

ALLOCATION ALGORITHM FOR ATHLETES GROUP TO FORM TACTICAL TASKS IN GAME TEAM SPORTS USING THE METHODS OF MULTIVARIATE ANALYSIS (ILLUSTRATED WOMEN UKRAINIAN TEAM BASKETBALL WITH HEARING IMPAIRMENTS)Kozina Zh.L.¹, Sobko I.N.², Kolomic N.A.³, Jagiełło Władysław⁴, Jagiełło Marina⁴Kharkov National Pedagogical University¹Kharkov National Economic University²Academy of Design and Arts³Academy of Physical Education and Sports, Gdansk, Poland⁴

Annotation. *Purpose:* develop and prove experimentally allocation algorithm athletes in groups to form a tactical tasks in team sports game using methods of multivariate analysis. *Material:* The study involved 12 basketball hearing impaired 20-25 years old - female players team of Ukraine on basketball. Analyzed the results of testing and competitive activity 12 basketball players with hearing impairments - Lithuanian team players. *Results:* An algorithm for distribution by groups of athletes for the formation of tactical tasks. The algorithm consists of the following steps: 1 - testing of athletes; 2 - A hierarchical cluster analysis performance testing; 3 - Distribution of sportsmen groups, analysis of the characteristics of athletes, the formation of tactical tasks. Found higher rates of reaction rate at the offensive players. We pivot revealed a higher level of absolute strength. The defenders found a higher frequency of movement and jumping. *Conclusions:* The algorithm is the basis for determining the best options mutual combination players in the development and implementation of tactical combinations, the selection of partners when working in pairs and triples in training.

Keywords: cluster, basketball, tactic, Deflimpiada, preparedness, hearing.

Introduction

In basketball training process there happen situations when coach shall quickly and effectively determine the most rational tactic interactions between players and role of every player [1, 2, 3, 4, 10, 11]. This task is closely connected with determination and specification of players' functions that is especially important for combined teams, which are composed from players of different clubs and, thus, there can be excess of one role games and deficit of other role ones [14, 18, 19, 20, 21, 22, 37].

Such situation is also important for combined team of Ukraine – basketball players with hearing problems [23, 25, 32]. It is conditioned by the fact that there is relatively little quantity of sportswomen with hearing problems – candidates for combined team of Ukraine. That is why coach of combined team faces not only the problem of formation of team but also the problem of physical and technical-tactic training of sportswomen [5, 6, 8, 12, 16, 17, 34]. Coaches of combined teams of healthy sportswomen face such problems to less extent [20, 28, 29, 31, 35, 36, 38].

Individual approach in sportswomen's training is also of great importance [21, 22, 24, 30], as well as the problem of rational distribution of players by their functions, determination of optimal sportswomen's combinations in pairs, threes, when forming start groups for games and with replacements in games.

As a rule, in most of teams these tasks are solved by coaches in process of all many years' training process, basing on own experience and intuition. However, in combined teams, as we have already mentioned, demand in formation and coordination of team in relatively short terms complicates this task. In this connection it would be purposeful to use methods, which would permit to accelerate and raise effectiveness of this tasks' solution. [22, 23, 25, 27]. Among such methods there is method of multidimensional analysis (cluster, factorial, discriminative analysis and other) [9, 19], for realization of which it is necessary to work out algorithm of application of such methods.

The research has been fulfilled in compliance with "Combined plan of scientific-research works in sphere of physical culture and sports for 2011-2015" by topic 2.4 "Theoretical-methodic principles of individualization in physical education and sports" (state registration number 0112U002001) and in compliance with research works, which are financed by Ministry of education and science of Ukraine for 2013-2014 and 2014-2015 "Theoretical-methodic principles of application of informational, pedagogic and medical-biological technologies for formation of healthy life style" (state registration No. 0113U002003) and "Theoretical-methodic provisioning of formation of personality's healthy life style in conditions of educational establishment, in context of European integration" (state registration No. 0114U001781).

Purpose, tasks of the work, material and methods

The purpose of the research is working out and experimental proof of algorithm of sportsmen's distribution in groups for formation of tactic tasks in team kinds of sports with the help of method of multidimensional analysis.

The methods of the research: theoretical analysis and generalization of special literature, methods of psycho-physiological testing (determination of time of simple and complex direct and cross responses in different conditions of tests, tapping test), which was conducted with the help of device "Sport psycho-physiologist"; methods of pedagogic testing, which included tests for special physical and technical fitness; method of determination of competition functioning's effectiveness; pedagogic experiment; methods of mathematical statistics.

