The journal represents original scientific researches of scientists from the East-European region.

The Journal welcomes articles on different aspects of physical education, sports and health of students which cover scientific researches in the related fields, such as biomechanics, kinesiology, medicine, psychology, sociology, technologies of sports equipment, research in training, selection, physical efficiency, as well as health preservation and other interdisciplinary perspectives.

In general, the editors express hope that the journal “Physical Education of Students” contributes to information exchange to combine efforts of the researchers from the East-European region to solve common problems in health promotion of students, development of physical culture and sports in higher educational institutions.
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Relationship between “self-efficiency“ competence levels and constant sportive self-respect levels of football players

(Sample of Istanbul European Side)

Aydın Pekel1, Kubilay Çimen2
1İstanbul Gelişim University Vocational School, İstanbul, Turkey
2İstanbul Gelişim University School of Physical Education and Sports, İstanbul, Turkey

Abstract

Purpose: Super amateur cluster is examination of the relationship between “self-efficiency” and competence levels and constant sportive self-respect levels of football players.

Material: Population of the study consists of 80 super amateur cluster football clubs operating in European Side of Istanbul Province, and sample of the study consists of (n=310) volunteer football players playing football in 21 sports clubs determined with simple random method. Questionnaire method was applied as data collection tool. The participants were applied personal information form, Self Efficiency Competence Scale which was developed by Sherer and colleagues in 1982 and adapted to Turkish by Gözüm and Aksayan in 1999 and Constant Sportive Self-Respect Scale which was developed by Vealey in 1986 and of which validity and reliability studies were conducted by Yıldırım in 2013. The obtained data was recorded with the package program named “IBM SPSS 22”. Correlation analysis and regression analysis were applied as statistical procedure.

Results: It was seen that “self-efficiency“ and - competence levels of amateur football players were in a good level and constant sportive self-respect levels were high. It was detected that there is a high-level positive relationship between constant sportive self-respect level and “self-efficiency“ and -competence level, and that “self-efficiency“ and - competence level predicted constant sportive self-respect level.

Conclusions: It may be considered that sufficient performance of the football players results from self-completion, motivation, belief in themselves and desire to act for success by using their skills.

Keywords: Football Player, Self-efficiency, Competence, Constant Sportive Self-respect.

Introduction

Individuals may experience some problems and difficulties for reaching success in some periods of their lives. Overcoming problems may be associated with competences and efficiencies of individuals. Self-competence is the perception to be able to perform a behavior to obtain a certain outcome [1]. According to Yardımcı and Başbakkal [2], self competence is the emotion that an individual is sufficient and effective. Self competence is effective in initiating and stimulating a behavior and enabling continuity and realization of individual-specific performance; at the same time it has an important role in development of a skill in an individual by enabling compatible integration of skill and information or initiation and application of learning procedure. Individuals with strong self-competence belief have a success and goodness, and personal development and skills are also enriched. Lowness of self-competence perception may cause experiencing failure particularly in situations requiring the same level of performance constantly [3, 4]. Highness or lowness of self-competence level possessed by individuals may reveal an undeniable truth in exhibition of required performance and realization of a task to be done successfully.

“Self-efficiency“ and -competence is defined as self-judgment of faith of an individual in organizing activities required for exhibiting a certain performance and capacity to realize the same successfully [5, 6]. Self-efficiency and competence level may prevent or enhance motivation to take action. Individuals with high self-efficiency may choose more complicated and risky missions. Their targets are high and they work determinedly for reaching these targets [7]. On consideration of targets of the football players, it is required that their self-efficiency and -competence levels should be high in trainings and matches, because complicated and skill-requiring structure of football and internal and external environmental factors may affect efficiency and competence. “Self-efficiency“ and - competence levels of football players and individual and sportive confidence of football players may developed in the same direction. Tutko and Tosi [8] define confidence as faith in his/her own skills, acceptance of struggles pushing the limits, knowing his/her own strength and weakness and struggling to achieve a desired outcome. Vealey [9] developed the concept of confidence which he defines as certainty of possession of required skills for sportsmen’ success. Vealey [9] indicated constant sportive confidence as competence faith of competence of a person relating to his/her skill to be successful in sports.

As a consequence of the explanations, the aim of the study is to examine the relationship between “self-efficiency“ and -competence levels and constant sportive self-respect levels of the super amateur cluster football players.

Material and methods

Participants

The aim of the study is to examine the relationship between self-efficiency and competence levels and constant sportive self-respect levels of the super amateur cluster football players. In line with the aim of the study, the population of the study consists of 80 super amateur cluster football clubs operating in European Side of

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İstanbul Province, and sample of the study consists of 310 volunteer football players playing football in 21 sports clubs determined with simple random method. The participants were asked to fill in an informed voluntariness form. The participants were informed about the study. The participation was based on voluntariness.

**Measurements and Procedures**

Questionnaire method was used as the data collection tool. The participants were applied personal information form (age, year of sports, status of being professional and status of sports-making in the family), self-efficiency and-competence scale and sportive self-respect level scale.

Self-Efficiency Competence Scale (SECS) which was developed by Sherer and colleagues [10] and adapted to Turkish by Gözüm and Aksayan [7] was used to measure “self-efficiency” competence levels of the participants. The scale consisted of 23 items. Validity and reliability of the scale was performed by Gözüm and Aksayan [7], and Cronbach Alpha internal consistency coefficient was found as 0.81. The scale consisted of four sub-dimensions. Behavior initiation sub-dimension consisted of (2, 11, 12, 14, 17, 18, 20 and 22nd) items, behavior continuation sub-dimension consisted of (4, 5, 6, 7, 10, 16 and 19th) items, behavior completion sub-dimension consisted of (3, 8, 9, 15 and 23rd) items and obstacle management sub-dimension consisted of (1, 13 and 21st) items. On evaluation of the scale, (2, 4, 5, 6, 7, 10, 11, 12, 14, 16, 17, 18, 20, 22nd) items were scored reversely. The highest point of the behavior initiation sub-dimension was 40, the lowest point was 8; the highest point of the behavior continuation sub-dimension was 35, the lowest point was 7; the highest point of the behavior completion sub-dimension was 25, the lowest point was 5; and the highest point of the obstacle management sub-dimension was 15, the lowest point was 3. Throughout the scale, the lowest point was 23, and the highest was 115. High point indicates high level of self efficiency and competence level. The scale is evaluated over 5-point Likert type scale as “does not define me” 1 point, “defines me a little” 2 points, “neutral” 3 points, “defines me well” 4 points, “defines me very well” 5 points. Constant Sportive Self-Respect Scale (CSSRS) which was developed by Vealey [9] and of which Turkish validity and reliability studies were conducted by Yıldırım [11] was used to detect sportive self-respect level of the participants. CSSRS had a single sub-dimensioned structure and consisted of 13 items. Scale reliability coefficient was calculated as .84. The highest point of the scale was 85 and the lowest point was 13. The scale items were evaluated over 5-point Likert type scale as (1) ‘Very Low, (2) ‘Low, (3) ‘Medium, (4) ‘High and (5) ‘Very High’.

**Statistical Analysis:**

The data obtained from the personal information form (age, year of sports, status of being professional and status of sports-making in the family), sportive self-respect level and “self-efficiency” and competence scales was entered into SPSS22.0 package program and analyses were conducted by means of this program. Personal information relating to the candidates, inventory averages and factor points were provided by detecting frequency (f) and percentage (%) values. Parametric and nonparametric distribution curves of parametric and nonparametric distribution statuses of points were looked by examining skewness-kurtosis values. The data exhibited nonparametric distribution. Sperman correlation and regression analysis were utilized as statistical procedure.

**Results**

On examination of Table 1, it was seen in terms of ages of volunteers participating into the study that 20% were between age range of 18-20, 17.4% were between age range of 21-23, 25.5% were between age range of 24-26, 20.6% were between age range of 27-29, 16.5% were 30 and above. It was seen in terms of year of sports of the football players that 7.1% had a sports year between 1-5, 31.0% had a sports year between 6-10, 41.9% had a sports year between 11-15 and 16.5% had a sports year of 16 and above; for the question whether they were professional or not, 32.6% answered yes and 67.4% answered no; for the question whether there was a sportsman in the family, 41.9% answered yes and 58.1% answered no.

On examination of Table 2, it was seen that the constant sportive self-respect scale average score was 4,10±0.66, the “self-efficiency” and -competence scale behavior initiation sub-dimension score was 21,63±6.22, the behavior continuation sub-dimension score was 20,98±4.83, the behavior completion sub-dimension score was 19,98±3.02, the obstacle management sub-dimension score was 11,24±2,05 and the “self-efficiency” and -competence total score was 73,84±10,83.

On examination of Table 3, it was seen that there was a high-level positive relationship between the constant sportive self-respect level and the “self-efficiency” and competence level ($r$=.793, $p$=.000). On examination of the relationship between the constant sportive self-respect level and the “self-efficiency” and competence sub-dimensions, it was detected that there is a low-level positive relationship with the behavior initiation sub-dimension ($r$=.212, $p$=.000), medium-level positive relationship with the behavior completion sub-dimension ($r$=.438, $p$=.000), medium-level positive relationship with the obstacle management sub-dimension ($r$=.450, $p$=.000) and no relationship with the behavior continuation sub-dimension ($p$>.001).

On examination of Table 4, there was a significant relationship between the self efficiency and competence level and the constant sportive self-respect level ($R$=.202, $R^2=.041$; $p$<.001). On examination of t-test results relating to significance of regression coefficient, it was seen that “Self efficiency- and -competence” total score ($t$=3,173, $p$=.000) was predictor of the constant sportive self-respect level, and it corresponded for approximately 41% of total variance.
Table 1. Socio-demographical Features of Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Features</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18-20</td>
<td>62</td>
<td>20,0</td>
<td></td>
</tr>
<tr>
<td>21-23</td>
<td>54</td>
<td>17,4</td>
<td></td>
</tr>
<tr>
<td>24-26</td>
<td>79</td>
<td>25,5</td>
<td></td>
</tr>
<tr>
<td>27-29</td>
<td>64</td>
<td>20,6</td>
<td></td>
</tr>
<tr>
<td>30 and above</td>
<td>51</td>
<td>16,5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100,0</td>
<td></td>
</tr>
<tr>
<td>1-5</td>
<td>22</td>
<td>7,1</td>
<td></td>
</tr>
<tr>
<td>6-10</td>
<td>96</td>
<td>31,0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100,0</td>
<td></td>
</tr>
<tr>
<td>Year of Sports</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-15</td>
<td>130</td>
<td>41,9</td>
<td></td>
</tr>
<tr>
<td>16 and above</td>
<td>62</td>
<td>20,0</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100,0</td>
<td></td>
</tr>
<tr>
<td>Are you professional?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>209</td>
<td>67,4</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100,0</td>
<td></td>
</tr>
<tr>
<td>Is there any sportsman in the family?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>180</td>
<td>58,1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>310</td>
<td>100,0</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Descriptive Statistics of Answers Given for Scales by Participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>answer</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>X±Sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Sportive Self-Respect</td>
<td>CSSR Average</td>
<td>310</td>
<td>1,54</td>
<td>5,00</td>
<td>4,10±0,66</td>
</tr>
<tr>
<td></td>
<td>Behavior initiation</td>
<td>310</td>
<td>8,00</td>
<td>40,00</td>
<td>21,63± 6,22</td>
</tr>
<tr>
<td></td>
<td>Behavior continuation</td>
<td>310</td>
<td>10,00</td>
<td>35,00</td>
<td>20,98± 4,83</td>
</tr>
<tr>
<td>Self efficiency and competence</td>
<td>Behavior completion</td>
<td>310</td>
<td>6,00</td>
<td>25,00</td>
<td>19,98± 3,02</td>
</tr>
<tr>
<td></td>
<td>Obstacle management</td>
<td>310</td>
<td>4,00</td>
<td>15,00</td>
<td>11,24±2,05</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>310</td>
<td>45,00</td>
<td>115,00</td>
<td>73,84±10,83</td>
</tr>
</tbody>
</table>

Table 3. Relationship between Self efficiency Competence Levels and Constant Sportive self-respect Levels

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant Sportive Self-Respect</td>
<td>r</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavior initiation</td>
<td>r</td>
<td>,212**</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Behavior continuation</td>
<td>r</td>
<td>,101</td>
<td>,415**</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>,076</td>
<td>,000</td>
<td>,000</td>
<td>,000</td>
<td></td>
</tr>
<tr>
<td>Behavior completion</td>
<td>r</td>
<td>,438**</td>
<td>,126''</td>
<td>,281''</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>,000</td>
<td>,027</td>
<td>,000</td>
<td>,000</td>
<td>,000</td>
</tr>
<tr>
<td>Obstacle management</td>
<td>r</td>
<td>,450''</td>
<td>,155''</td>
<td>,002</td>
<td>,450''</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>,000</td>
<td>,006</td>
<td>,968</td>
<td>,000</td>
<td>,000</td>
</tr>
<tr>
<td>Self efficiency and competence</td>
<td>r</td>
<td>,793</td>
<td>,762''</td>
<td>,751''</td>
<td>,536''</td>
<td>,213''</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>,000</td>
<td>,000</td>
<td>,000</td>
<td>,000</td>
<td>,000</td>
</tr>
</tbody>
</table>

P< 0,001

Table 4. Regression Analysis relating to Prediction of Constant Sportive self-respect Level

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>β</th>
<th>t</th>
<th>P</th>
<th>R</th>
<th>R²</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>,202</td>
<td>3,173</td>
<td>,001</td>
<td>10,067</td>
<td>,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self efficiency and competence</td>
<td>,202</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P< 0,001
Discussion

It was seen that the constant sportive self-respect levels of the volunteers participating into the study were in a good level with respect to the constant sportive self-respect scale average scores. On examination of the literature, the constant sportive self-respect level average points of the sportsmen were detected as 4.26 in a study conducted by Çetinkaya [12] to team sportsmen. It was seen in our study that the constant sportive self-respect levels of the football players were lower compared to similar studies. In this study, it was seen that point averages were high in sub-dimensions of the behavior initiation, continuation and completion, medium in the obstacle management sub-dimension, and the self efficiency and -competence levels were in a good level. In a study conducted by Akgül [13] on health personnel, behavior initiation point average was found as 20.35±8.16, behavior continuation as 18.27±7.48, behavior completion as 18.94 ± 4.14 and obstacle management point average as 8.9 ±2.48. 

Self efficiency and -competence total point average was detected as 66.53 ±14.80. Yiğitbaş and Yetkin [14] detected in their study conducted on health college students that self efficiency and competence scale total point average was X: 91.01; and in terms of sub-dimensions, behavior initiation (DB) was detected as X:29.61, behavior continuation (DS) as X: 21.19, behavior completion (DT) as X:19.15 and obstacle management (EM) as X: 9.62. In a study conducted by Okçin and Gerçeklioğlu [15] on students, self efficiency and -competence average score was detected as 82.4069± 12.74782. According to this result, it was seen that the self efficiency and -competence level and the sub-dimension’s levels of the football players were in a good level. There is no study in the literature that examines “self-efficiency” and competence levels of amateur sportmen. In other studies, on different participant groups, existence of studies with higher and lower scores than the “self-efficiency” and -competence level in our study are seen [6, 7, 13, 14]. These differences may be resulted from environmental factors, education level, current conditions and internal factors.

It was seen that there was a high-level positive relationship between the constant sportive self-respect level and the self efficiency and -competence level. On examination of the relationship between the constant sportive self-respect level and the “self-efficiency” and -competence sub-dimensions, it was detected that there was a low-level positive relationship with the behavior initiation sub-dimension (r=,212, p=.000), medium-level positive relationship with the behavior completion sub-

dimension ( r=,438, p=.000) and medium-level positive relationship with the obstacle management sub-dimension (r=,450, p=.000), and no relationship with the behavior continuation sub-dimension. On examination of the literature, although there are different studies relation to “self-efficiency” and -competence and constant sportive self-respect [15, 16, 17, 18], there is no study examining the relationship between the “self-efficiency” and -competence level and the constant sportive self-respect level. The “self-efficiency” and -competence level and the constant sportive self-respect level provide a positive relationship. It was seen that it was predictor of the constant sportive self-respect level and corresponded to approximately 41% of total variance. Although there are different studies in the literature [19, 20]. No similar study was seen on examination of the literature.

Conclusion

It may be considered that sufficient performance of the football players results from self-completion, motivation, belief in themselves and desire to act for success by using their skills. Development of thought, behavior and emotions, instinct to become successful and development of evaluating environmental effects may be associated with levels of being affected from internal and external factors, “self-efficiency” and -competence and constant sportive self-respect levels.

It is considered that trainings of the football players were not sufficient in terms of development of technical and tactical skills and exhibition of optimal or same level of performance. Due to factors such as complicated play structure of football and audience, self-respect levels, self-competence and efficiency levels of the football players are important factors for performances of the football players. For development of the self-competence and -efficiency level and the constant sportive self-respect levels of the football players, regular mental training education as well as theoretical educations for cognitive and affective development by experts may be provided, and the effect of these educations on performance may be evaluated.

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Conflicts of interest

The authors have no conflicts of interest relevant to this study.
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Statistical analysis of morphometric indicators and physical readiness variability of students
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2South Ural State University, Russia

Introduction
Education in higher education is a complex and lengthy process. A number of authors note a number of problems that develop into intellectual, emotional and mental stress. The main reason for this is as follow: the changed socio-economic conditions of students’ study and life; excess strain. This phenomenon takes on stagnant nature and aggravated by a decrease of physical activity [8]. Adaptation of students takes place against the backdrop of intensified learning, the increasing volume of teaching load, the changing forms and methods of teaching, and pedagogical requirements. Such intensification is accompanied by an increased load on the psychophysiological potential (PPP) [5, 6]. One of the modern and accessible methods for assessing the relationship between the work of the cardiorespiratory system is the assessment of physical preparedness and morphofunctional indices [4, 13]. There is a sufficient amount of data to study the variability of the cardiorespiratory system at rest and in the transition to the orthostatic position [10, 22, 26]. The study of changes in various variability in the phenomena of the organism, which makes it possible to disclose the features of the functioning of the organism and systems, the regulation of physiological systems is of a great interest in physiology [2].

Morphometric indicators for the prospects of young athletes are presented in various studies [1, 3, 9]. However, there is no detailed analysis in physical education among students. Different contingent and methods do not allow such a comparison. It is needed more researches. We have not encountered similar structuring and differentiation of groups in the literature. Therefore, it is impossible to compare the obtained data.

The main goal of physical education and mass sports at the university is as follows: to make students healthier; improving the level of motor activity; preparation for participation in local (intra-university, district and inter-university) and regional (city, regional and republican) student competitions.

Morphometric features of a person are one of the genetically predetermined factors. They determine the specific physical development of the individual and allow us to assess reserve capabilities in motor activity and mass sports. Distribution of loads in different training groups depends on hereditary factors, features of the habitat and differentiation of structural indicators. It is necessary to take into account the peculiarities of biorhythms, reactivity, physiology of adaptation processes [5, 11, 12].

Other studies highlight the main directions for improving the system of physical education of students such as: program has been developed that will enable and effectively develop and maintain a level of health in physical education [21]; it has been established that personal, psychosocial and environmental factors are closely related to moderate and vigorous motor activity [23]; the level of teacher training influences the successful formation of the necessary competencies of students [14, 23]; satisfaction of the basic needs of students leads to greater self-determined motivation. This helps to increase cognitive skills and motor activity [20].

Important element of the physical education system is as follow: optimization of physical activities [16, 19]; the use of modern means and methods of teaching [15, 25]; accounting for individual morphofunctional indicators [17, 27]; the organization of pedagogical control over motor readiness of students [18].

Such approaches allow to motivate students: to success through physical education classes; to a positive

Abstract

Purpose: To evaluate the interaction of morphometric characteristics with the reactions of the cardiorespiratory system and the indices of physical training during the process of physical exercise training at the university.

Material: The students of the first course (n = 91, aged 17-18) took part in the survey. The students were divided into 6 groups. All students were engaged in physical training. All the studied indicators were conditionally divided into two groups. The first group of studies included indicators of physical fitness. The second group was formed by morphofunctional indices.

Results: The indicators of the physical preparedness of students demonstrate a wide range and heterogeneity. This should be taken into account when staffing training groups. When using the technique of development of local regional muscular endurance, the values of orthostatic test and the Skibinski index show significant variability. Also high and significant correlation interactions are shown by indicators: manual dynamometry; strength endurance; the values of the Skibinski index. Also, in the orthotropic test, the same effect was observed: age, body length, heart rate. A similar analysis of morphofunctional indices shows significant correlation links: the Skibinski index and orthotropic tests; age and the Skibinski index; weight and body length.

