






Experimental Assessment of the Dynamics of Functional Measures of Female Students with the Use of Software Tools

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Abstract

On a basis of the analysis of a complex of literary sources, the authors examined the specific features of the construction of educational and training process of female football-players to be. The investigation of education experience made it possible to establish the fact that in the process of training of sportswomen to be their specific gender features are fairly often ignored and their training is carried out using the methods which were developed for men in same sports without a corresponding biomedical, psychological and educational adaptation. The measurements and statistical calculations of the integrated indices of physical development of sportswomen to be of different age groups were carried out by the authors using the educational computer program «Methods of diagnostics of functional status of human body».

Keywords: mini-football, educational and training process, multi-factor differentiation, medical and educational control, sensitive periods of development, adaptation index, level of functional status, health index.

1. Introduction

The topicality and purposefulness of the research are determined by a complex of the factors the most important of which is a progressive deterioration of health status of the youth. Social, political and demographic changes as well as a global ecological crisis in Ukraine result in increasing number of children who suffer from mental and physical diseases. There are only 10–12 % of healthy children of primary school age, 8–10 % of healthy children of secondary school age and 5–8 % of older healthy children. Almost a half of children of school age at the end of the school day are overstrained in Ukraine. Every year these indices reduce by 3–5 %. At the same time a number of neuropsychic, bodily and congenital diseases increase continuously. Thus the children's and youth's involving in sports is an unconditional factor of the improvement of their health status [1; 8; 13; 14; 15; 16; 17].

The indicated status of the problem is caused by the lack of differential approach to the physical education of the people of different sex, age, physical development status and so on. In spite of much attention paid to the problems of female sports, the experience of modern female sports education requires constant update of methods and approaches. In particular, it concerns the sports which became «female» not long ago like mini-football. Theoretical and methodical basis of education of sportswomen to be was investigated by a number of researchers, among them H. Lysenchuk, L. Matvieiev, V. Platonov, L. Serhiienko and others. Methodical basis of the development of moving qualities of teenagers was investigated by M. Lynets, R. Misharovskiy, S. Prysiazhniuk, O. Tymoshenko and others. Single aspects of the development of moving qualities of the youth were investigated by R. Boichuk, E. Vilchkovskiy, L. Volkov, M. Korop and others. Biomechanical models of the impact moves in sports in the context of the improvement of technical training were investigated by S. Yermakov, A. Laputin, M. Nosko and others.

Thus the considering of gender aspects is an essential factor of the development of modern sports. For women all around the world the sports became a social power, a mean of emancipation and well-being, which determines their social status. However the data showing the health status of sportswomen to be,

their functional capacity, specific features of adaptation reactions for the extremal physical, psychological and emotional pressure, which are contained in sport physiology and medicine, are insufficient and need to be expanded by the information about the specific features of female body.

The main factors of organization of the system of female mini-football and sports education are: diagnostics of individual skills and selection of the appropriate type of sports activity; educational and training process, competitions, rehabilitation; lifestyle which makes it possible to combine sports activity and personal intellectual and emotional development; control and correction of the whole system of training and its components [10; 11]. The research of functional measures of female body in the process of mini-football training is an issue of the day for achieving the high sports results in mini-football. But for all that it is reasonable to calculate and register the functional data using modern educational computer programs.

2. Materials and methods

The aim of the study is to develop, theoretically prove and experimentally examine the educational system of monitoring of the development of functional parameters of female body in the process of mini-football training using the educational computer program.

The experiment was conducted in Kotsiubynske Children's and Youth Sports School, Complex Children's and Youth Sports School № 8 of Kharkiv Regional Council, Dnipropetrovsk Regional Children's and Youth Sports School «Spartak», Mykolaiv Complex Children's and Youth Sports School «Spartak», Municipal Institution of Poltava Regional Council «O. Butovskiy Children's and Youth Sports School», Shevchenkove Children's and Youth Sports School of Kharkiv Regional Council, Irpin Children's and Youth Sports School, Hrebinka Children's and Youth Sports School. Altogether 226 female sportswomen to be from children's and youth sports schools took part in the experiment.

To achieve the goal, a set of research methods, in particular theoretical ones, is used: historical-comparative and logical, terminological, quantitative-qualitative (bibliometry), generalization, abstraction, analysis and synthesis, modeling, studying documents; empirical: observation, survey, analysis of products of activity, complex pre-nasal diagnostics. To integrate the results of research and experimental work the authors elicited the statistical regularities of the revealed variables. Using the method of sampling the authors got the data displaying the results of taken experimental measurements, correlated the averages out of two selections and drew a conclusion about the level of development of functional measures and specific features of their dynamics in educational and training process.

