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CONTENTS

PERFECTION OF COORDINATION WITH THE HELP OF JUMP EXERCISES ON TRAMPOLINE

Boloban V.N., Tereshchenko I.A., Otsupok A.P., Krupenia S.V., Kovalenko Y.O., Otsupok An.P.
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Abstract. *Purpose:* to work out methodic of sportsmen's coordination perfection with the help of jumps on trampoline. *Material:* in the research 259 1st and 2nd year students (age 17-19 years) participated. The students were representatives of game and cyclic kinds of sports, sport gymnastic and martial arts. Among them there were 99 sportsmen with sport degrees. *Results:* we gave the definition of the term – coordination training. The students' sensor-motor coordination was confidently improved by means of the worked out methodic realization. The methodic included program of jump exercises on trampoline. We achieved positive dynamic of static-kinetic and static-dynamic balance as well as increased the quality of mastering of exercises with complex coordination. *Conclusions:* the methodic of sportsmen's coordination training with the help of jump exercises on trampoline was worked out, considering specificity of kinds of sports and sportsmen's qualification. This methodic improves sensor-motor coordination and is the basis of technical training and technical fitness.

Key words: sportsmen, sensor-motor abilities, methodic, coordination training, exercises, jumps on trampoline, testing, technical fitness.

Introduction

In kinds of sports with complex coordination structure competition exercises are fulfilled in difficult conditions of static-kinetic and static-dynamic balance [9, 11, 15]. Such kinds of sports include: sport kinds of gymnastic [1, 4, and 6], mountain skiing [11], sport wrestling [12], basketball [17], football [15] and other. Sportsmen have to solve motor tasks of body positions' control on supports and without support. They achieve coordination accuracy of motor actions in complex phase structure of sport exercises. Scientists conclude that decisive role in effective motor actions' control is played by sensor-motor coordination [2, 4, 18]. As it is shown by practice and experimental-methodic researches in some cases sensor-motor coordination is not sufficiently effective in demonstration of sports exercises. It is expressed in disordering of: body and bodies' system balance; space-time orientation of body on support and without support; temp-rhythm; differentiation of motor parameters. When fulfilling program reconstructions of competition exercises' motor structure, technical mistakes were found. Analysis of sport training modern state witnesses, that *coordination training* (CT) shall be an important direction. It shall be regarded as training process, directed at development and perfection of motor coordination with the help of special (specific) coordination exercises. Such exercises improve space, time and power indicators of systemic control over sportsman's movements. Coordination training is built, considering sportsman's indicators of special motor (physical) and special technical fitness. Besides, such training is built considering sensor-motor coordination (SMC), accumulated knowledge about level of perfection and individual sportsman's coordination abilities (CA); presence of valid means (coordination exercises) and methods of their realization in training and competition functioning. Coordination training is an element of system of sportsmen's many years' preparation.

Sensor motor coordination

In monograph by Prof. N.A. Bernstein [2] the following is written: "Coordination indeed is nothing but overcoming excessive degrees of freedom of our motor organs; i.e. transformation them into controlled systems". "We call introduction of continuous corrections in our movements on the base of sensor organs reports, principle of sensor corrections". "Sensor" (translated from Latin) means "related to sensitivity", "based on sensitivity" (p.54). Motor coordination (by N.A. Bernstein) ensures interaction of movements' construction levels at the account of sensor integration of Central nervous system (CNS) structures. Motor coordination abilities are understood as human abilities to quickly, accurately, bio-mechanically purposefully and inventively solve any motor tasks. Results of foreign scientists' works [14, 16, 17] also witness that sensor motor coordination is integral functioning of organism's sensor systems. Motor coordination is directed at development, control and correction

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of movements by means of sensor system's functioning: visual, tactile, proprioreceptive and interceptive sensor systems and olfaction sensor system.

Sensor motor coordination is rather a complex motor skill. This skill is in the base of control over sportsman's movements. It illustrates motor skills of elite sportsmen and sportsmen of low qualification. Sportsmen-beginners are separate category. At beginning stages of training – movements are included in sensor-motor coordination exercises. They can consist of a number of separate sensor-motor reactions, every of which has own beginning and end. In the process of training separate sensor-motor reactions are combine in flexible, plastic system of sensor-motor corrections of the fulfilled action – movement. Such approach is required for realization of generalized target (for example fulfillment of holistic sports exercise). Further complication of sensor-motor coordination takes place in case if it is necessary to control complex system. It is possible, when general and local coordination abilities are developed properly.

Coordination abilities

Multiple researchers of recent years showed that different manifestations of human coordination in physical education, sports, labor and military activity are rather specific. That is why instead of earlier term "dexterity" (which was rather multivalent) term "coordination abilities (CA) was introduced in theory and practice of sports. Besides, the system of such abilities and demand in differentiated approach to their development, have become relevant [3, 11, and 17]. Term "abilities" is regarded as manifestation of personality's individual qualities, which are subjective conditions of successful realization of motor functioning. They are not reduced to available knowledge, skills and abilities. Person's bents are their base. Abilities are detected by quickness, depth and strength of mastering motor actions' means and techniques. They are ordered psycho-physiological regulators, which condition possibilities of their acquiring and realization. Coordination abilities ensure economic and inventive, i.e. the most perfect, solution of motor tasks (especially difficult and sudden).

Professor Yu.K. Gaverdovskiy [6] regards these abilities as bents, developed by purposeful work. He points that there are the following abilities: to generalized or specialized types (equally important in any kind of activity); local abilities, which express the most brightly individual's bents to certain forms of activity. As a rule, full development of exactly such abilities plays decisive role in human self-realization (in particular sportsmen's).

Professor V.N. Platonov [11] writes: "Sportsman's coordination abilities are variable and specific for every kind of sport. However, they shall be differentiated into separate kinds by specific features of their manifestation, criteria of their assessment and factors, which condition them. Basing on results of special researches… one can mark out the following relatively independent kinds of coordination abilities: assessment and regulation of dynamic and movements' space-time parameters; keeping of balance and stability; sense of rhythm; orientation in space; inter and intra muscular coordination; ability for relaxation; coordination of movements. In actual training and competition functioning all mentioned abilities manifest not purely but in complex interaction. In definite situations some coordination abilities are leading and other are secondary. With it, instant change of different abilities' role is possible, caused by change of external circumstances. Especially noticeable it is in sport gymnastic, acrobatic, sport games, martial arts, mountain skiing: in all kinds of sports, in which result mainly depends on coordination abilities" (2015. – Vol. 2. – Pg.797).

Exercises of sport kinds of gymnastic were created artificially [1, 6]. They practically are not used in everyday life. At the same time, in the world unique competition exercises' systems with complex motor coordination exist and successfully develop. They are also successfully demonstrated in the form of compositions at sport competitions of different levels, Olympic Games including. In this connection requirements to physical, functional (sensor-motor) coordination and technical fitness of sportsmen are being worked out and perfected. Coordination complexity of competition programs remain the key tendency. Their difficulty (according to tables of difficulty of International gymnastic federation) shall be related to it also.

Professor V.N. Boloban [3] studied twelve coordination abilities, which correspond to specific of sport kinds of gymnastic. They characterize quality of sportsman's motor control. These abilities are realized in training and competition functioning differently. They are the basis of technical perfection and technical fitness. They are abilities for the following:

- Static and dynamic balance; balancing in system of interacting bodies;
- Assessment of proprioreceptive signals in orthgrade and reverse body positions;

- Vestibular balance and sensitivity;
- Assessment of time and space on support and without it;
- Differentiation of motor parameters;
- Assessment of motor stability and watching object (partner, opponent);
- Manifestation and change of motor rhythm-temp;
- Reactivity of movements by time of motor reaction;
- Movements frequency;
- Movements symmetry and asymmetry;
- Movements' concordance with music.

Many scientific works are devoted to study significant coordination abilities in many kinds of sports. Insignificant discrepancies, existing in them, only prove specific character of one or another ability manifestation and individual distinctions in its domination in relative kind of sports (or in separate kind of sports).

Development and perfection of coordination training programs

Recent years, in the world exercises' programs of general [11] and specific (local) influence on sportsman's motor coordination have been being worked out and perfected [5, 8, 12, 15].

General exercises' programs are directed at formation of solid foundation for motor skills in exercises' fulfillment. In this case, indicators of space, time and power motor parameters are considered. On the base of exercises' programs and algorithms of their realization basic fund of individual sportsman's movements – exercises is created. With it, sportsman's individual indicators of special fitness, specific of kind of sports, stages of training are considered. Exercises' programs with application of new technical means are used: SportKat (diagnostic-exercise); step-platforms Body – Balance (exercises on moving platforms); fit-ball; platforms – semi-spheres of type BOSU Balance Training; water slides with spring board of different height, which push sportsman in free flight with "landing" in water. They permit to develop body movements and perfect their control in space (usually used in freestyle). Means for training static-dynamic balance are used (for example ball throws in basket, standing on moving platform or semi-sphere) and etc. Different by structure exercises are fulfilled: turns, body twisting, forward and backward body bents with support on fit ball, with other subjects [11, 14, 15]. Sportsmen have opportunity to train surface and deeper muscles as well as to form muscular corset; to work at sensor systems' development and perfection of their integrative interaction in process of sports exercises' fulfillment. With it, improvement of vestibular sensor system's functioning, as the base of technical fitness, is accented [4, 13].

Programs of special exercises are worked out and realized for training local manifestation of specific coordination abilities; determination of their functioning characteristics and assessment criteria, as well as factors, which condition them. Such specific and locally manifested CA include: motor control in space; balance in reverse body position; balancing, juggling; temp-rhythm; feeling of time; feeling of sport apparatus; feeling of object; feeling of water; feeling of partner or opponent; muscular-joint feeling; vestibular sensitivity; balance in motion; fine motor abilities; balancing on narrow, mobile or high support; jumping; interaction of music and movements and so on. Special exercises' programs of specific impact actually have the same names in coordination training: program of positions; program of orientation; program of coordination; program of balance or stability; program of "light" acrobatic; program of rhythm; program of "sanging" [temp-rhythmic sportsman's boy interactions with support (hanging), without support and with turns around longitudinal axis]; program of mechanic interaction with support; program of landing; program for flexibility, mobility and other. For their realization physical and sport exercises of certain kind of sports are used as well as exercises of other (relative) kinds of sports and technical means [4,13]. *Alongside with it, it should be noted that there nearly no scientific-methodic materials, which would substantiate usage of trampoline jumps. Especially it concerns training and improvement sensor-motor coordination. In this case special importance is acquired by coordination training structure in different kinds of sports.*

Trampoline jumps is an Olympic kind of sports (since 2000). The prospects of this kind of sports are as follows: expansion of geography of countries, in which trampoline jumps are practiced; increase of quantity of trampoline jumpers; development of sport exercises of different groups of difficulty; perfection of sport technique; raising of sportsmanship level in individual and synchronous jumps.

Trampoline jumps exercises are used as mean of motor and functional-technical training in different kinds of sports, physical education and professional functioning (for example in vestibular analyzer training in mountain skiers, astronauts, sailors, drivers and so on). These exercises stimulate visual analyzer that facilitates motor control, avoiding air and sea sickness as well as activate breathing and improve blood circulation and result in positive psychological and emotional state. By effectiveness, trampoline jumps to large extent exceed usual cardio training. Scientists-physiologists from NASA found that usefulness of trampoline jumps significantly exceeds advantages of run (to be more exact by 68%). In contrast to track, trampoline springing jumps compensate up to 80% of loads on joints. By this reason 10 minutes of trampoline jumps have the same effectiveness as 30 minutes of jogging [19].

The purpose of the research: is to work out methodic of sportsmen's coordination training with application trampoline jumps.

The tasks of the research: 1. to study indicators of elite sportsmen's coordination indicators (in kinds of sports with complex motor coordination).

2. To work out coordination training methodic with application elite sportsmen's trampoline jumps as well as to test effectiveness of its application in practical trainings of 1st and 2nd year students of National university of physical education and sports of Ukraine (NUPESU).

Material and methods

Participants: in the research 1st and 2nd year students of NUPESU (n=238) participated. They were (142 boys and 96 girls of 17 – 18 years' age, who specialized in the following kinds of sports: games, cyclic, with complex coordination, martial arts. From them: masters and candidate master of sports – 78; 1st-2nd sports degrees sportsmen - 111 persons; without sport degrees - 49 persons. Besides 2nd year students of NUPESU n=21) (14 girls and 7 boys) of 18 – 19 years age, specializing in sport gymnastic, participated in the research. From them there were 15 masters of sports and 6 candidate masters of sports 13].

Organization of the research: the researches were conducted with 1st year students (September 2014 – May 2015 – 30 training sessions) and with 2nd year students (September 2015 – May 2016 – 30 training sessions). Sportsmen of sport gymnastic fulfilled coordination exercises during 30 sessions at 1st year and 60 training sessions at 2nd years (twice a week).

Statistical analysis: materials of the research were processed with the help of mathematical statistic methods (Excel, Statistika).

Results of the research

We have worked out methodic of sportsmen's coordination training with application of trampoline jumps (see fig. 1). Nine elements are in the base of it. The elements of priority are: individual indicators of students' technical fitness (sportsman, qualification) and program of trampoline jumps. The program included three blocks: elementary exercises on trampoline, combinations of elementary and basic exercises on trampoline.

Methodic and practical recommendations for mastering trampoline jumps' technique: the first practical steps of sportsmen in mastering trampoline jumps are connected with formation of "feeling" of sport apparatus, accurate body positions:

- Walking on trampoline network face or back toward direction of walk; rolls over on trampoline;
- Rocking and jumping on feet at little height on all surface of network (feet at shoulder width, feet apart (left leg, right leg));
- Rocking in the center of trampoline (on "cross", feet joined, arms downward, along torso) – "cross" is the main place of jumps on trampoline.

After acquiring self-confidence, jumps shall be fulfilled with arms raised upward [7, 10]. When training trampoline exercises, it is important to master required elements of *working carriage*. Working carriage permits to control feeling of body postures, body positions on support and without support. Specialists [1, 6, and 13] conventionally mark out the following types of working carriage: closed carriage, half-closed carriage, grouped carriage, half-grouped carriage, bent carriage, straight (arching) carriage. Working carriage is a multiplication of body postures and body positions in phase structure of sport exercise. For example, multiplication of posture

"grouped" with back somersault is a working carriage. Actually working carriage is a signal position of movement – exercise [4]. It orients sportsman for fulfillment of exercise without extra motor reconstructions. It facilitates the trainee not to accumulate technical mistakes in exercise phases. Working carriage shall be stable motor skill.