Conclusions: from the point of view of physical fitness, groups of sports training (the second group) and hypertensive groups (group 5) proved to be the most stable. A group of volunteers turned out to be the most stable relative to the morphofunctional indicators.

Keywords: health indicators, motor activity, statistical analysis, variability, physical readiness.
attitude towards one’s health.

The aim of the study is to trace possible interactions of morphometric characteristics with reactions of the cardiorespiratory system and indicators of physical preparedness.

Material and methods

Participants. According to the medical examination and choice of sports, students were divided into 6 groups: disorders of the musculoskeletal system and cardiopulmonary system (n=91, age 17-18 years). The characteristics of the groups by composition and formation characteristics are given in Table 1.

The following parameters were studied: age, weight and body length, levels of systolic (SAD) and diastolic (DAD) pressure, orthostatic test (ort), the Skibinski index (ind_Skib), mixed stops (s_u_p), indicators of pulling and loading press (pod_press), indicators of manual dynamometry (right – F_right and left – F_left). As indicators of physical readiness, the results of a cross between 500-1000 m (cross) and a sprint – running at 100 m (sprint) were considered.

Organization of the study. The first-year students engaged in physical training in one of the following training groups were examined: SMG (special medical group); with disorders in the cardiovascular system (CVS) – hypertensive; volunteers involved in general physical training; group with respiratory diseases; main group; sports group. Diagnosis was carried out using functional samples. Each group was engaged in its programs. Sports groups were in training everyday two hours a day five times a week. The main group was engaged three times a week according to the program of physical education of universities [1]. Also this group attended classes in the chosen sport twice a week. A group of volunteers practiced twice a week. It also took part in weekend trips. Groups with a violation of the cardiorespiratory system were engaged in low intensity physical exercises of a special correction. Special medical group (SMG) was engaged three times a week by educational corrective and sparing loads. Also this group was engaged two days a week on individual plans. The methodology for the development of local-regional muscular endurance (LRME) was put in the basic framework for the preparation of students (groups 1, 2, 4). Such a technique had an aerobic orientation [7].

Excess body weight can lead to an increased level of traumatism of students. Therefore, in the classes on physical training of students were included preventive, corrective-restorative and rehabilitation measures. A certain role was assigned to static stretching, swimming, the creation of an artificially training and restoring environment [3, 12].

All the studied indicators were conditionally divided into two groups. The first group included indicators of physical readiness: mixed stops (s_u_p), indicators of pull-up and load on the press (pod_press), indicators of manual dynamometry (right – F_right and left – F_left), cross results on 500-1000 m (cross) and sprint on 100 m (sprint). Thus, the indices of the first group reflect the response of the subjects to force loads. These indicators describe the motor abilities of individuals (power endurance, manual dynamometry), general endurance (running at 1000 and 500 m) and speed-power characteristics. The second group was formed by morphofunctional parameters: age, weight and body length, levels of systolic (SAD) and diastolic (DAD) pressure, orthostatic test (ort), the Skibinski index (ind_Skib).

Statistical analysis. To establish the significance of differences in physical fitness indicators in different training groups was used rank criteria of Kruskal-Wallis test. The mean and error of the mean, the strength of the correlation bonds, Pearson correlation coefficients were calculated.

Results

The general characteristics of the studied indicators are given in Table 2 (indicators of the first group) and Table 3 (indicators of the second group).

Table 1. Participants and groups of physical training

<table>
<thead>
<tr>
<th>№ of group</th>
<th>Code of group</th>
<th>Number of memberships</th>
<th>Peculiarities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Main</td>
<td>15</td>
<td>Main, boxers</td>
</tr>
<tr>
<td>2</td>
<td>Sports</td>
<td>15</td>
<td>Sport, swimmers</td>
</tr>
<tr>
<td>3</td>
<td>SMG (MSS)</td>
<td>15</td>
<td>SMG, MSS</td>
</tr>
<tr>
<td>4</td>
<td>Volunteers</td>
<td>15</td>
<td>Volunteers – GPT</td>
</tr>
<tr>
<td>5</td>
<td>Hypertensive</td>
<td>15</td>
<td>CVS deviation</td>
</tr>
<tr>
<td>6</td>
<td>Respiratory</td>
<td>16</td>
<td>Disease of respiratory system</td>
</tr>
</tbody>
</table>

Note. SMG – special medical group, MSS – musculoskeletal system, GPT – general physical training, CVS – cardiovascular system.
The age of the subjects is fairly homogeneous (17-18 years). Indicators of length and body weight also do not change very much. Blood pressure values are in the reference range for this age group.

The values of the orthotropic test and the Skibinski index show significant variability within the studied population.

Correlation effects. The analysis of correlation links between the indices of students’ physical readiness (Table 4 – Pearson correlation coefficients, second line – significance levels) did not show significant mutual influences: in cross and sprint; these indicators with other indicators of physical fitness. Weak (but significant!) correlation relationships demonstrate the pull-up + press with variable mixed supports and with indicators of manual dynamometry. High and significant correlation interactions show the indicators of manual dynamometry.

A similar analysis of morphofunctional indices (Table 5) shows significant correlation links: the Skibinski index and orthostatic tests; age and the Skibinski index; physiologically obvious relationship between the weight and body length of the subjects.

Comparison of interrelations on the internal-system (morphofunctional) and inter-system level with the results of cross and sprint should note the following. Among modern students system regulation and interrelation is carried out against the background of prolonged stress-tension, present in all groups of subjects. These processes occur in different ways. Clearly identified groups with greater synchronization and less dysregulation of the function. This is evidenced by the mechanisms of adaptation and dysregulation in the examined groups. From the information material on the state and preparedness can be found information about: which groups of students are more adapted to information loads; what groups are in the ranges of physiological stress; which are in a premorbid and stressful state [7, 12].

It should be noted that the observed relationships (Table 4, 5) between the indicators allow us to judge their role in the integrative activity of the organism. Strength endurance, strength of the hands and indicators of the cardiopulmonary system play a leading role in students life.

Intrasystem and intersystem connections allow us to talk about the inefficient adaptation of students to the significant loads associated with the educational process. In this connection, it became necessary to conduct a structural analysis of the studied indicators, which will

<table>
<thead>
<tr>
<th>Table 2. Statistics of the first group indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
</tr>
<tr>
<td>Cross 500, 1000 m</td>
</tr>
<tr>
<td>Running 100 m</td>
</tr>
<tr>
<td>Six mixed supports</td>
</tr>
<tr>
<td>Pull-up, press</td>
</tr>
<tr>
<td>Strength of right hand</td>
</tr>
<tr>
<td>Strength of left hand</td>
</tr>
<tr>
<td>N of valid</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 3. Statistics of the second group of indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indicators</strong></td>
</tr>
<tr>
<td>Age</td>
</tr>
<tr>
<td>Body weight, kg</td>
</tr>
<tr>
<td>Body length, cm</td>
</tr>
<tr>
<td>SAD, mm Hg</td>
</tr>
<tr>
<td>DAD, mm Hg</td>
</tr>
<tr>
<td>Orthostatic test</td>
</tr>
<tr>
<td>The Skibinski index, у.е.</td>
</tr>
</tbody>
</table>

Note: SBD – systolic blood pressure; DAD – diastolic blood pressure.
allow to judge the heterogeneity (homogeneity) of the groups under study.

The aim of the analysis is to free from random (including erroneous) emissions that are uncharacteristic for the population. As an example, consider the variable – age of students. The range of this change and its frequency characteristics are shown in Table 6. It can be seen from the table that the majority of students (85 out of 91, that is, more than 93%) are between the ages of 17 and 19. If we expand this range to 22 years, then it will get already almost 99% (90 out of 91) observations. Therefore, the characteristic values of the variable age should be considered values from the specified range.

The age characteristics of the training groups turned out to be heterogeneous. The median Kruskal-Wallace test indicates a significant difference in age groups in different groups. Age students are in the first group. Behind this group follows the fourth. Then the second and third indistinguishable by age are located. The youngest are members of the fifth and sixth groups.

Analogous arguments for other morphofunctional variables yield the results presented in Table 7. Comparison of the data in Table 7 with the initial data (Table 3) shows the following: the mean values of the indicators and the coverage of the observations have changed insignificantly; is saved from 94% to 98% of the original experimental data. At the same time, the initial range of variation of the orthotropic variable has changed significantly – it has almost halved.

Distribution of indicators by group. The distribution of the average values of the studied indicators by training groups is presented in Table 8 and Table 9. The greatest variation in the results was observed: in the cross – in the second group; in the 100 m race in the first and fourth groups; in terms of the indicator, mixed stops – in 3, 4, 6 groups; on the indicator pull-up + press –

Table 4. Pearson correlations. Physical fitness

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Cross 500, 1000 m</th>
<th>Sprint 100 m</th>
<th>Six mixed supports</th>
<th>Pull-up, press</th>
<th>Strength of right hand</th>
<th>Strength of left hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross 500, 1000 m</td>
<td>1</td>
<td>.090</td>
<td>-.083</td>
<td>.042</td>
<td>.022</td>
<td>.061</td>
</tr>
<tr>
<td>100 m</td>
<td>.090</td>
<td>1</td>
<td>-.077</td>
<td>-.004</td>
<td>-.030</td>
<td>-.112</td>
</tr>
<tr>
<td>Six mixed supports</td>
<td>-.083</td>
<td>-.077</td>
<td>1</td>
<td>-.377**</td>
<td>-.268*</td>
<td>-.191</td>
</tr>
<tr>
<td>Pull-up, press</td>
<td>.432</td>
<td>.470</td>
<td>.470</td>
<td>.970</td>
<td>.777</td>
<td>.292</td>
</tr>
<tr>
<td>Strength of right hand</td>
<td>.042</td>
<td>-.004</td>
<td>-.377**</td>
<td>1</td>
<td>.278**</td>
<td>.331**</td>
</tr>
<tr>
<td>Strength of left hand</td>
<td>.693</td>
<td>.970</td>
<td>.000</td>
<td>.008</td>
<td>.001</td>
<td>.000</td>
</tr>
</tbody>
</table>

Table 5. Pearson correlations. Morphofunctional indicators

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Age</th>
<th>Body weight, kg</th>
<th>Body length, cm</th>
<th>SAD</th>
<th>DAD</th>
<th>Orthostatic test</th>
<th>The Skibinski index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1</td>
<td>-.002</td>
<td>.062</td>
<td>-.057</td>
<td>.062</td>
<td>-.088</td>
<td>.280**</td>
</tr>
<tr>
<td>Body weight, kg</td>
<td>-.002</td>
<td>1</td>
<td>.633**</td>
<td>.099</td>
<td>-.067</td>
<td>-.186</td>
<td>.084</td>
</tr>
<tr>
<td>Body length, cm</td>
<td>.062</td>
<td>.000</td>
<td>1</td>
<td>-.035</td>
<td>-.073</td>
<td>-.166</td>
<td>.034</td>
</tr>
<tr>
<td>SAD, mm Hg</td>
<td>.558</td>
<td>-.099</td>
<td>.035</td>
<td>1</td>
<td>-.013</td>
<td>.172</td>
<td>.034</td>
</tr>
<tr>
<td>DAD, mm Hg</td>
<td>.592</td>
<td>.099</td>
<td>.035</td>
<td>1</td>
<td>-.013</td>
<td>.172</td>
<td>.034</td>
</tr>
<tr>
<td>Orthostatic test, alteration of heart rate</td>
<td>.406</td>
<td>.077</td>
<td>.166</td>
<td>.172</td>
<td>-.034</td>
<td>1</td>
<td>-.278**</td>
</tr>
<tr>
<td>The Skibinski index, g.e.</td>
<td>.280**</td>
<td>.084</td>
<td>.034</td>
<td>.034</td>
<td>-.101</td>
<td>-.278**</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: SAD – systolic blood pressure, DAD – diastolic blood pressure.
in 6, 4, 1, 5 groups; on indicators of manual dynamometry with the right hand – in 1, 3, 4, 6 groups and the left hand – in 3, 1, 2, 6 groups.

The second group was the most homogeneous, followed by the fifth group. In the remaining groups, the variability of the indicators was more extensive.

To establish the significance of differences in physical fitness indicators in different training groups (Table 8), the rank criteria of Kruskal-Wallis test was used.

In the cross, the differences between the results shown by the participants of the second (the worst result) and the fourth (the best result) groups were statistically significant. Sprint results are as follows: outsiders (the third group) have indicators that are significantly different from the results of the leaders (4, 5 and 6 of the group). Groups one and two showed intermediate results. These groups are significantly different from groups 3, 5. The remaining differences are insignificant. Indicators of manual dynamometry in the first group significantly exceed similar indicators in other groups. In terms of pull-up + press: the first, second and fourth groups significantly exceed the fifth and sixth groups. According to the indicator mixed supports: the fifth and sixth groups outstrip the first two. The remaining groups occupy an intermediate position.

The differentiation of morphofunctional indices is presented in Table 9. The greatest fluctuations were observed: the Skibinski index – in group 5, 2, 1; orthostyrene – in group 3; DAD – in the group 2, 3, 5; SAD – in group 1, 5; length of body – in group 3, 4, 5; body weight – in the group 1, 2, 6, 4, 3; age – in the group of 5, 1. On the length of the body a significant difference is observed between the third and the remaining groups. In the third group, the subjects are on average lower than in the other groups. The level of diastolic pressure is the same in all groups. By the level of systolic pressure: the first, second, fourth, fifth, sixth groups have the same, statistically indistinguishable SAD.

According to SAD: the first and fifth groups differ significantly from the second and fourth groups. Orthostatic test changes: from high rates in the third group to low – in the fourth. In this case, the first and second groups are not different from each other (p <0.05). The Skibinski index shows a monotonous decrease from the

<table>
<thead>
<tr>
<th>Lower bound of indices</th>
<th>Upper bound of indices</th>
<th>Mean error</th>
<th>Number of observations</th>
<th>Relative frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>16,0</td>
<td>18,3</td>
<td>17,1</td>
<td>44</td>
<td>0,4835</td>
</tr>
<tr>
<td>18,3</td>
<td>20,5</td>
<td>19,4</td>
<td>41</td>
<td>0,4505</td>
</tr>
<tr>
<td>20,5</td>
<td>22,8</td>
<td>21,6</td>
<td>5</td>
<td>0,0549</td>
</tr>
<tr>
<td>22,8</td>
<td>25,0</td>
<td>23,9</td>
<td>0</td>
<td>0,0000</td>
</tr>
<tr>
<td>25,0</td>
<td>27,3</td>
<td>26,1</td>
<td>0</td>
<td>0,0000</td>
</tr>
<tr>
<td>27,3</td>
<td>29,5</td>
<td>28,4</td>
<td>0</td>
<td>0,0000</td>
</tr>
<tr>
<td>29,5</td>
<td>31,8</td>
<td>30,6</td>
<td>0</td>
<td>0,0000</td>
</tr>
<tr>
<td>31,8</td>
<td>34,0</td>
<td>32,9</td>
<td>1</td>
<td>0,0110</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Diapason</th>
<th>Mean</th>
<th>Variation coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (kg)</td>
<td>49 - 93</td>
<td>68.2</td>
<td>11.6</td>
</tr>
<tr>
<td>Body length (cm)</td>
<td>162 - 189</td>
<td>175</td>
<td>3.8</td>
</tr>
<tr>
<td>SAD, mm Hg</td>
<td>110 - 165</td>
<td>131</td>
<td>8.9</td>
</tr>
<tr>
<td>DAD, mm Hg</td>
<td>52 - 87</td>
<td>74.9</td>
<td>9.6</td>
</tr>
<tr>
<td>Orthostatic test, heart rate</td>
<td>2 - 22</td>
<td>10.4</td>
<td>50.9</td>
</tr>
<tr>
<td>The Skibinski test, y.e.</td>
<td>18.2 - 65</td>
<td>40.5</td>
<td>33.6</td>
</tr>
</tbody>
</table>
first to the sixth group.

In mass sports, physical exertion is applied, which exposes the student to increased demands. Criteria for the morphofunctional capabilities of students, control standards and standards for normal and optimal health have been developed [1, 3].

A departure from normative assessments requires a deep structural and functional analysis and dynamic diagnosis of individual reference values of the key criteria of preparedness, functional status and health.

**Discussion.**

The indicators of SAD in sports and a group of volunteers were in the reference range. Indicators of

<p>| Table 8. Distribution of indicators of physical readiness |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Cross 500, 1000, m</th>
<th>Sprint 100 m</th>
<th>Six mixed supports</th>
<th>Pull-up press</th>
<th>Strength of right hand</th>
<th>Strength of left hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Minimum 3,37</td>
<td>10,00</td>
<td>61,93</td>
<td>50,80</td>
<td>46,13</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 5,30</td>
<td>11,30</td>
<td>85</td>
<td>70</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Minimum 3,32</td>
<td>9,02</td>
<td>55</td>
<td>36,32</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 15,20</td>
<td>12,00</td>
<td>73</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Minimum 4,13</td>
<td>1,56</td>
<td>34</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 4,60</td>
<td>16,00</td>
<td>62</td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Minimum 3,16</td>
<td>10,10</td>
<td>40</td>
<td>37</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 4,48</td>
<td>15,00</td>
<td>71</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Minimum 3,37</td>
<td>13,00</td>
<td>34</td>
<td>34</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 4,53</td>
<td>15,00</td>
<td>58</td>
<td>38</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Minimum 3,32</td>
<td>9,90</td>
<td>24</td>
<td>18</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum 5,29</td>
<td>14,00</td>
<td>53</td>
<td>45</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Mean 4,1520</td>
<td>14,00</td>
<td>75</td>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<p>| Table 9. Distribution of morphofunctional indicators |
|-----------------|-----------------|-----------------|-----------------|-----------------|</p>
<table>
<thead>
<tr>
<th>Group</th>
<th>Age</th>
<th>Body weight, kg</th>
<th>Body length, cm</th>
<th>SAD, mm Hg</th>
<th>DAD, mm Hg</th>
<th>Orthostatic test, heart rate</th>
<th>The Skibinski index, v.e.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mean 20,00</td>
<td>70,467</td>
<td>175,47</td>
<td>139,73</td>
<td>73,60</td>
<td>8,40</td>
<td>61,4333</td>
</tr>
<tr>
<td></td>
<td>Minimum 19</td>
<td>56,0</td>
<td>167</td>
<td>116</td>
<td>57</td>
<td>2</td>
<td>45,00</td>
</tr>
<tr>
<td></td>
<td>Maximum 22</td>
<td>100,0</td>
<td>186</td>
<td>167</td>
<td>87</td>
<td>11</td>
<td>68,00</td>
</tr>
<tr>
<td>Mean 18,47</td>
<td>71,827</td>
<td>176,87</td>
<td>123,20</td>
<td>73,40</td>
<td>7,00</td>
<td>51,6667</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Minimum 18</td>
<td>58,4</td>
<td>165</td>
<td>112</td>
<td>52</td>
<td>7</td>
<td>38,00</td>
</tr>
<tr>
<td></td>
<td>Maximum 19</td>
<td>95,0</td>
<td>198</td>
<td>138</td>
<td>88</td>
<td>7</td>
<td>62,00</td>
</tr>
<tr>
<td>Mean 18,47</td>
<td>63,300</td>
<td>169,13</td>
<td>132,33</td>
<td>73,60</td>
<td>22,13</td>
<td>36,6800</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Minimum 18</td>
<td>40,5</td>
<td>153</td>
<td>126</td>
<td>56</td>
<td>14</td>
<td>26,20</td>
</tr>
<tr>
<td></td>
<td>Maximum 19</td>
<td>80,0</td>
<td>192</td>
<td>142</td>
<td>91</td>
<td>50</td>
<td>53,00</td>
</tr>
<tr>
<td>Mean 19,00</td>
<td>68,533</td>
<td>176,57</td>
<td>125,00</td>
<td>76,13</td>
<td>4,67</td>
<td>40,0240</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Minimum 19</td>
<td>46,0</td>
<td>170</td>
<td>115</td>
<td>68</td>
<td>2</td>
<td>33,00</td>
</tr>
<tr>
<td></td>
<td>Maximum 19</td>
<td>76,0</td>
<td>185</td>
<td>135</td>
<td>85</td>
<td>8</td>
<td>49,30</td>
</tr>
<tr>
<td>Mean 18,87</td>
<td>69,830</td>
<td>177,93</td>
<td>140,47</td>
<td>72,07</td>
<td>15,60</td>
<td>32,7800</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Minimum 17</td>
<td>58,0</td>
<td>165</td>
<td>120</td>
<td>50</td>
<td>8</td>
<td>23,00</td>
</tr>
<tr>
<td></td>
<td>Maximum 32</td>
<td>84,0</td>
<td>189</td>
<td>165</td>
<td>85</td>
<td>20</td>
<td>58,00</td>
</tr>
<tr>
<td>Mean 17,94</td>
<td>66,063</td>
<td>174,63</td>
<td>129,31</td>
<td>78,94</td>
<td>10,75</td>
<td>22,2056</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Minimum 17</td>
<td>49,0</td>
<td>169</td>
<td>110</td>
<td>74</td>
<td>6</td>
<td>16,00</td>
</tr>
<tr>
<td></td>
<td>Maximum 18</td>
<td>81,0</td>
<td>187</td>
<td>175</td>
<td>85</td>
<td>17</td>
<td>29,00</td>
</tr>
<tr>
<td>Mean 18,78</td>
<td>68,312</td>
<td>175,09</td>
<td>131,68</td>
<td>74,67</td>
<td>11,42</td>
<td>40,5940</td>
<td></td>
</tr>
<tr>
<td>Minimum 17</td>
<td>40,5</td>
<td>153</td>
<td>110</td>
<td>50</td>
<td>2</td>
<td>16,00</td>
<td></td>
</tr>
<tr>
<td>Maximum 32</td>
<td>100,0</td>
<td>198</td>
<td>175</td>
<td>91</td>
<td>50</td>
<td>68,00</td>
<td></td>
</tr>
</tbody>
</table>

210
SAD in the group with respiratory disorders were in the borderline. In the remaining groups, SAD values exceeded the norm limits. These data confirm the existing thesis that even the representatives of the main group were in tension (especially with hypertensive disorders). Similar differences in groups in the literature, we have not met. Therefore, when comparing, they were guided by normative indicators. In this regard, in the group with hypertensive disorders, the Skibinski index was lower. In the process of work, this group was subjected to a corrective effect and a tendency to improve indicators was revealed.

