participants performed the pre-test which consisted of 15 attempts (5 throw from any distance). After resting for 72 hours, all participants conducted the retention test, like the pre-test. Changing the angle at a distance of 3.5 meters, the transfer test was conducted at the same day.

Statistical Analysis: The mean and standard deviation were used for statistical description of data, Shapiro-Wilk test was used to assess the normality of data distribution,

and Levene's test was used to evaluate the homogeneity of variances. The one-way analysis of variance was used to compare scores of pre-test in study groups. The factor analysis of variance was used to evaluate the effect of distribution and variability of practice and their interaction on acquisition, retention, and transfer stages at significance level of 0.05.

Results

The demographic characteristics of subjects showed that the mean of age was 11.28 ± 0.63 years old, the mean of height was 1.47 ± 0.09 m, and the mean of weight was 43.49 ± 9.24 kg. There was no significant difference between groups in terms of these three indicators.

The mean of scores in various stages of measurement including pre-test, post-test, retention test, and transfer test in massed practice groups and distributed practice groups is provided in Figures 1 and 2.

Shapiro-Wilk test was used to evaluate the normality of data distribution. The results showed that the data had normal distribution ($P > 0.05$). The homogeneity of variances was tested using Levene's test and was confirmed ($P > 0.05$).

The results of one-way analysis of variance to compare

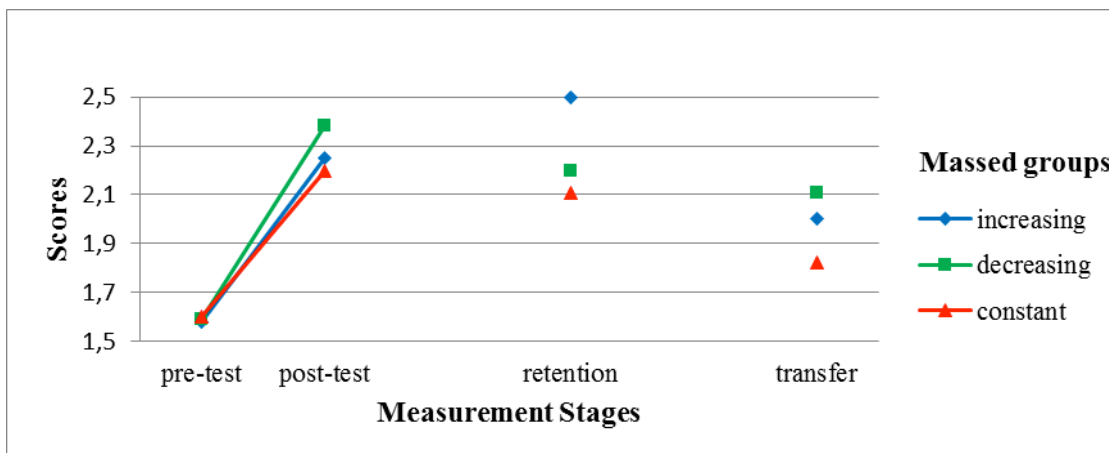


Figure 1. The mean of scores in various stages of measurement in massed practice groups.

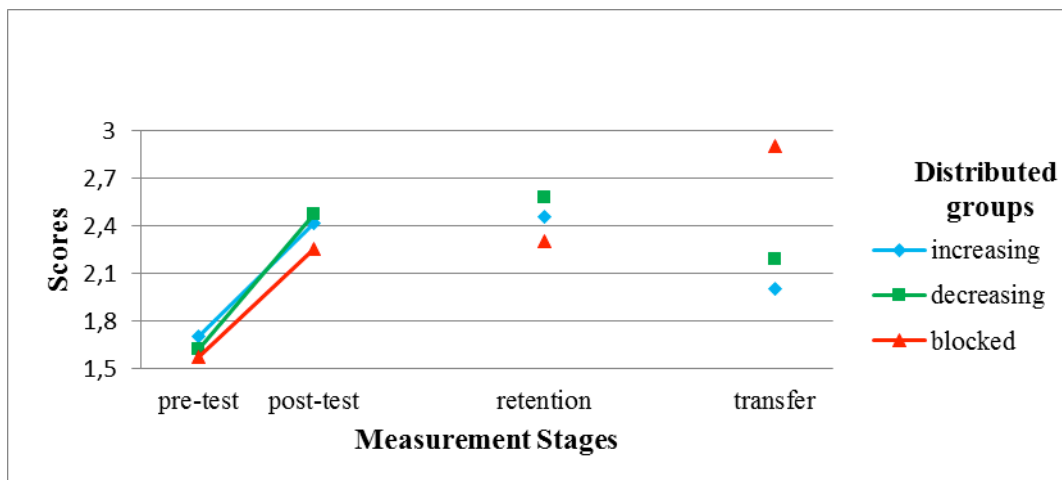


Figure 2. The mean of scores in various stages of measurement in distributed groups.

Table 1. Results of multivariate ANOVA in different stages of measurement

Measurement stage	Index Effect	df	F	P	Effect size
Acquisition	Distribution	1	0.887	0.349	0.011
	Variability	2	0.089	0.342	0.026
	Distribution × Variability	2	0.098	0.907	0.002
Retention	Distribution	1	1.78	0.186	0.022
	Variability	2	1.59	0.216	0.037
	Distribution × Variability	2	0.82	0.443	0.02
Transfer	Distribution	1	0.765	0.384	0.009
	Variability	2	1.61	0.205	0.038
	Distribution × Variability	2	0.67	0.511	0.016

the mean of pre-test scores in six groups showed that there was no significant difference between groups ($F_{(5, 84)} = 0.074$ and $P = 0.996$).

The factor analysis of variance was used to investigate the effect of distribution and variability of practice and their interaction on accuracy of basketball throw in acquisition, retention, and transfer stages. The results of analysis are summarized in Table 1.

According to table, the effects of distribution of practice, variability of practice and their interaction on participants' basketball throw skill is not significant.

Discussion

The findings showed that the distribution and variability of practice do not impact significantly on acquisition, retention, and transfer of basketball passing skill. This is consistent with findings of Lotfi et al and Mokhtari Dinani et al [13, 14]; it is also inconsistent with findings of Garcia et al and Rahavi et al [10, 19]. The inconsistency may be due to participants' different skills and ages. The results of variability of practice effect may be explained by second part of Magill and Hall's hypothesis; according to it, the parameter change in tasks which are controlled by a generalized motor program cannot lead to active processing and movement pattern reproduction and is not enough to cause interference.

Although some studies have not mentioned the number

of repetitions and rest time on a constant basis, the number of attempts selected for this study is almost the mean of figures in the literature. One reason for contradiction between the results of this research and other research may be the interference of variables such as skill level, task type, and practice amount (number of practice trials, practice sessions, and duration of acquisition period). The distributed practice may impact significantly if the performance of skill causes severe physical, muscular, neurological, and cognitive exhaustion. The complexity of skill is also one of the variables affecting the efficacy and superiority of distributed practice compared with massed practice. However, due to lack of research evidence, more research is still needed in this area.

Conclusions

Considering the insignificant difference in variability of practice group, it may be concluded that for development of contextual interference effect, the variability in parameters of a motor program is not enough. However, there is no unit practice for everyone. More research should be done to achieve a practice pattern and the affecting factors should be studied and compared.

Conflict of interest

The authors declare no conflict of interest.

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Cite this article as:

Lotfi Gh, Baghaeyan M, Baghaee N. The impact of variability and distribution of practice on student's learning of basketball throw skill. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):14–18. <https://doi.org/10.15561/18189172.2019.0102>

The electronic version of this article is the complete one and can be found online at: <https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 15.01.2019

Accepted: 10.02.2019; Published: 27.02.2019

Kinematic analysis of the “attack to the legs” from wrestling: impact of prior judo expertise

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: In the framework of motor skill learning and transfer, the objective of the present work is to highlight the kinematics during the technical execution of an “attack to the legs” in wrestling and compare expert wrestlers with wrestlers having a prior judo expertise. Moreover, this study aims to evaluate the effects of training on these characteristics.

Material: 10 male subjects were divided in two groups of five: the first group contains wrestlers with at least 7 years of wrestling practice. The second group contains two-year practice wrestlers with 5-year prior judo experience. Subjects had to perform a movement of attack towards the opponent's legs (free style wrestling). A three-dimensional analysis was carried, the displacement of seven passive markers placed over anatomical points was quantified (3-D motion analyzer, sampling rate 25Hz). The following parameters were calculated: angulation of the hip and of the knee, velocity and acceleration of the shoulder and of the wrist. The experiment was conducted twice: at the beginning of the wrestling training schedule and ten weeks later.

Results: Results showed marked differences between the two groups in the kinematics of the movement. These results suggest interference between prior automatisms and learning new skill. The prior experience in judo would have influenced posture in this group. In the framework of skill transfer and dexterity, this study appears promising to investigate the processes involved in this motor control.

Conclusions: Although wrestling and judo are two sport disciplines that belong to the same group of combat sport, this work underlines the specificity of learning and indicates that acquisition of motor abilities in a speciality is not transferred inevitably in a positive way in another speciality of the same group.

Keywords: Transfer of learning, motor skill, postural control, wrestling, judo.

Introduction

Combative sports with grasping are characterized by the existence of some common technical bases [1], which generate a comparison among the various disciplines based on these similarities. Athletic learning and training allow sportsmen to acquire new motor abilities [2]. However, sensory integration mechanisms and gesture automation differ according to the specificities of practiced sport [3, 4]. Former studies showed that sport training plays a significant role in postural control through the acquisition of new motor skills suitable for the nature of the activity [5]. Besides, sport training could support the choice of the strategy of posturo-kinetic coordinations adapted to the realization of the new motor task [6]. The perfect realization of every gesture could not be considered without the principal bases of any sport learning. These bases are the acquisition of particular motor program, the automatization of the gesture through its repetition, and the optimal treatment of sensory information. The latter one is performed through the development of the treatment of specific sensory entries of the task [7].

However, there is a fundamental problem: can sport training have a general influence on activities other than those practiced during this training or are skills built by specific training? Wrestling and most other sports depend on a specific body form for the effectiveness of their techniques [8]. The ability to attack or to defend against an attack under any circumstance depends largely

upon the production of specific movement. It is frequent that judokas and wrestlers move from one practice to another, but this transition is sometimes accompanied by difficulties in learning this new skill while learning to master technical movements [9, 10].

Hypothesis: While learning a new skill in a certain combative sport, prior practice in another combative sport would have an influence on performing this skill. Common posturo-kinetic control mechanisms would be responsible for this influence.

Purpose: In the framework of motor skill learning and transfer, the objective of the present work is to highlight the kinematics during the technical execution of an “attack to the legs” in wrestling, and compare expert wrestlers with wrestlers having a prior judo expertise. Moreover, this study aims to evaluate the effects of training on these characteristics.

Material and Methods

Participants: 10 male subjects were divided in two groups of five: the first group contains wrestlers with at least 7 years of wrestling practice (called “wrestlers”) (mean age 22.8 ± 3.6 years, height 178 ± 10 cm, weight: 82.8 ± 27.9 kg). The second group contains two-year practice wrestlers with 5-year prior judo experience (called “wrestler-judokas”) (mean: age 22.2 ± 2.7 , height 175 ± 62 cm, weight: 70.6 ± 12.2 kg). The average height and weight do not differ significantly between the two groups.

Research Design: Subjects had to perform a

movement of attack towards the opponent's legs (free style wrestling). The opponent was represented by a support made up of a square base (2cm height) on which was fixed a vertical bar surrounded by foam 120 cm high and 10 cm wide.

The purpose of the movement of attack to the legs is the simultaneous seizure of the two legs and the imbalance of the opponent backwards.

Seven passive landmarks were placed over anatomical points to record the movement of the body: shoulder (acromion), elbow (olecranon), wrist (styloid process of the ulna), hip (anterior superior iliac spine), knee (fibular head), ankle (lateral malleoles) and head (temple).

The experiment was conducted twice (first test T1 and second test T2) with a 10 week intervening period of wrestling training. All subjects had the same training schedule.

Movements were recorded and analysed using the 3-D vision system -Biometrics- (sampling rate 25Hz)

Statistical Analysis: The analysis deals with the first two phases of this technical movement: Guard and departure towards the legs and arrival and seizure of the mast. The following parameters were calculated:

The angle (α) determined by the head and the trunk and the angle of the hip (β), the value at the beginning of the movement (α_1 ; β_1), the minimal value of this angle (α_2 ; β_2) and its value at the end of the movement (α_3 ; β_3) when the subject seizes the support with the hand.

For the angle of the knee (γ), the value at the beginning of the movement (γ_1), the value corresponding to the angle (β_2) at the same moment (γ_2) and the value at the end of the analyzed movement (γ_3).

For speed and acceleration of the various markers, we recorded the values corresponding to the maximum and the times at which they appeared. We calculated the averages of the two trials for each parameter. For the analysis, we used nonparametric tests, Mann-Whitney's tests to compare the results of wrestlers and wrestlers-judokas. The evolution in (through?) time between the two tests (T1 and T2) was analyzed using Wilcoxon's test.

Results

When the subjects were tested for the first time, the angles calculated are closer among pure wrestlers than among the judokas. This difference reaches the significance level with regard to the angle of the knee at the beginning of the movement (γ_1), the minimal value of the angle of the hip (β_2), the angle of the hip at the end

of the analyzed sequence (β_3) (Mann-Whitney test: $U=1$, $p<0.02$; $U=1$, $p<0.02$; $U=1$, $p<0.02$ respectively).

The results of the evaluation carried out during the second test (T2), ten weeks after the first, at the end of the period of training are relatively similar to those of the previous test, the posture of the wrestlers seems more "crouched" compared with the movement realized by the wrestler-judokas. The wrestlers tend to keep the trunk more tilted ($U=4$; $0.05<p<0.10$) at the beginning of the movement. Their leg is more bent at the beginning (γ_1) and the trunk on arrival is more brought back towards the leg than that of the judokas (β_3) ($U=2$, $p<0.05$; $U=2$, $p<0.05$ respectively). In a general way, the wrestlers adopt a postural attitude consisting of a lowering of the centre of gravity more significant than that of the wrestler-judokas from the start and a more marked slope of the trunk on the leg.