12 female basketball players with hearing problems of 20-25 years old age – members of combined team of Ukraine participated in the research. For comparative analysis we analyzed also results of testing and competition functioning of 12 female basketball players with hearing problems – members of combined team of Lithuania.

Results of the research

For solution of the set tasks we considered to be purposeful application of mathematic methods for determination of sportswomen's individual features, the most rational variants of their distribution by game roles and determination of players' optimal combinations for working in pairs, threes at trainings. For these purpose methods of multidimensional analysis are the most suitable, in particular cluster and factorial analysis, algorithm of whose application in sport teams is described in works [21, 22].

On the base of theoretical conception of individualization of training process in sports, developed by [21, 22], we determined female basketball players' groups by indicators of complex testing:

The conception implies application of algorithm, which consists of the following stages:

- testing of sportswomen with not less than 10 tests;
- hierarchic cluster analysis of tests' indicators;

- on the base of cluster analysis distribution of sportswomen in groups; analysis of characteristics of sportswomen of every group; formation of tactic tasks, depending on characteristics of every group.

In our research we, first of all, fulfilled hierarchic cluster analysis of indicators of psycho-physiological and pedagogic testing for formation of groups, combining the most similar by psycho-physiological and pedagogic indicators basketball players.

The structure of this series of researches is given in fig.1. At first stage we conducted determination of psycho-physiological potentials, special and technical fitness of sportswomen.

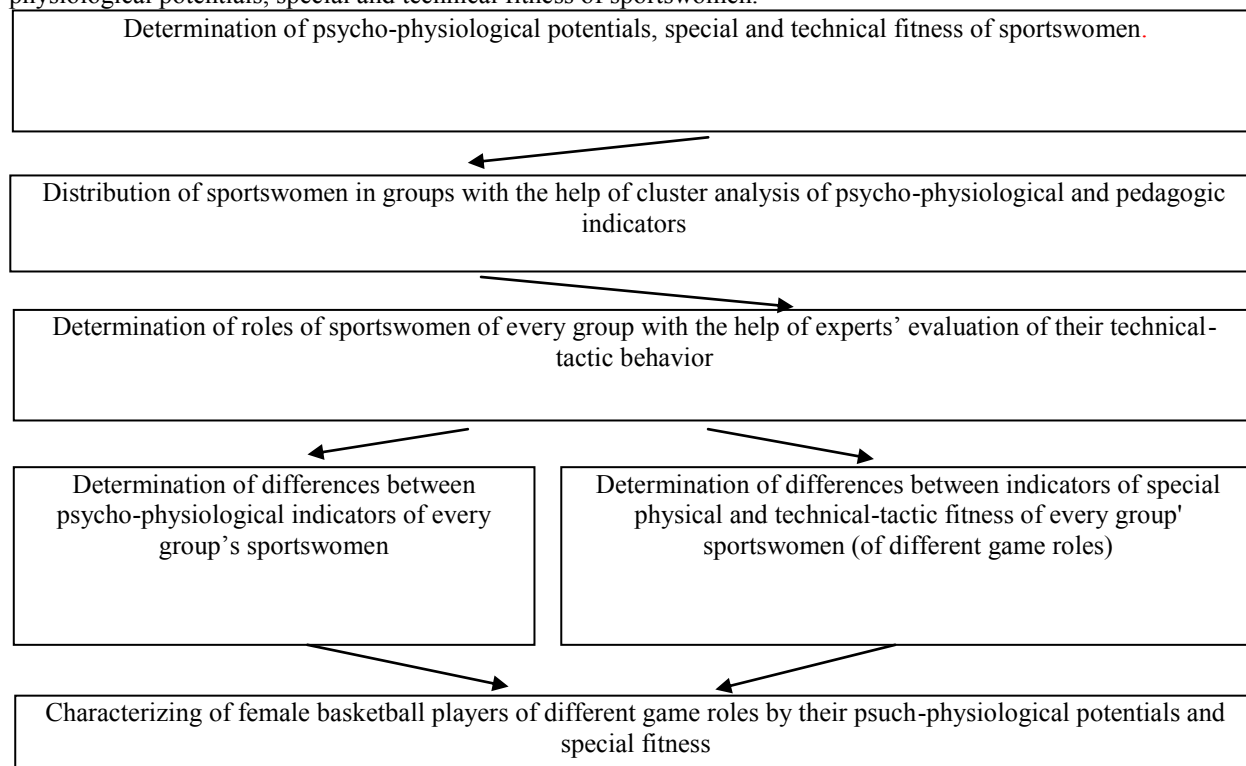


Fig.1. Schema of experimental researches for specifying of basketball players' game functions and formation of tactic tasks