Group 2 consisted of students with good physical training or having 3 ranks. The total characteristics of students and athletes did not differ significantly. Differences were detected in the values of blood pressure, which in students exceeded those of athletes. In athletes of cyclic sports (starting from the initial stage of selection), these indicators looked preferable under conditions of relative quiescence and under orthotropic conditions [9]. Especially clearly these differences were manifested when comparing athletes of high qualification [12]. It can be assumed that, due to heavy loads in sport of high achievements, the heart works more economically. In this case, peripheral vessels are subject to relaxation, which reduces their resistance and diastolic pressure.

The spread of indicators of total body size depends on the variability, age, health status, and violations. The values of SAD exceeding the reference boundaries (5, 1, 3, 6 of the group) were observed. The maximal DAD indices indicated the peripheral vascular tension of the central hemodynamics (orthostatic test group 3).

Conclusions
1. In the studied population, the morphometric parameters are stable (body length, SAD, DAD, body weight.). The Skibinski index and heart rate (orthostatic test) demonstrate significant variability. This characterizes the individual manifestation of the parameters.
2. Results in cross and sprint shows no significant impact on them of other indicators of physical fitness of students.
3. Analysis of correlation links revealed ineffective adaptation and mechanisms of dysregulation of students’ functions in the conditions of the educational process.
4. In the system of connections between the indicators of physical readiness, the values of manual dynamometry and strength endurance dominated. Among the parameters of the functional state, the values of the Skibinski index dominated. The same influence was shown: age, body length and heart rate in orthostatic test.
5. The groups of sports training (the second group) and hypertensive (group 5) proved to be the most stable in terms of physical fitness. The most stable relative to the morphofunctional indicators was a group of volunteers (group 4).

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Conflict of interest
The authors state that there is no conflict of interest.

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Evaluation of the anaerobic ability of alpine skiing skiers through the slalom simulator
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School of Physical Education and Sports Science, National and Kapodistrian University of Athens, Greece

Abstract

Purpose:
The purpose of the research was the evaluation of efficiency of anaerobic ability (power), anaerobic endurance, anaerobic fatigue and the restitution of the pulse rate of alpine skiing students through the slalom simulator. In addition, the aim of the research was the correlation of the special tests of alpine skiing on dry ground (octagon test) and in snow (triangle test and slalom test) with the target of determining ability levels.

Material:
The 20 people sample was composed by two teams of male and female who took the course for advanced (n = 7) aged 23±1.40 years and for beginners course (n = 13) aged 20±1.49 years. For the evaluation process two special tests were used, on the ground and in snow. The ground test was completed in the slalom simulator for 40 seconds. The second ground test was the octagon bouncing (40cm each side) x 3. The snow test was the Haczkiewicz test (triangle test) and the slalom (7 gates), where the time of a try was measured.

Results:
The best efficiency in anaerobic power was made by the advanced males and females, while in the anaerobic endurance by the beginners males and females. The best performance in the dexterity tests in snow on the triangle and slalom test was made by the advanced males and beginners females respectively.

Conclusions:
The significant correlation between the results of anaerobic performance in the slalom simulator and the triangle test in snow confirms the means of diagnosing skill and fitness on dry ground and snow respectively. There is a significant correlation between snow test results and there is no correlation with the octagon test. The aforementioned results can be used in the talent selection process of alpine skiing.

Keywords:
slalom simulator, anaerobic power, special tests, alpine skiing, selection.

Introduction

Anaerobic power is an indicator of metabolic process, and represents the leg muscle ability to produce high mechanical power in a short amount of time, up to 5 seconds (maximum power). Anaerobic ability (power) is an indicator of metabolic process and represents the leg muscle ability to produce high mechanical power in a longer amount of time, up to 30 seconds (average power), where the full development of the galactic mechanism requires at least 60 seconds [5, 11, 13]. Anaerobic endurance is the human body’s ability to resist fatigue in dynamic or static tries of small length. It is includes the speed endurance and the force endurance [12, 15, 29]. Anaerobic fatigue is the percentage decrease of power production during a trial and it represents the total ability of ATP production through median and short time energy systems [1, 27].

The following researchers have treated the subject of anaerobic ability of skiing athletes: [2, 7, 18], with its biomechanics of ski have treated the subject [4, 10, 22], while Giovanis et al. & Lazarenko [8, 16] have treated the subject of the simulation of winter and summer sports. The following researchers have treated the subject of anaerobic ability in physiology [19, 20, 21], and in training [3, 17, 26]. The following researchers have treated the subject of assessment of the physical condition and the restitution of the heart rate of the athletes: [6, 14, 30]. The following researchers have treated the subject of anaerobic ability with comparison Wingate test and Bosco test [24, 25, 28].

The purpose of the present research was the evaluation of the efficiency of anaerobic ability (power), anaerobic endurance, anaerobic fatigue and pulse ratio recovery of alpine skiing students through the slalom simulator. In addition, the aim of the research was the correlation of the special tests of alpine skiing on dry ground (octagon test) and in snow (triangle test and slalom test) with the target of determining ability levels.

Research questions and statistical hypotheses

The motives of initiating the present research were the following presented questions:
- Which alpine trial is the main talent selection in the alpine skiing?
- Which of the two teams composed (advanced skiers or beginners skiers) have the biggest anaerobic ability (power) and how is this calculated?
- Will the advanced skiers team overmatch the beginners team in the anaerobic tests, as they require experience and technique?

Statistical hypotheses: Zero hypotheses with the corresponding alternatives examined in this research are:
- Special tests can’t evaluate the athlete’s training level?
- Can special tests evaluate the athlete’s training level?

Material and methods

Participants:
The 20 people sample was composed by two teams of male and female who took the skiing course for advanced (n = 7) aged 23±1.40 years and for beginners course (n = 13) aged 20±1.49 years. Age, gender and body features of the skier teams are shown in table 1.

The measuring instruments and methods:
1) a timer with an accuracy of 0.01sec,
2) a slalom simulator of Spanish design BH SLALOM, MOD. G92,
3) a special rubber tape and the simulator platform,
4) two sticks (poles) of ski,
5) a UWE-type dynamometer, to determination the elongation force (resistance) of the simulator’s rubber tape (Table 2).
6) a digital camera (50hz) placed in 3,5m distance from the simulator. With the assistance of the video analysis

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in the “Kinovea 32” 3D application has determined the maximum deviation of the platform left and right.

7) two simple gates (red and blue) placed in spot “3” in the middle of each arm respectively, as a reference point of the platform’s deviation range.

8) The following equations of anaerobic ability (power), anaerobic endurance were used based on the definition of the equation in correlation with the athlete’s mass. The anaerobic fatigue in correlation with the length and the time exercise, and of the pulse restitution ratio [9, 14, 27]:

\[
\text{Anaerobic power (M)} = \frac{m \times s}{t} \quad [N]
\]

\[
\text{Max anaerobic endurance (Pmax)} = v \times m \times g \quad [W]
\]

\[
\text{Anaerobic fatigue (FI)} = \frac{t \times 100}{\text{THR} \times 2}
\]

Table 1. The body features of the athletes taking part in the research

<table>
<thead>
<tr>
<th>TEAMES</th>
<th>PARTICIPANTS</th>
<th>AGE (years)</th>
<th>HEIGHT (m)</th>
<th>WEIGHT (kg)</th>
<th>BMI (kg/m²)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
<td>SD</td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>ADVANCED SKIERS</td>
<td>7</td>
<td>23</td>
<td>1,40</td>
<td>1,73</td>
<td>0,05</td>
</tr>
<tr>
<td>M</td>
<td>5</td>
<td>23</td>
<td>1,41</td>
<td>1,75</td>
<td>0,05</td>
</tr>
<tr>
<td>F</td>
<td>2</td>
<td>22</td>
<td>0,71</td>
<td>1,69</td>
<td>0,01</td>
</tr>
<tr>
<td>BEGINNERS SKIERS</td>
<td>13</td>
<td>20</td>
<td>1,49</td>
<td>1,70</td>
<td>0,09</td>
</tr>
<tr>
<td>M</td>
<td>4</td>
<td>21</td>
<td>2,52</td>
<td>1,81</td>
<td>0,05</td>
</tr>
<tr>
<td>F</td>
<td>9</td>
<td>19</td>
<td>0,71</td>
<td>1,65</td>
<td>0,04</td>
</tr>
<tr>
<td>SUM</td>
<td>20</td>
<td>20,7</td>
<td>2</td>
<td>1,71</td>
<td>0,08</td>
</tr>
</tbody>
</table>

Table 2. Determination of the simulator’s rubber tape elongation force (every 10cm)

<table>
<thead>
<tr>
<th>Number of part (range of part)</th>
<th>1 (0-1)</th>
<th>2 (0-2)</th>
<th>3 (0-3)</th>
<th>4 (0-4)</th>
<th>5 (0-5)</th>
<th>6 (0-6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length of part (cm)</td>
<td>10cm</td>
<td>20cm</td>
<td>30cm</td>
<td>40cm</td>
<td>50cm</td>
<td>60cm</td>
</tr>
<tr>
<td>Elongation force of rubber tape (kg)</td>
<td>20kg</td>
<td>34kg</td>
<td>44kg</td>
<td>53kg</td>
<td>65kg</td>
<td>80kg</td>
</tr>
</tbody>
</table>

Figure 1. Regression between the force of elongation and the length of the parts

where:

- m – body mass (kg)
- s - distance (m)
- t - time (40 sec)

Max anaerobic endurance (Pmax) = v x m x g [W]

where:

- v - speed (m/s)
- m – body mass (kg)
- g - gravitation acceleration (m/s²)
where:
FI – Fitness Index
t - time of try (40 sec)
THR - total heart pulse (after the 1min and 3min)
8) The heart pulse restitution ratio Index (WR), has been used after the end of try, of 1 min and 3 min: WR = HRmax – HRmin
9) Octagon test (with a 40cm side length) on dry ground, with the goal of timing bounces of 3 rounds in an effort,
10) Triangle test Haczkiewicz [23] in snow (10mx10mx10m),
11) Slalom test (7 gates).

Test procedure
For the evaluation two special tests were used on dry ground and two in snow. On dry ground one test was used on a slalom simulator, where the subject, after warming up begins a try. From the initial position on the simulator platform, the goal of the subject is to apply pressure, for example on his right foot and subsequently to move the platform on the simulator’s rails, where the course’s difficulty marks are spotted, alternately left and right for 40 seconds (this corresponds to 40 turns or 20 cycles), counting the repetitions number in one try, which corresponds with the anaerobic ability (power – P). The second special test on dry ground was the octagon bouncing (40cm each side) x 3, counting the time on three consequent rounds of one try by choosing right or left (space and time sense test). In the snow, the first test was the Haczkiewicz test (triangle dexterity) and the second the slalom (7 gates), measuring the time of a try.

Statistical analysis
The research plan consisted of 4 research groups. For all the attributes of the subjects the average value (M) and the standard deviation (SD) were calculated. The statistical analysis was made with the statistic program Excel 2007. In order to evaluate the selected special tests on dry ground as feasible, they have been correlated with the two special tests in snow.

Results
Evaluation of the efficiency of the anaerobic ability using the slalom simulator
The table 3, present the differences between the advanced (males- females) and beginners (males- females) teams, that participated on the test of anaerobic power, anaerobic endurance, anaerobic fatigue as well as the measurements in the difference of maximum to minimum heart rate after the try. The second dry ground test was the octagon test, assessing the time performance. The results of the anaerobic power showed that the advanced team had better efficiency than the beginners team with 65,2±6,92 about males and 35,4±4,58 about females. The results of the anaerobic endurance showed that the beginners team had better efficiency than the advanced team with 663±101,77 about males και 599±68,02 about females.

The results of the anaerobic fatigue showed that advanced females had better efficiency than beginners females with 8,9±0,84, on the other hand beginners males had better efficiency than advanced males with 10,3±1,81 (Table 3).

The measurements of the max heart rate’s difference provided almost the same results for the advanced and the beginners team (table 3). The advanced team had a slightly larger heart rate difference than the beginners team with 48±12 versus 47±23,39.

Assessment of the performance of the skiers in the octagon test:
The results of the octagon test measurements showed that the beginners team had better records than the advanced team with 19,80±3,17 versus 20,71±1,52 (table

| Table 3. The efficiency of anaerobic ability (power) of the advanced and beginners teams that participated in the slalom simulator test and the octagon bouncing off on dry ground |
|---|---|---|---|---|---|---|
| TEAMS | Anaerobic power (M) | Anaerobic endurance (Pmax) | Anaerobic fatigue (FI) | Recovery factor H.R. (WR= max-min) | Time of octagon (sec) |
| | M | SD | M | SD | M | SD | M | SD | M | SD |
| ADVANCED SKIERS | | | | | | | | | | |
| M | 56,7 | 15,72 | 555,9 | 154,01 | 8,5 | 0,53 | 48 | 12 | 20,71 | 1,52 |
| W | 65,2 | 6,92 | 639,4 | 67,84 | 8,3 | 0,33 | 49 | 14,32 | 21,05 | 1,19 |
| BEGINNERS SKIERS | | | | | | | | | | |
| M | 35,4 | 4,58 | 347,3 | 44,89 | 8,9 | 0,84 | 45 | 4,24 | 19,87 | 2,50 |
| W | 39 | 13,73 | 619 | 81,31 | 8,9 | 1,56 | 47 | 23,39 | 19,80 | 3,17 |
| M | 55 | 8,65 | 663 | 101,77 | 10,3 | 1,81 | 41 | 36,46 | 18,96 | 0,61 |
| W | 32 | 7,98 | 599 | 68,02 | 8,3 | 1,03 | 49 | 17,18 | 20,17 | 3,79 |
3). Notably the best performances were (from best to worse): beginners males (18,96±0,61), advanced females (19,87±2,50), beginners females (20,17±3,79) and advanced males (21,05±1,19).

Assessment of the performance of the skiers on the dexterity tests in snow:

a) triangle test performance evaluation,
b) slalom test performance evaluation.

The table 4 presents the differences between the advanced team (males - females) and the beginners team (males - females), that participated on the triangle and the slalom test. The results of the triangle test measurements showed that the advanced team had better results than the beginners team with 27,92±4,58 versus 32,93±5,32 (table 4). Notably the best performances were (from best to worse): Advanced males (25,9±3,67), beginners females (32,99±0,57) and beginners males (34,36±6,10). The results of the slalom test showed that the advanced team had better records than the beginners team with 12,66±1,4 versus 12,99±1,84 (table 4). Specifically the performances were noted (from best to worse): Advanced males (12,26±1,33), beginners females (12,52±1,5), advanced females (13,65±1,39) and beginners males (13,79±2,45).

The important correlation between the anaerobic ability results of the slalom simulator and the triangle test in the snow confirms the evaluation techniques of the dexterity and physical state on dry ground and in snow respectively. There is also an important correlation between the results of the snow tests, while there is no correlation with the octagon test (table 5).

**Discussion**

In the procedure through simulator of slalom according to the results, in the anaerobic power’s efficiency it is observed that the advanced males and

<table>
<thead>
<tr>
<th>TEAMS</th>
<th>TRIANGLE TEST (sec)</th>
<th>SLALOM TEST (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td><strong>ADVANCED SKIERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>27,92</td>
<td>4,58</td>
</tr>
<tr>
<td>F</td>
<td>32,99</td>
<td>0,57</td>
</tr>
<tr>
<td><strong>BEGINNERS SKIERS</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M</td>
<td>34,36</td>
<td>6,10</td>
</tr>
<tr>
<td>F</td>
<td>32,29</td>
<td>5,2</td>
</tr>
<tr>
<td><strong>SUM</strong></td>
<td>31,18</td>
<td>5,53</td>
</tr>
</tbody>
</table>

**Table 5. The aggregated correlation results between the dry and snow performance of advanced skiers and beginners skiers respectively (p ≤ 0,05 n = 20)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Anaerobic power (M)</th>
<th>Anaerobic endurance (Pmax)</th>
<th>Anaerobic fatigue (FI)</th>
<th>Time of octagon</th>
<th>Triangle test</th>
<th>Slalom test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anaerobic power (M)</td>
<td>X</td>
<td>0,46</td>
<td>0,27</td>
<td>-0,07</td>
<td>-0,48</td>
<td>-0,05</td>
</tr>
<tr>
<td>Anaerobic endurance (Pmax)</td>
<td>X</td>
<td>0,39</td>
<td>-0,06</td>
<td>-0,42</td>
<td>-0,29</td>
<td></td>
</tr>
<tr>
<td>Anaerobic fatigue (FI)</td>
<td>X</td>
<td>-0,21</td>
<td>-0,19</td>
<td>0,01</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time of octagon</td>
<td>X</td>
<td>0,17</td>
<td>0,26</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Triangle test</td>
<td>X</td>
<td>0,71</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slalom test</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
females had better performance in comparison with the beginners. In the anaerobic endurance, it is observed that the beginners males and females had a better performance in comparison with the advanced teams. At last, in the anaerobic fatigue it is observed that the beginners males had better efficiency than the advanced males, although on the other hand the advanced females had better efficiency than the beginners females, but as a sum the beginners team appears to have better results than the advanced team. It should be pointed out that in relation to the heart rate after the procedure, the results of the male advanced team and the female beginners team were better than the male beginners and female advanced teams respectively. In the octagon test it is observed that male beginners had better results than advanced male and advanced females than beginners females. In the triangle and the slalom tests in snow it is observed that on both tests the best results of the snow tests, while there is no correlation with the anaerobic endurance, it is observed that the beginners males and females, while in the anaerobic endurance by the beginners males and females. At last the best efficiency in anaerobic fatigue and the best performance on the octagon test on dry ground was made by the beginners team. The best performance in the dexterity tests in snow on the triangle and slalom test was made by the advanced males and beginners females respectively. For the talent selection on Alpine skiing, the evaluation tests of anaerobic power efficiency on the slalom simulator outmatches the octagon test. The team of advanced skier students did not outmatch the beginners team. The application of the tests could be the evaluation criteria of the physical state and the technique of the athletes. The important correlation between the anaerobic ability results of the slalom simulator and the triangle test in the snow confirms the evaluation techniques of the dexterity and physical state on dry ground and in snow respectively. At last, there is also an important correlation between the results of the snow tests, while there is no correlation with the octagon test.

Conclusions
Based on the results of the present research we can conclude to the following: The anaerobic power’s efficiency evaluation of alpine skiing students is possible via the slalom simulator (“slalom ergo meter”). The best efficiency in anaerobic power was made by the advanced males and females, while in the anaerobic endurance by the beginners males and females. At last the best efficiency in anaerobic fatigue and the best performance on the octagon test on dry ground was made by the beginners team. The best performance in the dexterity tests in snow on the triangle and slalom test was made by the advanced males and beginners females respectively. For the talent selection on Alpine skiing, the evaluation tests of anaerobic power efficiency on the slalom simulator outmatches the octagon test. The team of advanced skier students did not outmatch the beginners team. The application of the tests could be the evaluation criteria of the physical state and the technique of the athletes. The important correlation between the anaerobic ability results of the slalom simulator and the triangle test in the snow confirms the evaluation techniques of the dexterity and physical state on dry ground and in snow respectively. At last, there is also an important correlation between the results of the snow tests, while there is no correlation with the octagon test.