Among wrestlers, the results show a great stability of time regarding the parameters taken into account (Wilcoxon test, NS). In the wrestler-judokas, it is noticed that the angular values seem lower on average during the second test, the statistical analysis however states that these differences are not significant for any estimated parameter.

Maximum speeds (Table.1) for both the first and the second test, of the various landmarks seem to be overall identical for the wrestlers and the wrestler-judokas. Between the first and the second test, these maxima do not evolve to a significant degree (Wilcoxon test, NS) among wrestlers, for the wrestler-judokas the difference is significant on the level of the knee (landmark 5) and the head (landmark7) (Wilcoxon test, $Z=1.752$, $0.05<p<0.10$; $Z=2.022$, $p<0.05$ respectively). In the second test, these subjects seem to improve the speed of movement execution.

Maximum speed is not reached more quickly (Mann-Whitney test, NS) during the two tests, except for wrestlers subjects at the level of the head in the first test (Mann-Whitney test, $U=3$, $p<0.05$).

Compared to the initial test, speed is reached more quickly during the second test, for the shoulder as for the wrist (test of Wilcoxon: $Z= -2,023$, $p<0,05$; $Z= -2,060$, $p<0,05$ respectively) in wrestlers. For the wrestler-judokas, it is at the ankle level that the difference is significant (Wilcoxon test: $Z= 2,022$, $p<0,05$).

Given the illustrated results (table.2), it seems that the peak of acceleration among wrestlers is higher than for the judokas during the first test. Nevertheless, this

Table 1. Peaks of speeds (m/s) on the level of the various landmarks for the wrestlers and the wre-judokas during the first and the second test. Average values and standard deviations

Group	Test Landmark 1		Landmark 2		Landmark 3		Landmark 4		Landmark 5		Landmark 6		Landmark 7	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Wrestlers	2.135 (± 0.46)	1.681 (± 0.54)	2.345 (± 0.41)	1.865 (± 0.24)	2.729 (± 0.62)	2.223 (± 0.41)	1.449 (± 0.23)	1.665 (± 0.23)	2.285 (± 1.38)	2.411 (± 1.45)	2.900 (± 2.4)	3.483 (± 2.00)	1.990 (± 0.15)	1.59 (± 0.55)
Wrestlers-judokas	1.688 (± 0.43)	1.727 (± 0.18)	1.875 (± 0.35)	2.115 (± 0.14)	2.575 (± 0.8)	2.753 (± 0.8)	1.444 (± 0.34)	1.813 (± 0.49)	1.359 (± 0.81)	1.925 (± 1.1)	1.529 (± 1.84)	2.313 (± 1.83)	1.736 (± 0.30)	1.560 (± 0.23)

Table 2. Peaks of acceleration (m/s²) on the level of the various landmarks for the wrestlers and the wre-judokas during the first and the second test. Average values and standard deviations

Group	Test Landmark 1		Landmark2		Landmark 3		Landmark 4		Landmark 5		Landmark 6		Landmark 7	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Wrestlers	15.748 (±4.86)	13.111 (±3.21)	17.225 (±5.22)	14.526 (±7.15)	23.205 (±5.23)	16.989 (±8.08)	11.828 (±1.86)	11.51 (±4.20)	18.774 (±9.65)	16.869 (±12.15)	26.856 (±20.12)	25.523 (±13.53)	14.556 (±1.02)	11.979 (±5.17)
Wrestlers -judokas	10.459 (±3.07)	10.880 (±1.29)	12.428 (±3.62)	14.428 (±6.56)	16.428 (±7.20)	19.410 (±8.83)	12.517 (±3.35)	12.417 (±4.54)	12.729 (±6.74)	16.294 (±8.62)	14.111 (±12.99)	22.228 (±16.29)	9.711 (±0.98)	9.515 (±2.27)

difference is statistically significant only for the shoulder (landmark 1) (Mann-Whitney test, $U=3$, $p<0.05$). During the second test, the subjects of the two groups present similar maximum accelerations. For the wrestler-judokas, as with the speed, acceleration of the knee seems to have improved (Wilcoxon test, $Z=2.022$, $p<0.05$).

Regarding the time of appearance of the acceleration peak, the statistical analysis does not make it possible to show differences with regard to the sporting origin of the subjects (Mann-Whitney test, NS). Between T1 and T2, there is an evolution for the ankle (landmark 6), both for the wrestlers and the wrestlers-judokas (Wilcoxon test, $Z=1.752$, $0.05<p<0.10$; $Z= 2.022$, $p<0.05$).

Discussion

We showed, during the first evaluation, which postural attitudes of the two groups are different at the beginning from the movement at the end. The wrestlers without a previous judo experience adopt a postural attitude of low guard (bent on the legs, trunk inclined forwards) more marked than that of the subjects having a previous judo experience, the difference not being significant on the level of the cephalic segment. In addition, their trajectory during the movement is characterized by a slope of the trunk more marked towards the lower limb, which is bent at approximately 110°. This difference between the two groups cannot be explained by morphological characteristics (size, weight) since the two groups do not differ statistically compared to these variables. In addition, the two groups respected the instructions related to the finality of the movement, since the seizure of the support was carried out strictly on the same level.

In the group of wrestlers, the control of the adversary results in a direct seizure of this one. The low guard reducing the distance with the adversary allows a better stability by lowering the centre of gravity of the wrestler. The position of high guard upright ensures a lower stability because of the high position of the centre of gravity and the reduction of the basis of support [11]. Moreover, the rise in the guard is accompanied by a reduction of the defence possibilities and by an increase in muscular efforts in order to maintain a balance. The kinematic data from the study among wrestlers is in agreement with the realization of this technical gesture by experts [11].

To carry out the requested technique, judokas of origin seem influenced by their knowledge of the judo practice. In judo, guard position is high (compared to that of the wrestling) with a catch of the adversary's kimono jacket,

which allows the mutual control of candidates [12, 13]. The judoka's postural balance takes into account these high supports of hands on the adversary. The realization of the legs attack in the wrestler-judokas could be influenced by the "Moroté-Garé" technique in judo. It differs from the legs attack in wrestling concerning control sought by the adversary. In wrestling, it is at legs level, in judo the action is more carried towards thighs and basin, the starting position not allowing to reach very quickly lower areas of the body.

An explanatory hypothesis of these differences between the two groups of subjects could be the degree of expertise in wrestling. One can to a certain extent consider that the installation of posturo-kinetic coordinations supporting the movement required for experts "wrestlers" can be compared to beginners. Thus, Béraud and Gahéry showed, in the case of French boxing, a reorganization of posturo-kinetic coordinations that accompany the movement, under the effect of sport training [14]. Compared to this possible positive influence on the performance of the acquisition of new sensorimotor plannings during sport training [4, 15], the difference between the two groups of the study could be explained by a different use of sensory information following training, with a more selective and specific treatment at the expert subjects. The vision undoubtedly plays a very significant role, a possible attack appropriateness generally begin with a visual treatment from information, which could explain the rectified position of the head of the attacker. In the same way, Perrot [16] specified that the role of vision in the control of the static postural balance decreases with the expertise level, for karate experts and French boxing fighters.

Whatever the subjacent factor of training effects [17], in our study we could, to a certain extent, consider that wrestler-judokas are beginners concerning wrestling, which could explain postural differences with the other group (7 years of practice at least). An argument in favour of this explication is that we observe wrestler-judokas improving the realization of the movement when they are tested after the training period of ten weeks compared to the initial test. Nevertheless, if our results are compatible with this assumption, it is not possible now to uncover the mechanisms (motor programming, sensory data processing). This assumption must however be nuanced by the fact that these judokas subjects had a two years old practice of wrestling before the initial test and are thus not really beginners, even if they do not reach the expertise

level of the other group.

The hypothesis of a negative transfer or an absence of transfer between both sport practices is also to explore. The existence of interference or absence of transfer between the two motor skills -judo and wrestling- are to be considered to explain the results [18]. Although this movement is a basic technique in training programs, the fact of having practised judo affects the postural attitudes of the subjects in the realization of this one. Moreover, this effect of the former practice of judo is particularly meaningful since these effects appear while at the same time these judokas have already made wrestling for two years. This is to be compared to the study of Travlos [19], which indicates that the increase of the number of training tests for a task can alter the transfer of learning on a new task. We can think that learning judo was accompanied, on the central organization level of the movement, by a "rigidification" of control. Thus, subjects with a previous experience in judo would have a good representation of the general goal of the action but not of the execution of the movement [20]. Bernstein points out that, with regard to the transfer abilities, a great confusion in the comprehension of the phenomenon comes from the fact that for a long time, the transfer was only considered through external similarity or composition of the movements [21]. According to him, the transfer is based on the use of previously acquired

automatisms; these automatisms are not movements but corrections controlling the movement and its components. In other words, a transfer is manifested by the existence of groups of similar corrections at the level of the control of the movement. In other words, a transfer takes place by the existence of similar groups of corrections at the level of the control of the movement. From this perspective, we can also consider that the nervous processes of control would be different between these two fighting sports, which are the judo and the wrestling, compared to the movement to be carried out and that there would thus not have a possible positive transfer. Thus, although these two sport disciplines belong to the same group of combat sport, this work underlines the specificity of learning and indicates that acquisition of motor abilities in a speciality is not transferred inevitably in a positive way in another speciality of the same group.

Acknowledgments:

Acknowledgments for Professor Fancine THULLIER, UFRSTAPS, University of Caen, France, for her general support.

Conflict of Interests

No conflicts of interest have been stated by the authors.

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Cite this article as:

Moufti H, Arfaoui A. Kinematic analysis of the "attack to the legs" from wrestling: impact of prior judo expertise. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):19–23. <https://doi.org/10.15561/18189172.2019.0103>

The electronic version of this article is the complete one and can be found online at:
<https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 30.09.2018

Accepted: 29.10.2018; Published: 27.02.2019

Changes in the oxygen transport system of erythrocytes in testing the general endurance of students

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: to reveal morpho-functional changes in erythrocytes in students with different levels of general endurance.

Material: It was examined 80 students (17-19 years old). The students performed a 12-min shuttle run (20m endurance shuttle-run - bleep test). The ventilation function of the lungs was estimated according to the forced exhalation data. The gas composition of the blood was determined by the gas analyzer OPTI CCA-TS.

Results: It was determined that in students with lower than average and low levels of general endurance, the increase of lungs ventilation is stipulated by the increase in the frequency of respiration. This leads to rapid tiredness of the respiratory muscles, reduces ventilation of the lungs and gas exchange. Low levels of blood oxygenation, intensity of oxidative phosphorylation and ATP resynthesis lead to the appearance of atypical forms of erythrocytes. It is established that at the low level of cardiorespiratory endurance there is an increase in the concentration of acidic metabolism products in arterial blood and reduce in its alkaline reserves.

Conclusions: Students with below average and low levels of physical fitness are characterized by: increased respiratory rate, reduced ventilation of the lungs and gas exchange. This leads to the formation of a hypoxic condition in the peripheral blood: a reduce of pO_2 , pCO_2 level and the appearance of metabolic acidosis symptoms. For students with below average and low level of physical fitness hypoxic condition leads to violation of bioenergetic processes in peripheral blood erythrocytes, reduction of ATP product, increase in the content of intra-erythrocytic 2,3-BPG.

Keywords: students, haemoglobin, erythrocytes, hypoxia, gas exchange.

Introduction

Hypoxia is a widespread phenomenon which appears in violation of the cardiorespiratory system functions and the transport function of the blood. Hypoxia appears in physiological conditions with submaximal and maximum aerobic physical loads [1, 2]. The increase in oxygen deficit appears in the process of performing such physical activity. This significantly reduces the intensity of oxidative phosphorylation. As a result, there is accumulation of lactic acid in the muscle tissue and in the blood and reduce of energy formation [3, 4].

It is known that all life processes require energy. Therefore, reduction of adenosine triphosphate (ATP) level is considered one of the main symptoms of hypoxia [3]. The intensity of oxidative phosphorylation during physical activity is reduced by 15-20% in people with a low functional reserve of the cardiorespiratory system [5]. It negatively affects the morpho-functional condition of the organism.

The study of Kuzmin et al. [6] and Ocak [7] point to low reserve capabilities of the cardiorespiratory system of modern students. It can be the reason of the negative changes in red blood cells in aerobic physical loads [8].

Other studies determine:

- The obtained results indicated that hyperoxia causes deep changes both in the composition and character of bilayer lipids of erythrocyte membranes, which affects the functional characteristics of erythrocytes, primarily the oxygen-transport properties of erythrocyte haemoglobin [9];

- The obtained results showed that the lipid phase plays an important role in the functioning of erythrocytes in health as well as in event of development of ischemic heart disease and other pathological processes that accompany hypoxia [10];
- The results of the study show that when the maximum physical load is performed, the microrelief is significantly enriched and the peripheral blood erythrocytes are deformed, which indicates the low stability of their membranes to the effect of various stress factors at a low level of somatic health of the students [11];
- RBC (red blood cell) deformability is influenced by age and endurance rate of the sport which suggests that the RBC system may adapt to changing conditions such as adolescence with the onset effects of sex hormones or physical exercise [12];
- Considering the variety of individual physiological processes in the oxygen transport system activity influenced by endurance training we studied the effective mechanisms of elements of adaptation in ski racers at rest. The obtained data suggested that wave characteristics (amplitude and frequency) of pulsatile arterial and venous blood flow (pressure) were essential for the circulation system functioning and for the high sport performance [13];
- Comparison of main stages of training and competitive conditioning in exercise tolerance revealed that activity of metabolic processes in hurdlers depended on the volume of specific muscle work in the zone of anaerobic-alactic energy supply [14];
- Changes in the TC (training camp) conditions

result in redistribution of generalized reactions of interchangeability of the functional stability and metabolic state, mutual substitution of regulating function systems, and oscillatory changes in the specific and functional system in the integrative activity of in the middle-distance runners and steeplechasers [15];

- The study provided information on the importance of indexes reflecting a correlation of various biochemical indicators to estimate the sufficiency of training loads. [16].