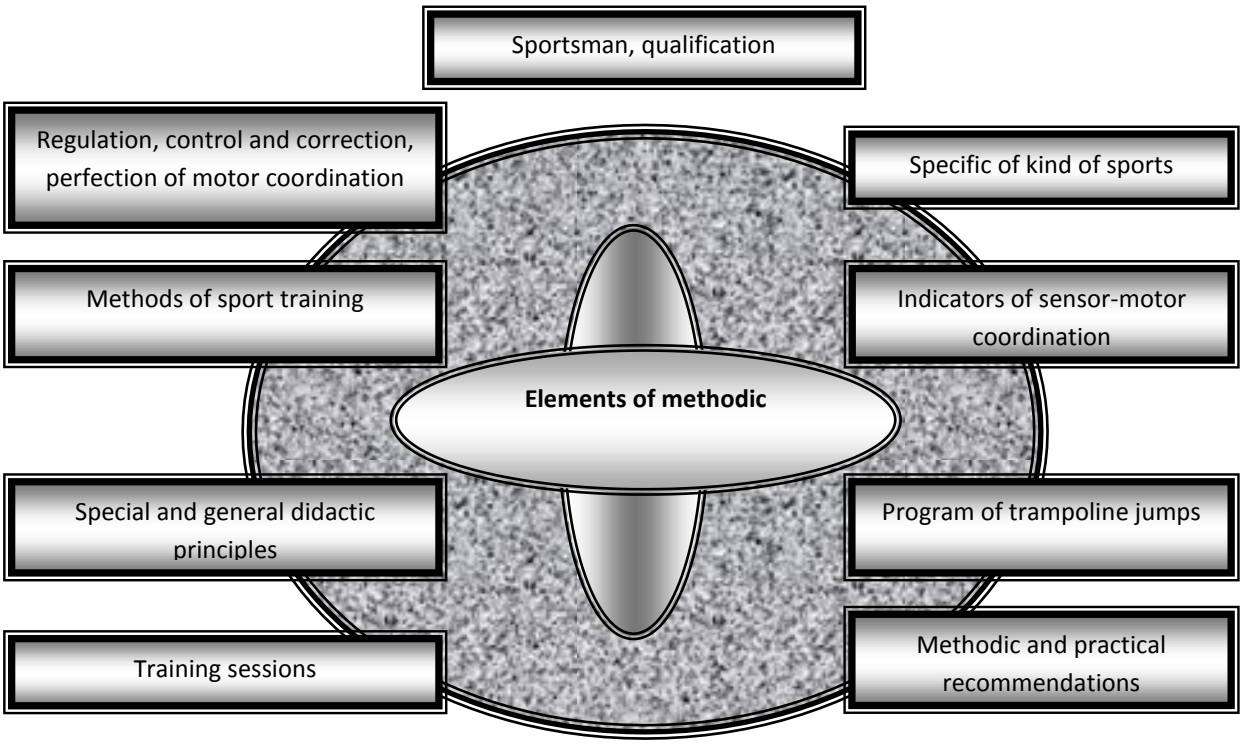

Fig.1. Elements of sportsmen's coordination training methodic with application of trampoline jumps

To achieve sufficient flight height after pushing off is possible only after 2-3 (sometimes 5-7), depending on exercise' complexity) jumps on the spot (in the center). In practice such jumps are called "temp jumps". This, at first sight simple exercise, shall be carefully mastered and perfected at all stages of sport exercises. In initial position legs are in narrow stance (for beginners it is possible to keep feet at shoulder width); torso is straight; arms – a little bit backward; eyes look forward. Pushing off is fulfilled at the account of ankle, knee joints' bending, agreed with elasticity of network; when legs are straightened and with pushing off arms are driven forward and upward. In flight hip, knee and ankle joints are straightened, toes – are also straitened and feet touch each other. From position arms upward (arms and body make one straight line): in the process of body descend arms move to horizontal position. Then arms start move a little back and downward. Just before touching the network, legs move to closed position (or at shoulder width) to increase stability; elite sportsmen usually keep feet close. *It is important to watch rhythm of arms' movement.* Jumps are fulfilled standing on legs, from sitting position,; from position on abdomen, on back; from position on knees; without rotation; with rotation forward and backward (around transapical axis) and around (together functioning) longitudinal and transapical axes (pirouettes). Exercises have different forms (compulsory body positions): grouped, half-grouped, bent, bent with feet apart; arching and straightened as well as additional body positions [for example jump "kazak", half-split, split, split with left (right) leg forward and other].

Helping plays important role in training of exercises of progressing difficulty. The most effective helping is with application of suspended turning belt. Besides, the following is used: manual belt (initial stages of training); helping with arms; foam mats in the place of sportsman's landing. Then it is possible to used built-in the floor trampoline; complex: trampoline and pit filled with foam polyurethane; in some cases all free trainees shall locate around trampoline for assistance, if required.

Program of jump exercises on trampoline

Block 1. Elementary exercises of trampoline jumps are: body in vertical sitting position; hands are on trampoline network with fingers pointed forward; stand on knees with arms dropped down; standing on knees with

hands on network; grouping in lying on back position; lying position with arms pointed forward; body in lying on abdomen position with feet touching each other and bent arms with hands on network (see fig.2).

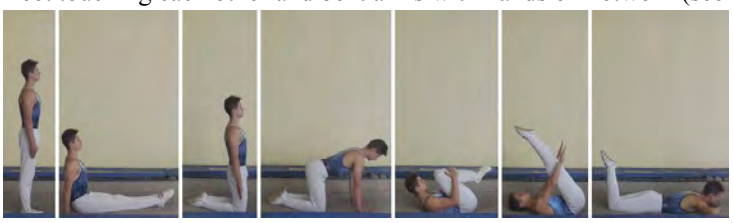

Fig. 2. Elementary exercises of trampoline jumps

Block 2. Basic exercises of trampoline jumps are: temp jumps; jump with landing in sitting position; jump with landing on abdomen; jump with landing on knees; jump with landing on knees and hands, touching network; jump with turn by 90° (4 x 90°) in both sides; jump with turn by 180° (2 x 180°) in both sides; jump with turn by 180° and landing in sitting position in both sides; back jump with landing on back, grouping; forward jump with landing on back; forward somersault, grouping; forward somersault, bending; backward somersault, grouping; backward somersault, bending; backward somersault in straightened position (¾ of rotation) with landing on abdomen; jump with turn by 360° in both sides; back somersault, bending, with turn by 360°.

Fig.3. Temp jumps

Recommendations: keep vertical position (shots 1 – 3, half-closed working carriage) – head a little bent with chin touching chest and shoulder and hip joints bent (shots 4-5). It permits for sportsman to control straightness of body. Arms are waved from down to upward. Safety measures are: when landing with mestakes (absence of vertical position) it is necessary to relax legs and damp landing on network. Fulfill 5-7 repetitions in 4-5 attempts. In all next exercises technique of temp jumps is the same.

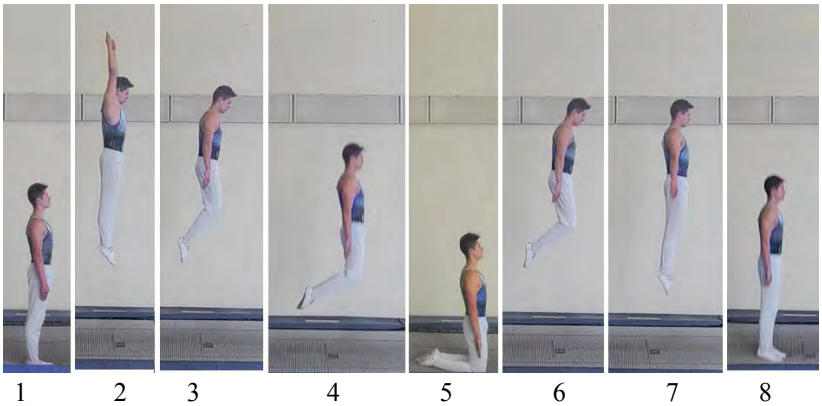

Fig.4. Jump with landing on knees

Recommendations: not high temp jumps (vertical position, shots 1-2); jump with landing on knees with straightened toes and arms dropped (shots 3-5); temp jumps with following stop (shots 6-8). Pay attention to

absence of angle in hip joints; keep buttock muscles tensed with knees at the width of foot, when landing on knees. Repeat exrcise 2-4 times in 2-3 attempts.

Fig. 5. Jump with landing in sitting position

Recommendations: fulfill temp jumps (vertical position, shots 1-2); whenn landing, raise legs forward and take sitting position with arms bent behind torson, on network and hands directed forward (shots 3-5); fulfil temp jump and stop (shots 6 – 8). Pay attention to simultaneous touching network with all back surface of legs and hands' position. Repeat exercise 2-4 times in 2-3 atempts.

Fig.6. Jump with left turn by 360°

Recommendations: fulfill temp jumps (shots 1-2); then – upward jump with left turn by 360° (shots 3 – 6), with following temp jump and stoppage (shot 7). Turn shall be fulfilled in ascending part of jump in vertical position with arms pressed to torso. Fulfill exercise 2-4 times in 2-3 attempts.

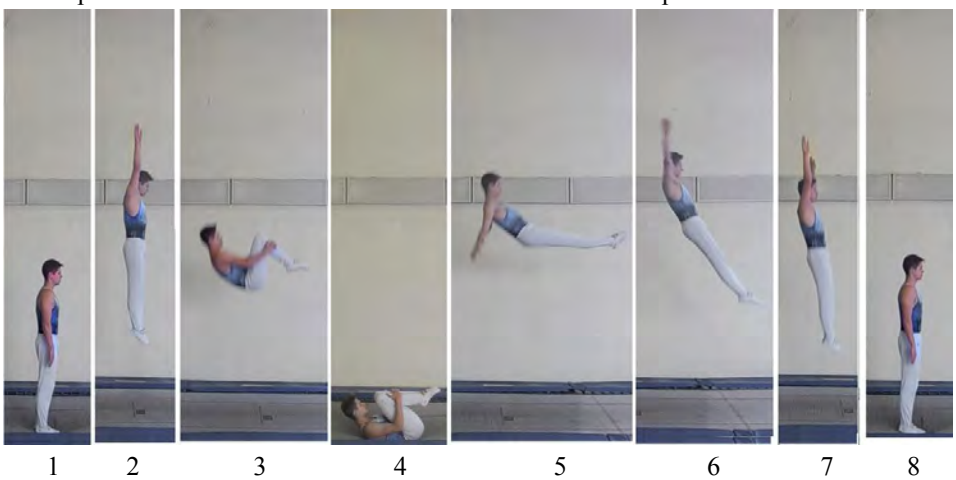

Fig.7. Backward jump with landing on back, grouping

Recommendations: fulfill not high temp jumps (shots 1-2); bending legs and grouping fulfill jump backard, landing on back, grouping (shots 3-4); unbending legs forward-upward land on network And stop (shots 5-8). Fulfill exercise 3-4 times in 2-3 attempts.

Fig.8. Forward jump with landing on back, bending with arms, directed forward

Recommendations: fulfill not high temp jumps (shots 1-2); bending shoulders forward and bnding in hip joints fulfill forward jump with landing on back in bent position with arms directed forward (shots 3 – 5); unbending elgs forward-upward, fulfill landing on network and stop (shots 6 – 8). Fulfill exercise 3-4 times in 2-3 attempts.

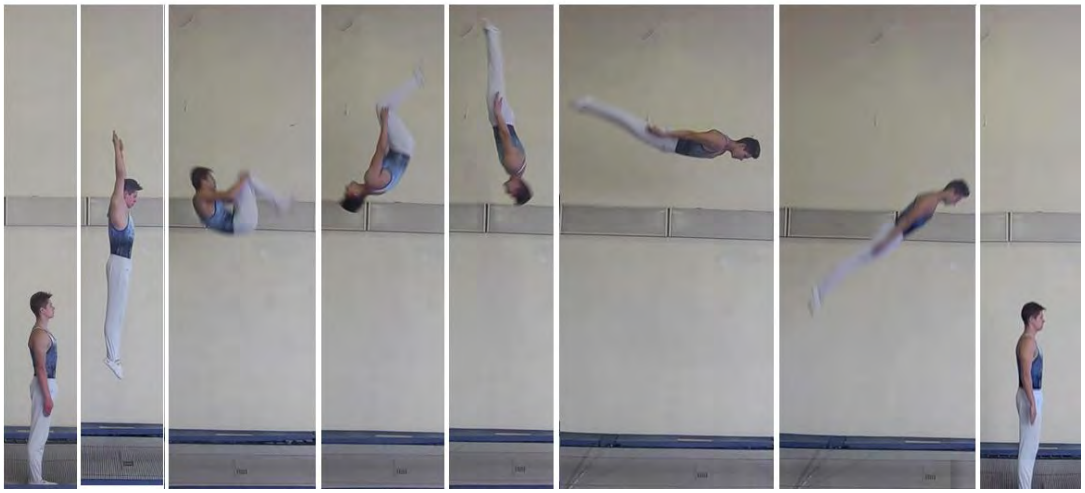

Fig.9. Back somersault

Recommendations: fulfill temp jumps (shots 1-2). In tep jumps create backward rotation and grpup body, bending legs with following quick ungrouping in ascending part of jump (shots 3-5). In descending part of jumps raise shoulders upward, taking vertical position with arms pressed to torso, land and stop (shots 6 – 8). Pay attention to tightness and quickness of grouping. Fulfill exercise 2-4 times in 2-3 attempts.

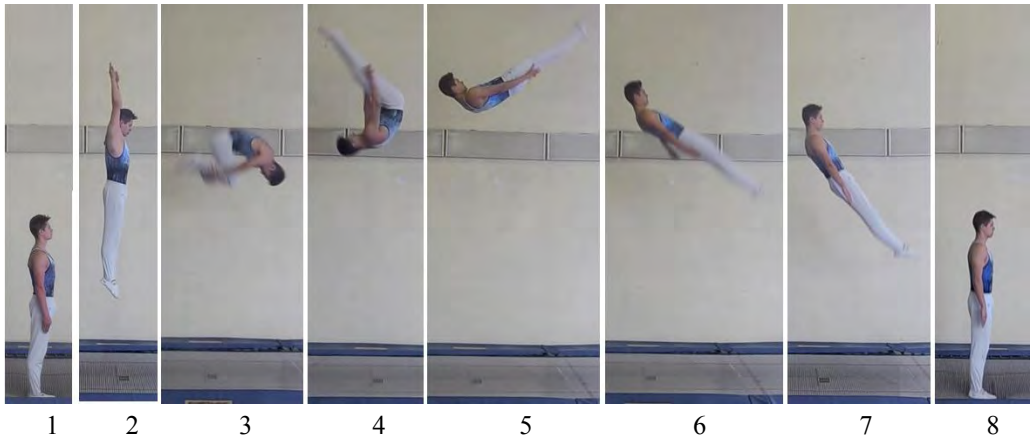

Fig.10. Forward somersault

Recommendations: fulfill temp jumps (shots 1-2); bending torso forward and legs, group body with following quick ungrouping in ascending part of jump (shots 3 – 5). In descending part of jump raise shoulders upward, taking vertical position with arms pressed to torso, then land and stop (shots 6 – 8). Pay attention to tightness and quickness of grouping. Fulfill exercise 2-4 times in 2-3 attempts.