The average of the selection by formula (1):

$$\bar{x} = \frac{1}{n} \sum_{k=1}^n x_k \quad (1)$$

To establish a level of relation of individual measures the authors used a method of Spearman rank correlation as a way to define the measures of factor relations. Spearman's rank correlation coefficient was calculated by formula (2):

$$\rho = 1 - \frac{6 \sum_{i=1}^n d_i^2}{n^3 - n} \quad (2)$$

where $d_i^2 = (x_i - y_i)^2$ is a squared difference of rank indices (in this case - thegnoseological and technical ones);

n is an amount of sampling (a number of sportswomen to be in a group).

To define the adequacy of the measurements and to get the reliable addition in the measures as well as to make it possible to transform the experimental results to general block the authors calculated the mean error by formula (3):

$$m = \pm \frac{\sigma}{\sqrt{n}} \quad (3)$$

where σ is a square mean error; n is an amount of sampling [6].

3. Results and Discussion

In the researches of V. Platonov (2013) the periodization of sports education is divided into two groups: training at the first stage of the process of a long-term improvement (includes the stages of early training, preliminary basic training, specialized basic training, training for progress); training at the second stage of the process of long-term improvement (the stage of maximum implementation of individual capacities, the stage of conservation of sports technique, the stage of progress loss, the stage of leaving the sport of high progress) [7]. The researcher determines the approximate age limits (minimum) for particular sports, but doesn't focus on mini-football, in particular a female mini-football. The above-cited classification is adapted by the authors the specific features of female mini-football.

At the moment such biological feature of female body as reproductive system cyclic recurrence is ignored in planning of a process of training while cyclic recurrence of hormone status cause the specific features of neurohumoral regulation and coordination of the functions of all physiological systems. A status of immunological resistance of women body which plays a central role in the development of individual adaptation responses is also ignored in planning of educational and training process. It relates to the fact that in a system of sports training apart from the general regulations for men and women the specific features which are typical only for women and cause the differences in proceeding of adaptation processes in women bodies exist.

O. Stepanova (2009) in her research concluded that the bodies of young sportswomen to be with different somatotypes are characterized by specific phenotypic features of perception of physical activity: hypersthenic somatotype is the most susceptible to physical activity of both strength and speed-and-strength type and the least susceptible to the development of general (aerobic) endurance and flexibility; asthenic somatotype is the most susceptible to the development of speed, spring ability, general (aerobic) endurance and flexibility and the least susceptible to the development of strength as well as speed and strength (anaerobic) endurance; normosthenic somatotype is characterized by harmonious perception of physical activity of different types. The researcher notes that the above-mentioned patterns can be a basis for the forecasting of sports aptitudes and for the selection of sportswomen to be for the different sports [12].

The diagnostics of body functional status in female football should be turn to the control of the following systems: cardiovascular system as one of the main unit of circulation of the blood, functional spare capacities of the heart, central and peripheral circulatory dynamics, a status of vascular tone; autonomic nervous system, its tone and reactivity that play the central role in an autonomic ensuring of the capacity for work: peripheral rheography of the vessels of limbs, rheoencephalography of the vessels of brain; the status of neuromuscular system: electromyography and electrostimulation, examination of muscular status, myotonometry; a system of analyzers: motor analyzer, vestibular apparatus; body muscle and fat mass; psychophysiological status; energy supply system [9].

The tasks of medical supply of educational and training process are the following: diagnostics of sports aptitude of female students for football, rating of their availability, functional status; control of physical activity during the studies; estimation of the adequacy of techniques and methods in the process of sports training camps (STC); hygiene and sanitary control of the places of studies and living conditions of sportswomen to be; trauma and disease prevention; providing of the first aid; organization of medical treatment of the sportswomen to be. The forms of biomedical control in female mini-football are given in the table 1.

Table 1. Forms of biomedical control

Types of examination	Tasks	Content and organization
In-depth	Control of health status, abnormality test, making the recommendations for preventive measures and treatment. Assessment of special training and development of individual recommendations for the improvement of educational and	Complex clinical examination at medical and sports health centre: examination by physician, otolaryngologist, oculist, neuropathologist, gynaecologist, stomatologist, conducting of electrocardiography with specific effort tests, blood test and urinalysis.

	training process.	
Step-by-step	Control of health status, indicators dynamics, injury and disease residual effects tests. Validation and correction of recommendations. Assessment of functional training after definite stage of training and development of recommendations for planning of the next stage	Selective clinical examination at medical and sports health centre: on the basis of the physician's advice – the examination by the doctors who have remarks on the health status of the sportswomen to be, electrocardiography, tests.
Running	Operative control of functional status of sportswomen to be, assessment of passing the tests, recommendations for planning and individualization of the training, means and methods of training. Health status abnormality tests.	Rapid control before, in the process and after training which are conducted by doctor and coach: visual observation, anamnesis, pulsometry, taking blood pressure, coordination and balance tests.