Further, with the help of cluster analysis of psycho-physiological and pedagogic indicators we fulfilled distribution of sportswomen in groups and analyzed characteristics of sportswomen of every group with the help of experts' evaluation of their technical tactic actions. As a result every group was named in compliance with game function in basketball. After it we complexly determined differences between psycho-physiological indicators and indicators of pedagogic testing by every group, i.e. by different game functions, and formed characteristics of female basketball players with hearing problems by different game functions and psycho-physiological potentials and special physical and technical fitness.

Thus, for specifying of game functions of female basketball players with hearing problems – members of combined team of Ukraine – we used hierarchic cluster analysis of indicators of psycho-physiological and pedagogic testing [9]. In hierarchic cluster analysis every separate case forms, first, its separate cluster. At every step two separate clusters, the most close to each other, combine in one cluster.

Stages of clusters' formation are shown in fig.2. In dendrogram (fig.2) we can see that at first step sportswomen No.2 and No.5 were combined in one cluster.

This means that these sportswomen are close by structure of their psycho-physiological potentials and special physical and technical-tactic fitness that should be considered in trainings.

At the next stage of cluster analysis sportswomen No.4 and No.3 and so on will join them.

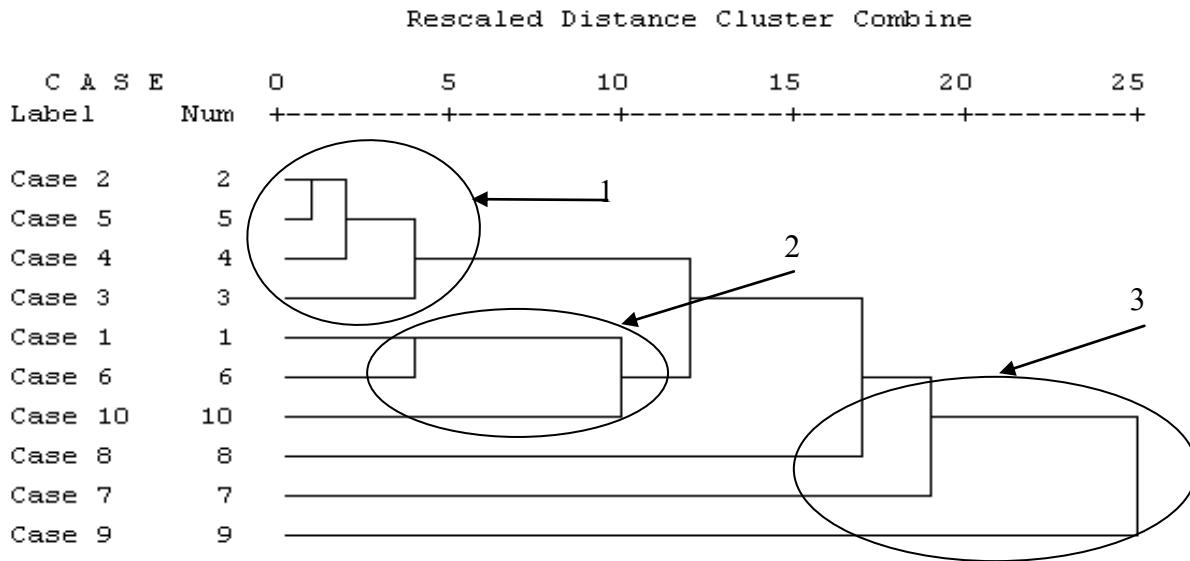


Fig.2 Dendrogram of cluster analysis of distribution in groups of Ukrainian combined team players with hearing problems, in compliance with indicators of complex testing: 1 – first cluster, forwards; 2 – second cluster, backs; 3 – third cluster, central players; Rescaled Distance Cluster Combine – Conventional scale of differences between players with their combining in clusters by indicators of complex testing; Case – the tested, conventional number; Num – number; Labe – level.

For detecting what quantity of clusters is optimal it is necessary to deduct number of step, on which cluster coefficients start to grow in non-linear way, from quantity of analyzed sportswomen. In our case it is step № 7 (fig. 4.3). That is why optimal quantity of clusters is $10-7=3$.