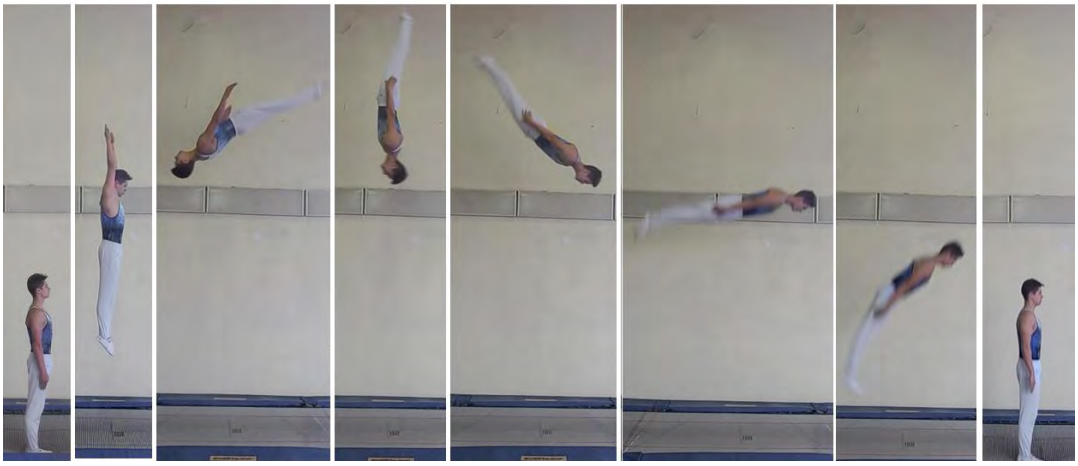

Fig.11. Back somersault, straightening

Recommendations: fulfill temp jumps (shots 1-2); in ascending part of jump, bending backward with insignificant arching raise straightened legs and press arms to torso (shots 3 – 5). In descendin part raise shoulder upward, taking vertical position, kand and stop (shots 6 – 8). Pay attention to straightness and tightness of body position in space. Fulfill exercise 2-4 times in 2-3 attempts.

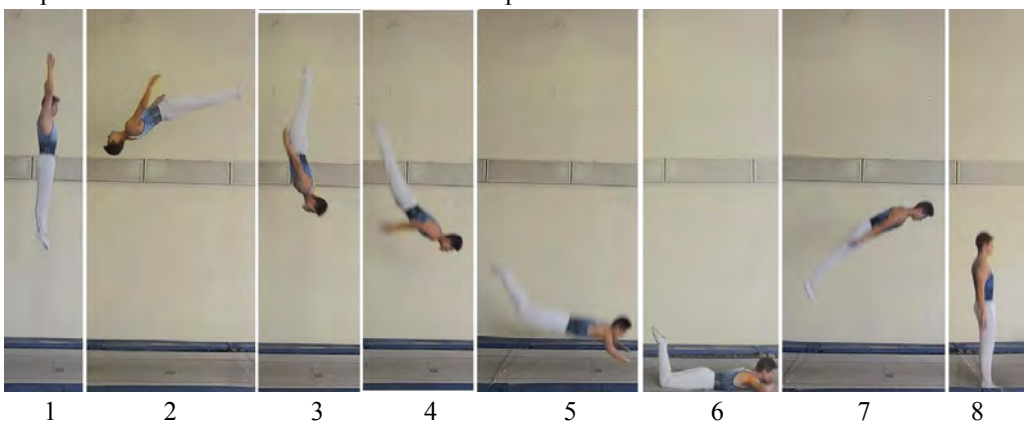

Fig.12. Back somersault, straightening with landing on abdomen

Recommendations: temp jumps (shot 1, three-four temp jumps are also possible); ¾ of back somersault straightening (shots 2 – 4)with landing on abdomen (shots 5 – 6) and coming upward to stop (shots 7 – 8).

Block 3. Examplary combinations of elementary and basic exercises of trampoline jumps program

Fig. 13. Combination 1. Temp jumping (shot 1); jump in stance on knees (shots 2 – 3); jump upward with left turn by 180° and landing in sitting position (shots 4 – 6), then stop (shots 7 – 9).

Recommendations: in jump combination it is necessary to coordinate arms movements (in ascending part of trajectory arms go upward and in descending part – downward with accented arm moving to the side of turn (to the left or to the right)). Pay attention to accuracy of turn and taking sitting position with hands on network and fingers directed forward. Fulfill combination 2-4 times to each side.

Fig.14. Combination 2. Temp jumping (shot 1); jump in stance on knees (shots 2 – 3); jump forward with landing in position lying on back, bending, arms are directed forward (shots 4 – 6); coming out of lying on back position and stoppage (shots 7 – 8).

Recommendations: Pay attention to creation of forward rotational movement with round back, head, bent on chest and to landing on network by all surface of back. Fulfill 2-3 times in 3-4 attempts.

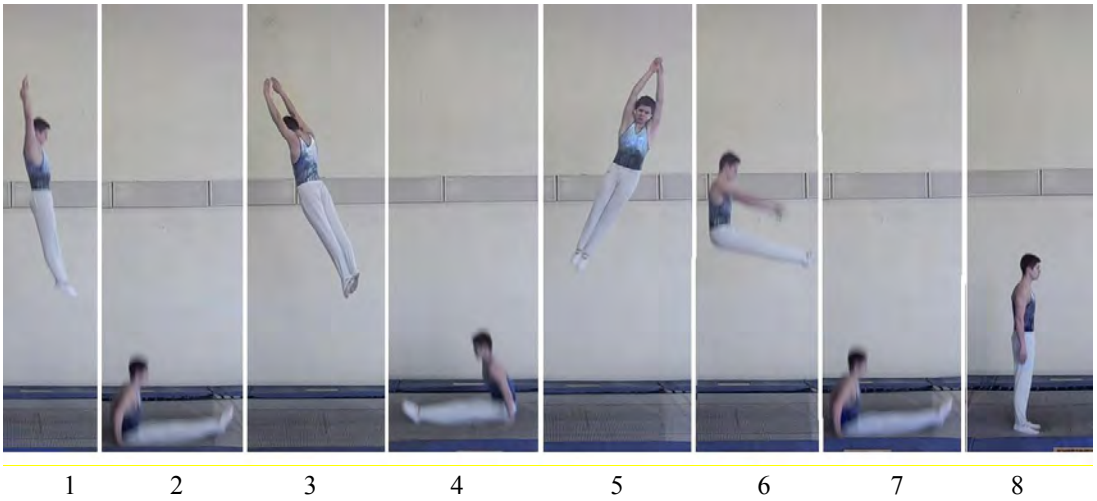

Fig.15. Combination 3. Temp jump (shot 1) and landing in sitting position (shot 2); jump upward with left turn by 180° andlanding in sitting position (shots 3 – 4); jump upward with right turn by 180° and landing in sitting position (shots 5 – 7); stoppage (shot 8).

Recommendations: when fulfilling right or left turns body shall be straightened with armes raised upward; landing shall be accurate. Fulfill 2 repetitions in 2-3 attempts.

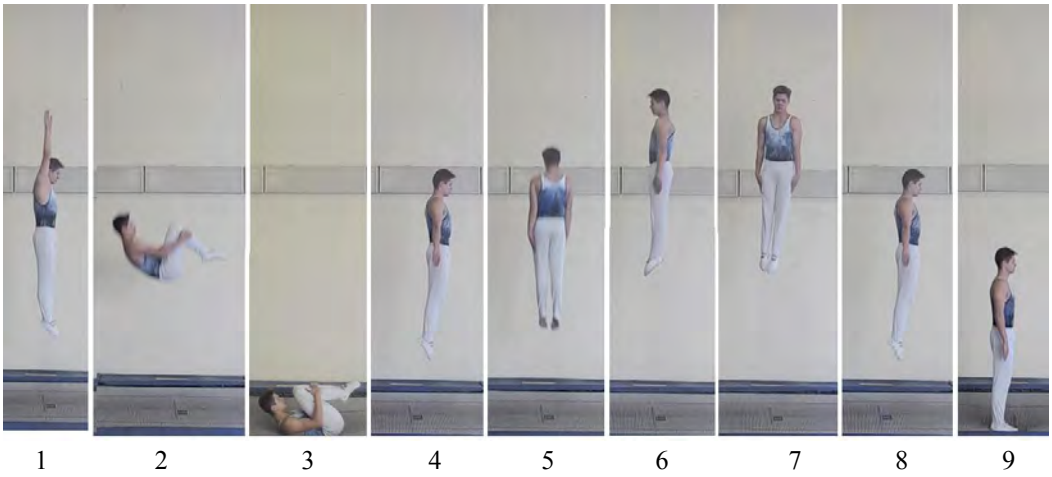

Fig 16. Combination 4. Temp jump (shot 1); jump backward, taking position landing on back and grouping (shots 2 – 3); jump forward and temp jump with turn by 360° (shots 4 – 8); stop (shot 9). 2 repetitions in every attempt, (2-3 attempts).

Recommendations: Pay attention to creation of back rotational movement with accent on taking lying on back position, groupoing. Left turn by 360° sall be fulfilled in ascending part of jump, in vertical position with arms, pressed to torso. Fulfill combination 2-4 times in 2-3 attempts to both sides.

The program exercises improved the quality of control over movements in space, regulation of body position on support, when fulfilling tests for static-kinetic and static-dynamic body stability; for coordination of symmetric and asymmetric limbs' movements. The confidentiality of results was at $p \leq 0.05$ (for sportsmen, specializing in game, cyclic sports and kinds of sports with complex coordination and in martial arts) and at $p \leq 0.01$ (sport gymnastic, calisthenics, sport acrobatic).

Discussion

"Coordination training" term in system of sportsmen's Olympic training has been becoming still more important by its efficiency in separate elements of motor functioning, resulted in appropriate sport results. Coordination training is one of modern training process components and important indicator of results, acieved by sportsmen in competition functioning. We worked at this article in period of Olypic games, 2016. Sportsmen

demonstrated excellent results; they achieved impossible. Alongside with organism's high functional potentils, sportsmen demonstrated excellent motor control, static-dynamic balance and accurate regulation of body and bodies' system: triathlon – bicyclist; gymnast – apparatus; shooter – arm; female gymnast – object; horseman-horse; wrestler- opponent; rower – boat and etc. We are sure that for achievement of target sportsmen need to manifest high potentials of vestibular analyzer; ability to contract and relax activly working muscles; keep balance in orthograde and reverse body position; control and change temp-rhytm of movements – exercises; demonstrated proper coordination. Event at present time, Nikolay Alexandrovich Bernstein, at Olympic games 2016, would have stressed significance of perfection of sportsman's sensor systems, their functioning, depending on dynamic of motor and psycho-physiological tasks. Unfortunately not all Olympic games' participants had the best results. Specialists will have to analyze every separate case of failure; may be there will appear understanding of global work at development and perfection of sensor-motor coordination in coordination training structure in many years' sport training. There are examples to it. First of all they are the works of Professor V.N. Platonov [11], containing new knowledge on this problem as well as the works of other domestic and foreign authors c [4, 13, 17]. For this purpose exercises' programs with application of new technical means are used. It permits to train and perfection motor control in space, static-kinetic and static-dynamic balance. With the help of technical means different by structure exercises are fulfilled: turns, body twists, forwad-backward torso bents (for example with support on fit ball; with other objects designed for creation flexible-rigid but plastic muscular corset) [14, 15, 18]. The researches showed that in demonstration of training and competition programs sensor-motor coordination manifests weakly and is insufficient in motor, bio-mechanical and functional structuires of the fulfilled exercises. The following technical mistakes are registered: in motor control in space; in landing; in keeping balance of body and bodies' system; body stiffness in movements, requiring plasticity; inaccurate working carriage [4]. In our opinion, alongside with realization of traditional training and competition programs individual work with sportsman is required, which would be directed at sensor-motor coordination's training and perfection; at recognizing coordination abilities of first priority. Such abilities shall reflect specificity of a kind of sports, feeling of sport apparatus, partner, opponent. Besides, they shall be carefully considered by a coach.

Let us also note nearly complete absence of scientific-methodic materials, substantiating usage of trampoline jumps for development and perfection of sportsmen's sensor-motor coordination. One of the most important elements of the methodic is the program of trampoline jumps; methodic recommendations; regulation, control and correction of training process. With it, we found high role of factor "technique-coordination" in sportsmen's motor actions: technical level determines successfulness of control tests' fulfillment. In its turn, sensor-motor coordination is the base of technical fitness. Results of pedagogic experiment proved effectiveness of trampoline jumps exercises for perfection of motor coordination.

Conclusions

1. We registered no high level of sensor-motor coordination as the base of technical fitness of elite sportsmen, specializing in sports with complex coordination.

2. The worked out and implemented in training process methodic with application of trampoline jumps confidently improved sensor-motor coordination. It is the base of sportsmen's technical fitness and shall be of priority in system of sport training.

3. The methodic includes interconnected on the base of factor "technique-coordination" the following elements: sportsmen's technical fitness by individual indicators of sensor-motor coordination; specificity of kind of sports; program of trampoline jumps exercises, including three blocks of exercises: block of elementary trampoline jumps; block of basic trampoline jumps; block of elementary and basic exercises' combinations; methodic and practical recommendations; special and general-didactic principles; forms of trainings; elements of regulation, control and correction of motor actions.

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Conflict of interests

The author declares that there are no conflicts of interests.

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CORRECTION OF PHYSICAL EDUCATION PROGRAM FOR TECHNICAL HIGHER EDUCATIONAL ESTABLISHMENT GIRL-STUDENTS ON THE BASE OF THEIR HEALTH INDICATORS

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Abstract. *Purpose:* to illustrate opportunities of physical education in health strengthening of technical HEE girl-students through correction of their biological age components. *Material:* 127 girl-students participated in the research. *Results*: the authors' program of biological age correction permitted to increase breathing pauses, hand strength, time of static balance and reduce blood pressure. Knowledge of biological age and mechanisms of too early ageing facilitates practicing healthy life style and formation of body-motor conditions. We offered trainings of biological age correction' methodic, oriented on prophylaxis of organism's ageing, reduction of biological age and prolongation girl-students' active life. *Conclusions:* specially determined biological age of an individual can be used as integral characteristic of his/her health condition.
Key words: physical, education, biological, age, health, girl-students.

Introduction

The problem of health protection and strengthening is one of main tasks of our society. Modern conditions of education in higher educational establishments set high requirements to students' health. Absence of healthy life style and low motor activity condition sharply accelerated ageing, characteristic for all age groups. It reflects general tendency to worsening life quality, health and physical fitness. Besides it determines the demand in prophylaxis of too early ageing and working out health related technologies.

To day actually every forth patient and fifth citizen of workable age have diseases of cardio-vascular system, [22, 41, 50]. Vegetovascular dystonia is one of the most frequent cardio-vascular diseases among young persons. With it among women it is 2-3 times more frequent than among men [1, 25, 43, 46].