Thus, there is clearly a need for more profound studies concerning the rapid tiredness of the respiratory muscles of young people, the presence of a low level of cardiorespiratory endurance during exercise on endurance.

The aim of the work is to reveal the morpho-functional changes in erythrocytes in students with different levels of general endurance.

Material and methods

Participants

The study involved 80 students (17-19 years old). Students were asked to complete a 12-min shuttle run (Eurofit test). All students were divided into groups: the first group (DG-1) – students with a higher average level of general endurance ($n = 20$); the second group (DG-2) – students with average level of general endurance ($n = 20$); the third group (DG-3) – students with below average level of general endurance ($n = 20$); the fourth group (DG-4) – students with a low level of general endurance ($n = 20$). The intergroup comparison was performed for the analysis of experimental data.

Design of research.

The ventilation function of the lungs was estimated according to the flow-volume curve of the forced exhalation. The SpiroCom + was applied (Kharkov, Ukraine). The gas composition of the blood was estimated by a gas analyzer PTI CCA-TS (Ciba Corning, Germany).

Erythrocyte medications were prepared according to generally accepted rules [17]. Erythrocyte medications were examined in the electron microscope “JEOL-25A-T3225” (Japan). The percentage of different types of erythrocytes was determined by “Biovision-4.01” software (USA).

The content of 2,3-bisphosphoglycerate (2,3-BPG) and adenosine triphosphoric acid (ATP) in erythrocytes was determined by method of Kim et al. and [18]. All laboratory tests were performed before and after 12-min shuttle run. The research was conducted at the Department of Laboratory Diagnostics of the Central Clinical Hospital (№ 1, Ivano-Frankivsk, Ukraine). Students gave written consent for participation in the experiment. It was considered the requirements of the Helsinki Declaration (2008).

Statistical analysis.

The obtained data was processed by methods of nonparametric statistics applying the Mann-Whitney test. Computer processing of data was performed applying the statistical package Stat.Soft.Inc; Tulsa, OK, USA; Statistica 6. Selective parameters and text have the following meaning M – sample mean, m – standard error of the mean. Statistical changes were considered significant when the obtained significance level was determined at $p < 0,05-0,001$.

Results

Indicators of external breathing in students are presented in Table 1.

Students of DG-3 and DG-4 have the radical reduce of indicators FEV_1 , MEF_{25} , MEF_{50} , MEF_{75}

At the same time, students of DG-1 have higher level of partial pressure of CO_2 (pCO_2) than students of DG-3. The alkaline surplus (BE) in students of DG-1 is lower ($p < 0,05$).

After testing, the frequency of breathing in students of DG-4 significantly increases. At the same time, it is

Table 1. Indicators of ventilation lung function in students after a 12-min shuttle run, depending on the level of cardiorespiratory endurance (in % of the proper value, $n = 80$)

Indicators	The group of students by the level of cardiorespiratory endurance				p	p ₁
	DG-1	DG-2	DG-3	DG-4		
VC	112.3±1.52	109.4±1.52	95.9±1.25	88.4±1.62	<0.01	<0.01
FVC	107.9±0.5	98.6±0.5	83.5±1.33	87.6±1.78	<0.05	<0.01
FEV ₁	94.2±0.25	89.5±0.25	66.3±1.05	62.8±1.44	<0.01	>0.05
FEV ₁ /VC Tiffeneau index	93.9±0.25	83.2±0.25	74.2±1.22	66.7±1.53	>0.001	>0.05
MEF ₂₅	92.1±3.31	86.2±4.44	39.9±1.15	28.3±1.07	>0.001	<0.01
MEF ₅₀	85.6±0.72	80.7±0.53	31.5±1.01	29.1±1.23	<0.001	>0.05
MEF ₇₅	83.9±0.57	80.5±0.61	38.8±1.14	32.7±1.51	<0.001	>0.05

Notes: 1. Corresponding units: VC is the vital capacity; FVC – forced vital capacity; FEV₁ – forced expiratory volume in 1 sec; MEF₂₅ – forced expiratory flow at 25% FVC; MEF₅₀ – forced expiratory flow at 50% FVC; MEF₇₅ – forced expiratory flow at 75% FVC.

2. The level of significance between differences of DG-1 and DG-3 (p) and DG-1 and DG-4 (p₁).

revealed the reduce of AB indicator (true values of bicarbonate – $\text{HCO}_3\text{-act}$), the standard values of $\text{HCO}_3\text{-std}$ bicarbonates and the change of pH in the acid environment. Partial pressure of CO_2 and oxygen saturation ($\text{SO}_2\text{ sat}$) in students of DG-4 reduce, and basic buffer capacity increases.

Partial pressure of oxygen (pO_2) in venous blood of DG-3 and DG-4 students after testing is reduced to a greater extent than in students of DG-1 and DG-2. It is observed the reduce in the total amount of haemoglobin against the background of a radical reduce of pO_2 in peripheral blood of students with a low level of cardiorespiratory endurance. Therefore, in the venous blood of DG-3, DG-4 students observe the increase of 2,3-BPG content.

The morpho-functional changes of red blood cells of peripheral blood appear against the background (Fig. 1). The students of DG-3, DG-4 have reduce of the content of discocytes. However, the number of echinocytes, leptocytes and degenerative forms of erythrocytes has probably increased ($p < 0,05$).

In students of DG-3, DG-4 after physical activity increase the level of lactate in peripheral blood in 2,3 times (in comparison with students of DG-1 and DG-2). Students of DG-3, DG-4 have activate synthesis of 2,3-BPG. In students of DG-4 this leads to reduce in the content of ATP in erythrocytes of peripheral blood in $10,5 \pm 1,03\%$.

Discussion

It is determined that in a low level of cardiorespiratory endurance there is an increase in the concentration of acidic metabolism products in arterial blood and its reduce in alkaline reserves.

At the same time, the level of pCO_2 reduces at an average in $4,0 \pm 0,12\%$, and BE index increases in $28,5 \pm 1,07\%$. According to Ocak data [7], this fact indicates the formation of compensated respiratory acidosis.

The novelty of our data is to determine a simultaneous increase in the respiratory rate among students of DG-4 in $25,0 \pm 1,93\%$ ($p < 0,05$). At the same time there is an increase in the amount of acidic products in the blood. This is observed against the background of reducing the indicators of the true value of $\text{HCO}_3\text{-act}$ bicarbonate (in $8,9 \pm 0,87\%$) and the standard values of $\text{HCO}_3\text{-std}$ bicarbonates (in $6,12 \pm 0,54\%$). These figures are not accidental. It is known that the change in the acid-base balance in the blood of DG-4 students leads to a shift of pH toward the acidic reaction. This is reflected by expressed symptoms of metabolic acidosis and hypoxia.

We for the first time discovered that at lower levels of cardiorespiratory endurance (students of DG-3 and DG-4) partial pressure of CO_2 reduces, and basic buffer capacity increases. There is reduce in $\text{HCO}_3\text{-act}$ (AB) and saturation with oxygen ($\text{CO}_2\text{ sat}$). Therefore, the condition of the expressed respiratory acidosis is observed in the blood of these students. Lactate acidosis is normally compensated by a carbonate buffer system and respiratory alkalosis [8].

According to Abdelha at al. [5], the same pattern

is observed in tissue fluid. According to our data, it is stipulated by expressed venous hypoxia.

We have determined that against the background of a radical reduce of pO_2 in the peripheral blood of DG-3 and DG-4 students there is an increase of hypoxemia in the arterial and venous blood. At the same time, the amount of oxygen reduces in $13,7 \pm 1,4\text{ g} / 100\text{ ml}$, and the saturation of haemoglobin with oxygen reduces in $14,7 \pm 1,01\%$ (in comparison with DG-1).

The increase in the figure of actual alkaline surplus in 24,7% (in students of DG-4) indicates the hypoxic state symptoms of tissue structures. According to other authors [3], it is observed in many organs. We have found that morpho-functional changes are expressed in erythrocytes of peripheral blood (in the first place). It is known that their structural reconstruction is an integral cellular index, which indicates the development of membranopathy [8].

In reduce of the basic fraction of haemoglobin HbA and in increase of the minor component of HbA_2 , there are conformational changes in haemoglobin. This leads to premature destruction of red blood cells. It also leads to a decrease in the processes responsible for the transport of oxygen to tissues [5]. At the same time, if the students of DG-4 have increase of the thermolabel fractions content of haemoglobin, its conformational ability should radically change, which contributed to the violation of the connection of haema with globin [2]. As a result, the phenomenon is the oxidation of the iron atom before the formation of methaemoglobin [4]. It also changes the saturation of blood with oxygen. According to Karaseva & Metelitza data [19], this is due to a interrelation change of the haemoglobin with 2,3-BPG.

According to other authors [3], such changes are the limiting factor for the synthesis of ATP. This allows to explain the radical reduce in the content of ATP in students of DG-4 in erythrocytes of venous and arterial blood.

Thus, the results of our study confirm the data of scientific literature [5, 6, 20]. We could confirm that the expressed hypoxemia in students of DG-3 and DG-4 after the maximum physical activity, provoke respiratory acidosis, suppresses the energy exchange.

It can be confirmed that the limiting factor in the energy supply of peripheral blood erythrocytes is the synthesis of ATP. This is stipulated by the low difference of this marker between arteries and veins. This causes direct pathological changes in erythrocytes of peripheral blood.

Many studies [2, 4] determined that the majority of people have no significant changes in the number of reticulocytes (even at maximum physical activity). In our opinion, the reason of the anemic states in prolonged physical activity is pathological changes of peripheral blood erythrocytes.

We also defined that in the hypoxic state (after 12-min shuttle run) in the students of DG-4 increase the destructive changes in peripheral blood erythrocytes. At the same time, a lot of degenerative forms appear. Simultaneously the energy processes violate: the content of ATP reduces and the content of 2,3-BPG increases.

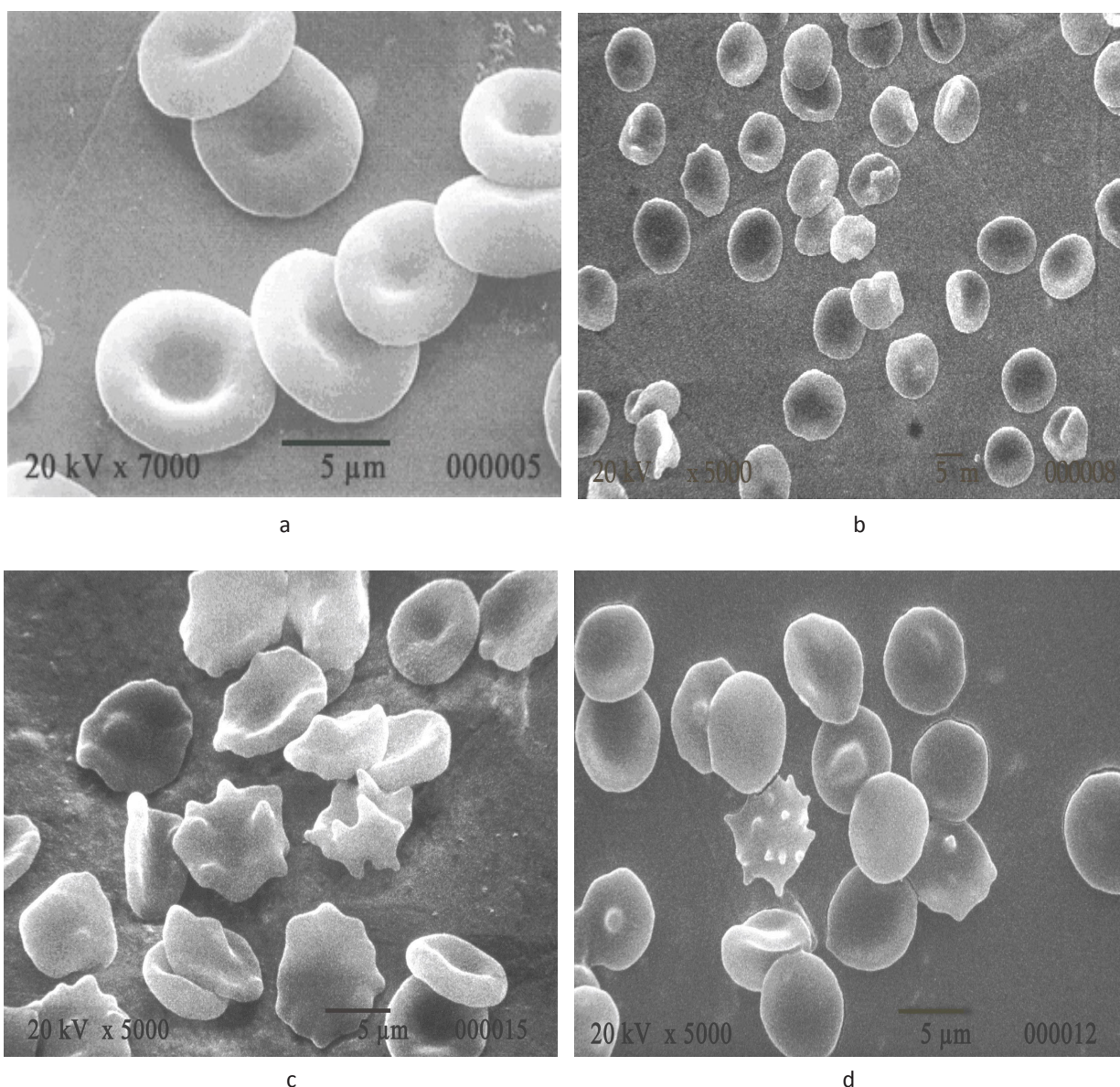


Fig. 1. Conformal changes in red blood cells of peripheral blood, depending on the level of physical fitness of students in performing the shuttle run test (12-min run in 20 m): a – above the average, b – average, c – lower than average, d – low level of physical fitness. Method: scanning electron microscopy.

According to the other authors [8, 21, 22], it is consequently created multi-directional forces, which lead to deformation of the membrane. At the same time, red blood cells themselves may have extensive and deep cavities. For the first time we discovered that this is a morphological substrate for the appearance of various inverse and irreversible forms of peripheral blood red blood cells.