So, we received 3 clusters, i.e. 3 groups of sportswomen-basketball players. In basketball it satisfies three main game functions.

In fig.2 we can see belonging of every player to certain cluster.

Thus, cluster analysis of indicators of psycho-physiological testing, of special and technical tactic fitness showed presence of 3 groups of sportswomen.

Experts' evaluation of basketball players' game functions showed that first group was composed of forwards (attackers), second group – of backs (defenders) and third – of central line players.

As far as in cluster analysis, alongside with indicators of special and technical tactic fitness psycho-physiological indicators participated (sportswomen were distributed in three groups of different game functions), we can make conclusion about high influence of psycho-physiological potentials on formation of sportswomen's game functions, while game function is usually determined, as a rule, by anthropometric characteristics of basketball players.

At the next stage we fulfilled comparison of formed groups of basketball players by psycho-physiological potentials and indicators of special and technical-tactic fitness. It should be noted that distinctions by psycho-physiological potentials are physiological basis for formation and manifestation of individual style of functioning [13, 26].

For example, higher indicators of forwards' quickness of response condition formation of their playing style, which requires quick responding to changing situation, quick taking of decisions. Besides, forward's playing style implies execution of accurate actions in quickly changing conditions. Physiological pre-conditions of such style's formation and manifestation are such indicators as quickness of work, quickness of response, quickness of run, jump endurance (see table 2).

Table 2

Indicators of psycho-physiological and pedagogic testing of different game functions' players with hearing problems – members of women combined basketball team of Ukraine

Test	Groups	Statistical indicators					
		\bar{X}	S	m	Compared groups	t	p
1	2	3	4	5	6	7	8
Simple sensor-motor response, left arm, \bar{X} , msec.	B	392.83	36.21	20.91	1-2	1.80	0.13
	F	350.45	56.58	28.29	1-3	-2.35	0.08
	C	485.7	58.21	33.61	2-3	-3.09	0.03
Cross sensor-motor response of choice of right arm and left eye, \bar{X} , msec.	B	391.9	17.15	9.90	1-2	4.95	0
	F	314.45	22.46	11.23	1-3	-0.23	0.83
	C	401.50	69.99	40.41	2-3	-2.08	0.16
Cross sensor-motor response of choice of left arm and right eye, \bar{X} , mc	B	348.97	27.75	16.02	1-2	0.29	0.79
	F	343.45	23.66	11.83	1-3	-1.99	0.12
	C	454.73	87.96	50.78	2-3	-2.49	0.06
Cross sensor-motor response of choice of left leg and right eye, \bar{X} , mc	B	459.3	69.22	39.96	1-2	2.53	0.05
	F	358.75	36.53	18.26	1-3	-0.61	0.58
	C	450.87	61.38	35.44	2-3	-2.51	0.05
Tapping test, left leg, 1 st stage, q-ty	B	62.33	3.21	1.86	1-2	-4.31	0.01
	F	98.75	14.03	7.02	1-3	-0.66	0.57
	C	64.67	18.04	10.41	2-3	-0.61	0.58
Tapping test, left leg, 2 nd stage, q-ty	B	47	3.61	2.08	1-2	-5.99	0
	F	88	11.20	5.60	1-3	-2.46	0.07
	C	60	3.61	2.08	2-3	-0.61	0.58
Tapping test, left leg, 3 rd stage, q-ty	B	51	8.66	5.00	1-2	-3.02	0.03
	F	79.75	14.43	7.22	1-3	-1.50	0.21
	C	67	3.61	2.08	2-3	-0.61	0.58
Tapping test, left leg, 4 th stage, q-ty	B	44.67	11.50	6.64	1-2	-5.89	0
	F	80.75	4.35	2.17	1-3	-1.56	0.19
	C	63.33	3.61	2.08	2-3	-0.61	0.58
Tapping test, left leg, 5 th stage	B	45.33	12.06	6.96	1-2	-3.15	0.03