Recent scientific researches witness that in health rehabilitation and strengthening active role is played by complexes of rehabilitation measures. Such complexes are directed at treatment of existing pathological; syndromes and improvement of students' health. Physical education means engage important place in these complexes that is proved by scientific works [10, 18, 26, 53]. Systemic physical exercises' practicing facilitates significant strengthening of students' organism's resistance and physical fitness [34, 42, 47, 51]. With it harmony of he whole organism is achieved.

Compliance of students' individual morphological functional level with mean statistic standard of this population reflects non-uniformity of development, maturity and ageing of different physiological systems. The temp of organism's adaptation potentials' age changes determines such model conception as biological age [11, 32, 44, 48]. Biological age is an indicator of wear out of structure and organism's definite structural element or group of elements and organism in the whole, expressed in units of time. It is found by correlating the measured individual bio-markers with reference mean population curves of these bio-markers' dependences on calendar age [5, 8, 11, 17].

It is known that mean biological age of Ukrainians is much higher than in their European peers. This age is nearly equal to Africans' age [6, 30, 37, 38]. Comparing with Europe, in Ukraine youth more frequent has diseases [4, 9, 35].

The problem of too early ageing is relevant due to its biological and economic consequences. It is known that early ageing significantly influences on period of working and creative activity. In Ukraine this indicator is 30 years (in the range of age from 20-25 – to 50-55 years). In poorer countries it lasts 45-50 years [2, 12, 31, 36].

If to analyze literature sources chronologically it is seen that interest to too early ageing was manifested by many authors. In modern literature the problem of students' biological and passport age correlation is regarded in the works of many authors [3, 13, 20, 23]. In these works it is pointed that students' biological age is, in average,

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from 40 to 46 years, Discrepancy between biological and passport age is from 10 to 40 years. Approximately 15-20 years ago this difference was 4-5 years [14, 27, 39, 45].

In scientific works significance of biological and passport age coincidence is noted. If biological age of heart is much higher than passport age there appears a risk of cardio-vascular system's disease and too early heart's ageing [16, 24, 40, 52].

From medical sources it is known that every person's organism ages hetero-chronically. In different life periods, ageing of people from different countries and continents is different [19, 29, 33, 49]. In respect to Ukrainians, there is no mentioning of "age strata" with higher ageing temps. Also it is unknown, if ageing temps are equal for men and women in Ukraine. In scientific journals there are very few works, devoted to biological ageing and its correction by physical education means, especially in respect to students.

Hypothesis: it was assumed that partial individualization of girl-students' physical education on the base of data about their health would permit to raise the level of their physical fitness.

The purpose of the research: is to illustrate opportunities of physical education in health strengthening of technical HEE girl-students through correction of their biological age components.

Material and methods

Participants: in the research 127 1-st – 2nd year girl-students of 17-21 years' age, from Kiev national university of technology and design participated. All girl students were practically healthy (I.e. did not have any health problems). The girl-students were divided into experimental and control groups.

Organization of the research: the research was conducted in 2015-2016. At the beginning of 2015 we registered girl-students' biological age, detected weak organism' systems, worked out individual program of physical education. At the end of 2016 we again registered biological age of the same girl-students. The experiment implied working out means for biological age correction and implementation of the authors' program and methodic in educational process.

For determination of personal biological age we used some modified methods [25]. For biological age assessment we used indicators of separate organism systems' maturity. The assessment was fulfilled by comparing girl-students' appropriate indicators with standards, characteristic for this age group. For correct assessment of biological age it is desirable to use several indicators in heir combination. However, in practice, when doing mass examinations, one has to consider separate indicators, which reflect human state rather satisfactory. Biological age assessment shall reflect clear age changes, which can be measured or described. The method of such changes' assessment shall not be harmful for the health and shall not cause unpleasant feelings. It shall be suitable for screening of great number of girl-students. We used abbreviated method of biological age determination [25]: determination of obesity degree (weight-height indicator); hand power (hand dynamometry); testing of cardio-vascular system (heart beats rate –HBR after 20 squats); state of nervous system (Romberg's test); state of respiratory system (vital capacity of lungs – VCL); determination of blood vessels' elasticity (blood pressure); functional state of respiratory and blood circulation systems (Genchi's test).

Statistical analysis:

For processing of the research's results we used mathematical statistic methods. For every indicator we calculated mean values and mean square deviation. Confidence of results was assessed with Student's t-criterion at 1% and 5% significance levels.

In conduct of complex pedagogic and biologic testing of girl-students we observed health protection laws of Ukraine and Helsinki declaration 2000; directive №86/609 of European community on human participation in medical-biological researches.

Results

Results of preliminary research (2015) showed that girl-students' average biological age (27.9 years) does not correspond to passport age (18.6 years) exceeding it. Accelerated temps of ageing are observed in 99% girl-students. Distribution by biological age is not uniform and the rage of variations is 27.0 years. In 17% girl-students biological age is within from 23 to 26 years; in 10% from 27 to 30 years; in 31% - from 31 to 34 years; in 21% - from 35 to 38 years; in 14% it is from 39 to 50 years; 4% have biological age from 51 to 60 years; 1% - from 61

to 70 years. Thus, biological age of most of girl-students is in the range form 30 to 40 years. The quantity of girl –students with low biological age (18-20 and 20-22) is insignificant and is not obligate (1% and 1% accordingly).

By results of preliminary testing in 83 girl-students we registered low health level; in 29 – below average and in 15 girl-students – average level. Thus, the girl-students' health can not be assessed as above average. Therefore, no one of them is in "safe zone". It is connected with deficiency of physical functioning and absence of systemic sports practicing.

Other mean-statistic data of our research are given in table 1.

The youngest biological age was 19.7 years. It exceeds passport age by 1.7 years. It should be noted that it is the best indicator. In all other cases biological age indicators are much worse.

The methodic of biological age assessment did not envisage study of volume and content of motor functioning. That is why we could not analyze influence of the latter on biological age.

Pedagogic experiment implied initial testing of control and experimental groups' girl-students. During academic year experimental group was trained by the authors' program of biological age correction. After finishing pedagogic experiment we received results of finalizing testing of these groups' biological age (see table 1).

Table 1. Girls-students' biological age indicators before and after application the authors' program

№№	Indicators	Before experiment	After experiment	Confidence
1	Weight-height indicator, conv.un.	21.9	22.2	P≥0.05
2	Static balance (Romberg's test), sec.	51.4	45.6	P≤0.05
3	Blood pressure, mm.merc.col.	34.9	29.2	P≤0.05
4	Breath pause (Genchi's test), sec.	33.5	30.3	P≤0.05
5	Hand dynamometry, kg	38.5	31.7	P≤0.05
6	VCL, liters	18.1	18.2	P≥0.05
7	HBR restoration after 20 squats, beats per sec.	17.8	18.2	P≥0.05
8	Mean passport age, years	17.6	18.6	P≥0.05
9	Mean biological age, years	27.9	23.3	P≤0.05

It is undoubted that influence of physical education means on student's organism is extremely necessary. However, to influence on biological age it is required to determine the most significant indicators. With Pearson's method of pair correlation we determined correlation coefficients. The highest rating belonged to indicator of pause after exhale (r=0.91); the second place is taken by static balancing on one leg with closed eyes (r=0.59); third place belonged to blood pressure (r=0.43). All these were considered in selection of the authors' program means.

The worked out authors' program included theoretical part. This part is a cycle of lectures targeted to open main principles and sense of the studies conceptions. The second part included content of practical, methodic and independent trainings. In the process of trainings we practically familiarized girl-students with complex of targeted means, oriented on human biological age correction and on application of the received knowledge in practice. As a result of this part's realization girl-students mastered therapeutic physical culture exercises, vestibular and fine motor exercises, breathing methodic, psycho-correction techniques. Besides, the girl-students knew methods of determination of human biological age and learnt to independently find it by calculations.

Independent trainings by the authors' methodic were directed at better mastering of material. Practical classes were conducted in the process of compulsory academic hours on discipline "Physical education". In our opinion group practical classes shall be conducted with application of individual approach to girl-students. It will permit for them to self-influence by correction and prophylaxis exercises. Means for biological age correction can include: therapeutic physical exercises, breathing exercises and exercises for psycho-correction relaxation [15, 16, 19].

The repeated testing of biological age showed that in 21% girl-students it is within from 23 to 26 years; in 16.0% - from 27 to 30 years; in 32.0% - from 31 to 34 years; in 17.0% - from 35 to 38 years; in 10.0% - from 39 to 50 years and in 1.0% -from 51 to 60 years. The quantity of girl=student with low biological age (18-20 and 20-22) remained insignificant (1% and 2% accordingly). The main is: period of breath pause, hand strength and period

of static balance increases as well as blood pressure reduced (see table 1). With it the following indicators nearly did not change: weight-height indicator, VCL, HBR after 20 squats (restoration of pulse).

As it follows from the received data the authors' program of girl-students' biological age correction and its realization methodic showed their confident effectiveness by most of the tested indicators.

Discussion

The results of presented here work can be called deplorable: they witness about significant passport age exceeding by biological age. In the future this gap can only increase owing to accelerated ageing. If now biological age is about 28 years, then in the nearest 5 years it can raise up to 40 years. It is necessary to think about control over this process and improvement girl-students' health.

It should also be noted that ageing is a multi-factor process of biologically conditioned objective and subjective factors' influence, which depend on a person [19, 26, 33]. It can be assumed that correction of a number of physical defects is possible with the help of specially selected physical exercises. On the base of the present work we can conclude that one training a week is not enough for health strengthening and improvement. It is necessary to think about independent trainings (for example in sport circles). With it individual condition of girl-students shall be considered [15, 37, 40].

As a result of the authors' program application we registered that girl-students' heaviest problems appear in respiratory system. By Genchi's test 55.6% have low health level, 18.5% - health below average. For cardio vascular and respiratory systems aerobic kinds of sports can be proposed. For example: run or power walking, swimming bicycle racing, dances, skating (roller skating) or skiing, outdoor games with ball (basketball, football, volleyball and etc.) [15, 21, 28].

Besides, Romberg's test showed the presence of problems with nervous system in girls. Indeed, balancing, as one of coordination qualities, directly influences on professional qualities of technologists and designers [26, 40].

We compared the received data with the data of other authors, who studied this problem earlier. Results of biological age study in the whole coincide with the data of other authors, living in Ukraine.

Conclusions

1. Specially determined girl-students' biological age can be used as an integral characteristic of their health.

2. As far as human biological age is conditioned by physiological, functional and adaptation organism's potentials, physical education means can be considered to be the most rational mean for ensuring longevity and prevention from too early ageing. They permit to mobilize adaptation mechanisms of young people, who are bent to pathologies of different organism's organs and systems.

3. Knowledge of biological age essence and mechanisms of too early ageing can facilitate the tasks of girl-students' self-perfection, healthy life style and formation of body-motor conditions; self-correction of organism's systems and functions.

4. Within the frames of "Physical education" discipline in university it is purposeful to realize the course by choice. This course is based on mastering biological age correction methodic; reduction of biological age and prolongation of girl-students' active life.

5. It is purposeful to introduce lectures, methodic and practical classes in the process of physical education in university. Such classes will be mainly directed at future technologists (designers, engineers) preparation for ageing prophylaxis through biological age reduction and active life prolongation.

The prospects of future studies imply development and implementation of too early ageing prophylaxis program for students.

Conflict of interests

The authors declare that there is no conflict of interests.

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DEVELOPMENT DYNAMIC OF HEALTHY LIFE STYLE PERSONALITY COMPONENT IN RELATIVELY HEALTHY STUDENTS

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Abstract. *Purpose:* to determine effectiveness of different physical culture trainings for development of students' healthy life style personality components. *Material:* 1st – 3rd year students, trained at physical culture lessons, participated in the research. All students related to main health group (students, having no health problems). In total 803 students participated in the research. The testing was conducted in periods from 2001 to 2005 and from 2010 to 2015. *Results:* positive changes of different personality's component of healthy life style were observed. Parameters of emotional stability and tolerance were found. Teaching in last years develops personality's components to less extent. The highest changes were determined in 3rd year students, independent on the program of their training. We did not find differences in degree of trainings' influence of specialized and typical classes. *Conclusions:* at trainings it is necessary to pay more attention to development personality's components of healthy life style, especially emotional stability and tolerance in respect to other people.
Key words: students, physical culture, specialization, healthy life style, personality.

Introduction

Specialists' training at high quality implies provisioning students with certain amount of knowledge, formation and development of workable personality. Personality's effective functioning is impossible without his/her healthy life style (HLS). The most frequent HLS is understood as healthy behavior: regular motor functioning; correct eating; useful habits, connected with correct day regime and alternation of work and rest; absence of harmful habits [8, 24, 32]. Such understanding of human HLS is restricted with by regarding human life as life of his physical body. However, human being is not only body. Human HLS shall include his healthy soul. Thus, human HLS includes: healthy behavior and thinking; healthy emotions; harmony in relations with surrounding world and own self [27]. That is why it is necessary to study behavioral base of human HLS; HLS of his/her mental component and personality's components. Especially it concerns the problems of formation and development of HLS personality components in the process of students' study at HEE.

Personality's components of HLS can be understood as human personality qualities, which characterize healthy thinking and harmony of human behavior and relations with surrounding world and him/her self *(positive state);* tolerant attitude to other people (*tolerance);* self-confidence, based on positive attitude towards hum/herself (*confidence);* ability to be in any situation emotionally positive that is an important factor of stress-resistance *(emotional stability)* [18]; vital activity, which characterizes personality's orientation on positive functioning (*activity).*

Each of enlisted five positive qualities of a student is integral one. It includes several particular characteristics – features of character or person's abilities. The list of particular characteristics of HLS every integral personality's component is give in [13, 14].

In the process of study at HEE personality components of students' HLS develop differently. It is necessary to regard as positive such changes, under which the enlisted above five qualities strengthen.

Recent years, in practice new principle of physical culture (PC) trainings' organization (in respect to relatively healthy students, MHG-main health group) has been being applied [13]. Students can choose typical physical culture trainings or one of specializations (power training, swimming, shaping or outdoor games) and

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attend classes as per schedule of the chosen direction. Such approach permitted to increase students' interest to trainings, their responsibility; decrease missing of classes. However the influence of such trainings' organization on development of relatively healthy students' HLS personality components still remains to be an open question.

Recent years rather a high number of scientific works on different kinds of sports and health related systems has appeared [6, 30, 39, 43]. Some works are devoted to training of physical [9, 31, 33] and psycho-physical [9, 38, 40, 41] abilities of different specialties students. But development of HLS personality components in the process of study at HEE is not regarded in these works. Some authors study formation of professionally significant qualities in different specialties' students by means of physical culture and sports (the works by N.A. Aleshev are the closest to us by topics) [2]). However, these authors do not study the problem of students' personality development (and more over – about development of their HLS personality components) in conditions of different PC organization: by typical program or by specializations.