Particular attention should be paid to the fact that the students of DG-4 in reducing stages of the 20 m distances have hypoxia in the arterial (40,4%, $p < 0,05$) and venous (in 41,4%, $p < 0,05$) blood. The similar processes are also developing in the students of DG-3 (but to a lesser extent).

Conclusions

1. Students with below average and low levels of physical fitness during the test of cardiorespiratory endurance are characterized by: increased respiratory

rate, reduced ventilation of the lungs and gas exchange. This leads to the formation of a hypoxic state in the peripheral blood: reduce in the level of pO_2 , pCO_2 and the appearance of metabolic acidosis symptoms.

2. Students with below average and low level of physical fitness have hypoxic state which leads to: violation of bioenergetic processes in peripheral blood erythrocytes, reduction of ATP product, increase in the content of intra-erythrocytic 2,3-BPG.

3. Increase of hypoxemia in peripheral blood in students with lower average and low level of physical fitness destructively affects membrane of erythrocytes. This reduces the content of discocytes and increases the number of echinocytes, leptocytes and degenerative forms of peripheral blood erythrocytes.

Conflict of interest

The authors declare that there is no conflict of interests.

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Cite this article as:

Neporadna NI, Popel' SL. Changes in the oxygen transport system of erythrocytes in testing the general endurance of students. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):24–29.

<https://doi.org/10.15561/18189172.2019.0104>

The electronic version of this article is the complete one and can be found online at:

<https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 01.01.2019

Accepted: 05.02.2019; Published: 27.02.2019

Effect of physical exercises and perceived stress interaction on students' satisfaction with life

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: to find out the effect of regular physical exercises and perceived stress interaction on students' satisfaction with life.

Material: The study involved university students ($n = 355$; $M_{age} = 19,97$; $SD = 2,12$). The moderator analysis was conducted according to the cross-sectional questionnaire.

Results: It is determined that the difference in students' satisfaction with life at the average and high perceived stress is due to physical exercises. The influence of the interaction of variables (physical activity x perceived stress) on satisfaction with life was statistically significant.

Conclusions: It is revealed the peculiarities of interaction between the physical exercises and perceived stress. The reduce of satisfaction with life under the influence of perceived stress is more typical for those students who do not regularly practice physical exercises. Physical exercises act as a buffer against stress.

Keywords: physical exercises, perceived stress, satisfaction with life, students.

Introduction

Satisfaction with life is a key indicator of subjective well-being [1], along with the predominance of positive affection over negative. It is defined as a cognitive process in which people value their satisfaction with life. The evaluation is based on a comparison of their life situation with their own set of standards [2]. It is a reflexive evaluation of how much everything has been and remains well. Satisfaction with life can be understood as a product of differences between achievements and aspirations. Satisfaction with life is related to the physical and mental health of a person. It can determine the level of human happiness lifetime [3].

The study of satisfaction predictors with life and the mechanisms for its support is always of considerable interest. Researches among students are especially relevant. Student's age is a period of active professional and personal self-determination. One of the criteria for the success of self-determination can be a high level of satisfaction with life.

Students are confronted with a number of difficulties in life. These are worries about success, perfectionist standards, uncertainty about their future, economic difficulties, family problems, and difficulties in dealing with the opposite sex. The period of study at the university predetermines the use of time and financial resources by students without the guarantee of a satisfactory return.

Such circumstances of life can be perceived by students as threatening. Therefore, they will cause stress (according to the transactional model of stress) [4]. University students are at a socio-demographic age, in which stress disorders are more prevalent [5, 6, 7]. The prevalence of depression, anxiety, and stress among

students from France, Romania and the Republic of Moldova was respectively 39.0%, 47.0%, 35.8% [8]. The high level of perceived stress stipulates the emergence of negative emotions: anxiety, depression. The analysis of publications over 20 years has shown that the average prevalence of depression among students is 31%. It is much higher than in the general population [9]. Many of these disorders have high temporal stability. They can lead to long-term psycho-physiological changes. They increase the risk of cardiovascular disease. In some studies, there is a steady negative correlation between stress and quality of life in university students. It is expressed in the deterioration of their physical and mental health [10-12]. This fact is confirmed in another study [13].

These facts generated interest in methods applied to alleviate stress; to ways to maintain a good quality of life. One of the important ways to overcome stress among students is physical activity. There is plenty of evidence that regular physical exercise has a direct positive effect on health and satisfaction with life [14, 15, 16]. The study of Maher et al. [17] determines the connection between physical activity and sedentary lifestyle with life satisfaction in college students (from 18 to 25 years old). The authors found that an increase in daily physical activity and a reduction in the daily sedentary lifestyle could improve the satisfaction of college students' lives. M. Gerber, S. Brand, S. Herrmann, and others used objective data concerning physical activity. It is proved that active physical exercises are an important factor in stress management, pain perception and sleep quality [18]. However, the usual levels of physical activity were not associated with satisfaction with life in young people [19].

The direct effect of physical exercises on the general

satisfaction of life in a number of secondary analyzes is placed in question (for example, [20]). It is emphasized that personal characteristics and environmental features can mediate or mitigate this correlation.

The connection between stress and active exercise is also ambiguous. There are studies which didn't support this conclusion [21]. The majority of studies confirmed that stress is negatively associated with physical activity [22].

It is necessary to define the term "physical exercise" and distinguish it from the terms associated with it: physical activity; sport. Physical activity refers to the widest category that covers all types of human movements. Sport is an organized competitive physical activity. It is focused on the victories and performances at an elite level. Physical exercises are aimed at recovery and rest. These are structured and scheduled physical loads [23]. We define the term "physical exercises" as a sub-group of physical activity, which are planned and purposeful attempts to improve health and well-being.

Previous studies demonstrate a significant impact of perceived stress and physical exercise on student satisfaction with life. However, there are no studies devoted to the impact of these factors on the satisfaction of life in interaction. It is known that the study of the interaction effect allows to answer the question: "how?" or "under what conditions?" the predictive variable affects the dependent variable.

The hypothesis of research is the follows: the regular exercise is a buffer between perceived stress and student satisfaction.

The purpose of the study is to find out the interaction effect of regular physical exercises and perceived stress on student satisfaction with life.

Material and methods

Participants. The sample consisted of 355 university students (men - n = 154, women - n = 201, age 17-26, average age - 19.97 years, SD = 2.12) (Kharkiv and Odessa, Ukraine). Participants were selected using a random sample. Before the study, all students were informed about the content of the questionnaire. Students were informed that participation is voluntary and confidential.

Design of the research:

Psychological and socio-demographic indicators were obtained using questionnaires. Students' questionnaire surveys were conducted in groups up to 20 persons. The survey lasted approximately twenty minutes. All scales meet requirements standards of psychometric quality.

It was applied Ukrainian translation of the scale of satisfaction with life for evaluation satisfaction with life (SWLS; [24]). It consists of five points. Typical questions: "I'm satisfied with my life" or "The actual living conditions are the best." Students were asked to indicate their degree of agreement with five statements on the 7-point Likert scale (from 1 = "totally disagree" to 7 = "totally agree"). The higher is the amount of points, the more people consider themselves happy and satisfied with

their lives. In this study, this scale was demonstrated by Alpha Cronbach 0.752.

Stress was measured on a perceived stress scale (PSS; [25]). This is a 10-point instrument that measures the perception of stress. Participants were asked to choose how often they felt certain feelings and thoughts during the last month. It was used 5-point Likert scale in the range from 0 (never) to 4 (very often). Examples of questions: "How often have you been worried the last month because of unforeseen events?", "How often did you feel nervous tension or stress last month?"

The four points (4, 5, 7, 8) were reciprocal. Therefore, these points were inverted. The final score was obtained by summing all the marks by 10 points. Higher scores point to a higher level of perceived stress. Ukrainian translation of the PSS was applied in this study. The coefficient of internal consistency was 0.836.

The regularity of physical exercises was evaluated with the help of the question: "Do you practice physical exercises for at least an hour and at least three times a week?". Consent was encoded as "1", and disagreement – as "0".

Statistical analysis: Descriptive statistics (average values, standard deviations) and correlations between variables are calculated. The moderator analysis was conducted on the basis of regression analysis. All calculations were made applying SPSS version 19.0. The analysis of the interaction effect was carried out applying the PROCESS macros ([26]).

Results

Descriptive statistics, correlations between regular exercise physical activity, level of perceived level of stress and satisfaction with life students are shown in Table 1.

Table 1. Descriptive statistics and correlations of the analyzed variables

Variables	M	SD	Y	X	M
Satisfaction with life (Y)	16.32	5.27	1		
Perceived stress (X)	18.23	6.16	-.565***	1	
Physical exercises (M)	.52	.50	.296***	-.087	1

Note. *** p < 0.001.

Perceived stress (Table 1) negatively correlates with satisfaction with life ($r = -0.565$; $p < 0.001$). The regularity of exercises correlates positively with life satisfaction ($r = 0.296$; $p < 0.001$). It wasn't detected the interrelation between perceived stress and physical exercises.

The results of regression analysis are presented in Table 2 in the general regression model of life satisfaction with centered perceived stress (X), $Y = -0.557X + 2,628M + 0.215XM + 15,080$. The regression model explains 39.5% of the dispersion of life satisfaction ($F_{(3; 351)} = 76.513$; $p < 0.000$).

In a regression model $Y = i_1 + b_1X + b_2M + b_3XM$ b_1 and b_2 are conditional effects [26]. These coefficients of regression estimate the effect of X when $M = 0$ and the influence of M when $X = 0$, respectively.

The coefficient of regression for the variable of physical exercises is $b_1 = 2,628$. It is statistically different from zero ($p < 0.000$). This is the predicted difference in the satisfaction with life between active students (regularly practice physical exercises) and passive students (having zero according to the scale of perceived stress, $M = 0$). The coefficient is positive. It means that inactive students ($X = 1$), satisfaction with life is higher.

The regression coefficient for the perceived stress scale is $b_2 = -0.557$. It is also statistically significantly different from zero ($p = 0.000$). This is the predicted difference in the satisfaction with life between two passive students, which differ in one unit in their perception of stress ($X = 0$). The sign is negative.

The regression coefficient for physical exercises and perceived stress is $b_3 = 0.215$. This coefficient quantifies how changes the effect of physical activity on the satisfaction with life changes with the perceived stress per standard unit. Here b_3 statistically significantly differs from zero ($p = 0.003$). This means that the effect of physical activity on satisfaction with life depends on the interaction of perceived stress and physical exercises. An increase in perceived stress per unit leads to a difference in the satisfaction with life between passive and active students (by 0.215 units).

In fact, reducing the satisfaction with life under the influence of perceived stress is refracted through physical exercises. Active students are less inclined to reduce satisfaction with life under the influence of stressful circumstances of life. When one variable reduces the influence of another variable on the criterion, this variable buffers the influence of another variable. In our study, the role of a buffer variable plays the regularity of exercises.

Table 2 demonstrates the inclusion of the interaction increases R^2 by 0.021. Interaction is 2.0% of dispersion in satisfaction with life, without conditional effects [$F_{var}(1.351) = 8.956, p = 0.003$]. It may seem like a small value. However, it is the order that can usually be found

in behavioral research. Fig. 1 shows that the effect of buffering is really strong.

Discussion

In the presented study, the relationship between regular exercise with physical activity perceived stress, and student satisfaction is considered. In previous studies, we studied basically separate links between stress and physical activity, or stress and satisfaction with life, or physical exercise and life satisfaction. We studied the relationship between these three constructs. We hypothesized that regular exercise would be a kind of buffer. He softens the relationship between perceived stress and student satisfaction. Our hypothesis was confirmed. It was found that the effect of the interaction of physical exercises and perceived stress on satisfaction with the life of students is statistically significant.

Other researchers have shown the relationship between physical exercise and stress indicators. In this study, there was no significant association between exercise and perceived stress. It coincides with some studies [21, 22]. Non-consistency of the results may be due to some factors and conditions of research. The research involved people of different ages. The physical exercises of different types and intensity were also applied.

In general, the positive effect of the interaction of physical exercises and stress can be explained both at the level of physiological and psychological factors. So, physical activity can significantly increase the production of serotonin and endorphins in the brain. It contributes to a sense of well-being. Physical exercises contribute to the new growth of neurons in the adult's brain, especially in the hippocampus [27]. As a result, it is reduced the feeling of anxiety and depression.