Conflict of interests
The authors declare that there is no conflict of interests.

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Efficiency of the bicycle operation under various tactical variants

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1Kiev National University of Technology and Design, Ukraine
2National University “Odessa Academy of Law”, Ukraine

Abstract

Purpose: to determine the efficiency of the cyclist in various tactical options.

Material: In the experiments participated athletes (n = 6) of high qualification (mean age - 19.8 ± 1.3 years, mean weight - 71.4 ± 3.5 kg). As a model of the individual pursuit race at 4 km, a five-minute pedaling on the bicycle ergometer was used. Series of loads was set on the modernized mechanical bicycle ergometer “Monark”. The five-minute bicycle ergometer test is similar to the individual pursuit race at 4 km: according to the time of the exercise; on the frequency of pedaling (110-120 rpm); on the frequency of heartbeats.

Results: Tactical variants in the pursuit race at 4 km are considered. The total work in a free test was on average 106.38 ± 3.57 kJ. The operating energy consumption is on average for 379.0±16.1 kJ. The operating efficiency (economy) of the exercise attained on average for 28.0 ± 0.75%. This corresponds to the effectiveness of aerobic work of moderate power. The ratio of aerobic and anaerobic contributions to the provision of work was 77.3 and 22.7%. The smallest work was done in a test with step-increasing power. The athletes performed the closest work to the given job in the test with a variable (±15%) operating mode. The shortfall in it was on average for 0.46%. The absence of reliable differences in the economics of the work did not allow us to identify a rational variant of power distribution for an exercise lasting 5 minutes.

Conclusions: Tactical options in the pursuit race for 4 km depend on the features of the power systems of the rider. When optimizing tactics, it is necessary to select an individually optimal variant of the distribution of forces at a distance.

Keywords: cycling, tactics, energy expenditure, economy, aerobic, anaerobic

Introduction

Many experts recognize the need for scientifically based development of optimal layout of the passage of individual distances [1, 5]. To solve this problem by means of pedagogical observations and analysis of performances of athletes at the competitions is not completely possible. All the recommended distances are largely hypothetical. The objective comparison of the various tactical options have not much attempts [3, 8, 12]. The loads in these studies were not applied to the limit. This reduced the importance of the received information for the practice of sports.

Economy is the most common criterion of optimality. Economic efficiency quantitatively characterizes the ratio of the result of activity and an expenditure of achieving this result [16]. Quantitative indicator of the economy of movements is considered to be the mechanical efficiency of the work. Mechanical efficiency is calculated as the ratio of the useful work to the energy expended. For the quantitative estimation of profitability, varieties of the coefficient of mechanical efficiency are used [16]. The expenditure of moving segments of the moving person body is taken into account in determining the operational efficiency [3]. When pedaling on the bicycle ergometer, the overall efficiency factor does not exceed 20÷22%, the net efficiency factor is 25% [11, 15].

Tactical variety of options for the action of athletes is most fully manifested in competitive activities. Equally important is the use of the competitive method in training athletes [21], in physical education classes for students [20, 29, 35], and schoolchildren [18, 24, 37]. The effectiveness of such occupations depends on psychological factors [26, 44], the emotional state of athletes [34], the attractiveness of physical exercises [32, 33]. The success of athletes in competitive activity will be determined by morphofunctional features [25, 36, 38], individual characteristics of physical fitness [40], physiological and energy indicators [42], performance [41].

To optimize the competitive activities in cycling, it is necessary:

• to determine the energy cost of limiting work in a given power zone [6];
• to determine the profitability of limiting work in a given power zone [7];
• to reveal the ratio of the contributions of various energy mechanisms that ensure the performance of competitive exercises [14];
• to compare the energy cost of limiting work under different tactical options [13].

An aim of the work is to determine the efficiency of the cyclist’s work with various tactical options.

Material and methods

Participants. In the experiments participated athletes (n = 6) of high qualification (mean age - 19.8 ± 1.3 years, mean weight - 71.4 ± 3.5 kg).

Organization of the study.

As a model of the individual pursuit race at 4 km, a five-minute pedaling on the bicycle ergometer was used. Series of loads was set on the modernized mechanical bicycle ergometer “Monark”. The five-minute bicycle ergometer test is similar to the individual pursuit race at 4 km: according to the time of the exercise; on the frequency of pedaling (110-120 rpm); on the frequency of heartbeats. This made it possible to follow the dynamics of the performance of athletes. Individual abilities of athletes were revealed [10, 11].

Determined performance in a specific area of relative power. The load conditions were calculated. Athletes should perform the maximum amount of work in 5 minutes: forced resistance and arbitrary distribution of the
pedaling frequency (free test). In the following tests: the given operating modes were calculated from the total work done by the athlete in free test. The change in the power of work was carried out by adjusting the force on the pedals of the bicycle ergometer. The speed of the pedals was kept constant for the whole exercise. The speed of the pedals is equal to the average pedaling frequency in free test. The athletes performed the following modes of operation: fixed power (A), high power mode at the beginning of exercise (B), step-increasing (C) power, variable power (D). The frequency of pedaling was controlled by athletes on the speedometer and recorded by the indicators of the electromechanical speed counter. Variants of work (except D) corresponded to the basic tactical layout of the athletes’ distance in the individual pursuit race at 4 km [9].

The oxygen and carbon dioxide content of the air samples was determined on the Beckman analyzer. The volume of exhaled air was established using a dry spirometer. Calculation of consumed oxygen was carried out according to the standard procedure [17]. Analysis of samples of capillary blood (before and after the load), was carried out according to the Barker-Simmerson method in the Strohm modification [17]. The calculation of working energy expenditure was determined by summing up energy supply sources [17].

The following were recorded: pulse (fₚ), oxygen consumption (VO₂) and carbon dioxide emission, quantity (A) and power (N) of the work performed. The following were determined: the level of lactate (Lac) in the athlete’s blood; oxygen debt; oxygen cost per unit of work (VO₂/A); the oxygen demand for the work performed (ZО₂) and the oxygen deficit (DO₂).

Results

All 6 athletes did not perform free test with a uniform layout. Graph A (Fig. 1, 2) shows the dynamics of power work for 30-second segments (according to average data). The athletes performed the highest work in the first 30 seconds. At the same time, the average working level exceeded 17.5%. The lowest power level was maintained on the 8th and 9th segments. The change in capacity was 9.1%.

The greatest "underfulfillment" in tests with preset regimes was noted at the same site of the exercise (ie, from 3.5 to 4.5 minutes).

![Graph A](image1.png)

![Graph B](image2.png)

![Graph C](image3.png)

**Fig. 1.** Distribution of the actual pedal power at 30-second intervals: A — free test; B — fixed power test; C — test with intensive start.
The total work in free test was on average for 106.38 ± 3.57 kJ. The operating energy consumption is on average for 379.0 ± 16.1 kJ. The working efficiency (economy) of the exercise is on average for 28.0 ± 0.75%. This corresponds to the effectiveness of aerobic work of moderate power.

The ratio of aerobic and anaerobic contributions to the provision of work was 77.3 and 22.7%, respectively. The smallest work was done in a test with step-increasing power. The athletes performed the closest work to the given work in the test with a variable (± 15%) operating mode. The shortfall in it was, on average, 0.46%. The lactate component contributed the greatest contribution to free test and test with fixed power. Alaktat component contributed the most to loads with variable and increasing power. The aerobic component had the greatest influence in exercises with an overestimated onset (Table 1).

The absence of reliable differences in the economics of the work did not allow us to identify a rational variant of power distribution for an exercise lasting 5 minutes. Working with a fixed power did not find advantages over other options.

At different athletes the most effective were the tests with different layout options (Table 2). For L-v athlete the most preferable was variable-power work. In it, he was

![Fig. 2. Distribution of the actual pedal power at 30-second intervals: D — step-increasing power test; F — variable power test.](image)

**Table 1.** Total energy expenditure (KJ) ratio of various components of energy production (%)

<table>
<thead>
<tr>
<th>Tests</th>
<th>Operating energy consumption</th>
<th>Aerobic</th>
<th>Alaktat</th>
<th>Lactate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free</td>
<td>377.7</td>
<td>77.3</td>
<td>7.5</td>
<td>15.2</td>
</tr>
<tr>
<td>With fixed power</td>
<td>387.9</td>
<td>77.3</td>
<td>7.6</td>
<td>15.1</td>
</tr>
<tr>
<td>With intensive start</td>
<td>387.7</td>
<td>80.0</td>
<td>7.2</td>
<td>12.8</td>
</tr>
<tr>
<td>With step-increasing power</td>
<td>384.8</td>
<td>78.4</td>
<td>8.0</td>
<td>13.6</td>
</tr>
<tr>
<td>Variable</td>
<td>378.7</td>
<td>78.0</td>
<td>8.0</td>
<td>14.0</td>
</tr>
</tbody>
</table>

**Table 2.** Individual ranking of indicators of the performed work (I, II, III, IV) and economy (1, 2, 3, 4, 5)

<table>
<thead>
<tr>
<th>Athletes</th>
<th>Tests</th>
<th>Free, A</th>
<th>With fixed power, B</th>
<th>With step-increasing power, C</th>
<th>With intensive start, D</th>
<th>Variable, F</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-v</td>
<td>2</td>
<td>I/4</td>
<td>IV/1</td>
<td>III/5</td>
<td>II/2</td>
<td>I/2</td>
</tr>
<tr>
<td>K-v</td>
<td>3</td>
<td>II/1</td>
<td>IV/5</td>
<td>III/2</td>
<td>I/4</td>
<td>I/2</td>
</tr>
<tr>
<td>G-h</td>
<td>1</td>
<td>I/2</td>
<td>IV/4</td>
<td>III/5</td>
<td>II/3</td>
<td>I/3</td>
</tr>
<tr>
<td>L-v</td>
<td>1</td>
<td>III/5</td>
<td>IV/4</td>
<td>IV/4</td>
<td>I/3</td>
<td>I/2</td>
</tr>
<tr>
<td>B-v</td>
<td>4</td>
<td>IV/5</td>
<td>III/2</td>
<td>I/3</td>
<td>II/2</td>
<td>I/1</td>
</tr>
<tr>
<td>O-v</td>
<td>1</td>
<td>III/4</td>
<td>V/5</td>
<td>II/2</td>
<td>I/3</td>
<td>I/1</td>
</tr>
</tbody>
</table>
able to perform the full amount of work with economy, which is slightly inferior to the economy in free test. For athlete G-h, the most effective was working with a fixed power.

Discussion
In studies of cycling problems, it was found that the relationship between recovery and stress factors varies greatly over a relatively short period of time. These factors dynamically affect performance in multi-stage competitions [22]. Other studies have shown that the increase in performance of athletes is affected by: the level of self-esteem [23], the use of feedback for decision-making [27], planned adaptation to endurance training [31], psychosocial factors [46]. The results obtained by us confirm the necessity of taking into account various factors for increasing the productivity of athletes.

In a study by Waldron M. et al. [45] was highlighted the sprint characteristics of cyclists, which can be explained by mechanical and anthropometric parameters. The authors cite tests and equations that can be taken by trainers to predict performance and determine the appropriate intensity of training. Bini R.R. et al. have developed a model of a strategy to mitigate asymmetry in power supply. This approach allows elitist athletes to better support work during the 12-minute cycle. Leruite et al. developed a model of a strategy to mitigate asymmetry in the sprint characteristics of cyclists, which can be explained by mechanical and anthropometric parameters. The authors propose to change the policy in the sports federations, as well as initiatives to improve the competition conditions for these athletes. Pollastri L. et al. have investigated the interrelation of water consumption with a maximum capacity of different duration of time [39]. The authors note that due to improved thermoregulation, the productivity at the last stages increases. Turpin N.A. et al. have evaluated muscle activity in a wide range of output powers for sedentary and standing positions on a bicycle [43]. The authors note that the number and structure of muscle synergism play secondary role in using standing position when pedaling at high power outputs. Such approaches in many respects coincide with our ideas about modeling the training of cyclists.

According to some studies [1, 3], the coefficient of overall economy of work is 22-25%, the coefficient of net profitability is 26-28%. The results of our study are close to these values. The total work in free test was on average for 106.38 ± 3.57 kJ. In the studies of other authors the similar results were obtained [2, 16]. The ratio of aerobic and anaerobic contributions to the provision of work was 77.3% and 22.7%, respectively. This is close to the ratio that was obtained by R. Astrand and K. Rodahl [4]. The received data confirm mobilization of all mechanisms of power supply.

Conclusions
1. Tactical options in the pursuit race at 4 km are defined as individually optimal.
2. Tactical options in the pursuit race for 4 km depend on the features of the power systems of the rider.
3. When optimizing tactics, it is necessary to select an individual-optimal variant of the distribution of forces at a distance.

Conflict of interest
The authors state that there is no conflict of interest.

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Algorithm of athletes’ fitness structure individual features’ determination with the help of multidimensional analysis (on example of basketball)


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Abstract

Purpose: to determine main laws of determination of athletes’ fitness structure’s individual characteristics with the help of multidimensional analysis (on example of basketball).

Material: in the research elite basketball players (n=54) participated. Pedagogic testing included 12 tests, applied in combined teams of Ukraine and Russia. For every test three attempts were given and the best result was registered. The tests were passed during 2-3 training sessions.

Results: we worked out general scheme of ways of athletes’ training individualization. For every athlete we determined the groups of leading and secondary factors in individual structure of fitness. The process of athletes’ training shall contain basic and variable components. Basic component was 70% of means in general system of athletes’ training. Variable component was 30% of means and implies application of individual training means. Percentage of means in individual programs varies depending on the following: leading factors in fitness individual structure; period of individual dynamic of competition efficiency. In every micro-cycle 30% is assigned for athletes’ individual training; athletes received individual tasks; groups on the base of cluster analysis data were formed, if necessary.

Conclusions: when working out individual training programs, development of leading factors in individual factorial structure of athletes’ fitness shall be accentuated. Application of individual programs, combined with universal individualization methods creates preconditions for rising competition activities’ efficiency.

Keywords: structure, sports, individual approach, algorithm, basketball, factorial, cluster, analysis.

Introduction

At present individual approach is one of the main problems of elite athletes’ training. Even with successful sport selection the problem of individual approach to training of every athlete is still relevant. With it integrated approach to usage of physiological, biomechanical and psychological indicators is required. This problem concerns individual and team kinds of sports. In team kinds of sports players of different game roles differ by morphological, physiological and biomechanical parameters. Besides, individual differences are characteristic also for players of one game role. Disadvantage of individual approach can result in negative after effects in athletes’ training: reduction of competition efficiency; loss of training process’s effectiveness; traumatism and psychological problems.

Just the problems of athletes’ traumatism are studied in many works. Mainly, means of traumas’ prophylaxis and treatment of knee and ankle joints are analyzed. Especially this problem is characteristic for sportmen of contact kinds of sports (basketball, handball, football and so on).


The author found interconnection between sport/personality’s factors and frequency/heaviness of traumas in individual (swimming, tennis and light athletic) and team (basketball, handball, football) kinds of sports. He found that frequency and heaviness of traumas are confidently higher in young athletes and sportmen of team kinds of sports. Thus, this research shows demand in consideration of athletes’ individual psychological features for prevention of traumatism.

L. J. Backman and P. Danielson [5] showed that characteristic for basketball players increased traumatic hazard of ankle joint results in restriction of its mobility and reduction of bending angle. Such change results in emersion of patella pathologies. Thus, disordering of one joints’ functioning results in disordering of functioning of other joints. That is why it is so important to prevent athletes from traumatism. For this purpose it is necessary to consider individual biomechanical characteristics of every athlete’s movements.

D. R. Clifton et al. [10] found higher frequency and heaviness of ankle joint’s stretching among sportmen of American football, comparing with athletes’- beginners. However, prophylaxis of such traumas it is necessary to start just at the beginning of trainings. It will permit to avoid such traumas in the future and implies individual approach to training process’s planning.

It would be logical to assume that consideration of...
athletes’ individual features creates conditions for better ergonomics and effectiveness of training process. It is one of conditions of traumatism’s prevention.

Deficit of athletes’ individual features’ consideration can also lead to risk of different diseases. Casals et al. [9] showed that there is high risk of pulmonary embolism in basketball players. The authors found that in average frequency of such disease are 1.27 and 2.06 cases per 1000 players in year. This frequency is much higher than in general population researches for analogous age group. The authors also found that basketball players have higher risk of pulmonary embolism, comparing with their peers from general population. The authors concluded that additional researches are required for confirmation of these conclusions. For this purpose it is necessary to find factors, predisposing such disease. It will help to work out the methods of pulmonary embolism prophylaxis in basketball players. Such problem can also reflect the demand in individual approach to trainings’ planning in different kinds of sports.

These conclusions are in agreement with works of D. T. Brunelli et al. [7]. The authors found that training and competition periods can result in increase of upper respiratory tract diseases in athletes-adolescents. It can be connected with emersion of inflammatory processes, connected with immune weakening as a response to overloading at trainings and competitions. Consideration of athletes’ individual features with the help of complex analysis of their fitness can help to avoid such after effects.

For working out prophylaxis measures against traumatism and diseases of athletes it is necessary to fulfill comprehensive analysis of athletes’ individual features. Such analysis shall include morphological, physiological, psychological and biomechanical parameters. The methods of multidimensional analysis (factorial, and cluster analysis) of athletes’ complex testing are the most suitable for this purpose.

Such methods of mathematical-statistic data processing are the most frequently used in psychological researches at present time. Sports are not exclusion. One of popular directions of modern researches is determination of psychological and psycho-physiological characteristics of different kinds of sports representatives and athletes of different game roles in game kinds of sports. This direction also reflects study of individual approach in athletes’ training.

With the help of different factorial analysis methods of psychometric scaling results J. L. Arias-Estero et al. [2] found high correlation of different perception’s components (meaning perception of basketball players’ own sportsmanship) and received enjoyment from practicing this kind of sports. The received data witness about high informative value of multidimensional analysis methods.

With the help of different psychological researches in aggressive kinds of sports S. Avugos and M. Bar-Eli [4] showed arguable character of commonly accepted psychological affirmation that success results in the next success and failure results in the next failure. The authors point at the fat that this affirmation is far from being correct for all situations in sports. Such affirmation is correct for people with certain individual features.

P. K. Belling and P. Ward [6] showed the importance of baseball players’ cognitive training with the help of specially worked out video scenarios. Application of such technologies resulted in increase of competition activity’s effectiveness. The received data are in agreement with results of other studies [36]. Conscious fulfillment of different technical and tactic elements leads to formation of the most effective individual techniques for every athlete. In other works effectiveness was shown: application of methods of mind’s activation with the help of information technologies of football’s technique and tactic visualization [23]; effectiveness of methods of tactic actions’ visualization in female basketball players with hearing problems [22, 34]; effectiveness of methods for increasing consciousness in regulation of female basketball players’ physical load [25].

In athletes’ training great importance is assigned to the following: optimization of physical load [18, 19] and conscious fulfillment of physical exercises [27, 29, 35]; consideration of didactic laws of training process’s construction [3]; choosing of adequate tests for athletes’ fitness [16, 20]; consideration of models of coach’s (pedagogue’s) interconnection with athletes [15, 28]; substantiation of individual training models’ construction [12, 13] and criteria of successfulness in competition activity [14, 31]; influence of physical qualities on athletes’ workability [30, 33].

Other authors offered conception of training process’s individualization, which implies application of multidimensional methods [24]. In detail, this conception implies: determination of group and individual factorial structure of complex fitness with the help of factorial analysis; determination of mathematical regularities of competition efficiency’s individual dynamic; application of information technologies. They showed effectiveness of multidimensional analysis methods for determination of athletes’ individual features. The authors also specified mathematical regularities of strength, quickness and endurance dependence on athletes’ anthropometric data [26]. Also mathematical model of integral training of strength, quickness and endurance for representatives of kinds of sports with complex manifestation of physical qualities was worked out [21]. The authors presented the model of gradual change of different loads by principle of logarithmic spiral.

This conception is based on systemic analysis and specificities of self-organizing systems’ functioning [32]. Functioning of any self-organizing systems implies the presence of target, the structure with hierarchic organization and certain regularities of development of development. The same principles are presented in conception of athletes’ trainings’ individualization, reflected in quantitative characteristics, received with the help of multidimensional analysis methods [24].