In the course of our research we found the following *main contradictions:*

– Between active propaganda of healthy life style theory and practice and main directions of physical culture trainings' substantiation in modern society. It is connected with searching and opening new effective health related technologies and directions;

– Between theoretical substantiation of demand in strengthening students' motivation for healthy life style and actual situation as on to day. It is connected with insufficient quantity of physical culture motivated trainings;

– Between declaration healthy life style different elements' implementation in physical culture discipline and absence of specially worked out for students training programs. Such programs shall be based on application modern means for student' health improvement. Such programs shall facilitate actual increment of students, practicing healthy life style.

Recent years there have been observed unsubstantiated reduction of time for physical culture and quantity of youth, preferring sports or physical exercises to passive leisure [3, 35, 36, 42]. In this aspect we can mark out several works on the following problems: positive changes in students' personality [16, 17, 34]; HLS personality components in students of different health groups [14, 15, 37]. But some problems of dynamic of HLS personality components' development in students, trained by PC typical program and by specialization are being still unsolved. Besides, it is necessary to seek more effective variants of students' PC training.

The purpose of the work is to substantiate and perfect approaches to development of students' HLS personality components by means of physical culture trainings during three years of heir study.

The tasks of the research:

1. To fulfill comparative analysis of positive changes in HLS personality components of relatively healthy students, who are trained by at 1^{st}-3^{rd} years: a) by typical program (PC specialization); b) by specialization programs (PS (practicing sports) specialization).

2. To fulfill comparative analysis of HLS personality components' changes in relatively healthy students in periods from 2001-2005 and from 2010 to 2015.

Material and methods

Participants: 1^{st} – 3^{rd} year students, trained at physical culture lessons, participated in the research. All students related to main health group (students, having no health problems). For participation in the research we selected students, who actively attended physical culture classes. The students were combined in different groups: 2001–2005 and 2010–2015 years of study. These groups are marked in the following way (below, in brackets there are volumes of samples for groups of 2001–2005 and 2010–2015 accordingly): *1, 2, 3* – RHS (relatively healthy students) 1 (146 and 193 persons), 2 (163 and 83persons), 3 (46 and 50persons), who attended PC typical classes;) *1c, 2c, 3c* – RHS 1 (31persons), 2 (41persons), 3 (50 persons), who attended specialized trainings in 2010–2015.

Organization of the research:

The questioning was conducted in academic groups of 1^{st}-3^{rd} year students at the end of academic year. Questionnaires consisted of personality's main positive characteristics, located in free order. Students assessed (by

scale from 0 to 10 points) the degree of every characteristic in them at the beginning and at the end of study period [19].

Statistical analysis: confidence of differences between values was assessed by Student's t-criterion (at significance level less than 0.05). The differences were interpreted as tendency at significance level more than 0.05, but less than 0.15 (in the table below such cases are marked with *). The received data were processed with the help of Microsoft Excel program.

Results of the research

The main results of students' questioning are given in summarizing table.

Table. Average increment of students' HLS personality componentsT for study period

Personality qualities		Years	Increment of marks +(0 –10) points						Important significant correlations	
			1	*1c*	*2*	*2c*	*3*	*3c*	For every period of years	In dynamic
Positive state	1	2001–2005	0.6		0.6		1.0		`3`>`1`, `2`	`3₁`* > `3₂`
	2	2010–2015	0.2	0.2	0.4	0.3	0.7	0.9	`3, 3c` > (other)	`1₁`>1₂`, `1c`
Tolerance	1	2001–2005	0.2		0.2		0.6		`3`>`1`, `2`	`3₁` > `3c`
	2	2010–2015	0.1	0.0	0.1	0.1	0.4	0.2	`3` > (all, except `3c`)	
Self-confidence	1	2001–2005	0.6	–	0.7	–	1.0	–	`3`>`1`, `2`	`1₁` >`1₂`
	2	2010–2015	0.3	0.5	0.8	0.5	0.7	0.8	`2`,`3`,`3c` > `1` `2` > `2c`*	`3₁` > `3₂`
Activity	1	2001–2005	0.5	–	0.6	–	1.0	–	`3`>`1`, `2`	`3₁`>`3₂`,`3c`
	2	2010–2015	0.4	0.3	0.5	0.4	0.6	0.7	`3c`>`1`,`1c`	
Emotional stability	1	2001–2005	–0.1	–	–0.1	–	0.0	–	`1`= `2`=`3`	`3₁` > `3c`*
	2	2010–2015	–0.2	–0.2	–0.3	–0.3	–0.1	–0.3	`1`= `1c`; `2`=`2c`	

Notes: in the last two columns sign «`» marks the data of average increment of points for personality qualities of appropriate year students. Indices«1» and «2» after main symbol of group mean accordingly 2001–2005» and «2010–2015».

Questioning of 1st-3rd year students about five personality components at the end of academic year showed the following:

1. Students had positive changes of HLS personality components (in both time ranges). For three personality components of all years' students (except emotional stability and tolerance of 1st and 2nd years students) final progress was significantly higher than initial. Final tolerance level of 1st and 2nd year students did not differ significantly from initial. Concerning 3rd year students of PC specialization, their final tolerance was significantly higher than initial (in both time ranges).

2. Positive changes of four HLS personality components (except self-confidence in 2010–2015) in all RHS groups of 1st and 2nd years differ insignificantly (in both time ranges). Positive change of self-confidence in RHS of 2nd year was significantly higher than in RHS of 1st year students. Further, these indicators did not change for students of PC specialization in 2010–2015. For 4 HLS personality components (except emotional stability) increment of personality components in 3rd year PHS of PS specialization (in both time ranges) was much higher than in 1st and 2nd year students. For students of PS specialization such correlation was observed for 3 HLS personality components: positive state, self-confidence and activity.

3. Two HLS personality components (emotional stability and tolerance in respect to other people) in PS specialization students do not change during all period of study. In students of PC specialization emotional stability also does not change during first three years of study. In this category of students significant increment is observed only after 3 years of study (only in growth of self-assessment for tolerance to other people).

4. For specializations PC and PS we did not find significant difference for 4 personality components. Concerning fifth HLS component (self-confidence) in students of PC specialization after 2nd year of study there

appears a tendency of higher assessment of its level. In the aspect of HLS personality components' development PC trainings does not differ from typical classes by effectiveness.

5. Comparing of 2001–2005 and 2010–2015 data points at negative dynamic of HLS personality components development: in 3rd year students – for all qualities of personality; in 1st year students – for positive state and self-confidence. To larger extent it concerns 3rd year students of specialization. It means that recent years training develops HLS personality components of most students less than 10 years ago. Besides, it was found that PC specialized trainings do not have advantages in development of student's personality in this direction.

Discussion

V.M. Rozin especially underlines: "Health can not be formed or built as a building. It can only grow but not without our efforts" [26].

At present time still more intensive application of health related technologies for students' HLS personality indicators prove the relevance of the present research. In this connection it is necessary to actualize solution of problems, hindering development of healthy life style personality components in students' education. Besides, it is necessary to take all measures for improvement of students' health components.

Students shall be offered clear steps to preservation optimal health; to keep positive mood [11]; to control the system of personal values; to creation of personal image, including physical, emotional and intellectual principles of young person's personality; to enrich practical philosophy of health, paying attention to mental and body development [8]. In every physical culture training it is necessary to strengthen students' motivation for healthy life style [28].

It is necessary to pay attention to the fact that physical culture and sports practicing are means of health improvement as well as physical perfection and rational leisure; mean of social activity rising. Such approach substantially influences on other sides of human activity: labor, moral and intellectual qualities.

Indeed, physical culture is one of main kinds of human culture. Its specificity is that this kind is profiled in direction of physical condition's optimization and individual's development in integrity with his/her psychic development. The basis of it are rational and effective usage of own motor functioning in combination with other cultural values [29].

The validity of the received results and approaches to creation of youth's healthy life style foundations is proved by works of other authors:

- About influence of sorts on personality's development [12];
- About morality, culture and youth's to-day's attitude to life problems' solution [4];
- About physical culture, as kind of human activity, specific features [1];
- Setting for creation of youth's healthy life style foundations [25].

Conception of human harmonious development shall also include unity, concordance and proportionality of "out-of-body", intrinsic only to human being qualities (will power, super-will power, morality, aesthetic, intellect) with all these in body and spirit integrity [12]. Modern students spend nearly all their time in virtual reality, where in different social sites they see ideal, handsome bodies of famous and ordinary people [4]. From this it follows that sport is now understood as fashion as compulsory component of healthy life style. As on to day sports have become one of fashionable directions of physical culture. However, it does not influence positively on students' attendance of learning and sport classes in higher educational establishments. Overloading with academic material requires significant strength, nervous and time losses from students. It forces students to neglect physical culture and sports as well as facilitates students' not seeing significance of physical development. In such cases students pay dominant attention to natural and humanitarian sciences. That is why the problem is to over-persuade students. It is necessary to prove that personality's development and directly human activity are impossible without successful physical development and physical fitness.

In context of the present work a relevant task is: formation of vitally important physical and motor qualities; perfection of psychic processes at levels: psycho-motor skills, thinking and imagination. It will be genuine care about youth; their personality's indictors, health and future professional workability.

The statement about possibility of students' character's development and hardening through physical culture and sports' practicing is undoubted. Such active position of sport-practicing and relatively healthy young

people trains muscles and strengthens spirit. Comprehensively developed personality adapts to various modern conditions and successful future professional functioning quicker.

It is important to form attitude to sports [5, 7, and 22] as one of the main and integral values of young people's HLS. It will distract them from various harmful habits [19, 21]. Inculcation of such approach to youth's minds is important just at physical culture classes. [5, 20, 23]. It will result in active mastering personal values of physical culture practicing as well as facilitate practicing fashionable and useful healthy life style [10, 22, and 28].

Conclusions

1. In any variant of physical culture classes personality qualities of young people have tendency to certain development.

2. Correlation of HLS personality components with period of study is not linear. To larger extent their development is observed at first and third years of study. The highest changes of HLS personality components are observed in 3rd year students. These changes do not depend on the program of their training.

3. Trainings by specializations PC and PS influence approximately equally on development of students' HLS personality components.

4. At PC classes it is necessary to pay more attention to development of students' HLS personality components. Especially it concerns emotional stability and tolerance towards other people.

Conflict of interests

The authors declare that there is no conflict of interests.

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MODERN METHODIC OF POWER CARDIO TRAINING IN STUDENTS' PHYSICAL EDUCATION

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Abstract. *Purpose:* significant increase of students' physical condition and health level at the account of application of modern power cardio training methodic. *Material:* 120 students (60 boys and 60 girls) participated in the research. The age of the tested was 19 years. The research took one year. We used methodic of power and functional impact on trainees' organism (HOT IRON). Such methodic is some systems of physical exercises with weights (mini-barbells), to be fulfilled under accompaniment of specially selected music. *Results:* we showed advantages of power-cardio and fitness trainings in students' health improvement and in elimination obesity. Control tests showed experimental group students achieved confidently higher physical indicators. Boys demonstrated increase of physical strength and general endurance indicators. Girls had confidently better indicators of physical strength, flexibility and general endurance. Increase of control group students' body mass can be explained by students' insufficient physical activity at trainings, conducted as per traditional program. *Conclusions:* students' trainings by power-cardio methodic with application HOT IRON exercises facilitate development the following physical qualities: strength and endurance in boys and strength, flexibility and endurance in girls. Besides, it was found that such systems of exercises facilitate normalization of boys' body mass and correction of girls' constitution.

Key words: health, physical condition, students, physical education, power-cardio training, HOT IRON.

Introduction

Recent years there has been observed negative tendency to noticeable worsening of modern young people: students' and pupils' physical condition and health [11, 30]. K. Hardman in his works expresses serious trouble about significant falling of students' physical health standards and growth of obesity in developed European countries and developing countries of Africa and Asia [12, 13]. It was found that young people's excessive involvement in internet activity and computer games was a serious threat to their physical and psychic health [22-24]. For correction of this negative situation scientists recommend to raise everyday level of young people's physical functioning. However, specialists note that physical functioning level of most of young people does not correspond to optimal parameters. As per the data of D. Basset most of USA youth do not realize the recommended 60 minutes a day of physical functioning [4]. It is also noted that youth of Russian Federation has insufficient level of motor functioning [30]. In this connection it is necessary to introduce substantial changes in acting to day physical education programs for youth in educational establishments. In opinion of M. Chin, attitude to pedagogic aspects of physical education teaching in modern schools and universities shall be significantly re-thought for liquidation of global threats to health of our planet population – excessive weight and deficit of every day motor functioning [9].

The studies, conducted in a number of Norwegian universities witness that in the process of students' physical education it is necessary to use methodic, which would motivate young people for active participation in working out training programs, choosing form of classes and selecting physical exercises [1]. P. Sabramaniam also says about importance of development of students' interest to physical culture practicing. In his opinion students' interest to trainings can be noticeably increased at the account of changes of some aspects of young people's educational medium [34]. In general demand in substantial increase of students' motivation for regularly and active physical culture and sports practicing is discussed by many specialists [5, 21, 32, 33]. Chinese scientists L. Song

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and J. Chen note the absence of any interest to physical exercises in national HEEs students. It is connected with deficit of management and absence of encourage from physical education teachers [364]. Negative attitude to existing academic physical culture programs is demonstrated also by many American students [10].

The key to this problem's solution can be changes in physical education programs for students. Besides, it is necessary to raise the quality of young people's training. Rather important are modern training methodic, permitting for teachers to use new effective forms and methods of physical education in educational process. Scientists throughout the world discuss new styles of teaching in higher educational establishments [2, 3, 14-16]. The authors note that new styles of teaching permit for a student to actively participate in educational process and achieve the set targets with high effectiveness.

Specialists also note the absence of students' right for choosing the most favorable training programs in many higher educational establishments [37]. General orientation of physical education programs in higher educational establishments of Russian Federation, built on strict regulation of academic material is very serious pedagogic problem. Such orientation of physical education means and forms seriously restricts development of students' personal physical culture. It does not facilitate formation of their active interest to regular practicing physical culture and sports.

The demand in creation effective system of students' involvement in regular physical activity and healthy life style is pointed at by many scientists: A. Bolotin [6], Yu. Kopylov [18], A. Osipov [30, 31], M. Kudryavtsev [25, 26], I. Kramida [23], S. Iermakov [19, 20, 22, 27] et al. Modern fitness-technologies [35] and programs, based on power-cardio training can facilitate achievement of this target. It was found that significant part of modern youth desires to practice physical functioning. Such functioning includes dances, fitness-aerobic, power training in gyms. M. Byra affirms that active fitness-methodic can be successfully applied by HEE teachers in different forma of students' training [7]. Success of fitness-programs' application in students' health improvement is proved by studies of W. Chen [8]. Success of power-cardio programs' application in students' health improvement is proved by L. Konovalova [17].