Psychological explanation of the positive effect of regular physical exercises meet the psychological needs of the person. It is about the need to increase self-efficacy, achievement of mastery, overcoming alienation, strengthening the autonomy and enhancing belonging. Satisfaction of such needs affects the satisfaction of various spheres of life, which contributes to the satisfaction with life in general [28]. Our previous studies

Table 2. Regression analysis of satisfaction with life (Y) as a function of perceived stress (X) and physical exercises (M), n=355

Dependent variable: Y – satisfaction with life						
Predictors	Coefficient	SE	t	p	95% confidence interval	
					low	up
Constant	15.080	.308	49.031	.000	14.475	15.685
X	2.628	.438	5.996	.000	1.766	3.490
M	-.557	.047	-11.791	.000	-.650	-.464
X×M	.215	.072	2.993	.003	.074	.357
Increase R^2 due to interaction						
X×M	R^2 -var.	F	df1	df2	p	
	.021	8.956	1	351	.003	

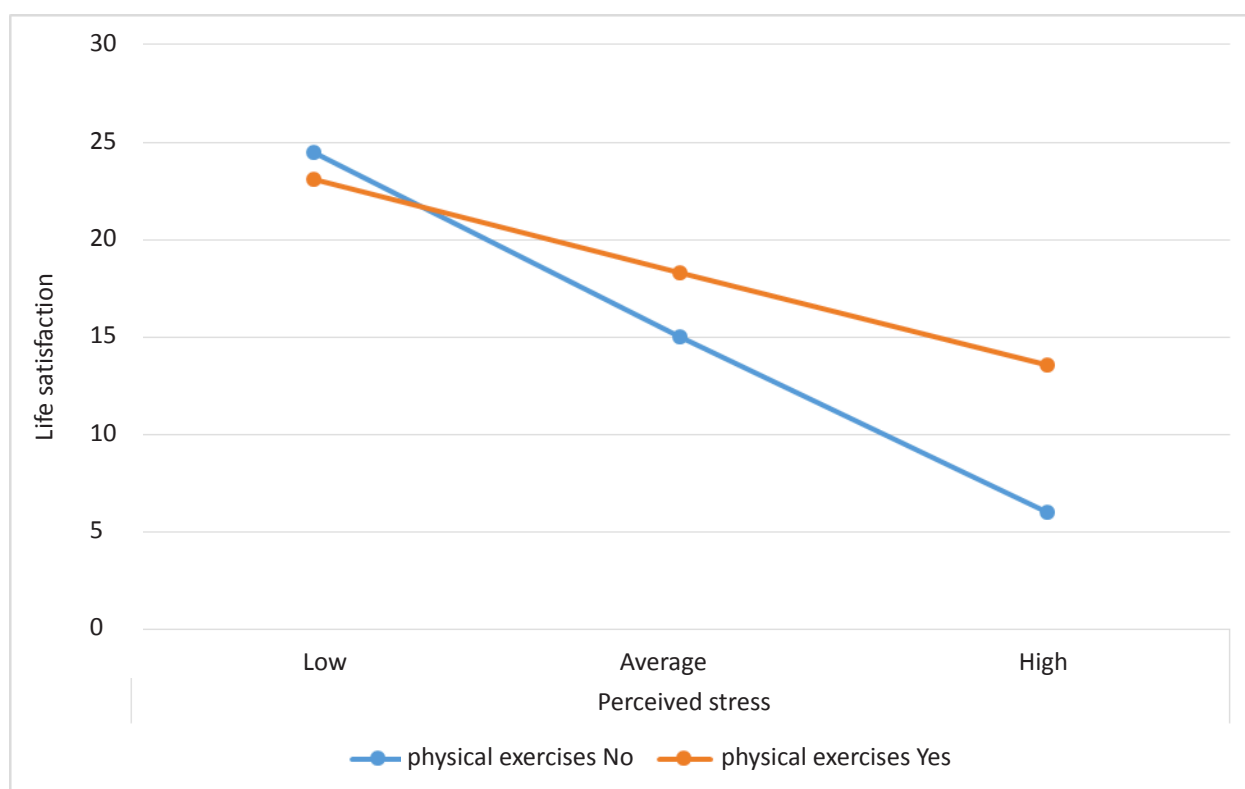


Fig. 1. Regression of satisfaction with life on physical exercises at three levels of perceived stress.

[29, 30] determined that people with a high index of personal resources (self-efficacy, self-control, viability, and optimism) are more capable to manage potential threats. They feel a lower level of excitement or anxiety, stress in the form of burnout. These personal resources are flexible and forming during life. Therefore physical exercises can be an effective means for their purposeful correction and formation. In addition, physical exercises can affect the quality of life. They provide opportunities to satisfy peak moments [31].

This study is expanding previous studies. This study evaluates the effect of physical activity and perceived stress with students' satisfaction with life.

The results of this study deserve attention. But there are certain limitations that can be leveled out in future studies. Firstly, the participants of this study were only young age students. Therefore, the result can not be generalized to the entire adult population.

Secondly, current results do not foresee causal relationships between perceived stress, physical exercises, and satisfaction with life (this study was cross-sectional). The prospect of further research is to carry out research on longitudinal plans. They could help to establish causal

relationships between physical exercises, perceived stress, and life satisfaction.

Conclusions

Thus, the obtained results confirm the hypothesis that physical exercises act as a buffer against the stress. They contribute to satisfaction with life at university students. The revealed features of the interaction of physical exercises with perceived stress are expressed in the fact that reducing the satisfaction of life under the influence of perceived stress is more characteristic of passive students (practice physical exercises not regularly). It is required the development of targeted activities among the university students. Such actions should be directed at the promotion and organization of physical exercises. The urgent task is to conduct long-term studies. The basis of such studies is objective indicators of motor behavior. It will help to extend the information about their impact on the quality of life of students.

Conflict of interest

The author declares that there is no conflict of interests.

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Cite this article as:

Olefir VO, Kuznetsov MA, Plokhikh VV. Effect of physical exercises and perceived stress interaction on students' satisfaction with life. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):30–35.

<https://doi.org/10.15561/18189172.2019.0105>

The electronic version of this article is the complete one and can be found online at:

<https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 15.01.2019

Accepted: 15.02.2019; Published: 27.02.2019

The relationship between life satisfaction and alienation level of disabled athletes (Kayseri Case)

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: The aim of this study is to investigate the relationship between life satisfaction and alienation level of disabled athletes living in Kayseri.

Material: The population of the study consists of 421 disabled athletes engaged in sports. The sample consisted of 109 disabled athletes identified by simple random sampling method. The study was performed by scanning method and the data was collected by survey method. Demographic information form consists of 5 questions, «Life Satisfaction Scale» which was developed by Diener et.al. and translated into Turkish by Köker, of which reliability and validity study had been conducted and the «Alienation Scale» developed by Dean and adopted into Turkish by Kinik were applied. The obtained data were recorded in the SPSS 23 package program. Mann Whitney U test was used for comparison of binary groups and Kruskal Wallis test was used for multiple comparisons. Spearman Correlation test was applied to determine the relationship between life satisfaction and alienation level sub-dimensions.

Results: It has been determined that there is a difference between life satisfaction and alienation level sub-dimension scores of disabled athletes according to the gender and marital status, that there is a difference according to life satisfaction level score and ages of 18-23, 24-29 and 18-23 and 30 and above in terms of alienation level and irregularity sub dimensions; and ages of 18-23, 24-29 and 18-23 and 30 and above in terms of social isolation sub dimension and that there is a statistically significant difference between their life satisfaction level score according to education status and alienation level sub dimension. It has been determined that there is a negative and medium sized relation between the level of alienation and life satisfaction, weakness ($r = -.491, p = .050$) and the irregularity ($r = -.619, p = .050$) sub-dimension, and that there is a positive relation between life satisfaction and social isolation sub dimension ($r = .795, p = .050$).

Conclusions: A medium level negative relation was determined between the level of life satisfaction and alienation with gender, age, marital status and educational status and between the level of alienation with life satisfaction and weakness and irregularity sub dimensions; and a high positive relation was determined with the social isolation sub dimension.

Keywords: disabled individuals, alienation, life satisfaction, athletes, social.

Introduction

It is known that disabled individuals in Turkey have intense problems in terms of integration with the society. Problems in many areas of life make it difficult for disabled individuals to live in a functional unity with the society they are a part of. Individuals who constantly struggle with problems and who cannot produce meaningful solutions will feel unhappy. This means a lower quality of life, eliminating the self-realization, a fundamental human right [1]. Quality of life indicates the result of comparing the expectations of individual with the real status, depending on life satisfaction. Because life satisfaction determines the level of individual reaching the goals he/she has set or reaching to happiness. Any increase in reaching the individual goals will increase the life satisfaction [2]. In other words, it is related how much a person likes his/her own life [3]. Improving the quality of life of the disabled individuals will be possible through integrating disabled individuals within the society at the highest level and this is also a social responsibility [4].

But today, the rapid change brought with

industrialization and technological developments causes the individual to suffer from loneliness and alienation. On the other hand, individuals are concerned about fulfilling their responsibilities in daily life, building relationships with others and maintaining a healthy life. The emergence of the phenomenon of alienation increases rapidly as these changes and developments occur [5]. In addition, alienation can be directed towards one's own self or to the parts of the self as well as towards others [6]. Considering the individuals with disabilities, it has been suggested that alienation is a disease that occurs due to social conditions and emotional personality. There are five different dimensions of alienation regarding an individual's self-perception and behavior. These are: Weakness, Futility, Irregularity, Alienation to Society and Self Alienation [7].

Finally, the restrictive, stigmatizing, discriminatory and hence obstructive attitudes of the society towards disabled individuals set up the environment where individuals with disabilities are isolated from society. In recent years, the integrative approach of social model between the disabled individuals and society has been increasingly accepted. It is stated that individuals with disabilities have a great need for such an approach [8].

Hypothesis: There is a relationship between the level of life satisfaction and the level of alienation of disabled individuals engaged in sports. According to some demographic characteristics of disabled individuals engaged in sports, there is a difference between the levels of life satisfaction and alienation.

Purpose: The purpose of this study is to investigate the relationship between life satisfaction and alienation level of disabled athletes living in Kayseri.

Material and Method

Participants

Forming Voluntary Groups:

For the purpose of the study, the population of the study was composed of disabled (physical, auditory and visually impaired) individuals ($n = 421$) and the sample consists of voluntary disabled athletes who were selected by simple random method ($n= 109$). After the participants were informed about the study, participation in the study was carried out voluntarily.

Measurements and Procedures.

The study was performed by scanning method and the data was collected by survey method. Personal information form (gender, age, marital status, education status), life satisfaction and alienation scale were applied to the participants.

In order to measure the level of life satisfaction of the participants, a 5-item life satisfaction scale was used, which was developed by Diener et al. [9] and translated into Turkish by Köker [10] with a validity and reliability value of 0.90. The highest score that could be obtained from the scale is 35, whereas the lowest score is 5. The reliability of life satisfaction scale is 0.90. It is stated that life satisfaction increases as the score obtained from the scale does [10]. The scale questions consist of seven scales in the Likert Type Scale; such as “I Completely Agree”, “I Strongly Agree”, “I Agree”, “I Somewhat Agree”, “Neutral”, “I Disagree” and “I Totally Disagree”. In order to measure the alienation level of participants, the “Alienation Scale”, which was developed by Dean [11] and adapted to Turkish by Kınık [5] with validity and reliability value of 0.82 was used. Alienation scale consists of 24 items and 3 sub dimensions. The Weakness dimension of the Alienation process consists of items 2, 6, 9, 13, 15, 18, 20, 21 and 23; the Irregularity dimension

of the Alienation process consists of items 4, 7, 10, 12, 16 and 19; and the Social Isolation dimension of the Alienation process consists of items 1, 3, 5, 8, 11, 14, 17, 22 and 24. There are five statements in each of the 24 items in the Alienation Survey. The items in the scale are in the form of “5-Likert Type Scale” with 1 as “Never”, 2 as “Rarely”, 3 as “Sometimes”, 4 as “Mostly” and 5 as “Always”.

Statistical Analysis

The data obtained were recorded on computer with package program of IBM SPSS 23.0. Personal information, inventory averages and factor scores were provided by determining the frequency (f) and percentage (%) values of the participants. The parametric and non-parametric distribution of the were analyzed by focusing on parametric and non-parametric distribution curves and skewness-kurtosis values. Data have non-parametric distribution. Mann Whitney U test was used for comparison of binary groups and Kruskal Wallis test was used for multiple comparisons. Spearman Correlation test was used to determine the relationship between the sub-dimensions of Life satisfaction and Alienation level.

Results

When Table 1 is examined, it is determined that among the disabled individuals; 54.1 % are male and 45.9 % are female, 28.4 % are between the ages 18-23, 21.1 % between the ages 24 and 29 and 50.5 % are 30 years or above; 54.1 % are single and 45.9 % are married and 26.6 % have primary school education level and 73.4 % have secondary school education level.

Table 2 indicates the comparison of life satisfaction scores and alienation level sub-dimension scores according to the gender of the participants. A statistically significant difference was found between the participants’ life satisfaction level scores and alienation level scores ($p < 0.05$).

Table 3 indicates the comparison of life satisfaction scores and alienation level sub-dimension scores according to the age of the participants. According to the age group of the participants, there was a statistically significant difference between the ages of 18-23 and 24-29, and between the ages 18-23 and 30 ($p < 0.05$). Statistically significant difference was determined regarding the level of alienation of participants under the sub dimension of

Table 1. Socio-Demographical Characteristics of Participants

Characteristic	Variables	Frequency	Percentage
Gender	Male	59	54.1
	Female	50	45.9
Age	18-23	31	28.4
	24-29	23	21.1
	30 and above	55	50.5
Marital Status	Married	59	54.1
	Single	50	45.9
Educational Status	Primary School	29	26.6
	Secondary School	80	73.4

irregularity for the ages 18-23 and 24-29 and 27-29 and above 30, and under the sub dimension of social isolation for the ages 18-23 and 24-29 and 27-29 and above 30 ($p < 0.05$).