The presented literature data condition the demand in further researches, devoted to application of
multidimensional analysis methods for determination of athletes’ individual features. Especially urgent is development of algorithm for athletes’ determination of group and individual factorial structure of athletes’ fitness. Working out of algorithm for finding the groups, inside which athletes are the most similar is also relevant.

The purpose of the research is to determine main laws of determination of athletes’ fitness structure’s individual characteristics with the help of multidimensional analysis (on example of basketball).

Material and methods

Participants: in the research elite basketball players n=54), average age 21.3 years, average height 180±4.16 cm average weight – 73±7.8 kg, participated. The athletes’ qualification: 1st sport category (n=28), candidates master of sports (n=19), masters of sports (n=9).

Organization of the research:

Pedagogic testing included 12 tests, applied in combined teams of Ukraine and Russia [26]. Fulfillment of every test implied 3 attempts with registration of the best results. The tests were conducted during 2-3 trainings. Time was registered by electronic stop-watch.

Description of the tests:

20 m run with registration of time of passing 6 meters’ fragment (sec.).

28 m run (the length of site) with stoppage and hand touching of face line and return back. Time of fulfillment was registered.

High jump from the spot. The athlete’s height with raised arm was measured. After it, high jump with pushing by two legs was fulfilled. The highest point of hand touching the stand was measured. The difference between the data was calculated in cm.

High jump from run (pushing by one leg – analogous two step throw in the ring). The testing was conducted by the same methodic as at high jump from the spot (cm).

Jumping for quickness. By corners of square stands are located. By square diagonals ropes are tightened (skipping ropes) at 30 cm height. During 20 seconds circular jumps were fulfilled over the ropes. The quantity of jumps was registered.

Technique for quickness. Dribbling of ball with following throw in basket was fulfilled. Condition was compulsory hitting the ring. Then, athlete fulfills dribbling in reverse direction between stands. The time of the test’s fulfillment was registered. With missing the ring results was not considered.

Throwing of 3 kg filled ball by one arm from run (the distance of run not more than 5 m). The distance of ball throw was registered (m).

Throwing of 3 kg filled ball by one arm from the spot. The distance of ball throw was registered (m).

Speed of defensive movements (see fig.1). The test requires compulsory touching of the marked points. The time of this test’s fulfillment was registered (sec.).

Throws from average and far distance (see fig. 2). The throws were fulfilled from 10 points, located at 4-6.5 meters’ distance from the ring. In total 40 throws were fulfilled. In total 40 throws were fulfilled. The quantity of hits was registered and percentage of hits – calculated.

Penalty throws. 20 penalty throws, by 2 throws’ series in ring were fulfilled. Athlete independently chose ball after second throw and moved (with dribbling) to opposite side.

Endurance for quickness. Shuttle run 5xL with high jumping and touching the board, where L – the length of site. 3 attempts with 30 se. rest between the attempts. The sum of 3 attempts’ fulfillment was calculated (sec.).

The methods of athletes’ organism’s functional state determination: Blood pressure was registered with the help of membrane device of general purpose (athlete sits

![Fig.1. Diagram of test “Speed of defensive movements”: 1 – Moving by side steps; 2 – Run with face forward; 3 – Defensive movements with back forward; 4 – Usual movements with back forward.](image)
Indicators of variation pulse metering: for analysis of vegetative regulation of cardiovascular functioning we used one of mathematical statistic methods of heart beats rate variability – variation pulse metering. Recording of signal was realized on portable cardio graphic device. The recording was fulfilled during 5 minutes in lying position after 5 minutes’ rest.

The following cardio-intervals’ processing permitted to determine a number of cardio rhythm variability’s statistical characteristics [24]:

- As indicators of heart beats rate we found:
  - $M_0$ (mode of RR-intervals’ duration) the most frequent interval between teeth RR (sec.);
  - $A M_0$ (amplitude of mode of duration of RR-intervals) – percentage of intervals’ quantity (the most frequent) to the total quantity of the measured intervals (in our case we used 50 RR-intervals) (%);
  - $\Delta x$ – variation range of RR-intervals’ duration: there is difference between the highest and the least value of RR-intervals (sec.);
- Index of tension (conv. un) of regulatory mechanisms (IT) we found by formula:

$$IT = \frac{AM_0}{2M_0 \cdot \Delta x}$$

Where $\Delta x$ - is the value of variation range of RR-intervals’ duration (sec.);
- $M_0$ – mode of RR-intervals’ duration (sec.);
- $A M_0$ - amplitude of mode of duration of RR-intervals (%).

The enlisted indicators of heart beats rate reflect different contribution of sympathetic and para-sympathetic sectors of vegetative nervous system in regulation of heart functioning. Increase of $A M_0$ duration of RR-intervals and IT witness about tonus increase of sympathetic sector. Increase of variation range of RR-intervals’ duration witnesses about increase of para-sympathetic sector’s influence [9].

**Method of workability determination by sub-maximal test PWC$_{170}$.** This test was approved by World health protection organization (WHPO) for determination physical workability by reaching heart beats rate (HBR) 170 bpm$^{-1}$ (power of physical load is expressed in kgm/min or W). Such load level is the indicator of PWC$_{170}$. The test is fulfilled in the following way: on ergo meter athlete fulfills two loads of different power (N1 and N2, duration – 5 minutes each, with 3 minutes rest between them). The load is chosen so that to receive several values of pulse in the range from 120 to 170 bpm$^{-1}$. At the end of each load HBR is determined (accordingly $f_1$ and $f_2$). After it load (at HBR 170 bpm$^{-1}$ ) is calculated by graph or by formula:

$$PWC_{170} = N_1 + (N_2 - N_1) \times \frac{170-f_1}{f_2 - f_1}$$

Where $N_1$ and $N_2$ – two loads of different power in test PWC$_{170}$.$f_1$ and $f_2$ – HBR after first and second load.

For comparing of the similar relative indicators of workability are usually calculated: PWC$_{170}$ is divided by athlete’s weight. In our research we used absolute values and relative PWC$_{170}$ indicators. The testing was conducted on ergo meter Kettler AX1.

**Determination of organism’s adaptive potentials**

For determination of organism’s adaptive system’s effectiveness we used biochemical blood tests. The tests were conducted with the help of practicing endocrinologist on the base of Institute of medical radiology, named after S.P. Grigoryev of AMS of Ukraine. As analyzes indicators we chosen: cortisol, insulin, optiomy peptide of β-endorphin (regulates organism’s adaptive systems’ functioning) and hemoglobin concentrations. Besides, we calculated tension index of adaptation systems by formula

$$IT_{k/i} = \left[ \frac{k_2 \times 100\%}{k_1} \right] / \left[ \frac{i_2 \times 100\%}{i_1} \right]$$

Where $IT$ – tension index of adaptation systems;
- $k_1$ – mean cortisol concentration in group before experiment;
- $k_2$ – mean cortisol concentration in group after experiment;
- $i_1$ – mean insulin concentration in group before experiment;
- $i_2$ – mean insulin concentration in group after experiment;

As it is known, index c/I (in our case – index of adaptation systems’ tension) – is relation of normal values’ percentage of cortisol and insulin. The lower it
is the higher are organism’s compensatory reserves. The testing was conducted at 8 30 a.m. fasting.

The methods of psycho-physiological indicators’ registration.

Registration of psycho-physiological indicators was fulfilled with computerized methods of research. As psycho-physiological indicators we registered speed of simple reaction to sound, to light and tapping test.

The method of determination of kinesthetic sensitivity’s threshold

Kinesthetic sensitivity is one of the main indicators of nervous muscular apparatus’s functioning. Preciseness is the main indicator of game effectiveness in basketball.

Measuring of kinesthetic analyzer’s sensitivity was fulfilled with the help of kinesthesiometer (Kinaesthesiometer) — instrument for determination of human awareness of own muscles and joints’ movements. In the process of measurements athlete holds light polyethylene bag filled with water, coming from glass vessel, in the right hand. Water volume was measured with graduated glass tubes, which are connected with vessel and bag by rubber tubes. The weight of bag together with ball and rubber tube is 70 g. Water comes to the bag until the tested starts to feel initial weight increment.

Minimal weight increment is registered by experimenter as threshold of distinguishing (g). After it initial weight is set again. In the course of experiment 16 thresholds of distinguishing are registered after every minute interval. From all values average threshold is calculated. It is used as indicators of relatively constant sensitivity level of kinesthetic sensor system.

With initial weight of 70 g sensor metering permits to find the state of the most sensitive sensor channels of kinesthetic analyzer.

Statistical analysis: it included application of factorial analysis by main components’ method and further determination of factorial values for every athlete. Besides, we used hierarchic cluster analysis. Mathematical statistic processing was fulfilled with the help of «EXCEL», «SPSS» computer programs.

Results

Basing on literature data generalization, results of our experiments and fulfillment of general theoretical-analytical work we worked out general scheme of ways of athletes’ trainings’ individualization [24, 26, 36].

The first direction of these series of researches implies creation of algorithm of mathematical systemizing and processing of wide spectrum of indicators, reflecting separate sides of fitness and player’s state (as system). Such direction regards the state of player or group of players in definite period of time.

The second direction is connected with analysis of factors, conditioning individual dynamic of athletes’ game efficiency.

The third direction of the research is connected with development of universal methods, permitting to individualize different aspects of training process.

On the base of the received results individual programs for athletes’ training are created.

Such principles can be applied for athletes of different qualification, age, kind of sports and other individual or group peculiarities.

Let us regard main stages of algorithm of the first direction of this scheme. In its base there is processing of testing indicators’ wide range with the help of factorial analysis by method of main components (see fig. 3).

Algorithm of determination of athletes’ fitness individual factorial structure and finding the players, who have the most similar fitness indicators

At first stage complex expanded athletes’ testing is conducted, which includes: pedagogic tests, functional tests; biochemical indicators; indicators of nervous system’s properties and speed of reaction. At second stage general structure of athletes’ fitness is determined with factorial analysis (finding of principle factors). The procedure of factorial analysis permits to determine individual factorial values for every athlete. In our research it is finding of individual factorial values for every athlete. That is why we offer the next (third) stage in this algorithm. At third stage individual factorial parameters are determined. On fourth stage hierarchic cluster analysis of testing indicators is fulfilled. The athletes are divided into groups by degree of their indicators similarity. On fifth stage individual factorial values are considered. Basing on factorial values and cluster analysis athletes’ individual characteristics are composed.

Let us provide some examples of application of first research direction’s algorithm.

We fulfilled complex testing of elite basketball players by 26 pedagogic, psycho-physiological and biochemical indicators. The received data were processed with factorial and cluster analysis. Then, we built individual factorial models of players and worked out individual programs of basketball players’ training.

For determination of fitness’s individual structure, first it is necessary to find general structure of athletes’ fitness. For this purpose factorial analysis was used. With the help of factorial analysis great number of variables (in our case – 26) was reduced to less quantity of independent values (factors).

In general structure of basketball players’ fitness we marked out six factors (see table 1). Let us open the meaning of each factor.

In the first factor the following indicators entered: body length and mass, accuracy of penalty throws, absolute PWC170 value, minimal threshold of kinesthetic sensitivity.

It is not difficult to notice that body height, weight and absolute PWC170 value are naturally interdependent. It is natural that with increase of height, weight and strength absolute indicators also increase. Strength is manifested in indicators of PWC170 test, requirements of which raise with increasing of athletes’ weight.

Accuracy of penalty throws is also connected with higher indicators of body mass and length. Taller athletes require less force to throw ball. That is why they have
more opportunities to fine differentiation of force.

This factor also includes indicators of minimal kinesthetic sensitivity threshold. Kinesthetic sensitivity threshold increases with increasing of athletes’ weight and height.

It is connected with the fact that with increasing of absolute muscular mass the felt minimal threshold of the hold weight also increases. The first factor included: speed jumping (quantity of jumps per 20 sec.) with negative coefficient of interconnection; time of shuttle run (sum of three attempts). These indicators worsen with increasing of anthropometric data. It corresponds to the delivered in the second part of theoretical conception of athletes’ trainings’ individualization.

Analysis of the first factor correlations shows that Indicators of jump from the spot are directly interconnected: the more is basketball players’ body length the higher indicators of jump from the spot they have. The highest accuracy of penalty throws is also observed with the highest values of body length and jump from the spot.

With average values of body length and jump from the spot we observed the least accuracy of penalty throws and results of jump from the spot: indicators, which require sufficient level of physical condition’s absolute indicators.

On the base of testing indicators’ analysis (first factor) we characterized it as “morphological functional development”.

The second factor included indicator of RR intervals’ variation range in analysis of heart beats rate data. With increasing of RR intervals, variation range activity of para-sympathetic sector of nervous vegetation system in rest state also increases. It characterizes ability for relaxation.
The most precisely the second factor characterizes the following indicators: reaction to light and audio irritators; RR intervals’ variation range. With increase of nervous system’s strength RR intervals’ variation range also increases. It can be noted that with increase of nervous system’s strength ability for relaxation also increases. All these indicators are mutually conditioned.

This group of indicators reflects the strength of nervous system, its stability and ability for relaxation and was called “strength of nervous system”.

The third factor included: accuracy of throw from middle distance; relative PWC$_{170}$ indicator; Level of nervous system’s functional potentials; hemoglobin and cortisol concentration in blood; tension index in heart rhythm; time of 2•28 m distance run. Test for accuracy of throws from middle distance is determined by speed-power endurance. Speed-power endurance is connected with relative indicator PWC$_{170}$ and hemoglobin concentration in blood.

The third factor is characterized the most precisely by relative indicator PWC$_{170}$, hemoglobin concentration and accuracy of of middle distance throws. Indicators of PWC$_{170}$ relative values and hemoglobin concentration are directly interconnected. The highest accuracy of middle distance throws was also observed at the highest hemoglobin concentration and indicators of relative PWC$_{170}$. At average values of hemoglobin concentration and average values of relative PWC$_{170}$ we observed average of middle distance throws’ accuracy. It can be noted that with increase of aerobic and anaerobic

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Components (factors)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threshold of kinesthetic sensitivity (r)</td>
<td>0,97</td>
</tr>
<tr>
<td>Body length (cm)</td>
<td>0,91</td>
</tr>
<tr>
<td>Body mass (kg) Jumping for quickness (quantity of jumps per 20 sec.)</td>
<td>0,85</td>
</tr>
<tr>
<td>Jump from the spot (cm)</td>
<td>-0,84</td>
</tr>
<tr>
<td>PWC$_{170}$ (kgm/min)</td>
<td>0,63</td>
</tr>
<tr>
<td>Shuttle run, Sum of three attempts (sec.)</td>
<td>-0,62</td>
</tr>
<tr>
<td>Penalty throws (% of hits)</td>
<td>0,51</td>
</tr>
<tr>
<td>Time of reaction to light (msec.)</td>
<td>0,95</td>
</tr>
<tr>
<td>Time of reaction to sound (msec.)</td>
<td>0,95</td>
</tr>
<tr>
<td>Variation range of RR intervals in indicators of heart beats rate (sec.)</td>
<td>-0,74</td>
</tr>
<tr>
<td>Time of 6 meters’ distance run (sec.)</td>
<td>-0,58</td>
</tr>
<tr>
<td>Strength of nervous system by 12 points scale</td>
<td>0,60</td>
</tr>
<tr>
<td>Concentration of hemoglobin in blood (g/l$^{-1}$)</td>
<td>0,95</td>
</tr>
<tr>
<td>Time of defensive moving (sec.)</td>
<td>0,43</td>
</tr>
<tr>
<td>Accuracy of throws from middle distance (%)</td>
<td>0,82</td>
</tr>
<tr>
<td>PWC$_{170}$ relative (kgm/min$^{-1}$·kg$^{-1}$)</td>
<td>0,75</td>
</tr>
<tr>
<td>Cortisol concentration in blood (nmole/l$^{-1}$)</td>
<td>-0,44</td>
</tr>
<tr>
<td>Time of 2•28m distance run (sec.)</td>
<td>-0,71</td>
</tr>
<tr>
<td>Tension index in heart beats rate (conv.un)</td>
<td>0,44</td>
</tr>
<tr>
<td>Jump from run (cm)</td>
<td>0,95</td>
</tr>
<tr>
<td>Insulin concentration in blood (nmole/l$^{-1}$)</td>
<td>-0,41</td>
</tr>
<tr>
<td>Throw of filled ball from the spot (m)</td>
<td>0,60</td>
</tr>
<tr>
<td>Throw of filled ball from run (m)</td>
<td>0,54</td>
</tr>
<tr>
<td>Mo in indicators of HBR (sec.)</td>
<td>0,66</td>
</tr>
<tr>
<td>Cortisol concentration in blood (nmole/l$^{-1}$)</td>
<td>0,87</td>
</tr>
<tr>
<td>Mode amplitude in indicators of HBR (%)</td>
<td>0,47</td>
</tr>
<tr>
<td>Speed technique (sec.)</td>
<td>0,51</td>
</tr>
<tr>
<td>Tapping test (quantity of pressing per 1 sec.)</td>
<td>-0,53</td>
</tr>
<tr>
<td>Sum of factorial loads</td>
<td>7,00</td>
</tr>
<tr>
<td>Factor’s contribution in total dispersion</td>
<td>35,48</td>
</tr>
</tbody>
</table>

Method of selection: analysis of main components;
Method of rotation: Varimax with Keiser’s normalization;
Rotation was during 11 iterations.
workability accuracy of middle distance throws also increases.

Level of functional potentials conditions endurance of nervous system. That is why the third factor was called as “special endurance”.

The fourth factor included indicators of jump from run, throw of filled ball (from the spot and from run), mode indicators (Mo) in heart rhythm, insulin concentration in blood. Jump from run, throw of filled ball are speed-power indicators. These indicators depended on many biochemical parameters, including insulin concentration.

Mode in heart rhythm reflects activity of humoral link of heart rhythm’s vegetation regulation and indirectly – para-sympathetic sector of nervous system. This principle relates to those qualities, which are conditioned by creatine phosphate system of energy supply.

For fourth factor interconnection between mode indicators in heart rhythm, jump from run and insulin concentration are the most characteristic.

With increase of HBR in rest (i.e. with increase Mo) insulin concentration in blood increases: activity of organism’s energy supply increases and speed power qualities improve.

That is why the fourth factor was called “speed-power qualities”.

The fifth factor included: amplitude of mode in heart rhythm indicators; total quantity of pressing in tapping tests; cortisol concentration in blood. Cortisol concentration conditions adaptive potentials of organism and activity of sympathetic sector of vegetative nervous system. Mode amplitude and tension index in heart rhythm indicators condition activity of sympathetic sector of nervous system. On the base of data analysis the fifth factor was called “vegetative regulation of functions”.

The sixth factor included indicators: “speed technique”; maximal frequency of pressing in tapping test. Basin on these indicators’ analysis the sixth factor was characterized as “speed abilities”.

Factorial analysis permitted to determine the structure of basketball players’ fitness, which included six expressed factors:

- First factor – morphological functional development;
- Second factor – strength of nervous system;
- Third factor – special endurance;
- Fourth factor – speed power qualities;
- Fifth factor – vegetative regulation of functions
- Sixth factor – speed abilities

Table 2. Examples of individual values of athletes’ factors (main staff of team)

<table>
<thead>
<tr>
<th>Athlete’s №</th>
<th>Factors 1</th>
<th>Factors 2</th>
<th>Factors 3</th>
<th>Factors 4</th>
<th>Factors 5</th>
<th>Factors 6</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-0.11</td>
<td>0.70</td>
<td>-0.02</td>
<td>1.67</td>
<td>-0.23</td>
<td>-1.34</td>
</tr>
<tr>
<td>2</td>
<td>0.56</td>
<td>-0.39</td>
<td>-0.86</td>
<td>0.39</td>
<td>1.86</td>
<td>0.57</td>
</tr>
<tr>
<td>3</td>
<td>1.03</td>
<td>1.14</td>
<td>-0.10</td>
<td>0.01</td>
<td>-0.99</td>
<td>1.34</td>
</tr>
<tr>
<td>4</td>
<td>0.00</td>
<td>-0.58</td>
<td>2.15</td>
<td>0.01</td>
<td>0.33</td>
<td>0.27</td>
</tr>
<tr>
<td>5</td>
<td>-1.96</td>
<td>0.79</td>
<td>-0.26</td>
<td>-0.68</td>
<td>0.21</td>
<td>0.34</td>
</tr>
<tr>
<td>6</td>
<td>-0.33</td>
<td>-1.75</td>
<td>-0.72</td>
<td>0.19</td>
<td>-1.17</td>
<td>0.20</td>
</tr>
<tr>
<td>7</td>
<td>0.82</td>
<td>0.10</td>
<td>-0.19</td>
<td>-1.60</td>
<td>-0.01</td>
<td>-1.37</td>
</tr>
</tbody>
</table>

Table 3. Fragment of agglomeration order in cluster analysis of basketball players’ testing indicators

<table>
<thead>
<tr>
<th>Step</th>
<th>Combining in clusters</th>
<th>Coefficient</th>
<th>Step at which cluster is the last</th>
<th>Next step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3 7</td>
<td>27,483</td>
<td>0 0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>3 6</td>
<td>37,926</td>
<td>1 0</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3 4</td>
<td>46,644</td>
<td>2 0</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>2 3</td>
<td>52,279</td>
<td>0 3</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>1 2</td>
<td>68,268</td>
<td>0 4</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>1 5</td>
<td>91,713</td>
<td>5 0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 4. Every athlete’s belonging to cluster

<table>
<thead>
<tr>
<th>Athletes</th>
<th>5 clusters</th>
<th>4 clusters</th>
<th>3 clusters</th>
<th>2 clusters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>7</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>
Fifth factor – vegetative regulation of functions;
Sixth factor – “speed abilities”.