Hypothesis: it is assumed that for successful solution of students' physical condition, physical fitness and health worsening it is necessary to change the form and methodic of physical culture classes in HEEs. It is offered to use methodic of power and functional training, known as HOT IRON. This methodic is a system of training exercises with mini barbells, oriented on increase of students' power endurance. The main exercises are: lunges with barbell on shoulders; squats with barbell; bench press of barbell, fulfilled under accompaniment of specially selected music. Positive effect of HOT IRON trainings are: reliable correction of body figure, loosing weight, growth of muscular tissues. Many scientists note that improvement of appearance (athletic body constitution, harmonious muscles and physical attractiveness) is an important stimulus for young people's regular trainings. This fact permits to use HOT IRON methodic in mixed and separate groups. It is known HOT IRON trainings can be practiced only with instructor\, who was trained in special centers and received appropriate certificate. That is why most of HOT IRON trainings are practiced in private fitness-centers, but not in educational establishments [29]. Therefore, HOT IRON application in education establishments is a kind of scientific novelty.

The purpose of the research: is significant increase of students' physical condition and health level at the account of application of modern power cardio training methodic.

Material and methods

Participants: 120 students (60 boys and 60 girls) participated in the research. The age of the tested was 19 years. All students gave consent for their participation in experiment.

Organization of the research: the researches were conducted in 2014-2015. The researches lasted one year. In training of experimental groups the author used methodic of power-cardio training on the base of HOT IRON program. The trainings were conducted by qualified instructors, who were trained in specialized HOT IRON centers. This fact guaranteed high quality of students' trainings. At the beginning of the research all students passed medical examination in university polyclinic and were admitted for physical trainings without any limitations. After it the tested were divided into 2 control groups (1st boys group and 3rd – girls' group) and 2 experimental groups (2nd – boys group and 4th- girls' group).

Control groups were trained on the base of sport and outdoor games. They were trained in gym. Experimental groups were trained as per HOT IRON programs under accompaniment of special music (power

exercises with weight). At the beginning and at the end of the researches all students passed a number of control tests for assessment their physical condition and physical fitness. Strength was estimated by quantity of chin ups on horizontal bar (for boys) and quantity of pressing ups in lying position (for girls). Endurance was assessed by Cooper's test – running the most possible distance for 12 minutes. Flexibility was assessed by forward bending from position standing on pedestal< on which there were marks for measurements. Students fulfilled forward bent with straightened legs, touching the pedestal by hands fingers. !00 meters' run was used for assessment quickness.

Statistical analysis: was fulfilled with the help of SPSS program. Difference between mean values was found with Student's t-criterion.

Results

At the beginning of the research test results did not show any confident differences between experimental and control groups' students. At the end of experiment boys of experimental group were confidently far ahead of his peers from control group in strength (P<0.01) and endurance (P<0.05). Besides, difference in body mass values was also found. Body mass of experimental groups' students practically did not change. Body weight of control groups' students confidently increased (P<0.05). Results of boys' control tests are given in table 1.

Table 1. Physical condition and physical fitness indicators of the tested boys

Physical qualities	Before experiment		After experiment	
	Control group	Experimental group	Control group	Experimental group
Strength (chin ups, q-ty of times)	9±3	8±4	10±3	15±2**
Flexibility (forward bents, cm)	4±2	5±2	5±2	6±2
Quickness (100 meters' run, sec.)	13±4	14±4	13±2	12±4
Endurance (Cooper's test, km)	2.3 ±0.4	2.2±0.3	2.2±0.2	2.5±0.4*
Body mass, kg	72±4	73±3	77±4*	72±4

Notes: * - P<0.05; ** - P<0.01.

At the end of experiment girls of experimental group were confidently far ahead of his peers from control group in strength (P<0.01), flexibility (P<0.01) and endurance (P<0.05). Body mass of experimental group's girls confidently reduced (P<0.05). In control group the girls' body weight increased (P<0.05). The girls' control tests results are given in table 2.

Table 2. Physical condition and physical fitness indicators of the tested girls

Physical qualities	Before experiment		After experiment	
	Control group	Experimental group	Control group	Experimental group
Strength (chin ups, q-ty of times)	12±2	11±2	14±2	24±3**
Flexibility (forward bents, cm)	9±3	10±2	10±3	15±4**
Quickness (100 meters' run, sec.)	16±2	17±3	15±3	14±2
Endurance (Cooper's test, km)	1.8±0.4	1.9±0.4	2.0±0.3	2.3 ±0.4*
Body mass, kg	55±3	56±2	58±3*	53±2*

Notes: * - P<0.05; ** - P<0.01.

Discussion

The received data are interesting because they permit to objectively assess different programs of students' physical education. The results of the experiment coincide with the data of other studies [18, 24, 35]. The trainings by HOT IRON methodic demonstrate significant increment of students' physical strength and endurance. Increment of these indicators took place both in girls and boys. It permits to recommend such methodic for mixed contingent of trainees. Trainings based on traditional physical education programs (general physical training, sport and mobile games) do not permit to achieve significant results in training of physical qualities.

We registered disturbing tendency of body mass increase in control groups' students. The increase was in average from 3 to 4 kg. This tendency permits for the authors to agree with specialists' conclusions about insufficient effectiveness of the existing standard physical education programs for students [4, 9, 12, 36]. At classes

conducted by HOT IRON methodic demonstrate preservation of body mass at previous level or its reduction within body figure correction. It permits for the authors to agree with statements of other specialists about advantages of power-cardio and fitness training in students' health protection and obesity liquidation. Students' body mass increase in control groups can be explained by insufficient physical functioning of young people on physical culture trainings, conducted by traditional program.

Specialists note that students' technical fitness in sport games is insufficient. Teachers have to spend a lot of time for training of the simplest technical elements instead of sport perfection and increase of trainees' game experience [11, 24, 28]. That is why motor density of such trainings remains to be low and students' motor functioning – insufficient.

Conclusions

The research permits to make the following conclusions:

1. Analysis of scientific data witnesses about substantial decrease of physical condition, physical fitness and health of most of modern young people. The sharpest threat, as considered by specialists, is deficit of youth's everyday motor functioning. The reasons of low physical functioning are: deficit of youth's motivation for regular practicing of physical exercises and absence of interest to acting in HEEs physical education programs.
2. For substantial increase of students' motivation for regular physical culture trainings at HEEs specialists recommend to apply new, effective forms and methods of physical education. Such methods can include students' physical culture trainings, based on power-cardio training. Successfulness of different fitness programs' application in students' health improvement is proved by domestic and foreign specialists.
3. For solution the problem of students' bad physical condition and health the author recommends to use HOT IRON exercises system at physical culture lessons in HEEs.

Conflict of interests

The author declares that there is no conflict of interests.

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PHYSICAL WORKABILITY AS THE BASE OF STUDENTS' FUNCTIONAL POTENTIALS

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Abstract. *Purpose:* to assess the level of students' physical workability and find its connection with physical fitness. *Material:* we tested 150 students (86 girls and 64 boys) of 17-19 years' age. All students were in main health group. The students fulfilled test on stationary bicycle. The complex of tests for physical fitness was used. *Results:* it was found that boys' physical workability results were better than girls'. Analysis of correlation matrix showed that physical workability parameters had close correlations with physical workability. Exception was only some pedagogic tests for explosive power of arms and torso as well as flexibility. *Conclusions:* physical workability indicators were within age and gender standards. Analysis of correlations showed that physical workability parameters substantially influence on results of control tests for physical fitness.
Key words: physical, workability, fitness, functional, testing, students, correlation.

Introduction

It was found that physical workability indicators are the base of functional potentials. Physical workability is an integral indicator, which permits to determine coordinated work of organism's organs and systems, health state, physical condition and functional state of human organism [2, 5]. It is known that physical workability depends on a number of factors, which determine and limit it. Demand in determination of the so-called dynamic health is also paid attention to [1].

In pedagogic researches the main source of information about functional potentials is different test batteries for physical fitness. The same situation exists in physical education process in different educational establishments. In physical education control exercises for physical fitness are used as main criterion of students' functional potentials [11, 12]. When creating factorial structure of girl-students (17-18, 18-19, and 19-20 years' age) functional potentials it is necessary to consider the following indicators: physical condition, physical fitness, physical workability, energy level, cardio-vascular system's condition, effectiveness of cardio functioning regulation and central nervous system [4]. Cardio vascular system's functioning influences on general endurance, speed-power abilities and coordination [15].

In other works it was noted:

- Determination of dynamic of students' somatic health, physical condition, physical and mental workability changes under impact of comprehensive school load [29];
- Substantiation of basketball and volleyball health related influence on functional state of first year students' visual analyzer in period of their adaptation to learning loads. Application of visual trainings at physical education classes permits to improve visual analyzer's indicators [18];
- Control of physical functioning in out-of-class time and at curriculum lessons [24];
- Purposefulness of fitness-yoga for strengthening of psycho-physical and psycho-social state of special health group girl-students at physical culture recreational and training classes [31];
- Raising of schoolchildren's motor fitness through pedagogic control t physical culture lessons [21, 28];
- Weakening of harmful habits' influence on students' workability 25, 26];
- Increase of students' mental workability [20, 27];
- Consideration of perceived tension under game loads [23].

The authors note that:

- Physical workability dynamic depends on period of week and terms of students' studying at educational establishments [30];
- The most important factors in complex fitness of physical rehabilitation group students are power and functional potentials [32];
- Application of modified variant of Harvard step-test permits to completely assess functional potentials of

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students with deviations in their health [22];

– Application of oriental gymnastics increase students' physical workability [19].

By completeness of information physical fitness indicators yield the data of physical workability. Especially it concerns the data, received with the help of modern functional tests. However, pedagogic control exercises inform about condition of certain physical qualities.

Physical fitness and physical workability complex study [5] permits to wider assess functioning of children and youth's organisms. In physical culture lessons at educational establishments the received data will permit for teacher and instructor to control educational process at higher quality as well as to have more exact information about pupils/students' physical condition.

For better understanding the structure and correlations of functional potentials' parameters it is necessary to fulfill comparative analysis. When realizing pair correlation it is possible to analyze inter-influence of separate components within certain structure.

The purpose of the work is to assess 17-19 years' age students' physical workability within physical education process and determine its interconnection with physical fitness.

Material and methods

Participants: we tested 150 students (86 girls and 64 boys) of 17-19 years' age. All students were in main health group.

Procedure: for determination of physical workability we used methodic by D.N. Davidenko et al [5]. The students fulfilled test on stationary bicycle (60 rpm $^{-1}$). Load intensity changed with permanent speed (200 kg.m.min $^{-1}$) by closed cycle: first – from zero to heart beats rate (HBR) 153-155 bpm^{-1} (the moment of reverse); then at the same speed it reduced to zero (see fig.1). For this methodic modern software was created [2], which permitted to quicker receive the required information.

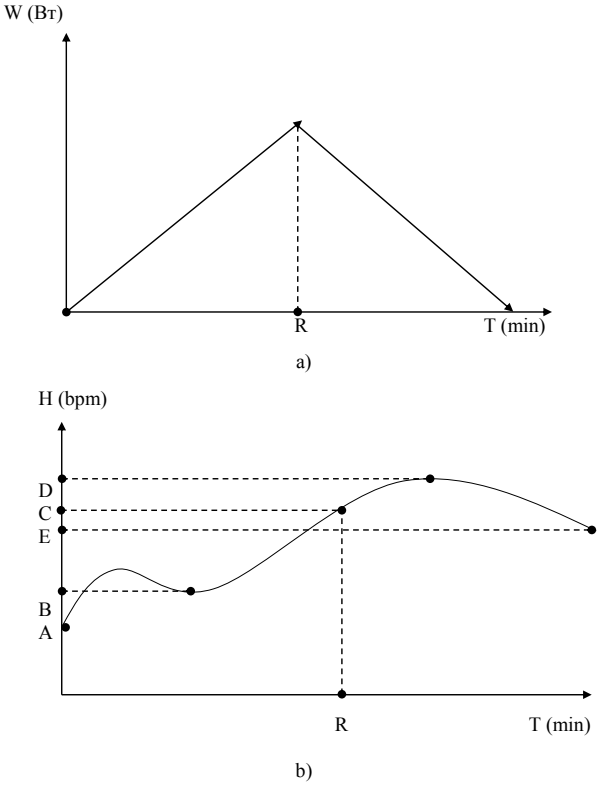

Fig.1. Dynamic of stationary bicycle load (upper part of figure) and heart beats rate changes during test (lower part of figure): W – power of load; R – power of load at reverse; T – time of testing; H – heart beats rate (HBR); A – initial HBR; B – threshold HBR; C – reverse HBR; D – maximal HBR; E – HBR of coming out of load.

The testing was conducted in the following way:

- Sensors of pulse were fixed on student's body;
- Student took seat on stationary bicycle and adapted to appropriate conditions during several minutes;
- Student started to fulfill test according to methodic;
- After test student was on stationary bicycle 1 minute more for recreation.

In the process of testing correlation of heart beats rate and physical load's power were registered in the form of hysteretic loop. Hysteretic loop reflects organism's systemic adaptation to physical load (see fig.2).

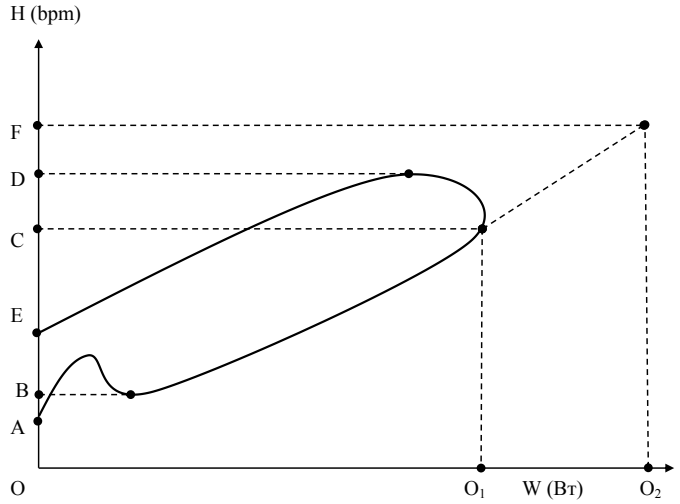

Fig.2. Dynamic of heart beats rate in functional testing: H – heart beats rate (HBR); W – power of load; A – initial HBR; B – threshold HBR; C – reverse HBR; D – maximal HBR; E – HBR of coming out of load. F –HBR=170 bpm^{-1}.

The methodic permits to assess the components of systemic organism's reaction: functions tension under load test; energy and regulatory components of systemic organism's reaction; general physical workability (see table 1).

Table 1. Indicators of physical workability

Indicators	**Description of indicators**
T_{tot}, sec.	Period of work during testing
W_{rev}, Watt	Physical workability at HBR = 153-155 bpm^{-1} (the moment of load reverse). To be determined by segment O-O_1 in fig.2.
A_{tot}, kJ	Scope of work during testing. To be determined by formula: $A_{tot} = W_{rev} \bullet T_{gen}/2$.
PWC_{170}, Watt	Level of physical workability at HBR = 170 bpm^{-1}. To be determined by segment O-O_1 in fig.2.