Table 4 indicates the comparison of life satisfaction scores and alienation level sub-dimension scores according to the marital status of the participants. A statistically significant difference was found between the participants'

Table 2. Assessment of Participants' Life Satisfaction and Alienation Level and Perceptions According to Their Gender

Characteristic	Gender	<i>n</i>	<i>median</i>	<i>min</i>	<i>max</i>	<i>Z</i>	<i>P</i>
Life Satisfaction	Male	59	14	10	20	-8.014	.000
	Female	50	30	27	34		
Weakness	Male	59	24	14	33	-1.442	.000
	Female	50	22	22	24		
Irregularity	Male	59	18	7	19	-6.104	.001
	Female	50	14	15	15		
Social Isolation	Male	59	26	15	28	-7.589	.000
	Female	50	29	30	31		

Note: $n = 109$; Life Satisfaction: ($Z = 8.014$; $P = .000$); Weakness: ($Z = -1.442$; $P = .000$); Irregularity: ($Z = -6.104$; $P = .001$); Social Isolation: ($Z = -7.589$; $P = .000$); $P < 0.050$

Table 3. Assessment of Participants' Life Satisfaction and Alienation Level and Perceptions According to Their Age

Characteristic	Age	<i>n</i>	<i>median</i>	<i>min</i>	<i>max</i>	χ^2	<i>P</i>	Difference
Life Satisfaction	18-23 ¹	31	31	19	33	34.11	.000	1-2 1-3
	24-29 ²	23	17	12	28			
	30 and above ³	55	19	12	34			
Weakness	18-23 ¹	31	24	24	35	4.59	.101	-
	24-29 ²	23	24	14	35			
	30 and above ³	55	24	14	35			
Irregularity	18-23 ¹	31	15	15	20	17.09	.000	1-2 1-3
	24-29 ²	23	16	7	20			
	30 and above ³	55	16	7	20			
Social Isolation	18-23 ¹	31	31	25	31	40.89	.000	1-2 1-3
	24-29 ²	23	26	16	31			
	30 and above ³	55	26	16	31			

Note: $n = 109$; $P < .050$

Table 4. Assessment of Participants' Life Satisfaction and Alienation Level and Perceptions According to Their Marital Status

Characteristic	Marital Status	<i>n</i>	<i>median</i>	<i>min</i>	<i>max</i>	<i>Z</i>	<i>P</i>
Life Satisfaction	Married	59	16	12	22	-9.014	.000
	Single	50	31	27	34		
Weakness	Married	59	26	14	35	-3.743	.000
	Single	50	24	24	24		
Irregularity	Married	59	19	7	20	-6.608	.000
	Single	50	15	15	15		
Social Isolation	Married	59	26	16	29	-9.509	.000
	Single	50	31	31	31		

Note: $n = 109$; Life Satisfaction ($Z = -9.014$; $P = .000$); Weakness: ($Z = -3.743$; $P = .000$); Irregularity: ($Z = -6.608$; $P = .000$); Social Isolation: ($Z = -9.509$; $P = .000$); $P < .001$

Table 5. Assessment of Participants' Life Satisfaction and Alienation Level and Perceptions According to Their Educational Status

Characteristic	Educational Status	<i>n</i>	<i>median</i>	<i>min</i>	<i>max</i>	<i>Z</i>	<i>P</i>
Life Satisfaction	Primary School	29	16	15	19	-6.123	.000
	Secondary School	80	30	12	34		
Weakness	Primary School	29	35	14	35	-3.537	.000
	Secondary School	80	24	24	26		
Irregularity	Primary School	29	20	7	20	-3.198	.001
	Secondary School	80	15	15	19		
Social Isolation	Primary School	29	25	16	25	-8.432	.000
	Secondary School	80	31	26	31		

Note: *n* = 109; Life Satisfaction: (*Z* = -6.123; *P* = .000); Weakness: (*Z* = -3.537; *P* = .000); Irregularity: (*Z* = -3.198; *P* = .001); Social Isolation: (*Z* = -9.509; *P* = .000); *P* < .050

Table 6. Relation Between the Life Satisfaction and Alienation Level of Participants

Characteristic	Spearman Correlation	1	2	3	4
Life Satisfaction	<i>r</i>	1			
	<i>p</i>				
	<i>n</i>	109			
Weakness	<i>r</i>	-.491	1		
	<i>p</i>	.000			
	<i>n</i>	109	109		
Irregularity	<i>r</i>	-.619	.904	1	
	<i>p</i>	.000	.000		
	<i>n</i>	109	109	109	
Social Isolation	<i>r</i>	.795	-.247	-.458	1
	<i>p</i>	.000	.010	.000	
	<i>n</i>	109	109	109	109

Note: Life Satisfaction (1) - (*r* = 1); Weakness (2) - (*r* = -.409; *p* = .000); Irregularity (3) - (*r* = -.619; *p* = .000); Social Isolation (4) - (*r* = .795; *p* = .000); *P* < .001

life satisfaction level scores, their alienation level scores and perception sub dimension scores (*p* < 0.05).

Table 5 indicates the comparison of life satisfaction scores and alienation level sub-dimension scores according to the educational status of the participants. A statistically significant difference was found between the participants' life satisfaction level scores and alienation level scores according to their educational status (*p* < 0.05).

As it can be seen in Table 6, it has been determined that there is a negative and medium sized relation between the level of alienation and life satisfaction, weakness (*r* = -.491, *p* = .050) and the irregularity (*r* = -.619, *p* = .050) sub-dimension, and that there is a positive relation between life satisfaction and social isolation sub dimension (*r* = .795, *p* = .050).

Discussion

Life satisfaction is described as the individual's feeling of well-being from different perspectives such as happiness and spirits and as the dominance of positive emotion over negative ones as a result of person's good feelings in social and physical terms [12]. Alienation is a psychological state which appears as a result of individual and social processes. Therefore, the role of the individual in society and acceptance of society are important in personal self-realization [13]. The number of people with disabilities is increasing in Turkey and sport is considered as an important factor in adapting the disabled individuals to the society. Regarding the disabled individuals within the scope of this study, the importance of sport for their reintegration into the society and their life satisfaction and

alienation levels were examined to find out whether there were any differences or not.

There was a statistically significant difference between the satisfaction level score and alienation level sub-dimension scores of participants according to their gender. According to this, life satisfaction score of women with disabilities is higher than that of men with disabilities. Again, it is seen that social isolation level of disabled women as a sub dimension of alienation is higher than the disabled male individuals. In this case, it can be said that life satisfaction of disabled individuals participating in the study is affected by their gender. When the literature is examined, studies indicate that self-confidence and life satisfaction levels of the physically disabled athletes differ according to gender variable. It is reported that female athletes with physical disabilities have a higher self-confidence and life satisfaction when compared with the male athletes [14]. Culture, type of sports, self-esteem and activity [15], ability to manage the situation, and to have a feeling of significance with themselves and their environment are reported as contributing to life satisfaction [16].

When the comparison of life satisfaction and alienation level sub-dimension scores according to the age of the participants is examined; a significant difference was determined regarding the level of alienation of participants under the sub dimension of irregularity for the ages 18-23 and 24-29 and 27-29 and above 30, and under the sub dimension of social isolation for the ages 18-23 and 24-29 and 27-29 and above 30. The level of perception of life, level of alienation and sub-dimensions of perception of alienation and social isolation were high. In this case, although the sports activities of disabled individuals increase their life satisfaction levels, it is understood that social and cultural characteristics, self-realization level and ages also increase the alienation level of the disabled individuals. No studies could be found in the literature that support our research.

According to the marital status of the participants, it was found that there was a statistically significant difference between the level of life satisfaction and alienation level sub-dimension scores. It is seen that the single disabled individuals have higher level of life satisfaction levels than the married ones.

It is seen that weakness and irregularity levels, two sub dimensions of alienation, are higher among the married disabled athletes than the single ones; and the social isolation levels of singles are higher than the married ones. The perspective of individuals to the dimensions of alienation according to marital status differ. In general, if we consider marriage as a situation that enables the development and happiness of the individual, the high levels of life satisfaction rates and social isolation among singles in this study reveals different results. Şahin and Akpınar [17] reported that life satisfaction of married persons with disabilities was higher than that of singles. This study is not in parallel with our findings.

A statistically significant difference was found between life satisfaction level and alienation level sub-

dimension scores according to the education level of the participants.

According to the level of education, life satisfaction scores of secondary school graduates are higher. When the sub-dimensions of alienation were examined, it was found that the scores of primary school graduates in weakness and irregularity were higher and the scores of secondary school graduates were higher in social isolation dimension. When the literature is examined, Puruçuoğlu and Aksel [18] reported that the level of education affects the behavior and lifestyle of women with disabilities. Considering that the educated individual is better acquainted with self, it is stated that life satisfaction will also increase [18]. There are studies in the literature which state that there is a relation between the variables of education level and occupation status and the life satisfaction.

It has been found that there is a high positive relationship between life satisfaction of disabled individuals and alienation level's sub dimensions of weakness and irregularity in a negative level, and a high positive relation between life satisfaction and social isolation sub-dimension.

The conclusion of the fact that disabled individuals involved in sports have a certain level of life satisfaction, but also feel as isolated from society is an unexpected result. We can explain this with psychological and physical circumstances of the individual. Individuals may have been satisfied with life with the support of sports in their inner world by isolating themselves from today's society. On the other hand, individuals with disabilities may feel isolated from the society due to their physical and physiological deficiencies. We define weakness as the person's inability to influence the society he / she lives in, and to think that he / she does not have anything to change the result. In addition, irregularity is defined as the individual's adoption of unacceptable behavior by the society in order to achieve the achievement goals determined by social norms [21]. According to these explanations, it can be seen that there is a negative relationship between the life satisfaction of disabled people and weakness and irregularity.

Conclusions

As a result, it is determined that the level of life satisfaction and alienation is related to gender, age, marital status and educational status; and that there is a medium level negative relation between the sub dimensions of weakness and irregularity; and a high level of positive relation between the life satisfaction and alienation level and social isolation sub dimension.

It is considered that the type of sports disabled individuals does, their social and cultural environment, self-esteem and physical activity level have positive contribution to their life satisfaction. In addition, when we look at the average of the variables such as gender, marital status, age, education level and occupation of the disabled individuals; we can say that sport has increased the life satisfaction of the individual. At the same time, it

is considered that the fear that the individuals' attitudes and behaviors will not be accepted within the society and that they will not have equal opportunities and rights with other individuals also increase the level of alienation.

The study group consists of physical, auditory and visually impaired people. Therefore, there are differences in life satisfaction levels and alienation levels. A separate study can be conducted done for each disabled group. Thus, different disability groups can be evaluated separately and then compared with other disabled groups. On the other hand, the study consists of disabled individuals living in Kayseri only, which is a limitation of our study area. The

study can also be extended to a wider geography and thus the research area can be expanded. Despite the fact that people with disabilities have provided life satisfaction, physical and physiological insufficiency compared to other individuals in society may have caused social alienation. For this reason, training and counseling should be done within the scope of rehabilitation program which may be psychological support for disabled people.

Conflict of Interests

No conflicts of interest have been stated by the authors.

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Cite this article as:

Özkatar Kaya E, Pekel A. The relationship between life satisfaction and alienation level of disabled athletes (Kayseri Case). *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):36–42.
<https://doi.org/10.15561/18189172.2019.0106>

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Received: 08.12.2018

Accepted: 15.01.2019; Published: 27.02.2019

The development of speed-power qualities of schoolchildren with different typologies applying coordination training

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: to determine the influence of coordination abilities on the development of speed-power qualities in 7-8 years old schoolchildren with a different type of nervous system.

Material: the pedagogical experiment was conducted in a regular school and lasted 7 months. The study involved children 7-8 years old ($n = 60$). All schoolchildren were differentiated into 3 groups (in each group – $n = 20$). Coordination abilities were determined by the test "3x10 shuttle run". Speed- power qualities were determined by the test "Standing Long Jump". The strength of the nervous system was diagnosed according to the "Tapping test" method.

Results: it was determined that it is necessary to develop the coordination abilities of 7-8 years old schoolchildren. It was determined the interrelation of coordination abilities and speed-power qualities. It was confirmed the effectiveness of a differentiated approach based on the typology of children. The results were realized at physical education lessons at school.

Conclusions: it is recommended to develop coordination abilities during 12-15 minutes in physical education classes for schoolchildren. Such training will be more effective if consider the typology of the nervous system of schoolchildren.

Keywords: speed-power qualities, differentiated approach, coordination of motion, schoolchildren, typology.

Introduction

Coordination abilities were classified about 70 years ago [1]. The level of their development affects the accuracy of different motor actions. The value of coordination in a person's life is huge. Such abilities allow you to solve unexpected motor problems accurately and quickly [2, 3]. The most common are general coordination abilities. They are the foundation for the development of special and specific abilities. A sensitive period for the development of coordination abilities is the primary school age [4].

The several studies devoted to interrelations of coordination abilities and physical qualities [5, 6]. Among the physical qualities should be noted speed-power qualities. Such qualities express in motor actions, which require significant muscle strength and quickness of motor actions [7].

The teachers often apply a differentiated approach to work with children. Such approach allows to reveal the internal reserves of the schoolchildren body, to reveal their physical and mental potential [8, 9]. Despite differences in children, they can be grouped by criteria. For example, by age, gender, height, technical training [10, 11]. One of these criteria is typology. In turn, typology features the express of the properties of the nervous system. The concept of the type of nervous system includes strength, mobility, lability, and some other features. The strength of the nervous system by activation process is a prospective study. The effectiveness of applying the differentiated approach using the criterion of the nervous system strength was proved in several studies [12, 13].

Other studies confirm:

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doi:10.15561/18189172.2019.0107

video feedback in fostering motor learning, motivation and self-assessment during a physical education program with young children [14];

Visual-motor integration is a complex ability that combines fine motor coordination (an aspect of school readiness) and visual-spatial reasoning skills [15];

Playing and exercising during the school day are important in fulfilling the recommendations for daily physical activity for children, as well as in promoting their mental and social health [16];

Results revealed that trait personality (particularly the social self-esteem aspect of extraversion) predicted lower anxiety and higher self-efficacy and intentions to exercise in both females and males [17].

We failed to find data concerning the influence of coordination abilities on the level of development of speed-power qualities of children 7-8 years old with different strength of the nervous system. This problem is the aim of this study.

Research hypothesis. If apply exercises for the development of motor actions coordination in children at physical education classes, the indicators of coordination abilities and indicators of speed-power qualities will improve. Such exercises are performed within 12-15 minutes. The load is regulated depending on the age of the children (7-8 years old) and the type of the nervous system.

Material and methods

Participants:

The pedagogical experiment involved 60 girls and boys of 7-8 years old who study in the first form of the ordinary school. Parents gave the written consent for the

participation of their children in the experiment.

Design of research:

The children were healthy and admitted to physical education classes. Before the experiment, all schoolchildren were differentiated into 3 equal groups [18].

1) in the CG (control group) were children who trained according to the standard program of physical education for first-form pupils [19].

2) in the EG-1 (experimental group – 1) were schoolchildren who trained according to the standard program [19]. However, after a short warm-up, the children performed coordination exercises within 12–15 minutes. Exercises were easy to perform. Exercises without objects (running, jumping, somersaults) and with objects (hula hoop, stick, bench, ball). Coordination complexity in performing exercises increased due to the introduction of additional objects, new elements of exercises, changing the movement direction. And some other methodical techniques [7].

3) in the EG-2 (experimental group – 2) were schoolchildren who trained according to the standard program [19]. Children performed exercises on the development of coordination abilities [7]. The differentiated approach was applied at the classes with schoolchildren, which is based on the strength of the nervous system by the activation process. For children, the load was differentiated according to the strength of their nervous system. For schoolchildren with a strong nervous system, the load was intense, and for schoolchildren with a weak nervous system – the load was volume. The intensity of the load was increased by reducing the time of rest and increasing the number of exercises. The volume of the load was increased by increasing the number of exercise repetitions and increasing the time of rest [13, 20, 21].