Determination of basketball players’ fitness’ individual structure and specifying of their game functions. For determination of basketball players’ fitness’ individual structure we calculated individual factorial values, presented in Table 2. Every individual factorial value can vary from -3 to +3. In our study first factor (morphological functional development) is the most expressed in athlete № № 3 and 7 (see Table 2, fig. 5). Second factor (strength of nervous system) is the brightest in athlete № 5 and 3. Third factor (special endurance) is the most expressive in athlete № 4; fifth factor (vegetative regulation of functions) – in athlete № 2, and sixth factor (speed abilities) – in athlete № 3 (Table 2, fig. 5).

For specifying basketball players’ game functions we used hierarchic cluster analysis of testing indicators. In hierarchic cluster analysis every separate case forms, first, own cluster. With every step two, the most close to each other separate clusters, combine in one cluster. The stages of combining in clusters are given in Table 3. From tables 3 and 4 and from fig. 4 we can see that at first step players № № 3 and 7 combined in one cluster.

From this it follows that theses players are the most close by their fitness structure. It shall be considered in trainings and games. For example these athletes can form pairs at trainings. These athletes can also replace each other in game and be on the site simultaneously, depending on the tasks of training.

Below there is example of calculation of clusters’ optimal quantity:

- 7 (quantity of players) - 4 (№ step) = 3 (clusters).
- Cluster 1 – “central players” (athlete 1).
- Cluster 2 – “forwards” (athletes 3, 7, 6, 4, 2)
- Cluster 3 – “backs” (athlete 5).

At the next stage of cluster analysis athlete № 6 joins them. And so on.

For determination of clusters’ optimal quantity it is necessary to deduct number of step, at which clusters start to grow in non-linear way from the quantity of analyzed athletes. In our case it is step № 4 (see Table 3, 4, fig. 4). That is why optimal quantity equals to 7-4=4.

So, we found 3 clusters: 3 groups of basketball players. In basketball it corresponds to 3 main functions of players: central players, wing forwards and backs. In fig. 4 we can see belonging of every player to definite cluster.

First cluster (central players) consists of athlete № 1. Second cluster (wing forwards) consists of athletes № № 3, 7, 4, 6, 2. It should be noted that athlete № 2 joint cluster “wing forwards) as the last. That is why he can be regarded as player with transitive function between wing forward and central player. Third cluster (backs) consists of one player № 5 (see fig. 5).

Thus, as a result of cluster analysis we specified basketball players’ functions that cause some difficulties in coaches’ work with athletes, who have not expressed game roles. The received distribution corresponds to models of physical qualities’ interconnection, presented in conception of individualization of athletes’ training process. Central players have expressed factor “speed power qualities”. Speed-power qualities are determined multiplying force by speed (F•V). Wing forwards have the most developed factor “special endurance” and “speed power qualities. Quickness is prevalence of V (speed) in multiplication force by speed. Special endurance in basketball is prevalence of product V•t (speed manifested during period of time). Backs have better speed abilities (V) and special endurance (V•t). Thus, we experimentally proved theoretical model of physical qualities’ interconnection.

On the next stage of the research individual fitness factors and results of cluster analysis were combined and individual profiles of basketball players, with specifying their game functions, were created (see fig. 5).

Analysis of confidence of basketball testing results of different game roles by Student’s t-test showed that more than 2/3 results are confidently different in different game roles basketball players in tests for physical and technical fitness and by biochemical and psycho-physiological indicators [26].

![Fig. 4. Fragment of dendogram of athletes’ combining in clusters.](image-url)
Discussion

Generalization of the received data and theoretical analysis permitted to formulate theoretical conception of individualization of athletes’ training process [24, 26, 36]. According to this conception individualization system implies application of the following methods:

Method of determination of athletes’ fitness structure and finding of leading factors in fitness structure;

Method of competition efficiency individual laws’ determination, method of creation of individualization methodic, for athlete to open his potential.

The conducted study permits to characterize possibilities of practical application of means and methods’ system for individualization of athletes’ training process. When working out training individual programs development of leading factors in individual factorial structure shall be accentuated. For every athlete we found groups of leading and lagging factors in individual structure of fitness. Leading were the factors making in sum more than 50% in individual structure of fitness. The rest factors were lagging behind. For development of leading factors 60-80% of individual training were assigned and for lagging factors - 20-40%. Accent on leading factors’ development increased with approaching to competition period. In competition period correlation of leading and lagging factors was 70:30.

When completing start staffs of teams (replacements in game, formation of pairs and “three” on trainings it is necessary to consider the data of cluster analysis about players’ similarity and their division in groups. Depending on the tasks of training and peculiarities of definite game we formed acting groups, playing in concordance from “similar” players and from different athletes.

In individual structure of athletes’ fitness we marked

Fig. 5. Individual values of factors of athletes of team main staff: №№ 6,7 – forwards, №5 – back. Names of the factors: 1 – morphological functional development; 2 – strength of nervous system; 3 – special endurance; 4 – speed power qualities; 5 – vegetative regulation; 6 – speed abilities (0 corresponds to average expressiveness of the factor); negative values correspond to factor’s expressiveness below average; positive values – to level above average).
out the factors with indicators, correlating with them. Besides, for individual training programs we composed distribution of means of physical, technical, tactic, game and psychological training.

The process of athlete’s training shall contain basic and variable components. Basic component is 70% of means in general system of athletes’ training. Variable component implies application of individual training programs. Variable component is 30% of means: is application of individual training programs. For athletes with prevailing development of factors, making approximate models of means distribution by kinds of training. Besides, the periods of biorhythms are considered. Percentage of means correlation in individual training programs varies depending on leading factor in individual fitness structure; period of individual dynamic of competition efficiency. In every micro cycle 30% of time is assigned for players’ individual training: athletes receive individual tasks; if necessary groups are formed on the base of cluster analysis data.

Carlsson and C. Lundqvist [8] regard the problem of individual distinctions exclusively from the point of psychological distinctions. With the help of factorial analysis the authors showed peculiarities of different behavior types of coaches in training and competition process. But they do not consider other psycho-physiological, physiological and morphological indicators of coaches and athletes. Most of psychological studies in sports do not touch individualization problem from the point of human state analysis as system, combining a complex of different indicators. That is why from this point of view our work is of certain novelty.

It should be noted that D. Conte et al. [11] try to give integral assessment of individuality, considering wide spectrum of indicators. The authors found influence of players’ different quantity and trainings’ regimes on motor load in basketball. 20 young basketball players fulfilled four game exercises in groups 2x2 and 4x4. Wide spectrum of physiological, subjective and technical indicators was registered. Physiological load was assessed by percentage of maximal heart beats rate (% HRmax) and subjective feeling of the endured load (RPE). Besides, the analyzed the following technical actions: dribbling, taking ball away, pick ups, losses total quantity, correct and wring actions, % neznano of total throws’ quantity). The authors found that the most physically and technically loading are game exercises, fulfilled by 2x2. This conclusion was made on the base of data processing with the help of factorial analysis. The received by us data prove results of D. Conte et al. [11] about effectiveness of multidimensional analysis for complex assessment of fitness and effectiveness of training process’s different regimes. However, the mentioned study did not imply determination of layers’ individual characteristics. From this point of view our work is of certain novelty. From this point of view our work is of certain novelty.

In sport physiology and medicine individual distinctions are registered by peculiarities of reaction to load by cardio-vascular and nervous systems. Our conception permits to combine physiological and psycho-physiological indicators in single integral picture of athlete’s individual portrait.

In sport games athletes are classified by functions – game roles. With recommendations for training of different game role players being available, the problems of individual distinctions (psychological, physiological and psycho-physiological characteristics) are practically not elucidated. That is why algorithms for determination of leading factors, offered by us include wide complex of analyzed indicators in the structure of athletes’ fitness. Such direction seems to be a new approach to problem of athletes’ trainings’ individualization.

Working out of training process’s individualization theoretical methodic principles is directly connected with the future of sport games. Construction of training process is significantly complicated by demand in study and application of individual approach to every player. However, it is the main requirement of modern sports. Individual approach is required by every player of different game roles and players of similar functions. Modern scientific methods permit to give exact characteristic of athletes’ individual features and build the so-called “ideal” models of athletes. However such methods are seldom used. That is why effectiveness of training process weakens noticeably. Just because of it our approach is new and promising direction in theory and methodic of sports training.

J. Henderson et. al. [17] regard the problem of individualization from the point of athletes’ genetic properties. The authors think that determining factor of sport successes if genetic one. They offer to use the data about structure of DNA in building training process and predicting athletes’ success. However, the authors did not studied: on which base it is necessary to individualize load and plan individual trainings. In literature we did not find algorithms for determination of leading factors, offered by us include wide complex of indicators (physiological, physiological and morphological, game roles and players of similar functions. Modern scientific methods permit to give exact characteristic of athletes’ individual features and build the so-called “ideal” models of athletes. However such methods are seldom used. That is why effectiveness of training process weakens noticeably. Just because of it our approach is new and promising direction in theory and methodic of sports training.

Generalizing results of these works we can note that the offered by us algorithm for determination of leading and secondary factors in individual structure of athletes’ fitness combines offers of the mentioned above authors and permits to quickly and effectively find athletes features.

Too many of talented athletes left sports, not opening all their potentials. They were trained by standard methods. Such system does not consider their individual features, functional reserves adaptation potentials. When specialists were able to realize individual training program, athletes achieved outstanding results. Sport training programs shall not be strictly determined. They shall be auxiliary materials for a coach or pedagogue but not the main manual.

In this connection it should be noted that principles, offered by us permit to avoid negative mass approach for athletes’ training and permit for athletes to open their potentials completely.
Every talented athlete goes to the peak of sportsmanship to large extent by their own way. For some athlete such way is shorter and straight. The other has to go by winding and longer way. On all ways of sportmen formation sport training’s individualization significantly expands the circle of talented athletes. In this connection our work is a particular offer for seeking the way, required for athlete’s individual realization.

Thus, in our research we expanded, integrated and specified the deducted by different authors the following principles of athletes’ training’s individualization:

- Alive system (including man) has own specific reaction to changing environmental conditions. It also concerns organism in the whole and its separate organs, systems, tissues and cells;
- Preparation for main competitions shall be built, considering individual features and reserve potentials of athletes;
- Demand in creative approach to training process with compulsory feedback;
- Need in training system, which would consider athletes’ individual features, their functional reserves and adaptation potentials.

Conclusions

Results of our researches showed that creation of effective individual training programs of athletes requires application of multidimensional analysis of different aspects of organism’s functioning. The main laws of athletes’ or team development repeat general laws of complex systems’ development in alive and not alive nature. For analysis of athlete as system and creation of individual training programs it is necessary to base on fitness structure. Algorithm of athletes’ individual factorial structure’s determination and finding of similar players in clued the following stages. On the first stage complex, expanded athletes’ testing if conducted, which includes pedagogic tests, functional tests, biochemical and nervous system’s indicators, speed of reaction. On the second stage general structure of athletes’ fitness is determined with factorial analysis; determination of main factors and composing of characteristics. On third stage individual factorial parameters are found. On fourth stage hierarchic cluster analysis of testing indicators is fulfilled. As a result athletes are divided into groups by similarity of their parameters. On fifth stage (on the base of individual factorial values and cluster analysis) individual characteristics of athletes are composed. Application of individual training programs in combination with universal individualization methods will create preconditions for increase of competition functioning’s efficiency.

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Conflict of interests

The author declares that there is no conflict of interests.

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Influence of Qigong training on reduction of harmful computer habits and their danger for students with weak health

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Abstract

Purpose: to show influence of health related Qigong training of reduction of harmful computer habit and their danger for students with weak health.

Material: 1st-3rd year students of Krasnoyarsk were the object of the research (n=1158). Students were trained by discipline “Physical culture” for main health group (no health problems). Students with weak health were trained by Qigong program (n=129).

Results: Qigong training reduces total time of students, which they spent for computer habits. The most frequent of all students is internet. The spread of this habit in students of all tested groups does not change noticeably in the course of study. Qigong training reduces the quantity of students, who spend dangerously much time every of three computer habits.

Conclusions: Qigong training of reduction of harmful computer habit and their danger for students with weak health. It is more effective in reduction of time, spent for all harmful habits than typical physical culture trainings.

Keywords: students, Qigong training, computer habits, internet, computer games, physical culture, healthy life style.

Introduction

We call “computer” the habit (CH) connected with long term interaction of person with notebooks and other gadgets. They include three the most frequent habits: internet search of contacts in social nets, computer games, watching anime. They threat the level of education; lead to loss of concentration on most important life directions [22]. Modern students have net to sped time in nets. [4]. Young generation understands internet as the main mean of education and personal communication [30]. Increase of students’ age internet users, working out of new high speed programs of communication and virtual interaction resulted in rising of internet addiction and mass computer game addiction [5]. It is necessary to take measures for resistance students’ computer habits [23].

Important tasks are the following: studying of harmful computer spread among students [16]; creation of educational technologies, which would weaken computer habits and resistance to computer addictions [21]; creation of preconditions for formation of ideas about life quality [3, 9]; motivation for physical activity [13, 28]; monitoring and control over motor activity [12, 32].

Important criterion of computer habits is time, which is spent for them during day. If contact with computer is more than 2 hours without break, it becomes dangerous for human health. If student spend more than four hours a day for computer habit there is high probability of emersion of harmful for health addiction.

Many students have weak health. Way of life plays main role in preservation and strengthening of health. Life style as subjective characteristic to large extent depends on a person [14, 27]. Organizing life activity, person makes it more ordered, using some firm structural components. It can be certain day regime, when student goes to bed, do exercises, uses hardening procedures in one and the same time [6, 11]. Students’ unhealthy life style results in bent to diseases [31, 33]. Thus, development of socially significant demands in students is one of the most important tasks of formation of full fledged healthy personality. Such personality naturally combines spiritual wealth, moral purity and physical perfection [10, 15].

The health is recognized as high and global value by the most of students. However, conscious formation of own life style of health’s strengthening and perfection is achieved not by all students [29, 30].

We regard as relatively healthy students (RHS) those, who attend physical culture lessons (PC) for main group. For students with weak health, in our HEE PC specialization “Health related Qigong training” (QT) is practicing. QT program includes relaxation and joint warming up, Chinese gymnastic Qigong and psychological training [17]. Such trainings are directed at improvement of students’ physical and psychic health [19].

It is very important to comprehensively study the status of scientific problems on formation of principles of students’ healthy life style practicing. As per data of M. Argile, health level is closely connected with the following factors: presence of great number of social connections and friendly contacts; strong family and presence of children in it; interesting work, bringing moral satisfaction; active practicing of physical exercises in the fresh air; special features of personality, characterized by perception of life difficulties as a source of personal progress, belief in high ideals and religiosity, making people supporters of moderate way of life without harmful habits [1]. It is very probable that determining factor of human health is his way of life. Way of life is rather complex, multi facet and dynamic phenomenon. Its forms to large extent are preconditioned by personal qualities [7, 8] and social-cultural medium [24, 25], in which realization of personal values and interests of definite man take place [34].

Study of QT effectiveness is shown in different
The authors delivered results of QT on monitor [17] (including computer) habits of students with weakened health [16]. In these researches there was used insufficient volume of students’ sample, which was trained by QT program. That is why, conclusions of such researches are rather preliminary.

The purpose of the research is to show influence of health related Qigong training of reduction of harmful computer habit and their danger for students with weak health.

The tasks of the research is to make comparative analysis of students’ time expenditures for CH of main health group and groups QT.

Material and methods

Participants: 1st-3rd year students of Krasnoyarsk were the object of the research (n=1158). Students were trained by discipline “Physical culture” for main health group (no health problems). Students with weak health were trained by Qigong program (n=129). The students were divided into experimental group (students with weak health, trained by QT program) and control group, trained by academic program of Physical culture.

Organization of the research: in our research we used the following methods:

1. Pedagogic experiment. In the course of experiment we registered time expenditures of experimental and control groups’ students for every computer habit at the beginning (October, November) and at the end of academic year. Analysis of difference between the received data for one group of students permits to make conclusions about influence of studying at HEE on appropriate parameters. Comparison of the received data will witness about effectiveness of trainings on reduction of danger of computer addictions.

2. Self-assessment. This method is very wide spread in psychological-pedagogic researches. Concept of self-assessment is directly connected with human estimation of own qualities. In the process of self assessment personality learns reality, to which his/her activity is directed. Personality also assesses own potentials and own qualities, ensuring fulfillment of this activity. Self-assessment is a result of these two lines of cognition [2].

As N.V. Liashchenko noted, formation of adequate self-assessment is rather complex process [26]. That is why it is necessary to carefully and objectively study personality, which will help to find his/her abilities and form adequate self-assessment. Such self-assessment will facilitate more effective training and competition process.

In the works of V.V. Tsybulskaya it is shown that students with high self-assessment rarely have motivation for physical culture practicing [35].

We intentionally limited the sample of our research by students, who are able to consciously assess distribution of their lives’ time. We were interested in students, who in the nearest 10-20 year can become managers of different levels and will influence on progress in our country. The method of self assessment is subjective and not accurate. We reduced to minimum the influence of such factors: increased samples of control and experimental groups; students were offered convenient for them self-assessment scales. Students were offered to relate to different time ranges duration of their computer habits during day.

Statistical analysis: processing of the received experimental data included: co; counting of mean quantity of girls’ and boys; computer habits; counting of different percentage for every group; calculation of mean values, relating to every CH; assessment of confidence of differences by Student’s t-test (level of significance less than 0.05). The received data were processed with statistical functions of Microsoft Excel program.

Results

The main results of students’ questioning data processing are presented in tables 1-3. In these tables we give results of mean time calculation (hours/day), spent by boy students (b) and girl students (g) of every year for each CH at the beginning of studying at HEE and at the end. Besides, we give percentage of students, who have no CH and students, who spend regulated time for CH. Percentage was calculated by relation to the quantity

| Table 1. Students’ distribution by time expenditures (hours/day) for habit to spend time in internet |
|-----------------|--------|--------|--------|--------|--------|--------|--------|
| Group          | N     | Mean time, hrs/day | No., % | < 1, % | 1–2, % | > 2, % | > 4 %  |
| B, beginning   | 217   | 2,4 ± 0,1          | 5      | 18     | 34     | 44     | 20     |
| G, beginning   | 185   | 3,0 ± 0,1          | 4      | 7      | 27     | 62     | 29     |
| QB, beginning  | 22    | 2,8 ± 0,5          | 0      | 32     | 18     | 50     | 32     |
| QG, beginning  | 29    | 2,6 ± 0,4          | 7      | 21     | 21     | 52     | 24     |
| B              | 285   | 2,8 ± 0,1          | 2      | 18     | 31     | 50     | 29     |
| G              | 180   | 3,2 ± 0,1          | 3      | 9      | 21     | 67     | 32     |
| QB             | 36    | 2,4 ± 0,3          | 3      | 11     | 44     | 42     | 19     |
| QG             | 82    | 2,7 ± 0,2          | 0      | 15     | 32     | 54     | 22     |

Notes: N – total volume of sample; “No” – students, having no CH; B (boys, group MHG); G – (girls, group MHG); QB – boys, Qigong group; QG – girls, Qigong group; “beginning” – beginning of studying in HEE.
of the questioned students of appropriate group.

Analysis of time expenditures for computer habits shoes the following:

1. Ordinary students of any group spend for all computer habits in total 4–5 hours a day. In QT group this time noticeably reduced, while in control group – increased.

2. The habit to spend time in internet is the most wide spread in experimental and control groups The spread of this habit in all groups does not change significantly in the course of studying (difference between values in column “No”, table 1 is insignificant. At the end of academic year, in QT group the quantity of students, who pay CH dangerously much time (more than 4 hours) – reduced. Besides, the quantity of QT students, who spend more than 2 hours a day also reduced. In group MHG (boys and girls) the quantity of students, paying more than 2 hours in internet, increased. More over, the quantity of boys, who spend in internet more than 4 hours, increased.