Test battery for functional fitness included the following control exercises: 30 meters' run; 60 meters' run; 1000 meters' run; shuttle run (4×9 m); long jump from the spot; high jump from the spot; triple jump from the spot; legs' raising during 30 sec. lying on back; throw of filled ball from sitting position (ball mass – 1 kg); pressing ups; torso bending from sitting position with feet apart.

Statistical analysis: experimental data were processed with statistical programs SPSS 16. For every studied parameter we determined mean arithmetic (M), error of mean arithmetic (m). In our work we used correlation (by Pearson) analysis. The confidence of the received results was checked by application of standard diagnostic methodic (Student's t-criterion).

Results of the research

In our research we received the following data (see table 2).

Total time of work fulfillment (T_{tot}) of girl students was 442±13.6 sec., of boy students – 535.05±14.1 sec. Average difference between them was 93.4 sec. Scope of fulfilled work (A_{tot}) in girls' group was within 18.4±0.4 kJ, and boys'– 27.9±0.5 kJ. The distinctions of the received results was confident at $p < 0.001$ and was within 9.5 kJ.

It should be noted that determination of PWC_{170} indicators by the offered methodic is the most accurate. When predicting this indicator, we used great number of points on graph. Other methods are less confident. For example, determination of PWC_{170} with the help of one-moment and two-moment functional tests [9].

Table 2. Indicators of 17-19 years' age students (M±m)

Indicators	Girls (n=86)	Boys (n=64)
T_{tot}, sec.	442.1±13.6	535.5±14.1**
A_{tot}, kJ	18.4±0.4	27.9±0.5**
PWC_{170}, W	109.2±4.4	152.1±4.9**
PWC_{170}/kg, BW•kg^{-1}	1.64±0.08	1.85±0.09
W_{rev}, W	82.4±2.5	109.1±3.2**
MOC, ml•min^{-1}	2348.6±67	3069.7±81**
MOC, ml•min^{-1}. kg^{-1}	35.2±1.1	38.6±1.4*

Notes: * – $p < 0.05$; ** – $p < 0.01$; T_{tot} – total time of work fulfillment; A_{tot} – total scope of fulfilled work; W_{rev} – load power at the moment of reverse; MOC – maximal oxygen consumption.

PWC_{170} indicator of girl-students-beginners was 109.2±4.4 W and boy students – by 42.9 W more (152.1±4.9 W). According to the offered in literature physical workability standards [9] the received data in the whole corresponded to average level. After recalculation of PWC_{170} indicator on 1 kg of body mass we can see that in girls it was less (1.64±0.08 W.kg^{-1}) comparing with boys (1.85±0.09 W•kg^{-1}). However, the difference between them was unconfident. Load power at the moment of reverse (W_{rev}): the data of girls were 82.4±2.5 W and boys – 109.1±3.2; difference was within 26.7 W (practically at level of standard deviation in both groups).

The leading indicator of physical workability is maximal oxygen consumption (MOC), which is determined by efficiency of cardio-respiratory system. PWC_{170} value and MOC level determine human physical workability. However, these indicators are directly interconnected. V.L. Karpman et al. [9] determined this connection by formula:

For not-trained:

$$MOC = 1.7 \bullet PWC_{170} + 1240, \text{ if } PWC170 < 900 \text{ kg•m•min}^{-1};$$

For trained:

$$MOC = 2.2 \bullet PWC_{170} + 1070, \text{ if } PWC170 \geq 900 \text{ kg•m•min}^{-1}.$$

The calculated MOC values have error up to ±15% from MOC value, received by direct method.

When fulfilling muscular work the girl-students' MOC was 2348.6±67 ml•min$^{-1.}$ The boys' MOC was 3069.7±81 ml•min^{-1}. Relative MOC indicators and relative PWC_{170} values were at lower border of norm 9].

The data of physical fitness and physical workability correlation analysis are given in table 3.

Correlation analysis permitted to find numerous direct and reverse correlations between appropriate groups of indicators. For example in first years' students we found significant reverse correlations between most

of physical workability parameters, such as: total time of work (T_{tot}), power of load at the moment of reverse W_{rev}), PWC_{170}, PWC_{170}/kg; total scope of fulfilled work (A_{tot})) and run tests, which give information about the whole spectrum of motor abilities (speed and speed-power qualities, dexterity, general endurance). We found weak negative correlation, first of all with short distances run (r = -0.22÷-0.44), moderate strength of correlations (r = -0.5÷-0.69) mainly with 1000meters' run and shuttle run (4×9 m), except some cases, where weak correlation prevailed (PWC_{170} – 'shuttle run (4×9m)" (r = -0.35), PWC_{170} – "1000 meters' run" (r = -0.44), PWC_{170}/kg – "1000 meters' run" (r = -0.38)) and strong correlation between control exercise for endurance and total scope of fulfilled work (r = -0.72).

Table 3. Correlation between physical workability and physical fitness indicators of 17-19 years' age students (n=150)

Indicators	**T_{tot}, c**	**W_{prev}, W**	**PWC_{170}, W**	**$PWC_{170/kg}$, $W \bullet kg^{-1}$**	**A_{tot}, kJ**
30 meters' run	-03*	-0.26*	-	-0.36*	-0.39*
30 meters' run (from running), sec.	-	-0.24*	-	-0.22*	-
60 meters' run, sec.	-0.41**	-0.33*	-0.32*	-0.39**	-0.44**
Forward torso bending, in sitting position with feet apart, cm.	-	-	-	0.24*	-
Pressing ups in lying position, q-ty of times	0.48**	0.42**	0.39**	0.49**	0.57**
Legs' raising during 30 sec., q-ty of times	0.36**	0.31*	0.28*	-	0.39**
Long jump from the spot, cm	0.54**	0.45**	0.39**	-	0.59**
High jump from the spot, cm	0.44**	0.41**	0.35**	0.38**	0.45**
Triple jump from the spot, cm	0.66**	0.54**	0.48**	0.31*	0.69**
Throw of filled ball, cm	0.22*	-	-	-0.29*	-
Shuttle run (4×9 m), sec.	-0.58**	-0.5**	-0.35**	-	-0.63**
1000 meters' run, min., sec.	-0.69**	-0.52**	-0.44**	-0.38**	-0.72**

Notes: * – $p<0.05$; ** – $p<0.01$, confident correlation

Practically all parameters of physical workability had confident positive influence (r = 0.31÷0.69) on results of jump exercises. Exception was relative level of physical workability and long jump from the spot.

Much worse was influence of physical workability on results of pedagogic tests, which informed about backbone flexibility and about explosive power of arms and torso. It was witnessed by little quantity of weak correlations (1-2).

Discussion

In the sphere of physical culture and sports for monitoring students' physical workability there are widely used one-moment, two-moment and functional tests. Besides, methods of physical workability quantitative assessmentB were often used. Among them Ruffiet's test, Harvard step-test and test PWC_{170} are the most frequent [1, 4, 9]. However, the received by the mentioned above tests results give little information. The main reasons of it are: inaccuracy in receiving results; inaccuracy of approaches to finding appropriate indicators; they do not consider age changes in organisms of children and youth. Such researches were also accompanied by the absence of single approach and contradiction character of results. It is proved by our research. Some data confidently differ and exceed the compared figures nearly twice. The range of physical workability fluctuations is so wide that their practical usage is possible only with significance caution.

In our opinion method of physical workability testing with the help of physical load by closed cycle [5] complies with the most of known requirements. On the base of the received physical workability results we can assess health state as well as to correct physical education process in higher educational establishments.

This methodic did not get widespread use and was applied only in single studies of elite sportsmen functional reserves [5, 7]. Besides, it was implemented in physical education process of primary schools and some other educational establishments [12]. In available literature there are no complex studies of students' functional potentials, considering physical workability and physical fitness.

The received results of PWC_{170} and MOC are in good agreement with results of other researches [9]. It is worth to pay attention to the fact that fundamental researches of different age people's physical workability (including students) were conducted about 30 years ago. That is why fulfillment of mass studies for receiving up to date PWC model characteristics and other parameters is rather relevant. The presented new parameters of physical workability (T_{tot}, A_{tot}, W_{rev}) provide quite real opportunities to have widespread use in practice alongside with more known indicators of MOC, PWC_{150}, PWC_{170}. It proves relevance and promising potential of further researches.

Conclusions

Physical workability indicators were within age standards. These indicators were predicted better in boys than in girls. In most cases differences of the mentioned parameters between students by sex were confident.

Analysis of correlations showed that physical workability indicators substantially influence on physical fitness. The most intensively results of control exercises were influenced on (exercises, which assessed endurance, dexterity and legs' explosive power). It is expressed in maximal quantity of significant correlations and their strength. Physical workability moderately correlates with tests for speed power qualities at the account of weak correlation strength. Physical workability practically did not influence on development of flexibility and arms and torso explosive power. In total we registered only 3 significant weak correlations.

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Conflict of interests

The author declares that there is no conflict of interests.

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INVESTIGATION OF EGO AND TASK ORIENTATION AMONG INTERNATIONAL WRESTLING REFEREES

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Abstract. *Aim:* study was to investigate any possible effect(s) of experiences from active membership and participation in task or ego orientations among referees in the sport of wrestling. *Material:* The sample consisted of 213 international referees from 30 countries (Greece, Turkey, Bulgaria, France, Italy, Germany, Sweden, Finland, Switzerland, Russia, Poland, Hungary, U.S.A, Ukraine, Armenia, Azerbaijan, Iran, Japan, Korea, Mongolia, Kazakhstan, Egypt, Canada, Georgia, Croatia, Uzbekistan, Norway, Cuba, Belarus, & Tunisia). Their age ranged from 26 to 60 yrs. old (*M*=43, *SD*=8.6). During the procedure, the participants were asked to fill a specific questionnaire, the «Task and Ego Orientation in Sport Questionnaire» (Duda & Nicholls, 1992). Results: Results showed that the referees from elite wrestling level' countries (Russia, Azerbaijan, Iran, Turkey, Georgia, Armenia, Bulgaria, Ukraine, U.S.A., Korea, Japan, Kazakhstan, & Cuba) are more task oriented than those from the non-elite wrestling level' countries. Researchers believe that this occurred because referees from non-elite wrestling level' countries might have less game-sport experience and more specifically in high level games. At the same time, the Olympic experience referees were more task oriented than the non-Olympic experienced. *Conclusion:* Referee's decisions are an important issue in the sport milieu. The investigations in decision-making by referees and factors that affect it are rather scarce and research should focus on such topics. Improvement of decision-making by referees, would lead to safer and better performance. Thus, better understanding of referees' behavior, through identification and operationalization of the factors affecting it, might lead to more effective selection, training and performance.
Key words: task orientations, referees, decision-making, wrestling.

Introduction

One of the factors which could assist in better comprehending referees' decisions is achievement orientation. In achievement motivation in sport, goals have been perceived as being related to the way individuals believe, feel or regulate their abilities [1, 8, 11-13]. Nicholls [14] claimed that goal orientation is related to a number of attitudes, convictions and values. In his theory he postulated the existence of two main goal orientations, task and ego, which are independent of each other but differ among individuals and across environments. Research has showed that a person with an ego orientation is more likely to approve improper sport behaviors and accept athletic aggression, while this does not hold true for persons with task orientation [5, 6]. Individuals with task orientation are more likely to choose moral than non-moral values when there is a conflict [4, 5] and to respect social conventions, personal commitment, the rules and officials [7].

Cross-sectional studies in the USA [3] and Greece [16] have indicated positive relationship between participation in sport and goal orientations, but it is still unclear whether this is the cause or effect of youngsters' involvement in sport. According to social learning theory [2], participation in sport is expected to cultivate youngsters' goals to further improve and demonstrate their sport abilities. Hence, the positive relationship between goal orientations and participation in sport, found in cross-sectional studies, could be ascribed to social learning effects of sport involvement on goal orientations, rather than the opposite. In addition, given the different opinions about the role of ego orientation in sport achievement [4, 9], the interactive effects of task and ego orientation should be also reported. One could possibly assume that the positive effects of task orientation on sport involvement are even stronger when they are accompanied by high ego orientation but they are undermined when

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they are joined by low ego orientation [9], although some authors suggest that ego orientation has no benefits in youth sports [10].

Internationally minimal attempts were made in order to investigate any relations between goal orientation and any sport officials. As a result of that, the significant aspect of this study is the first attempt to investigate levels of goal orientation among international wrestling referees.

Hypothesis: The task orientations among international referees of wrestling depend on the development of the struggle in a particular country.

Aim: the study was to investigate any possible effect(s) of experiences from active membership and participation in task or ego orientations among referees in the sport of wrestling.

Materials and Methods

Participants

The sample consisted of 213 international referees from 30 countries (Greece, Turkey, Bulgaria, France, Italy, Germany, Sweden, Finland, Switzerland, Russia, Poland, Hungary, U.S.A, Ukraine, Armenia, Azerbaijan, Iran, Japan, Korea, Mongolia, Kazakhstan, Egypt, Canada, Georgia, Croatia, Uzbekistan, Norway, Cuba, Belarus, & Tunisia). Their age ranged from 26 to 60 yrs. old (M=43, SD=8.6).

Research Design

During the procedure, the participants were asked to fill a specific questionnaire, the "Task and Ego Orientation in Sport Questionnaire" (Duda & Nicholls, 1992). This questionnaire was translated into Greek with the use of the back-translation technique [15]. Apart from, this questionnaire was adapted from to Greek mentality and modified for referees [17]. There are two independent scales related to either Task or Ego Orientation. In its present form, each statement begins with "I feel more successful as a referee when …" followed by 13 different endings. For example, the endings related to Task Orientation include "I learn to apply the rules correctly", "something I learn makes me want to referee even more", "learn something that helps me referee better by trying harder", "try really hard to referee well". For Ego Orientation, examples are "I am the only one who can referee a hard game", "I can do better than other referees", " other referees cannot do as well as I can", "other referees mess up while I do not", "my decisions are better than those of other referees". The respondent was asked to indicate how much he agreed with each of the 13 statements (7 of which relate to Task Orientation and 6 to Ego). Responses are given on a 5-point Likert scale with anchors of 5: strongly agree and 1: strongly disagree.

Statistical Analysis

Statistical analysis was performed with the help of programming package Statgraphics 5.1 (Manugistics, Inc.). The methods of parametric statistics of t-criterion of Student were applied.

Results

The results showed that using the Cronbach's coefficient α internal consistency for "Task" was .80 and for "Ego" .84.

Although the analyses revealed no statistical significant differences among the sample, crosstabs indicated significant results. More specifically, the sample divided into 2 groups. Group 1, referees of Elite wrestling level' countries (N=70), and Group 2, Non-elite (N=40). Results showed that the referees from Elite wrestling level' countries (Russia, Azerbaijan, Iran, Turkey, Georgia, Armenia, Bulgaria, Ukraine, U.S.A., Korea, Japan, Kazakhstan, & Cuba) are more task oriented, than those from Non-elite wrestling level' countries. Researchers believe that this occurred because referees from non-elite wrestling level' countries might have less game-sport experience and more specifically in high level games (Fig. 1).