The control and diagnostic tasks of the determination of the level of *anthropometric and functional criterial indices* of development of motor skills of 11-14-year-old sportswomen to be using the means of mini-football include a complex of anthropometric measurements (body length, body weight, chest size (when breathing in), chest size (when breathing out), dynamometry (right and left arms), deadlift strength (back), deadlift strength (legs), shoulder size, forearm size, hip size, calf size, head length, body length, arm length, shoulder length, forearm length, hand length, leg length, hip length, calf length, foot length) and functional tests (expiratory vital capacity (EVC), heart rate (HR) (in quiescent state, after dosed training, after recovery), systolic and diastolic pressure, Index of Mass Corporal, vital index, systolic blood volume, minute blood volume).

The educational program «Methods of diagnostics of functional status of human body» (patent) is a modern mean of study which increases the quality of education, develops creative ability, intuition and creative thinking, helps to improve the individual skills and satisfies the requirements of time saving. Using the program makes it possible to optimize the work of educator and to increase the motivation level of the students. Providing for the continuity and completeness of the education process cycle the program places the theoretical information, organizes the training and educational activity as well as the knowledge control, information searching activity, mathematical and simulation technique with computer visualization and service functions [2; 3; 4].

Capabilities of the program: user's personal data input; indices calculation and determination of respondent's body status; body status self-control; acquainting of the user with operation and functions of the program.

In the structure of the program three main subsystems can be defined: educational block «Methods of diagnostics of functional status in physical rehabilitation, physical culture and sports»; experimental block; subsystem of complex test control of the knowledge. The experimental block is of information value for our research.

The experimental block provides for the researcher's work with the program of calculation and registration of individual developments data of the sportswomen to be. In the structure of the subsystem the following parts can be defined: block of respondent's personal data (age, sex, weight, height, heart rate, blood pressure, dynamometry and pulse recovery); method of data measurement (M1-M6), calculation data (P1-P4) – systolic blood volume, level of functional status, adaptation capacity, index of health level; calculation results. Each parameter under research is provided with methodical recommendations for the measurement and calculation, average standard indices, illustration of gaging equipment, research remarks and precatory words, software standards. The research results can be printed for every respondent. The examination data can be compared in the repeated tests to assess the dynamics of physical development and to develop the effective training program.

The experimental part in educational block was set up using the JavaScript language which is interpreted by the browser and is conducted on the client's side to provide for the required calculations using any computer without setting up the extra components. To process the separate elements the packages Adobe Photoshop CS6, Corel Draw X3 were used. To combine all structure elements into one the program SiteInFile Compiler v4 was used. The application compresses the HTML-pages or the whole site with all resources (including HTML, CSS, WAV, TXT, JPG, GIF, JavaScript, PNG and others) into one compact file with built-in browser.

The experimental part contains a table of personal data of the respondent and hyperlinks (M1-M6) for the methods of measurement. After personal data input a user can calculate the indices by pushing the button «calculate» and read the information about the calculation (hyperlinks P1-P4).

According to the diagnostic opportunities of the program the authors chose three main indicators of health status and physical development of the female football-players to be from the experimental group: 1) a level of functional status of the blood circulatory system; 2) adaptation capacity; 3) index of health level (after H. Apanasenko).

The level of functional status of the blood circulatory system (LFS) is an integrated index which includes the data of heart rate, age, height, body weight, indices of arterial tension of the respondent. The calculations are conducted using the formula:

$$LFS = 700 - 3 \times HR - 2,5 (DP + SP - DP/3) - 2,7 + 0,28 \times BW / (350 - 2,7 \times A + 0,21 \times H)$$

Scale of the assessment of «LFS» index: low (0,375 and less), below the average (0,376-0,525), average (0,526-0,672), above the average (0,673-0,825), high (0,826 and more).

The adaptation capacity (AC) is an integrated index of the control of physical status of the sportswoman to be as well. It is assessed by the formula:

$$AC = 0,011 \times HR + 0,014 \times SP + 0,008 \times DP + 0,014 \times A + 0,09 \times BW - (0,009 \times H + 0,27)$$

An adaptation is a complex of physiological reactions which are the basis of adaptation of the body to the variable conditions of life and oriented to homeostasis conservation. The adaptation reactions provide for homeostasis, work capacity, continuation of life which is maximum possible under the specific conditions, reproductibility. The adaptation capacity of the body are widely used to determine a level of individual health. That's why the analysis of specific features of adaptation, control of adaptation processes and their correction are the important conditions of prevention of diseases.