Test	Groups	Statistical indicators					
		\bar{X}	S	m	Compared groups	t	p
	F	76.75	13.72	6.86	1-3	-1.60	0.18
	C	56.33	3.61	2.08	2-3	2.45	0.06
	B	85.33	20.01	11.55	1-2	-1.99	0.12
Tapping test, right arm, 2 nd stage, q-ty	F	100.25	7.68	3.84	1-3	1.80	0.13
	C	77.67	3.61	2.08	2-3	2.7	0.04
	B	78.67	15.63	9.02	1-2	-1.99	0.12
Tapping test, right arm, 5 th stage, q-ty	F	93.25	7.14	3.57	1-3	-0.61	0.58
	C	74.67	3.61	2.08	2-3	4.04	0.01
	B	85.33	21.73	12.55	1-2	1.80	0.13
Tapping test, right arm, 6 th stage, q-ty	F	98.25	14.97	7.49	1-3	-1.99	0.12
	C	56.67	6.03	3.01	2-3	3.6	0.02
	B	127	5.20	3.00	1-2	-4.24	0.01
Skipping, 1 minute, q-ty of times	F	145.5	6.03	3.01	1-3	1.80	0.13
	C	133.33	6.03	3.01	2-3	-1.99	0.12
	B	1.26	0.04	0.02	1-2	3.82	0.01
6 meters' run, sec.	F	1.13	0.05	0.02	1-3	-0.61	0.58
	C	1.37	3.61	2.08	2-3	-0.65	0.59
	B	22.67	1.53	0.88	1-2	-3.01	0.03
Rising of torso from lying position for 30 sec., q-ty of times	F	29.75	3.77	1.89	1-3	2.91	0.03
	C	22	4.93	2.85	2-3	-0.61	0.58
	B	36	2.65	1.53	1-2	-0.61	0.58
High jump from the spot, cm	F	33.25	3.61	2.08	1-3	3.82	0.02
	C	23.67	4.93	2.85	2-3	3	0.03
	B	5.63	0.23	0.13	1-2	-0.61	0.58
Throwing of filled ball from the spot, cm	F	5.7	6.03	3.01	1-3	-3.71	0.02
	C	6.9	0.54	0.31	2-3	1.80	0.13

B –backs; F – forwards; C –central line players; \bar{X} –mean arithmetic; S – mean square deviation; m –error of mean; t – Stjudent's criterion for comparison of means; p – level of significance for determination of confidence of differences.

It should be noted that central line players compensate insufficient quickness of response and quickness of works by higher absolute strength (see table 2), i.e. they throw filled ball at further distance.

From this it follows that for such sportsmen optimal variant of realization of their physiological potentials is training of actions, which do not require high variability and demand only strength in relatively similar actions that, just, is realized in functioning of central line players. Thus, physiological potentials are realized in certain abilities, which manifest themselves in formation of certain style of functioning, in our case, - game functioning. Analogous explanation can be given to higher jumping of defensive players (see tables 2).

Thus, we applied methods of multidimensional analysis for specification of game functions, detecting of the most optimal variants of players' combinations for realization of tactic combinations, for selection of partners for working in pairs, threes at trainings. On the base of received data we worked out system of training for female basketball players with hearing problems in annual cycle with application of innovative technologies, based on video-aids on game tactics and with application of light devices for increasing of effectiveness of sportswomen's control in the process of trainings. We determined model characteristics and scales for evaluation of indicators of special physical and technical-tactic fitness as well as competition functioning of qualified female basketball players with hearing problems, of different game roles.

Application of system for training of female basketball players with hearing problems in annual cycle with the help of innovation technologies rendered positive influence on indicators of physical and technical fitness, indicators of competition functioning and results in main competitions. Female basketball players of experimental group (combined team of Ukraine) confidently increased results of tests "Skipping, 1 minute, q-ty of times" (from 136.08 to 149.83 times, $p < 0.01$), "High jump from the spot, cm" (from 30.83 cm to 35.75 cm, $p < 0.05$), "Pressing ups in lying position for 30 seconds, q-ty of times" (from 28.17 to 33.67 times, $p < 0.01$), "Rising of torso from lying position for 30 seconds, q-ty of times" (from 26.17 to 34.17 times, $p < 0.001$), "Jumping for time, for 20 seconds, q-ty of times" (from 27.92 to 32.00 times, $p < 0.05$), "20 meters' run, sec."; they confidently improved results of tests "Speed techniques, sec." (from 35.00 sec. to 33.17sec, $p < 0.05$), "Penalty throws, q-ty of hits from 21" (from 11.42 to 14.17 times, $p < 0.05$), "3 scores' throws, q-ty of hits from 21" (from 5.58 to 8.33 times, $p < 0.01$), "2 scores' throws, q-ty of times from 21" (from 12.08 to 15.92 times, $p < 0.001$), "Middle distance throws, quantity of throws for 40 seconds" (from 7.33 to 8.42 times, $p < 0.01$), "Middle distance throws, q-ty of hits for 40 seconds" (from 2.67 to 4.92 times, $p < 0.001$), "Special endurance, q-ty of throws for 5 minutes" (from 81.5 to 88.5 times, $p < 0.01$), "Special endurance, q-ty of hits for 5 minutes" (from 32.42 to 44.17 times, $p < 0.001$), "Middle distance throws, q-ty of hits from 40" (from 18.92 to 23 times, $p < 0.01$). In control group (sportswomen from Lithuania) these changes are less expressed and in most cases are not confident.