3. Computer games are more spread among boys than among girls (differences between values in column “No”, table 2 for girls and boys of both groups are confident). At the end of academic year QT students spent for this habit much less time than at the beginning. In MHG average time losses for this habit did not change. In QT group the quantity of students, playing computer games more than 4 hours a day, significantly and rather noticeably changed. In MHG group these data did not change significantly. In QT group the quantity of girls, who play computer games more than 2 hours noticeably changed.

4. The less spread habit of students is habit to watch anime, manga and so on. For QT boys the spread of this habit noticeably reduced during studying at HEE (see table 3); the quantity of students (boys and girls) of QT group, who spend 2 or 4 hours a day, significantly reduced. In MHG group the quantity of boys, spending time for anime more than 2 or 4 hours increased. The MHG girls’ indicators significantly did not change.

Discussion

The authors of this research again attract attention of society and scientific workers to formation of students’ healthy life style. However, many students have quite unhealthy way of life [23]. It is connected with young people’s excessive involvement in internet [21] and computer games addictions [22]. Correction of such situation is possible only with interesting for young people measures, non traditional kinds of physical culture [33]. Qigong can be related to such kinds [18]. Young people shall see other values [27]. Only in this case youth’s self-assessment can be raised [26].

The authors agree with affirmation that it is necessary to create preconditions of formation of society’s demand in healthy life style [34]. Besides, it is necessary to actively realize them in students’ physical education [10]. Qigong training helps to receive positive feelings and emotions from physical culture and distract from “sitting at computer” [17]. In some cases QT can be very important factor of prophylaxis, for example alcohol addiction, among students [20].

The authors of the article proved that Qigong training facilitates weakening of students’ harmful computer habits. It is especially important for special health group students, who already have health problems. In this

### Table 2. Students’ distribution by time expenditures (hours/day) for habit to spend time for computer games

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean time, hrs/day</th>
<th>No, %</th>
<th>&lt; 1, %</th>
<th>1–2, %</th>
<th>&gt; 2, %</th>
<th>&gt; 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, beginning</td>
<td>1.8 ± 0.1</td>
<td>20</td>
<td>24</td>
<td>23</td>
<td>34</td>
<td>11</td>
</tr>
<tr>
<td>G, beginning</td>
<td>0.5 ± 0.1</td>
<td>69</td>
<td>16</td>
<td>8</td>
<td>8</td>
<td>3</td>
</tr>
<tr>
<td>QB, beginning</td>
<td>2.7 ± 0.6</td>
<td>14</td>
<td>27</td>
<td>18</td>
<td>41</td>
<td>41</td>
</tr>
<tr>
<td>QG, beginning</td>
<td>1.0 ± 0.4</td>
<td>48</td>
<td>31</td>
<td>3</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>1.7 ± 0.1</td>
<td>22</td>
<td>24</td>
<td>21</td>
<td>32</td>
<td>13</td>
</tr>
<tr>
<td>G</td>
<td>0.4 ± 0.1</td>
<td>72</td>
<td>16</td>
<td>7</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>QB</td>
<td>2.0 ± 0.3</td>
<td>17</td>
<td>28</td>
<td>11</td>
<td>44</td>
<td>17</td>
</tr>
<tr>
<td>QG</td>
<td>0.6 ± 0.1</td>
<td>52</td>
<td>29</td>
<td>11</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 3. Students’ distribution by time expenditures (hours/day) for habit to spend time for anime

<table>
<thead>
<tr>
<th>Group</th>
<th>Mean time, hrs/day</th>
<th>No, %</th>
<th>&lt; 1, %</th>
<th>1–2, %</th>
<th>&gt; 2, %</th>
<th>&gt; 4 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>B, beginning</td>
<td>0.3 ± 0.1</td>
<td>83</td>
<td>8</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>G, beginning</td>
<td>0.2 ± 0.1</td>
<td>90</td>
<td>5</td>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>QB, beginning</td>
<td>0.8 ± 0.4</td>
<td>68</td>
<td>18</td>
<td>0</td>
<td>14</td>
<td>9</td>
</tr>
<tr>
<td>QG, beginning</td>
<td>0.9 ± 0.4</td>
<td>72</td>
<td>7</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>0.4 ± 0.1</td>
<td>81</td>
<td>6</td>
<td>5</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>G</td>
<td>0.3 ± 0.1</td>
<td>87</td>
<td>4</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>QB</td>
<td>0.3 ± 0.2</td>
<td>81</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>QG</td>
<td>0.4 ± 0.1</td>
<td>76</td>
<td>12</td>
<td>7</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes: legend of table 2 and 3 – see table 1
connection they simply have no right to cause further, complete worsening of health because of excessive involvement in computer habits. Such students are not recommended to practice computer games as well [19].

The present study is confirmed by results of other scientists, who work out the most modern approaches to students’ health preservation by physical education means [11]. These authors underline the necessity in health related Qigong gymnastic training as dynamic factor of development of healthy life style’s personality’s component [18].

Owing to healthy life style young generation can change own views and habits to physical culture and sports practicing. Such youth can raise communication level and erudition without internet addiction [4].

Thus, we affirm that it is possible to reduce computer habits and inevitable influence of modern education on computer addictions. Harmful habits and their danger for students with weak health can be overcome in modern society with the help of Qigong training. It agrees with scientific concept of the authors of the present article and other scientists.

**Conclusions**

1. Most of students have 2-3 computer habits and pay to them much time. It negatively reflects on their health. Qigong trainings are the factor reducing time for these habits.

2. QT is more effective in weakening of spread and time losses than PC lessons for MHG.

3. Analysis of time losses, connected with computer habits does not permit to directly assess QT effectiveness in reduction of students’ computer addictions. On this problem additional study was conducted, results of which would be presented in future publication.

**Conflict of interests**

The authors declare that there is no conflict of interests.

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Influence of physical activity on students’ life quality
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Abstract
Purpose: influence of students' targeted and regular physical activity on their life quality.
Material: in the research students (n=325, age 18-21 years) participated. Students' life quality was studied with the help of questionnaire “MOS SF-36” (J.E.Ware). We determined students' physical workability and physical fitness.
Results: formation of students’ physical activity was based on the worked out technology: 1) motor functioning for general endurance; 2) account on speed-power training was made in second half of semester; 3) training of dexterity and flexibility was realized considering certain kind of academic material and future professional activity; 4) the structure of trainings in academic year included 3 stages. At first stage (September, October) 70% of time was spent for endurance, 15% - for quickness and 15% for strength. At second stage (November, March) 50% was assigned for endurance, 30% - for quickness and 20% - for strength. At third stage (April, May) 40% of time was assigned for quickness, 40% - for strength and 30% - for endurance. As a result of realization of the worked out technology for students’ physical activity their individual health improved and became the factor of students’ life quality perfection.
Conclusions: targeted and regular physical activity of students confidently influences on their individual health by all indicators: organism’s functional reserves; physical workability and fitness, way of life and organism’s resistance. Targeted and regular physical activity of students facilitates improvement of students’ life quality.

Keywords: physical activity, physical, health, life quality, students.

Introduction
In period of any society’s gradual development humanistic values and rising of life qualities are very important. Life quality of man to large extent is determined by human physical activity and health. In new conditions of development of Russia social component of physical activity in society increases and its role in formation of healthy life style and quality increase.

Students are main subject of educational process in HEE. In “Strategy of state youth policy in Russian Federation to 2016” youth’s quality id defined as resulting systemic indicator of youth policy’s effectiveness and its interaction with development of country. Improvement of youth’s life quality and development of country are defined as strategic task [1]. All efforts of science and education shall be directed at improvement of life quality. In this aspect higher educational establishments’ students’ are themselves interested in rising of their life quality, from position of active life, receiving good professional education, reaching proper professional fitness and so on.

Great number of scientific works is devoted to human physical activity. Physical activity is understood as targeted and regular motor functioning. This functioning is directed at improvement of physical condition, functional state and health. In this process motor functioning plays important role [2].

V.K. Balsevich thought that the most substantial manifestation of personality’s physical culture is physical activity as special form of human functioning [3]. N.I. Ponomarov says that human physical activity contains a system of ideas about main laws of controlled development of human potential; ways and means of personality’s active attitude to physical perfection; its forms and organization [4].

Thus, students’ physical activity we understand as students’ targeted and regular motor functioning, directed at their physical condition’s improvement as well as organism’s functional state and health [5].

Reduction of human physical activity, with simultaneous increase of nervous emotional tension, results in health worsening [6]. Such tendency is relevant both for adult and young population of Russia [7].

The work of N.V. Sokolova is devoted to study of hygienic factors’ role in formation of girl pedagogic HEE students’ life quality [8]. In work of S.I. Kartysheva there is analysis of formation of boy students’ life quality. The author found that formation of students’ life quality is influenced by such factors as: health, material conditions. Correct eating; high personal anxiety; relations in academic group; behavior risk factors [9]. The problem of students’ life quality were continued by N.V. Mukhina. She studied gender peculiarities of formation of students’ life quality and dynamic of studying in pedagogic HEE [10].

Recent years in scientific literature there have been appeared the works on physical culture means usage for rising human life qualities. Ye.V. Tokar and A.M. Koechevskiy regarded factors influencing on life quality of higher education establishments’ teachers [11]. In their research they showed that main factor was physical activity of teachers. I.V. Samsonenko showed positive influence of athletic gymnastic and information technologies on quality of students’ life [12].

Formation of students’ positive attitude to own health is influenced by the following: optimal physical loads [13, 14]; application of modern and attractive training forms [15, 16]; individual approach to training [17]; physical fitness [18]; possibility to choose kind of sports in compliance with own abilities [19, 20].

V.A. Orynychuk found interactions between physical, psychic and social components of student’s life quality and his/her way of life, educational medium of HEE [21]. I.A. Sviridova assessed system of vocational training and students’ medical aid organization. Such system
socially determines students’ health and raise life quality of Kemerovskaya region students [22]. Social principles of students’ physical activity’s formation and life quality rising are also regarded in other works [23, 24].

A number of foreign works was devoted to indicators of health and life quality: attributes and criteria of assessment [25]. In the study of Harris J. physical culture education of students, propaganda of healthy and active way of life was regarded [26]. In opinion of many authors life quality is subjective assessment of satisfaction with different aspects of life; the felt life quality, subjective feelings of individual, formed on the base of certain life conditions and emotional state [27]. Life quality can be regarded from the following positions: healthy way of life in regress of sub-optimal health state [28]; volume and social context of physical activity [29]; importance of physical activity and sleep [30]; control of physical load [31, 32]; satisfaction with trainings’ organization [33].

Thus, students’ life quality is understood by us as system of life values, which characterize the following: students’ educational and future professional activity; satisfaction of demands; personal development in aspect of satisfaction with life, social relations and surrounding, educational and personal medium. Great importance in its increasing has health, healthy lifestyle, targeted and regular physical activity [12]. Conception “system” in definition of life quality shows that main method of assessment and study of life quality components are systemic analysis, combination of scientific methods and practical techniques of the problem’s solution on the base of systemic approach and regarding the object of the research as a system.

The purpose of the research is substantiation of physical activity’s technologies in higher educational establishment and their influence on students’ life quality.

Material and methods

Participants: students of Amur State University, (n=325, возраст 18-21 год).

Assessment of students’ individual health was based on approach of V.I. Bielov [34], which permits to assess main systems of organism’s life provisioning (cardio-vascular, respiratory), physical condition, physical workability, way of life. Such methodic was supplemented by us by a number of informative indicators, permitting to assess physical workability and physical fitness. Health ranging was fulfilled by 4 levels.

Students’ life quality was assessed with the help of questionnaire “MOS SF-36» (Russian version of J.E.Ware,1992) [35].

Organization of the research

Pedagogic experiment was built on the base of longitudinal research, starting from first year and up to the forth, inclusive (2012-2013 -2015-2016 academic years). As a result technology of students’ physical activity was worked out, which included:

1. Motor activity was directed at increase of general endurance at the account of volume and intensity of load. Trainings for endurance were concentrated by us at the beginning of academic year during 1,5-2 months before starting of “geographic zone” (in Far East it is beginning of November) and were conducted in the fresh air. It increased resistance of organism to unfavorable climatic conditions. The achieved general endurance sustained during all academic year with aerobic cyclic exercises.

2. Accent on speed power training was made in second half of every semester. It included physical exercises with weights, different jumps, games in the fresh year and relay races.

3. Training of dexterity and flexibility was realized as per academic material, considering future professional activity.

4. The structure of trainings in academic year consisted of three stages. At first stage (September, October) 70% of time was devoted to training of endurance, 15%- quickness and 15% - strength. We used uniform method and different variants of alternative method. At second stage (November, March) – 50% were assigned for endurance, 30% - for quickness and 20% - for strength. We used uniform, alternative, repeated, interval and competition training methods. At third stage (April, May) 40% of time was spent for quickness, 40% - for strength and 30% - for endurance. Repeated, interval and competition training methods were used.

Statistical analysis

Student’s t-test was found by table of bordering values at confident level 95, 99, 99,9% of null hypothesis probability and number of degrees of freedom \( f = n – 1 \).

For determination of confidence of differences between mean values of compared parameters we used pair and not pair criterion t as well as non parametric criterion U (Wilcoxon-Manna-Whitney). When using not pair criterion the number of freedom degrees was found as \( f=n_1+n_2-2 \), for pair - \( f=2n-1 \). We considered significance levels of differences (p) 0,05; 0,01; 0,001. Differences considered to be confident at \( p<0,05 \).

With the help of computer program Deductor (Base Group) [36] we simulated indicators of physical condition: determined significance of a number of factors’ influence on final result and prediction.

Results

Results of the researches showed that by all indicators there happened confident changes (at \( p<0,05 \)) (See table 1).

In the process of experiment integral indicator confidently changed from 2,7±0,28 points in first year (2nd level) to 4,3±0,34 in forth year (4th level). Indicators of functional reserves confidently increased from 2,9±0,44 points in first year to 4,4±0,42 – in forth. Physical workability and physical fitness indicators increased from 2,4±0,22 and 2,7±0,32 points in first year (2nd level) to 4,4±0,22 and 4,6±0,38 points in forth (4th level). In forth year we observed a tendency to insignificant reduction of physical fitness indicators. It can be connected with insignificant weakening of physical activity. Indicators of students’ way of life and organism’s resistance (by frequency of diseases per year) changed, during
experiment, from 2.7±0.21 and 2.9±0.24 points in first year (2nd level) to 4.3±0.24 – in forth year (3rd level and 4th levels).

Results of study of experimental group students’ life quality (see table 2) show that in first and second years physical and psychic components of life quality are at low level (47±4.3 points), at (p<0.05).

Low indicators of physical components show that physical state restricts fulfillment of physical loads and physical activity. It influences on state of health. Low indicators of psychic component witness about presence of depressive, troublesome feelings, psychic troubles. In second year we also observed low (close to average) level of students’ life quality (60±6.3 points, p<0.05). Results of our research show that third year students have average and above average levels of life quality (73±6.4 points, p<0.05). Forth year has the highest indicators of life quality (89±7.4 points, p<0.05). Students of this group are well adapted to university conditions. They have high physical and life activity and low anxiety.

Table 1. Dynamic of changes of students’ individual health in points

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Group</th>
<th>1 year</th>
<th>2 year</th>
<th>3 year</th>
<th>4 year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>M±m</td>
<td>M±m</td>
<td>M±m</td>
<td>M±m</td>
</tr>
<tr>
<td>Functional reserves of organism</td>
<td>EG</td>
<td>2.9±0.44</td>
<td>3.0±0.40</td>
<td>3.7±0.33</td>
<td>4.4±0.42</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>0.05</td>
<td>0.05</td>
<td>0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Physical workability</td>
<td>EG</td>
<td>2.4±0.22</td>
<td>3.4±0.34</td>
<td>3.7±0.26</td>
<td>4.6±0.38</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Physical fitness</td>
<td>EG</td>
<td>2.7±0.32</td>
<td>3.4±0.35</td>
<td>3.9±0.41</td>
<td>4.5±0.42</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Way of life</td>
<td>EG</td>
<td>2.7±0.21</td>
<td>2.8±0.21</td>
<td>3.2±0.24</td>
<td>4.0±0.38</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Resistance of organism</td>
<td>EG</td>
<td>2.9±0.24</td>
<td>3.3±0.19</td>
<td>3.7±0.21</td>
<td>4.3±0.24</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Integral indicator</td>
<td>EG</td>
<td>2.7±0.28</td>
<td>3.3±0.30</td>
<td>3.7±0.29</td>
<td>4.3±0.34</td>
</tr>
<tr>
<td></td>
<td>p</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&gt;0.05</td>
<td>&lt;0.05</td>
</tr>
</tbody>
</table>

Table 2. Change of students’ life quality

<table>
<thead>
<tr>
<th>Components</th>
<th>1 year</th>
<th>2 year</th>
<th>3 year</th>
<th>4 year</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>x±m</td>
<td>x±m</td>
<td>x±m</td>
<td>x±m</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Physical component of health, points</td>
<td>48±5.3</td>
<td>58±4.7</td>
<td>75±7.2</td>
<td>84±8.1</td>
<td></td>
</tr>
<tr>
<td>Physical functioning, points</td>
<td>45±5.1</td>
<td>50±4.1</td>
<td>77±7.2</td>
<td>83±6.0</td>
<td></td>
</tr>
<tr>
<td>Role functioning, points</td>
<td>46±4.9</td>
<td>56±6.5</td>
<td>74±6.7</td>
<td>83±6.1</td>
<td></td>
</tr>
<tr>
<td>Intensity of pain, points</td>
<td>49±3.6</td>
<td>59±4.4</td>
<td>76±6.1</td>
<td>80±8.0</td>
<td></td>
</tr>
<tr>
<td>General state of health</td>
<td>56±6.5</td>
<td>58±5.9</td>
<td>75±6.1</td>
<td>84±9.5</td>
<td></td>
</tr>
<tr>
<td>2. Psychological component of health, points</td>
<td>47±4.8</td>
<td>63±5.3</td>
<td>72±7.6</td>
<td>86±9.9</td>
<td></td>
</tr>
<tr>
<td>Psychic health, points</td>
<td>44±5.6</td>
<td>62±6.1</td>
<td>77±6.4</td>
<td>85±7.0</td>
<td></td>
</tr>
<tr>
<td>Role functioning, conditioned by emotional state, points</td>
<td>50±5.4</td>
<td>66±6.6</td>
<td>72±6.3</td>
<td>89±8.5</td>
<td></td>
</tr>
<tr>
<td>Social functioning, points</td>
<td>56±4.1</td>
<td>61±5.5</td>
<td>78±8.5</td>
<td>90±8.6</td>
<td></td>
</tr>
<tr>
<td>Life activity, points</td>
<td>44±4.8</td>
<td>59±5.1</td>
<td>79±6.3</td>
<td>81±7.7</td>
<td></td>
</tr>
</tbody>
</table>

Notes: x±m, (x – mean arithmetic, m – standard error of mean arithmetic)
Discussion

Many specialists note that physical activity is directed at strengthening of human physical condition, organism’s functional state and health. [3, 5, 6]. However, as on to day physical activity has not become a demand of students. Analysis of works, devoted to formation of students’ physical activity [6, 7, 26] shows that most of recommendations of scientists are not paid attention to by higher educational teachers and coaches. In our opinion the reasons are as follows:

1) Intensive engagement of students (academic, scientific, social). Not formed motives and demands in targeted and regular physical activity;

2) Low professional-pedagogic level of teachers, who, by a number of reasons, do not see potential of students’ physical activity and not overstep the frames of “Physical culture” discipline. For increasing of organism’s functional potentials, physical fitness and health strengthening discipline “Physical culture” is not sufficient;

3) Insufficient material-technical provisioning of training sites;

4) Insufficient financing of students’ physical culture and sports.

The received results proved that the worked our technology of physical activity influences on increasing of HEE students’ life quality. In our opinion the researches of such kind it is necessary to regard:

1) As substantiation of new modern technologies, built on the base of innovative and information approaches;

2) As substantiation of physical activity technologies and their influence on life quality in main, special and preparatory groups;

3) Objects of physical activity’s influence studying shall be all subjects of educational process (students and teachers).

Conclusions

1. The worked out technology of physical activity influences on students’ individual health by all indicators: organism’s functional reserves, physical workability, physical fitness, way of life and organism’s resistance.

2. Technology of physical activity is a factor, facilitating rising of HEE students’ life quality: physical and psychological components of health.

3. It is necessary to note that as a result of application of required physical activity means with usage of intensive physical loads in experimental group we found expressed positive changes.