The scale of assessment: satisfactory adaptation (2,1 and less), tension of adaptation mechanisms (2,11-3,20), unsatisfactory adaptation (3,21-4,30), disruption of adaptation mechanisms (4,31 and more).

The method of quantitative rapid assessment of the level of somatic health after H. Apanasenko makes it possible to determine the functional status of the body by the indicators of cardiorespiratory and muscular systems which are formalized in cardinal numbers (points) and related to the level of individual health. The method includes the determination of anthropometric and functional indices.

The researcher proposed to assess the level of health according to five categories to make it possible to determine so called «health profile». The scale of assessment: low health level (3 and less points), below the average level (4-6 points), average level (7-11 points), above the average level (12-15 points), high level (16-18 points).

The developed program «Methods of diagnostics of functional status of human body» makes it possible to calculate and output the indices in general report of the research automatically, by minimum time and error-free.

The results of the assignment of respondents from experimental group to their indicator status are shown in the table 2.

Table 2. Experimental work results

Level of functional status of the blood circulatory system					
	Low level	Below the average level	Average level	Above the average level	High level
Number of respondents	17	37	89	54	29
%	7,5	16,4	39,4	23,9	12,8
Mean error	0,009	0,009	0,009	0,009	0,009

Level of somatic health (after H. Apanasenko)					
	Low level	Below the average level	Average level	Above the average level	High level
Number of respondents	14	41	74	59	38
%	6,2	18,1	32,7	26,2	16,8
Error	0,009	0,009	0,009	0,009	0,009
Adaptation capacity					
	Satisfactory adaptation	Tension of adaptation mechanisms	Unsatisfactory adaptation	Disruption of adaptation mechanisms	
Number of respondents	54	94	62	16	
%	23,9	41,6	27,4	7,1	
Error	0,009	0,009	0,009	0,009	

Thus, according to the LFS indices the majority of the respondents showed an average level – 89 respondents or 39,4 %; 54 respondents (23,9 %) showed «above the average level» index; high level showed only 29 respondents or 12,8 %.

There is a similar situation in the index of somatic health: 74 respondents (32,7 %) showed the average level of somatic health, 59 respondents (26,2 %) are above the average level of somatic health; high level showed only 38 respondents or 16,8 %. Quite the high indices are fixed on the low level of somatic health (6,2 % out of total amount of respondents) as well as on «below the average level» – 18,1 %.

The index of adaptation capacity the majority of the sportswomen to be (94 respondents – 41,6 %) showed the tension of the adaptation mechanisms and unsatisfactory adaptation (62 respondents – 27,4 %). The critical indices of «disruption of adaptation mechanisms» are fixed on the measurements of 16 respondents or 7,1 %. Satisfactory adaptation is fixed on the measurements of 54 respondents (23,9 %).

In this case by every selection a mean error equaled: $m_1 = 0,090$; $i = 0,098$, that indicates of reliability of determination of the averages.

The results of the investigation make it possible to establish a fact that the optimization of educational and training process is impossible without application of differentiated approach and multi-factor differentiation. A differentiated approach is the realization of educational and training tasks according to the age, sex and level of training of the sportswomen by a coach. The differentiated approach in educational process lies in unlocking of individual features of the sportswoman to be and selection of the most favorable conditions for the development using the differentiated methods of education and training. The most complicated in this case is a problem of choice of the criteria of differentiation. The main task of the differentiated educational and training process is to provide for the maximum productivity of activity of each sportswoman to be and an optimal motor regimen, mobilize the skills of the sportswomen to be.

Multi-factor differentiation of educational and training process in mini-football is considered to be a process of development of motor skills of the sportswomen to be in a system and synergetic unity of sex, age, individual typological differentiation, assignment by psychological status, level of development of motor capacity and according to the level of training [5].

4. Conclusions

The operation of long-term system of sports training of the sportswomen to be is based on the results of the researches in education and psychology, biology and physiology, biochemistry and other fields of study which make it possible to organize the educational process effectively according to age and individual development of the sportswomen to be. The application of extensive data with development of basic principles of long-term training and education is to be carried out on a basis of system methodological approach.

Biological specific features of female body cause the need for considerable reorganization of the training process of sportswomen to be. There is a need for regular control of health of sportswomen to be, in particular a character of passing of menstrual function which can serve as an important indicator of adaptation reactions of the female body to the specific training and emulative activity.

The questions of substantiation of methodical aspects of multi-factor differentiation of educational and training process with regular registration of morphofunctional measurements need further research. The investigation of the foregoing problems is to be a subject of future research of the authors. A perspective problem for further research is the substantiation of differentiation of orientation of training activity in different stages of preliminary period in training process of female football-players to be.

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