Application of the worked out training system for female basketball players with hearing problems in annual cycle resulted in improvement of competition functioning's indicators. Female basketball players from experimental group (combined team of Ukraine) fulfilled confidently more throws and hits from long distance than Lithuanian basketball players (control group), who, before experiment, had equal to Ukrainian basketball players indicators and, in some cases, even better. Such indicators as "pick ups at own backboard, quantity per games" and "pick ups at adversary's backboard, quantity per game" also improved as well as quantity of interceptions; quantity of fouls of Ukrainian sportswomen reduced.

We registered positive influence of the worked out system for female basketball players with hearing problems in annual cycle with application of innovative technologies on results of main competitions. At 22nd Deaflympic game, by all indicators, except the last, sportswomen of Ukrainian combined team (experimental group) showed confidently higher results than combined team of Lithuania (control group). Accordingly, for the first time they won silver, moving aside combined team of Lithuania, which previously was ahead of combined team of Ukraine), to the third place. Improvement of intensity was reached owing to new system of communication between coach and sportswomen. The offered by us new means of training process's control helped to increase mobility, intensity and motor density of trainings of Ukrainian combined team; they facilitated increasing of speed and effectiveness of perception of information about tactic interactions and optimization of training process.

Conclusions:

1. We have worked out algorithm of sportsmen's distribution in groups for formation of tactic tasks in team kinds of sports with the help of multidimensional analysis (on example of women combined team of Ukraine-basketball players with hearing problems). Algorithm consists of the following stages: 1 – testing of sportsmen, including not less than 10 tests; 2 – hierarchic cluster analysis of indicators of testing; 3 – distribution of sportsmen in groups on the base of cluster analysis, analysis of characteristics of every group's sportsmen, formulating of tactic tasks, depending on characteristics of every group's sportsmen.

2. We have proved high influence of psycho-physiological potentials on formation of game roles of sportswomen, though, as a rule, game roles are determined exclusively by anthropometrical characteristics of basketball players.

3. It was registered that forwards (attackers) have higher indicators of quickness of response; central line players – higher level of absolute strength; defensive players have higher frequency of movements and jumping.

4. On the base of the received data we worked out training system for female basketball players with hearing problems in annual cycle, with application of innovative technologies. Application of training system for female

basketball players with hearing problems in annual cycle, with application of innovative technologies rendered positive influence on indicators of physical and technical fitness, competition functioning and results of main competitions.

In the future we offer to develop new technologies for disabled sportsmen, studying of influence of innovative technologies' application on efficiency of competition functioning, functional potentials, level of special physical and technical-tactic fitness of disabled sportsmen- representatives of other team kinds of sports.

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Information about the authors:

Kozina Zh.L.: ORCID: 0000-0001-5588-4825; Zhanneta.kozina@gmail.com; Kharkov National Pedagogical University; Artema str. 29, Kharkov, 61002, Ukraine.

Sobko I. N.: ORCID: 0000-0002-4920-9775; sobko.kh@mail.ru; Kharkov National Economic University; Lenina boulevard 9a, 61001, Kharkov, Ukraine.

Kolomiez N.A.: ORCID: 0000-0003-0204-8262; nadya.k@mail.ru; Academy of Design and Arts; ul.Krasnoznamennaya, 8, 61002, Kharkov, Ukraine.

Jagiello Władysław; ORCID: 0000-0001-7417-4749; wjagiello1@wp.pl; Academy of Physical Education and Sports; ul. Wiejska 1, 80-336 Gdansk, Poland.

Jagiello Marina: ORCID: 000-0001-5591-4537; wjagiello1@wp.pl; Academy of Physical Education and Sports; ul. Wiejska 1, 80-336 Gdansk, Poland.

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