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Conflict of interests

The authors declare that there is no conflict of interests.

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The effect of liquid losses in training sessions during competition period on some biochemical values of u18 male judokas (age 15-17)

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Abstract

Purpose: The purpose of this study is to investigate the effect of liquid losses occurring in training sessions during the competition period on some biochemical values of the male Judokas competing in the U18 category.

Material: The values of the 17 male athletes, who were included in the national team at least once, were checked in our study which compares the values of athletes before the competition and immediately after the competition. Urine Density, Urine pH, BUN, Creatine and Potassium values from the biochemistry values were measured besides the age, height and weight of the athletes participating in the study.

Results: As a result of the measurements made; it was found that the kg pre-test averages of the participant athletes were 67.82 ±17.87, post-test averages were 64.88±18.89. Urine Density pre-test averages were 1.017,94 ±7.08, post-test averages were 1.025±8.48. Urine pH pre-test averages were 6.15±0.70, post-test averages were 5.82±0.50. BUN pre-test averages were 15.65±3.14, post-test averages were 24.35±3.80. Creatine pre-test averages were 0.48±0.20, post-test averages were 0.93±0.41. K Potassium pre-test averages were 4.16±0.35, post-test averages were 4.95±0.64.

Conclusions: As a result; it is thought that in our country in which the adjustment of the weight class is made unconsciously and unplanned, this will lead to the health problems of the athletes in many ways, especially in the later ages. Particularly in the professional sense, the health problems, which athletes who enter weight competitions and who enter at least 10 international competitions in the Olympic sense for the Judo branch a year can experience in the later ages as a result of such exhaustion, should be well considered. The the significant differences in studies in the literature and in our work also indicate that acute and rapid dehydration causes athletes to be harmed in terms of health and leads to the loss of performance. The result of our study is that the athletes should be prompted for weight control in a planned way to prevent the adjusting weight by acute and excessive dehydration.

Keywords: Judo, Dehydration, weight loss, Olympic cycle, Biochemical Values.

Introduction

In today’s world of technology, sport is defined as a form of life and educational tool. The application of the sport in different age categories and performance levels by the individuals living in the society shows that it is an important component of life.

Among the factors that make individuals interested in sports are the earnings of successful athletes, being at the forefront in the society, the recognition by the whole world and the media [1]. Particularly with team sports, the right orientation and increased interest in individual sports have made sports more popular and appealing to the more people. Judo, one of the most important parts of the world, is considered to be one of the premise branches that young people are interested in.

In a sport that requires a high level of skill, such as Judo, the development of analytical functions and the ability to quickly perceive and act in the ever-changing conditions of the competition are described as the characteristics that the athletes dealing with this sport need to improve. In addition, the decisions that athletes will make in the event of a complex game are thought to depend on their perception of external stimuli. The level of quick thinking and interpretation plays an important role in preventing the opponent from making a successful tactical behavior or succeeding in his own tactic [2, 3].

In sports such as Judo, the level of training, perception ability, experience as well as body weight are seen as important factors for the success of the athletes. Athletes who want to be successful want to lose weight in order to compete in a lower weight class. Judokas frequently use training methods that include severe sweating, sweating in the sauna, heavy workouts and heavy exercises in a hot environment, with a severe or full hunger diet that they apply very seriously in order to be successful in falling to a lower weight class. The implementation of these intensive methods in short time by the athletes is causing health and performance problems. The use of weight loss and dehydration methods in such a short period of time by the athletes cause risks for both their health and their success [4, 5, 6]. While dehydration is known as fluid loss, it also means the losses of electrolytes in the clinical sense. In the early stages of fluid loss, sodium and chloride ions are lost along with the water in the body. If the water and the electrolytes of which level falls in the body are not replaced, the volume of intravenous fluid decreases. Blood circulation slows down. The slowing of blood circulation results in decreased oxygenation of tissues leading to adverse effects on performance [7, 8].

The way in which athletes lower their body weight is often seen as acute weight loss. It is not possible for the athletes in the developmental age to compete in a higher weight class due to their developing body structure. It is more common to lower the acute body weight in the athletes who see it as a disadvantage. Acute weight loss leads to a reduction in the plasma volume and blood volume of the athletes. In submaximal exercises, there are many changes physiologically and biochemically affecting the athlete in a negative way. In particular,
electrolyte imbalance, reduced volume of fluid filtered in the kidney, increased urine density, and reduced glycogen storage in the liver, resulting in poor performance [9]. In particular, the fact that the methods used in the pre-competition process do not adequately replace the loss of fluid in the body does not only reduce the performance, but also causes serious health problems and even deaths in the athletes [10].

Acute body weight decrease is important in determining how it affects the body of athletes and their biochemistry values, resolving this frequently encountered problem and increasing the knowledge of coaches and athletes about this issue, raising more efficient athletes and, most importantly, raising healthy and successful athletes. This study is planned to determine the extent to which damage to the athletes and biochemical changes will be caused by the methods of fast body weight loss applied in today’s sports events and weight sports like Judo.

**Methods**

**Participants**

Research group of the study consists of 17 male judoka volunteers who participated in the Turkish Judo National Team at least once, live in Konya province and will compete in the Turkish U18 Championship and whose average age was 16.29 ± 1.49 years and length averages was 174.35 ± 9.42.

**Collection of Data**

The training period and demographic measurements of this study were carried out in the Konya Metropolitan Municipality Judo Training Center Hall and biochemical analyzes were carried out in Selçuk University Medical Faculty Biochemistry Laboratory.

The age of the athletes participating in the study was determined by taking into account the identity information. The lengths of the subjects were measured with the F. Bosh FB-200 length measurement device. Subjects’ initial body weight measurements were measured in the morning, while the athletes were hungry and only had shorts on them. The second weight measures of the athletes were 21 days after the first measurement and in the morning of the competition and they were measured during the official weighing and also with the shorts which are the minimum clothes.

Urine and blood were collected from all the athletes who participated in the study for the determination of biochemical values, which are Urine Density, Urine PH, BUN, Creatine and Potassium values, 21 days before the competition. Biochemical changes were also investigated by taking urine and blood for biochemistry measurements 21-23 days after the first measurement from all the athletes participating in the study.

**Training Period**

Athletes participating in the training were included in the training program of the competition period under the supervision of Konya Büyükşehir Belediyesi Spor Kulübü coaches. The athletes who were preparing to participate in the Turkish Championship in the annual activity program participated in the competition after the measurements. The training program used was as follows; strenght exercises were applied as maximum strength, continuity of the strength and quick strength exercise, and they were programmed to be general and special strength. In addition to the strength training, durability and technical tactic trainings particular to Juda were also carried out.

**Statistical analyses**

Analysis of the data was done in SPSS Statistics 17.0 software package. The measurement results were given as mean (X) and standard deviation (SD). Paired t-test was applied to dependent groups to compare height weight and biochemical data before and after training. Significance level was accepted as p <0,05.

**Results**

Measurements of height and weight of the athletes participating in the study, as well as measurements related to the Biochemical Values before and after the 21-day Competition Training period were summarized in the following tables. When Table 1 is examined; the mean age of the athletes was 16.29 ± 1.49 years. When looking at the length measurements; length average was 174.35 ± 9.42 cm and the shortest athlete was 156 cm and the tallest athlete was 185 cm.

When Table 2 is examined; kg pre-test average was 67,82 ± 17,87 and post-test average was 64,88 ± 16,89. From the other values, Urine Density pre-test average was 6,15±0,70, post-test average was 5,82±0,50, Bun pre-test average was 15,65±3,14, post-test average was 24,35±3,60, Creatine pre-test average was 0,48±0,20, post-test average was 0,93±0,41, Potassium pre-test average was 4,16±0,35, post-test average was 4,95 ±0,64. Although there was no statistically significant difference in urine pH pre-test and post-test values as a result of the statistical analysis, statistically significant difference was observed between pre-test and post-test values of other selected parameters (p <0,05).

**Table 1. Demographic Characteristics of Judiciaries Participating in the Study (Mean ± SD)**

<table>
<thead>
<tr>
<th>Variables</th>
<th>n</th>
<th>X</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>17</td>
<td>16,2941</td>
<td>1,49016</td>
<td>14</td>
<td>19</td>
</tr>
<tr>
<td>Length (cm)</td>
<td>17</td>
<td>174,3529</td>
<td>9,42696</td>
<td>156</td>
<td>185</td>
</tr>
</tbody>
</table>
Discussion

In this study conducted to investigate the effect of liquid loss caused by the training of male Judo athletes competing in the U18 category during the competition period on pre-test and post-test results, body weight (67.82 ±17.87 kg, 64.88±16.89 kg, respectively), Urine Density (1.017,94 ±7,08 mg/dl, 1.025,00±8,48 mg/dl, respectively), Urine PH (6,15±0,70, 5,82±0,50, respectively), Bun (15,65±3,14 mg/dl, 24,35±3,60 mg/dl, respectively), Creatine(0,48±0,20 mg/dl, 0,93±0,41 mg/dl, respectively), Potassium (4,16±0,35 mg/dl, 4,95±0,64 mg/dl, respectively) were detected.

In the literature review, no study that examined the effect of liquid loss on judokas on the biochemical values we have studied was found. This raises the importance of our study and limits our discussion.

One of the most important factors in sports is to have the proper weight. In some sports, athletes try to gain weight, while in a weight class branches, athletes try to control weight or lose weight [11]. The total calories consumed by people vary depending on the size of the body, gender, and sport. The most effective way to lose weight is to reduce calorie intake and increase the burned calories [12]. While most of the athletes compete in their own weight class, some athletes compete in the weight classes below their weight. Weight loss and regain are common in these athletes. Typically, this turn is frequent, fast, and wide. The main purpose of the popular use of loss by the athlete is to overcome their opponents in the same weight class who have not lost weight and to provide a power advantage [13, 14]. Fast weight loss due to extreme fluid loss for 1-2 days of athletes will affect their performances negatively [15]. Weight loss through excessive fluid loss does not only disrupt muscle performance, it also prevents sweating and affects the regulation of body temperature during performance [16].

In the study conducted, pre-test and post-test body weights of male judokas were 67.82 ± 17.87 kg, 64.88 ± 16.89 kg respectively. A statistically significant difference was found in the body weight pre-test and post-test parameters in the 21-day competition preparation period (p <0,05).

In the study conducted by Rico et al. (2015), the body weights were determined as 73.58 ± 14.99 kg, 70.38 ± 14.84 kg respectively. In another study, Evans et al. (2011) reported that the average weight of the judokas was 70.13 ± 7.5 kg and that weight loss was 5% by various methods of weight loss in martial sports [18]. In another study, Alpay et al. (2015) compared 69 wrestlers who lost weight and who did not lose weight and they found that the body weight average in the athletes who lost weight was 78.98 ± 15.87 kg and body weight loss was 3.66 ± 1.41 kg [19]. In another study conducted by

<table>
<thead>
<tr>
<th>Variables</th>
<th>Measurements</th>
<th>n</th>
<th>X</th>
<th>SD</th>
<th>t</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body weight (Kg)</td>
<td>Pre-test</td>
<td>17</td>
<td>67,82</td>
<td>17,87</td>
<td>8,977</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>64,88</td>
<td>16,89</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urine Density (mg/dl)</td>
<td>Pre-test</td>
<td>17</td>
<td>1.017,94</td>
<td>7,08</td>
<td>-2,742</td>
<td>.014*</td>
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<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>1.025,00</td>
<td>8,48</td>
<td></td>
<td></td>
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<tr>
<td>Urine PH</td>
<td>Pre-test</td>
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<td>0,70</td>
<td>2,021</td>
<td>.060</td>
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<tr>
<td></td>
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<td>17</td>
<td>5,82</td>
<td>0,50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BUN (mg/dl)</td>
<td>Pre-test</td>
<td>17</td>
<td>15,65</td>
<td>3,14</td>
<td>-10,776</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>24,35</td>
<td>3,60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creatine (mg/dl)</td>
<td>Pre-test</td>
<td>17</td>
<td>0,48</td>
<td>0,20</td>
<td>-4,800</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>0,93</td>
<td>0,41</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium (mg/dl)</td>
<td>Pre-test</td>
<td>17</td>
<td>4,16</td>
<td>0,35</td>
<td>-6,513</td>
<td>.000*</td>
</tr>
<tr>
<td></td>
<td>Post-test</td>
<td>17</td>
<td>4,95</td>
<td>0,64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*p<0.05

Table 2. Values of Judokas 21 Days Before and During Competition (Mean ± SD)
Degoutte et al. (2006) on 10 jukodas about the effects of the nutritional restrictions of judokas on physiological, hormonal, biochemical and performance, body weight pre-test and post-test values were detected as 75.9 ± 3.1 kg and 72.1 ± 1.4 kg, respectively, and a statistically significant difference was determined [20]. When the literature is examined, it is seen that body weight values of the studies performed are in parallel with our study.

Urinary density is expressed as the weight in mg of 1 ml urine. Urinary density varies from 1015 to 1025 in adult humans, but it can be as low as 1002 or as high as 1040, depending on the amount of water intake. If the urinary density is higher than the densities of distilled water, that is, 1000, this is mainly due to Na⁺ and K⁺ from the organic and inorganic substances it contains. If the last two digits of urine density are multiplied by 2,237, known as the Häser coefficient, the amount of solid matter in 1 liter of urine can be found in grams.

The amount of total solids in a 24-hour urine of a healthy adult person weighing 75 kg is 60 g. It is defined as isostenuria when urine density is constantly around 1010. Isostenuria occurs during the terminal period of chronic glomerulonephritis. It is defined as hypertermia when urine density is continuously higher than 1030. Hyperthermia is seen in diabetes mellitus and dehydration [21]. During dehydration, urine density and osmolarity increase. In a severe dehydration the urine density goes above 1030 [22].

The pre-test and post-test urine densities of male judokas were 1.017,94 ± 7,08mg / dl and 1.025,00 ± 8,48 mg / dl, respectively. There was a statistically significant difference in the urine density pre-test and post-test values in the 21-day preparation period (p <0,05).

Akyüz (2009) determined the urine density pre-test and final test values as 1020,75 ± 7,39 ml / dl, 1019,13 ± 4,65 ml / dl in the study of the effect of rapid weight loss on physical, physiological and biochemical parameters in elite wrestlers and did not find a statistically significant difference [21]. This result is not statistically different from the values in our study, which is thought to be caused by preferences in the weight loss method.

Urine PH level of an adult person who takes nourishment at a normal level is around 5-6. Urine pH reference range may vary between 4.8-7.4. Measurement of PH is necessary to monitor the effects of kidney infections, stones, and certain medications [23,24]. Protein-rich nutrition, sleep, metabolic acidosis, respiratory acidosis, diarrhea and dehydration are factors that cause acidic urination. Causes such as bicarbonate intake, unbalanced nutrition with fruits and vegetables, urinary infections, metabolic alkalosis, respiratory alkalosis, renal disease (renaltubularasisosis) may also cause basic urine formation [23,24,25,26]. PH changes due to fluid loss are the most severe and most frequent changes in pH, which are described as hypochloremic alkalosis and hyperchloremic acidosis [21].

In our study, urinary pH values were detected as pre-test and post-test 6,15 ± 0,70 and 5,82 ± 0,50, respectively. As a result of the statistical evaluation, it was determined that there was no significant difference between the pre- and post-test PH parameters.

Akyüz (2009) found that urine PH values were 6.8 ± 1.04 and 6.70 ± 0.78 as the pre-test and post-test values, respectively, in the study of the effects of rapid weight loss on physical, physiological and biochemical parameters in elite wrestlers, and there was no statistically significant difference between them [21]. This result is parallel to our study.

The intention of urea synthesis is making the ammonia, which arises as the excess, non-toxic. For this purpose, 1 mol of free ammonia, 1 mmol of bicarbonate and 1 mol of aspartic acid the amino group nitrogen in liver cells are combined with a multi-step cycle, and urea is synthesized. In anormal human beings weighing 70 kg, urea is produced up to 0.5 mol (30 gr). Urea formation can rise up to 3 times in protein-rich diet. [27] Urea is a non-protein nitrogenous substance [28]. Urea is an ammonium-synthesized substance that is produced by the liver as a result of protein metabolism. It is usually a requested test for renal problems. However, changes may also be seen in cases where renal function is not present because the urea is synthesized in the liver and when there is tubular reabsorption. Excessive protein intake, infusion of aminoacids, gastrointestinal system bleeds, and the use of corticosteroids and tetracycline drugs are also factors that increase the level of urea. Blood urea levels may also be low in situations such as protein deficiency, acute and chronic severe liver disease caused by any reason. It is a product of protein metabolism and is thrown out through the kidneys with the urine. It is frequently is measured as the blood urea nitrogen (BUN) [29]. In normal individuals, about 40% to 60% of the filtered urine is thrown out with the urine. Urea is the most abundant waste product that should be thrown out by the kidneys.

In our study, BUN parameter pre-test and post-test results of the judokas were found to be 15,65 ± 3,14 mg / dl, 24,35 ± 3,60 mg / dl, respectively. It was determined that there was a statistical difference between BUN values of judokas.

Alpay et al. (2015) compared the 69 international wrestlers who lost/did not lose weight in the study and found that BUN value was 16.44 ± 3.44 ml / dl in athletes who did not lose weight and 14.31 ± 3.63 in the athletes who lost weight [19]. In another study, Akyüz (2009) found a statistically significant difference in BUN parameter pre-test and post-test values for the effect of rapid weight loss on physical, physiological and biochemical parameters of elite wrestlers [21]. In a similar study, Degoutte et al. (2006) reported that in the study of 10 jukodas, they found statistically significant differences in BUN pre-test and post-test results in studying the physiological, hormonal, biochemical effects of jukodas’ nutrition restrictions on performance [20]. Our work is parallel to these results.

Blood urea and blood urea nitrogen (BUN) and creatinine levels are increased (prerenal insufficiency) as glomerular filtration rate decreases during dehydration. Both urea and urea nitrogen (BUN) are affected by factors such as tissue breakdown and tubular reabsorption, as
well as the amount of protein taken in the diet.

Creatinine is filtered from the glomeruli, is not reabsorbed, is secreted in small quantities from the tubules. Creatine kinase is a very valuable for measuring the rate of glomerular filtration since creatine is completely excreted from the kidneys [21]. Creatinine values are a good parameter for kidney function. Creatinine is proportional to body muscle mass. For this reason, normal creatinine levels in young children are lower than in older children and adults. Children with chronic malnutrition may have normal serum creatinine levels, even if renal function is impaired, due to the lack of muscle mass. Creatinine measurements can be found to be high even if renal function is impaired by other chromogenic substances such as bilirubin and ketone bodies [22].

In our study, creatinine pre-test and post-test values were determined as 0.48 ± 0.20 mg/dl, 0.93 ± 0.41 mg/dl, respectively. It was concluded that there was a statistically significant difference between pretreatment and posttreatment values of creatinine. In a similar study, Akyüz (2009) found a statistically significant difference in creatinine pre-test and post-test values in the study of the effect of rapid weight loss on physical, physiological and biochemical parameters in elite wrestlers [21]. This result is statistically close to our study.

In the study conducted, potassium pre-test and post-test values were found to be 4,16 ± 0.35 mg/dl and 4,95 ± 0.64 mg/dl, respectively, and there was a statistically significant difference between them.

Costill et al. [31] and Sejersted et al. [32] observed a significant increase in the amount of blood potassium (K) due to muscle potassium (K) exchange in the event of body fluid loss based on training. Kenefik et al. [33], Ebert et al. [34] and Rivera et al. [35] observed an increase in blood potassium (K) levels in blood parameter results after exercise and heat acclimatization. Noakes et al. [36] studied 2135 athletes in their study and examined blood Hematocrit values there. Some of these subjects were dehydrated and fluid restriction was applied, and some of them received liquid supplement. As a result, a significant increase in the amount of blood potassium in the dehydrated group was observed while there was no significant increase in the amount of blood potassium in group that received liquid supplement. When we look at the literature we see that the results are parallel to our study.

Conclusion
As a result; it is thought that in our country in which the adjustment of the weight class is made unconsciously and unplanned, this will lead to the health problems of the athletes in many ways, especially in the later ages. Particularly in the professional sense, the health problems, which athletes who enter weight competitions and who enter at least 10 international competitions in the Olympic sense for the Judo branch a year can experience in the later ages as a result of such exhaustion, should be well considered. The significant differences in studies in the literature and in our work also indicate that acute and rapid dehydration causes athletes to be harmed in terms of health and leads to the loss of performance. The result of our study is that the athletes should be prompted for weight control in a planned way to prevent the adjusting weight by acute and excessive dehydration.

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Conflicts of interest
The authors have no conflicts of interest relevant to this study.

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