In total, 59 training classes were conducted during the pedagogical experiment. Classes were held twice a week for 45 minutes.

At the beginning and at the end of the pedagogical experiment, all the children passed the development tests: coordination abilities (3x10 shuttle run); speed-strength qualities (standing long jump). In EG-2, children were differentiated into two subgroups of 10 people, according to the strength of the nervous system according to by

activation process (tapping test).

Shuttle run [19]. Two lines are drawn at a distance of 10 m. At the signal, children must run from start to finish (touch the line by hand). Then go back to the start line (touch it by hand) and cross the finish line.

The standing long jump with double beat [19]. Three attempts are provided. The best result is taken into consideration.

Tapping test [22]. The paper has six squares. At the signal, the students begin quickly put points inside one square within five seconds. Then move to another square. After the sixth square the exercise finishes. The number of points in each square sum up. A graph is constructed and the strength of the student’s nervous system is determined.

Statistical analysis

Statistical processing of the results was carried out applying BioStat 2009 and Excel. The result was significant at $p < 0.05$ [23, 24].

Results

Before the beginning of the pedagogical experiment, all schoolchildren passed the test for the development of coordination abilities. The children were differentiated into three identical groups ($p > 0.05$).

Schoolchildren in EG-2 were differentiated into two subgroups based on the strength of the nervous system by activation process. After the end of the pedagogical experiment, the following results were obtained (Table 1).

Table 1 revealed that the indicators of schoolchildren in all tests have changed.

Schoolchildren of the CG (trained according to the standard program) improved their results in the “standing long jump” test (by 3.2 cm), but degraded results in the “shuttle run” test (from 10.3 ± 0.6 to 10.4 ± 0.6). Such indicators allow to confirm the low efficiency of application the standard teaching methods ($p > 0.05$).

Schoolchildren of EG-1 (trained according to the standard program and performed exercises on the development of coordination abilities) improved their performance in both tests. The standing jump length increased by 10.6 cm ($p < 0.05$), and coordination abilities improved from 10.3 ± 0.6 to 10.1 ± 0.5 ($p > 0.05$). These results allow to confirm the effectiveness of the application of coordination training.

Schoolchildren of EG-2 significantly improved their

Table 1. Indicators of coordination and speed-power qualities of schoolchildren of 7-8 years old ($M \pm m$)

Indicators	Group	Before the experiment	After the experiment	p
Shuttle run (s)	CG	10.3±0.6	10.4±0.6	>0.05
	EG-1	10.3±0.6	10.1±0.5	>0.05
	EG-2	10.3±0.6	9.7±0.5	<0.05
Standing long jump (cm)	CG	125.9±2.6	129.1±3.1	>0.05
	EG-1	131.3±3.4	141.9±2.9	<0.05
	EG-2	123.5±3.6	144.5±4.1	<0.05

performance in both tests. In the 3x10 shuttle run test the results improved by 0.6 s ($p < 0.05$), and the standing long jump increased from 123.5 ± 3.6 to 144.5 ± 4.1 ($p < 0.05$). The obtained results confirm a high level of efficiency in the application of a differentiated approach to physical education classes. This approach is based on the strength of the nervous system by the activation process

Discussion

Coordination abilities are important for schoolchildren and athletes. These abilities allow to perform precise motor actions and save energy during several motor actions [2, 3, 7]. There are several classifications of coordination abilities [1]. These studies consider individual abilities and give general recommendations for improving motor actions performance. It is known that the primary school age is a favorable period for coordination development. Our research only confirms these studies.

Some studies point at the correlation between coordination abilities and physical qualities [5, 6, 25-27]. However, we didn't find studies devoted to the influence of coordination abilities on children's physical qualities (for example, on speed-power abilities). Such abilities are also very important in physical education, sports, daily life, and human activities. The results of our study confirm the existence of such an interrelation. Schoolchildren improved coordination indicators and increased speed-power indicators.

The differentiated approach is the basis of pedagogical work at school. Such an approach allows to reveal the inner potential of the group and each student [8, 9]. Earlier we determined the wide variety of criteria that are applied to differentiate children into groups. One of these criteria is the typology of the nervous system [12, 13]. It is evident the need for a clearer revealing the application of physical activity for children with different nervous systems.

The essence of the application of the typological criterion is to differentiate the load in children with different strengths of the nervous system. For schoolchildren with

a strong nervous system, it is more efficient to apply an intense load, and for schoolchildren with a weak nervous system - a volume load [20, 21].

It is important to understand that children with a weak nervous system by activation process are not weak in general. Such schoolchildren need a different physical activity. Children with a weak nervous system have several advantages over children with a strong nervous system. For example, they are able to perform longer monotonous actions. Such children have high reactivity and the ability to master complex coordination exercises. Schoolchildren with different types of the nervous system go to the same aim in different ways.

Thus, our study determined the interrelation of coordination abilities and speed-power qualities among schoolchildren of 7-8 years old. It was revealed the effective influence of coordination training on the indicators of speed-power qualities. It is determined the efficiency of applying a differentiated approach based on the typology of schoolchildren. This allows to confirm the achieving the aim and complete confirmation of the research hypothesis.

Conclusion

It is necessary to develop coordinating abilities of schoolchildren within 12-15 minutes at every physical education lesson. It is necessary to apply a differentiated approach, which is based on the typology of the nervous system of schoolchildren. This approach will significantly improve the indicators of coordination abilities and speed-power qualities.

The results of our research can be used by teachers, trainers, and athletes. The research is relevant and promising for the study of new interrelations of coordination abilities and various physical qualities.

Conflict of interest

The author declares that there is no conflict of interests.

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Cite this article as:

Polevoy GG. The development of speed-power qualities of schoolchildren with different typologies applying coordination training. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):43–46. <https://doi.org/10.15561/18189172.2019.0107>

The electronic version of this article is the complete one and can be found online at:

<https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 10.01.2019

Accepted: 12.02.2019; Published: 27.02.2019

Structure and content of tourists' physical training at the stage of preliminary basic training

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Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection.

Abstract

Purpose: The purpose of the research is to substantiate scientifically the structure and content of tourists' physical training at the stage of preliminary basic training.

Material: The study involved athletes aged 12-13 years. The control and experimental groups consist of 32 young men in each group.

Results: It was developed and experimentally substantiated the structure and content of athletes-tourists' physical training. It was determined the content and volumes of physical training types (general, special and additional). It was developed the complexes of training exercises with a rational correlation of general and additional physical training means. The ratio of the main types of training was as follows: general physical training – 35%, special – 15% and additional – 50%.

Conclusions: The rock climbing and slacklining were offered for the preparatory period as the means of additional physical training. These means are based on the structure of motor activity and preferential orientation focused on the development of coordination, power, speed and speed-power qualities.

Keywords: tourism, physical training, young athletes, speed-power, coordination of motor actions.

Introduction

The stage of preliminary basic training plays an important role in the training of athletes [1]. This stage presupposes the development of physical qualities, the strengthening of the young athletes' health, the creation of motor capacity for learning motor skills. Physical training is an integral part of the process of athletic sports improvement. It provides the basis for technically challenging activities [2]. Other authors [3, 4, 5] emphasized the need to consider modern effective means of training with the acquisition of special technical skills. It is defined that achieving results in tourism is impossible without reliable physical training [6, 7]. That is why increasing the effectiveness of the training process is of particular importance for different types of tourism.

Complex improvement of the technical training of multi-player tourists explored Makarov [8]. Makhov studied the development of physical qualities and the formation of motor skills and of tourists' skills [9]. His studies considered forms and methods of preparation for hiking with different complexity levels [10]. Specialized training ground allows to conduct effectively the process of mastering the basic technique of overcoming obstacles and promotes the development of the necessary physical qualities of tourists [11]. Dem'ianchuk [12] and Kondratenko [13] developed software for training classes in sports tourism. The preparation of water tourism athletes at the stage of preliminary basic training is carried out in accordance with the "Curriculum for tourist circles of extracurricular education (sport and tourism profile)" (block "Water tourism") [14]. The program is designed for three years of study in circles and sections of the

corresponding profile and covers the stage of preliminary basic training.

According to Sukhovec point of view [15] there is a contradiction between the traditional approaches to the training process and the persistently increasing requirements to the level of tourists' physical fitness. This interferes with the harmonious development of athletes' technical skills of run required for passing the competing race [16-18].

Other studies stated:

There is a pressing need for research into the prevalence and incidence of aquatic injuries in children, so the effectiveness of preventive interventions can be determined [19];

During competition, kayak athletes must optimally adapt to environmental factors (e.g. wind, waves) to achieve peak performance [20];

Results highlight the importance of peripheral adaptations in both short and long events and stress the relevance of adding muscle oxygenation measurements during testing and racing in sprint canoe-kayak [21];

The results showed that reduction in both push and pull foot-bar forces resulted in a reduction of 21% and 16% in mean paddle-stroke force and mean kayak speed, respectively. Thus, the contribution of foot-bar force from lower-limb action significantly contributes to kayakers' paddling performance [22];

Today many compact and efficient on-water data acquisition units help modern coaching by measuring and analyzing various inertial signals during kayaking. One of the most challenging problems is how these signals can be used to estimate performance and to develop the technique [23].

The abovementioned stipulates the need to develop

the structure and content of tourists' physical training at the stage of preliminary basic training in the annual cycle.

The purpose of the research is to substantiate scientifically the structure and content of tourists' physical training at the stage of preliminary basic training.

Material and methods.

Participants. The study involved athletes aged 12-13 years. They were engaged in water tourism in the Dnipropetrovsk region (Ukraine). The control and experimental groups consist of 32 young men in each group. At the beginning of the experiment, there was no significant difference in the indicators of physical fitness, physical development and functional status between the groups ($p > 0.05$). Parents gave written consent to their children participating in the experiment.

Design of the research. The research was conducted on the basis of sports tourism clubs of Dnipropetrovsk region (Ukraine): "V.M. Shkurenko Physical Culture and Sports Complex", the sports club "Avangard" (Dnipro), the communal institution "Dnipropetrovsk Children and Youth Center for International Cooperation" (Dnipro), the communal educational institution "Center for Tourism and Country Study "Gorytsvit" (Kamianske). Experiment participants trained 6 times a week.

The training of the control group athletes was planned in accordance with the "Curriculum for the circles of the tourist country study direction of extracurricular education (sports and tourist profile)", the block "Water tourism" [14]. The program is designed for three years and covers the stage of preliminary basic training. The training process was 216 hours (6 hours per week). The program included participation in tourist activities (56 hours), general tourist training (52 hours), physical training (48 hours), special tourist training (40 hours), regional studies (14 hours), introduction and results (6 hours).

The structure and content of the physical preparation of tourists developed at the stage of the preliminary basic training were introduced in the process of training the experimental group athletes. We have defined the content and scope of physical training (general, special and additional). The distribution of hours for different types of physical training was determined in accordance with programs of other water sports [1, 4, 7, 8]. Such sports include canoe paddling and canoeing, paddle slalom. 35% were assigned to general physical education, 15% for special education and 50% for additional training.

The preparatory period was divided into general and special stages. Duration of the preparatory period was 8 months. The general preparatory stage was structurally divided into retractive and basic mesocycles. The retractive mesocycle contained 4 microcycles. The main task of the retractive mesocycle was athletes' preparation for the effective implementation of specific training work. The ratio of general, special and additional physical training was 60:10:30 (%).

The basic mesocycles contained 4 developmental and 4 recovery microcircuits. They were aimed at increasing the functional capabilities of the main body systems, the

development of technical and tactical preparedness.

The main task of developing microcycles was the stimulation of adaptive processes in the athletes' body, the solution of the main tasks of technical and tactical and physical training. They were characterized by a large total volume of work. The load was 70% of the maximum. Microcycles were aimed at the complex development of physical qualities with the predominant development of flexibility and coordination qualities. The ratio of general, special and additional physical training was 50:15:35 (%).

Recovery microcycles were planned after intense developing microcycles. Their main role was to provide optimal conditions for restorative and adaptive processes in the body of athletes. The ratio of general, special and additional physical training was 60:10:30 (%).

The targeted special training was presupposed for the special-preparatory stage. In the structure of the special preparatory stage were allocated 2 basics and 1 control preparatory mesocycles. The first basic mesocycle was aimed at the complex development of physical qualities with a predominant development of endurance. The ratio of general, special and additional physical training was 45:20:35 (%). The second basic mesocycle was aimed at the complex development of physical qualities with a prevailing development of power qualities. The ratio of general, special and additional physical training was 40:25:35 (%).

Control preparatory mesocycle was characterized by the wide application of special-preparatory exercises with the predominant development of high-speed and speed-power qualities. The ratio of general, special and additional physical training was 35:30:35 (%). It included developing, recovery and preparation microcircuits that were aimed at the direct preparation of athletes to the competition. The current and step-by-step control of the tourists' physical fitness level was conducted at this mesocycle.

Figure 1 presents the tasks and means of various training types of control and experimental groups' tourists. The preparatory period was divided into general and special stages. Duration of the preparatory period was 8 months. The general preparatory stage was structurally divided into retractive and basic mesocycles. The retractive mesocycle contained 4 microcycles. The main task of the retractive mesocycle was athletes' preparation for the effective implementation of specific training work. The ratio of general, special and additional physical training was 60:10:30 (%).

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Figure 1 presents the tasks and means of various training types of control and experimental groups' tourists.

During the preparatory period in the control group was planned general and special tourist training, general and special physical training [14].

The content of general tourist training included:

- historical aspects of the origin and development of tourism and water tourism in the world and in Ukraine,
- the question of sports tourism at the present stage of Ukraine development,
- the order of awarding sports titles;
- the basics of sport navigation,
- requirements of group and individual equipment, its repair,
- rules of camp organization in a hiking,
- the basis of nutrition in the hiking,
- the basics of safety in the hiking,
- sanitary and hygiene rules,
- the basics of the first aid.

The contents of the special tourist training include:

- technique of motor action and management of water crafts,
- requirements for water trips equipment;
- the basis of hiking and overnight organization in the water trip,
- safety insurance in water trip,
- basic knowledge of region tourism opportunities for water tourism,
- rules of water tourism competitions.

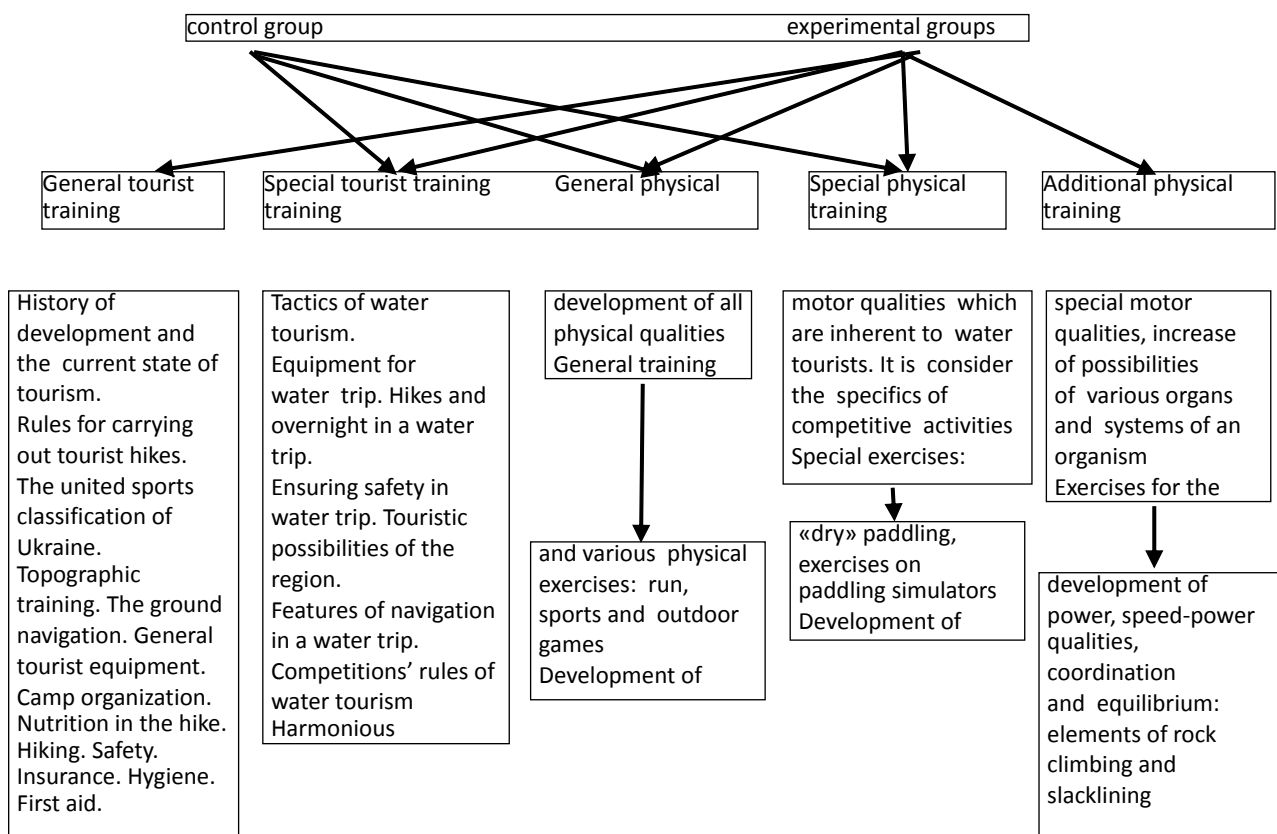


Fig. 1. Means of various training types of control and experimental groups' tourists at the stage of preliminary basic training in the preparatory period.

The development of special physical characteristics of tourists was emphasized in the experimental group. In order to increase overall physical fitness were applied the general development exercises, running, various hangs, rope climbing, hanging crossings, squats, jumps, and gymnastic exercises.

Special physical training was aimed at the development of special physical qualities. The following exercises were applied:

- elements of water tourism,
- touristic exercises of applied all-round,
- water racing
- passing “serpents”, direct and reverse gates,
- rise on a steep snowy or grassy slope,
- swimming,
- use of paddling simulators,
- overcome obstacles.

Additional physical training included exercises aimed at the development of coordination, speed, speed-power and power qualities. These exercises form the basis for the special motor actions formation - elements of rock climbing and slacklining.

We have developed 24 sets of training exercises. These

exercises emphasize the development of leading physical fitness of athletes. The duration of the complexes was 20-25 minutes. Exercises in each complex were carried out by the method of circular training. Increase of loads was achieved by gradual increase of volumes and intensity of exercises.

Dosing load was determined by:

- total amount of exercises
- the number of their repetitions
- duration of rest intervals between exercises,
- content of rest in intervals, efforts,
- the rate of exercise, their intensity.

The increase in the load increased by reducing the interval between individual exercises or their series and increasing their volumes.

In both groups, at the beginning and at the end of the preparatory period was conducted, the level of athletes' physical fitness did not have a significant difference at the beginning of the study ($P > 0.05$).

Athletes' competitions included:

- “Kayak” slalom. This is a short race to overcome the obstacles (gates) on the kayak (sports boat with a width of 0.56 m). Kayak is intended for runs in turbulent water;

Table 1. Indicators of physical fitness of 12-13 years athletes before and after the experiment

Indicators	CG (n=45)		EG (n=45)	
	$\bar{x} \pm S$		$\bar{x} \pm S$	
	before	after	before	after
Cadence Push-Up Test, quantity of times	18.13±4.40	19.20±2.30	17.65±1.75	20.30±3.10*
Standing Long Jump Test (Broad Jump), cm	164.30±5.70	165.70±6.10	164.53±3.07	173.81±5.90*
Eurofit Sit Up Test, quantity of times	24.20±4.45	27.6±1.60	26.40±2.84	30.60±2.70*
2 kg stuffed ball throwing, m	4.01±0.55	4.65±0.50*	4.03±0.35	4.80±0.30*
60 m run, s	11.10±0.48	10.84±0.20*	11.24±0.45	10.60±0.42*
Shuttle run 4×9 m, s	12.34±0.80	11.8±0.28*	12.35±0.46	11.50±0.37*
30 serpent run m, s	6.68±0.36	6.22±0.22*	6.53±0.33	6.00±0.30*
1500 m run, min	7.59±0.42	7.51±0.37	7.53±0.31	7.34±0.20*
Seated Forward Bend, cm	6.72±1.80	7.65±1.08	6.84±0.72	7.90±1.30*
Romberg's test, s	24.56±4.65	31.50±4.80*	24.06±1.46	36.00±2.20*
Handgrip Strength Test (right hand), kg	17.40±0.78	21.00±3.20*	25.06±1.93	28.47±2.47*
Handgrip Strength Test (left hand), kg	15.18±0.95	16.90±1.75*	19.75±1.40	22.75±1.77*
Lifting dynamometry, kg	31.70±3.40	31.70±2.70	31.34±1.03	37.40±1.50*
Passing the reverse gate, s **	38.03±4.50	37.75±1.12	37.5±1.92	32.00±2.70*
Passing 10 gates, min	2.99±0.43	2.55±0.30	3.11±0.07	2.38±0.10*

Note. * - $p < 0.05$; ** - gates which is opposite to the direction of the main flow of the river or canal.

Table 2. Results of the Athletes' Performance at the Sports Water Tourism Championship 2013-2014.

Year	Kayak slalom, min,sec,ms		Canoe slalom, min,sec,ms		Catamaran-2 slalom, min,sec,ms		Catamaran-4 slalom, min,sec,ms		Life-saving technique slalom, min,sec,ms	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
2013	2.03.44	2.07.13	2.46.22	2.44.41	3.02.89	2.56.15	3.36.27	3.44.52	1.19.43	1.25.28
2014	1.59.82	1.25.34*	2.42.09	1.57.03*	3.10.04	2.15.75*	3.36.22	2.58.84*	1.13.18	0.59.13*

Note. * – $p < 0.05$; CG – control group; EG is an experimental group.

- "Canoe" slalom. Speeding over the distance on a sports double boat (width 0.75 m, length 3,6 m). This boat is designed for racing on smooth water;

- "Catamaran-2" slalom and "Catamaran-4" slalom. Speed cover distance on a double / four-seater double-hull boat. The hulls of the boat are connected by a bridge (farm or a deck type).

Competitions on the distance "Life-saving technique" were conducted on a part of the river which length was 100-500 m. The zones of certain special tasks fulfillment were determined. The limiting devices and navigation points were applied to define areas of ship's overturning, rescue operations, and finish. The coastal landmarks, gates of the required width were applied as limiting devices. They limit the zones of special tasks. The marked place on the river bank above the boundary line was determined as the competition finish line.

Statistical analysis. The statistical processing of the study materials was conducted applying the Microsoft Excel 2010 software. The arithmetic average and the arithmetic mean error were calculated. The reliability of the differences between the indicators of the samples was verified by Student's criterion and was considered statistically significant at $p < 0.05$.

Results

Table 1 demonstrates the results of a comparative analysis of athletes' test data of the control and experimental groups.

According to the results of the experiment, significant differences were found among a number of physical fitness indicators of the control and experimental group. In the experimental group, there is a significant increase in all indicators of physical fitness ($p < 0.05$).

It is identified a little increase in power and speed-power qualities in the control group in the following tests: "Cadence Push-Up Test", "Standing Long Jump Test (Broad Jump)", "Eurofit Sit Up Test", "2 kg stuffed ball throwing" ($p > 0.05$). This is a predictable result because the age of 12-13 years old is one of the most favorable periods for the development of coordination, speed, and speed-power qualities. At the end of the experiment, athletes in the experimental group had significantly higher physical fitness indicators than athletes in the control group ($p < 0.05$).

It was conducted the comparative analysis of the athletes' performance at the Sports Water Tourism Championship (Dnipropetrovsk region) (2013-2014) to analyze the indicators of special fitness. The obtained data presented in Table 2.

We analyzed the results of passing distances Kayak slalom; Canoe slalom; Catamaran-2 slalom and Catamaran-4 slalom.

In the experimental group is observed the following statistically significant reduce of the time taken to pass the competitive distances according to the results of competitive activities:

- at Kayak slalom distance it improved by 33%,
- at Canoe slalom distance – by 29%,

- at Catamaran-2 slalom distance – by 23%,
- at Catamaran-4 slalom distance – by 21%,
- at Life-saving technique distance – by 30% ($p < 0.05$).

The results indicate an increase in the level of physical fitness and effectiveness of the athletes' competitive activity in the experimental group.

Discussion.

Analysis of scientific and methodological literature revealed a number of problematic issues. They relate to the peculiarities of the physical training process:

- definition of content and volume of physical training (general, special and additional);
- consideration of individual characteristics of athletes, territorial conditions and availability of material and technical base.

The study confirmed the opinion of various authors [4, 5] regarding the need to consider modern effective means of training with the acquisition of special technical skills.

We have developed the structure and content of physical training of athletes engaged in water tourism at the stage of preliminary basic training. We defined the content and volume of physical training (general, special, and additional). They are applied depending on the purpose, tasks, and orientation of the stages of the preparatory period. It was experimentally substantiated the efficiency of the training exercise complexes application with rational correlations of general and additional physical training means. They influenced the development of the leading physical characteristics of tourists at the stage of preliminary basic training.

The results of the study confirmed other data [1, 2] that physical training provides a basis for technically challenging activities. It was also confirmed the data of other researches [4, 11] regarding the influence of the physical fitness level of tourists on the effectiveness of competitive activities.

It was completed the data of Konstantinov [5], Makarov [8] concerning the physical training peculiarities of athletes engaged in tourism. It was also completed the data of other studies [8, 12, 13] concerning the design of the training process at the stage of preliminary basic training. The data of Sukhovec [15] regarding the application of means and methods of athletes' physical training.

Acknowledgements

The research was conducted in accordance with the Consolidated Plan of Research Work of Ministry of Family, Youth and Sports of Ukraine (2011-2015) the subject 2.6 "Theoretical and Methodological Basis of Training Process and Competitive Activities Improvement in the Structure of Multi-Year Athletes Training", the State Registration Number is 0111U001168.

Conclusions

1. Analysis of the literature on the issue of research and the synthesis of practical experience of tourists' preparation at the stage of preliminary basic training revealed a number of problem issues. They relate to

the peculiarities of the physical training process. Such questions are the definition of the content and volume of physical training, consideration the individual characteristics of athletes, the territorial conditions and the availability of material and technical base.

2. It was offered the application in the preparatory period of the means of additional physical training: rock

climbing and slacklining. These means are based on the structure of motor activity and preferential orientation focused on the development of coordination, power, speed and speed-power qualities.

Conflict of interest

The author states that there is no conflict of interest.

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Cite this article as:

Savchenko VG, Moskalenko NV, Mikitchik OS, Gorbonos-Andronova OR, Lukina OV. Structure and content of tourists' physical training at the stage of preliminary basic training. *Pedagogics, psychology, medical-biological problems of physical training and sports*, 2019;23(1):47–53.

<https://doi.org/10.15561/18189172.2019.0108>

The electronic version of this article is the complete one and can be found online at:

<https://www.sportpedagogy.org.ua/index.php/PPS/issue/archive>

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Received: 03.01.2019

Accepted: 12.02.2019; Published: 27.02.2019

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Information Sponsors, Partners, Sponsorship:

- Olympic Academy of Ukraine
- Ukrainian Academy of Sciences.

SCIENTIFIC EDITION (journal)

Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports. 2019;23(1)

designer: Iermakov S.S.

editing: Yermakova T.

designer cover: Bogoslavets A.

administrator of sites: Iermakov S.S.

passed for printing 27.02.2019

Format A4.

Red Banner str., 8, Kharkov, 61002, Ukraine.

PRINTHOUSE (B02 № 248 750, 13.09.2007).

61002, Kharkov, Girshman, 16a.