Also, the sample divided into 3 groups, according to their referring experience. Group 1 was referees with experience up to 11 yrs. (N=33), Group 2 from 12 up to 19 yrs. (N=34), and Group 3 from 20 yrs. and on (N=43). The results showed that referees with more experience are more Task oriented than the other 2 groups. Researchers believe that referees with more yrs. of experience are more into the "personal commitment" idea than less experienced ones (Figure 2).

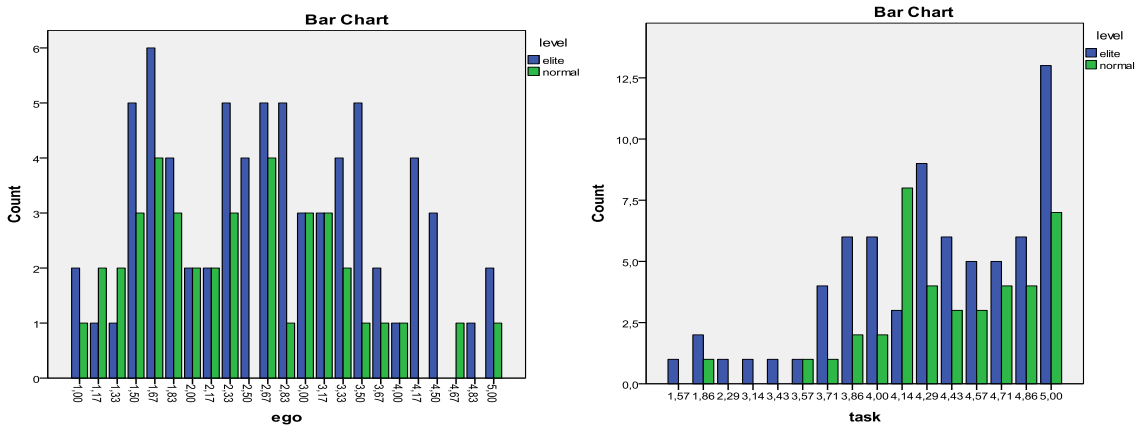

Figure 1. Elite and non-elite referees.

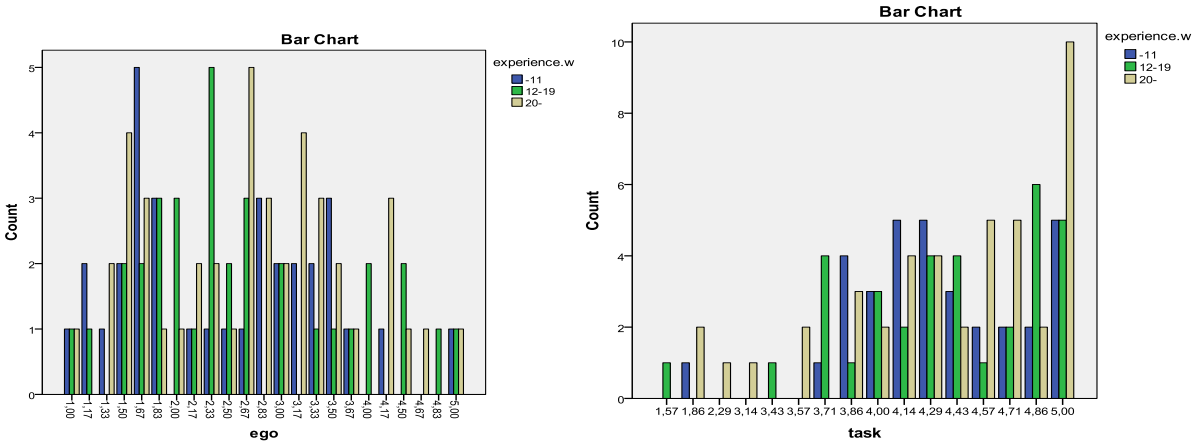

Figure 2. Levels of experience.

Finally, the sample divided into 2 groups according their Olympic Games' experience. Group 1, the Olympic referees (N=32), and Group 2 the Non-Olympic (N=78). The results showed that the Olympic experience referees were more Task oriented than the Non-Olympic experienced. These results are consistent with the previous ones (Figure 3).

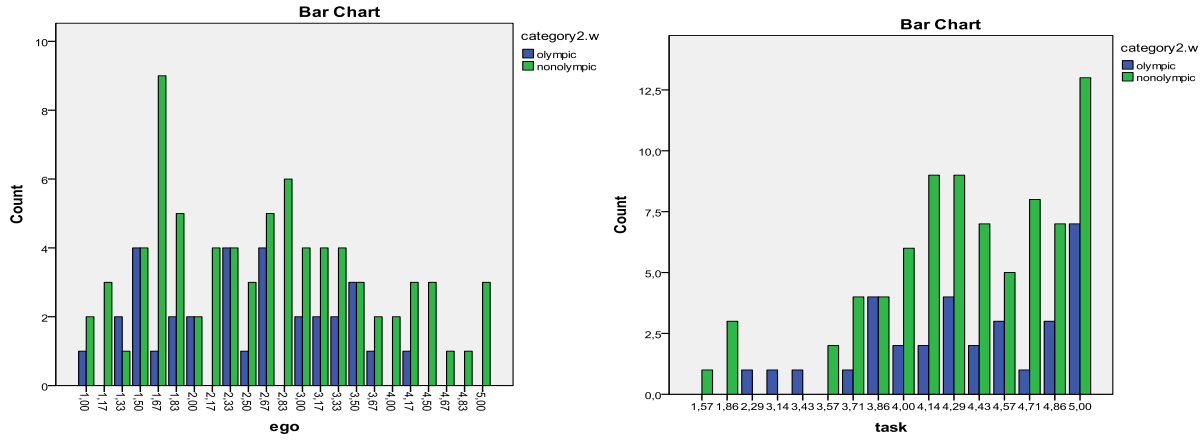

Figure 3. Olympic and Non-Olympic experience referees.

Discussion

The results of this study support the positive role of perceived athletic competence, task orientation and intrinsic motivation in sport and exercise involvement. Further studies examining the mediator variables between sport and exercise involvement and task orientation, perceived competence and intrinsic motivation are called for [8, 12, 13]. It is important to understand the self regulation strategies trigger port and exercise behaviour [2, 4, 5]. Referee's decisions are an important issue in the sport milieu [3, 16]. The investigations in decision-making by referees and factors that affect it are rather scarce and research should focus on such topics. Improvement of decision-making by referees, would lead to safer and better performance [10,14]. Finally, a better understanding of referees' behavior, through identification and operationalization of the factors affecting it, might lead to more effective selection, training and performance.

Finally, the causal relationship of sport and exercise involvement with goal orientations, perceived competence and intrinsic motivation must be investigated in different cultures to determine whether these social-cognitive variables have universal importance. Future research should be focused on comparison between referees (i.e. background difference, level difference, stress & anxiety, attention, self-confidence) on different exercise levels and settings.

Conclusions

Referee's decisions are an important issue in the sport milieu. The investigations in decision-making by referees and factors that affect it are rather scarce and research should focus on such topics. Improvement of decision-making by referees, would lead to safer and better performance. Thus, better understanding of referees' behavior, through identification and operationalization of the factors affecting it, might lead to more effective selection, training and performance.

Conflict of interests

The authors declare that there is no conflict of interests.

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ACADEMIC YOUTH'S HEALTH BEHAVIOR

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Abstract. *Introduction:* A very important role in the protection of human health is their life style, their habits and patterns of conduct. Early adulthood is the best period to achieve long-term benefits from a selection of healthy living. However, the results of studies on health-related behavior of youth in Poland and in the world are not satisfactory. *The purpose of the study:* The purpose of the research was to assess the health behaviors of students of higher education in Bydgoszcz. *Material and methods:* The study involved 272 students (124 women and 148 men) Bydgoszcz higher education students in the following fields of study: physiotherapy, nutrition, logistics and national security. The Inventory of Health-Related Behavior by Zygfryd Juczyński has been used in the research. The statistical analysis was performed using the package PQ Stat 1.6.2. *Results***:** Throughout the treatment group an average level of health-related behavior has been shown. The results of the different categories of health-related behavior were lower than the results of the standardization groups. A higher level of health behavior has been shown in a group of medical students compared to non-medical students. The results for women were higher than men's results. *Conclusions:* The results of personal research and the research findings of other authors demonstrate that there is a need for implementation of programs of health promotion and health education in all fields of study.
Keywords: health behavior, health, lifestyle, health promotion, academic youth.

Introduction

According to the World Health Organization (WHO) "Health is a state of complete well-being physical, mental and social welfare, and an individual or a group must be able to identify and pursue their aspirations, needs, as well as the environment changes, or to deal with it. That's why health is seen as a vital resource, and not the purpose of life. Health is a positive concept, including personal and social resources and physical capacity, and not just the absence of disease or disability "[1]. A very important role in human health protection is played by lifestyle, habits and patterns of conduct. They take the form of healthy factors that improve health status and also the anti-health factors affecting health [2].

The age of the young men and early adulthood is the best period for the achievement of the long-term benefits of choosing a healthy lifestyle. However, the results of studies on health-related behavior of youth in Poland and in the world are not satisfactory. Particularly troublesome is the phenomenon of addictions' visible growth and their threats in the group of children and adolescents [3-15]. A study conducted by the World Health Organization has shown that 30% of young people in the European Union regularly smoke cigarettes [16]. In 2015, in the framework of international project "the European School Survey Project on Alcohol and Other Drugs (ESPAD) an auditorium survey was carried out in Poland on a representative sample of third grade classes in grammar school (age 15-16) and second grade class upper secondary schools (age 17-18). Studies have shown that alcoholic beverages are the most common psychoactive substance among young people - at least once during the whole of their life 83.8% of students of the younger group drank alcohol and 95.8% of students from the older group [17]. Another problem is obesity among children and adolescents. The WHO report shows that in the last 20 years in our country the number of overweight children have increased three times [18]. The reason of obesity can be seen in low physical activity and poor eating habits. With age, the health consequences of obesity are becoming more and more serious [19-28]. An important determinant of health is also the ability to cope with stress. Studies show that children and young people as often as adults are exposed to stress. Chronic stress can lead to depression, which is now one of the most commonly diagnosed disorder in adolescents [29-31].

University for most students is the last stage before the beginning adult life and exactly the last years devoted on the tutorial process, when the pro - health attitude is also learnt. On the other hand, the research shows that students keep an anti-health lifestyle [32]. It is important therefore to monitor the risks, minimize risk factors and realize preventive activities.

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The purpose of the study

The purpose of the research was to evaluate health behavior of higher education students in Bydgoszcz.

Material and methods

The study involved 272 students (124 women and 148 men) of Bydgoszcz universities, ranging in age from 19 to 31 years old (average age 24.8 years old). Students were divided into groups:

Group I - students of physiotherapy (n = 108);
Group II - students of dietetics (n = 50);
Group III - students of logistics (n=62)
Group IV - students of national security (n = 52);

In the studies the Inventory of Health-Related Behavior (IHB) by Zygfryd Juczyński was used [33]. It is composed of 24 statements that describe any kind of behavior related to health. The numerical values are counted in order to obtain the overall rate of health behaviors. These values are in the range of 24 to 120 points. The higher the result, the greater the severity of health behavior is. The results of the raw turns are changed into the standardized scores:

-1-4 - low;
-5-6 - average results;
-7-10 - high scores.

Apart from this interpretation we also calculated separately the severity of four categories of health behavior:

- proper nutrition habits (PNH);
- prophylaxis behavior (PB),
- positive psychological attitude (PPA)
- health practices (HP);

Statistical analysis was conducted using the package PQ Stat 1.6.2. Investigated variables are presented in the form of descriptive statistics (mean arithmetic, minimum, maximum, standard deviation). The distribution of variables was checked with Shapiro-Wolf test. The comparison of the results between two groups was made using Student's t test for independent groups, between the four groups of Anova test at significance level $\alpha = 0.05$. The results are presented in the form of graphs.

Results

Table 1 shows descriptive statistics for the results of questionnaire IHB throughout the test group

Table 1. Descriptive statistics for the results of questionnaire IHB throughout the test group

Variable	Descriptive statistics				
	n	$\bar{x}$	SD	Min	Max
IHB - sten	272	6.13	2.03	1.00	1.00
IHB - proper nutrition habits	272	3.17	0.50	1.67	4.83
IHB- prophylactic behavior	272	3.16	0.58	1.33	4.50
IHB- positive psychological attitude	272	3.17	0.58	1.67	5.00
IHB - health practices	272	2.99	0.43	1.50	4.50

n – number of observations; $\bar{x}$ - mean arithmetic; Min - minimum; Max-maximum; SD – standard deviation

In the next stage, a comparison of questionnaire IHB results between the students of different faculties has been made.

Table 2. Statistical analysis of questionnaire IHB results between students of particular faculties

Variable		Descriptive statistics					Anova test	
		n	$\bar{x}$	SD	Min	Max	F statistic	P
IHB- sten	Physiotherapy	108	6.11	1.53	3.00	10.00	60.860029	< 0.000001
	Dietitics	50	8.32	0.91	6.00	1000		
	National security	52	4.23	1.74	1.00	8.00		
	Logistics	62	5.79	1.75	3.00	1.,00		
IHB - PNH	Physiotherapy	108	3.36	0.51	2.33	4.83	14.882557	< 0.000001
	Dietitics	50	3.25	0.27	2.33	3.66		
	National security	52	3.02	0.69	1.67	4.50		
	Logistics	62	2.86	0.42	2.00	4.00		
IHB - PB	Physiotherapy	108	3.48	0.61	2.17	4.50	25. 10459	< 0.000001
	Dietitics	50	3.18	0.31	2.33	3.83		
	National security	52	2.77	0.68	1.33	4.50		
	Logistics	62	2.91	0.49	2.00	4.33		
IHB - PPA	Physiotherapy	108	3.47	0.54	2.50	4.50	16.659682	< 0.000001
	Dietitics	50	3.04	0.44	2.16	3.83		
	National security	52	3.16	0.69	1.67	5.00		
	Logistics	62	2.87	0.53	1.83	4.50		
IHB -HP	Physiotherapy	108	3.04	0.41	2.16	4.50	2.574731	0.044332
	Dietitics	50	3.04	0.31	2.33	4.00		
	National security	52	2.96	0.65	1.50	4.50		
	Logistics	62	2.86	0.38	1.83	4.00		

n – number of observations; $\bar{x}$ - mean arithmetic; Min - minimum; Max-maximum; SD – standard deviation; p – level of probability

Comparing the Anova test statistic-based p-value (F) with the level of significance of $\alpha = 0.05$, it has been found that there is a statistically important difference in the results of the questionnaire IHB between the treatment groups. A graphical interpretation of these results show the Figure 1 - Figure 5.

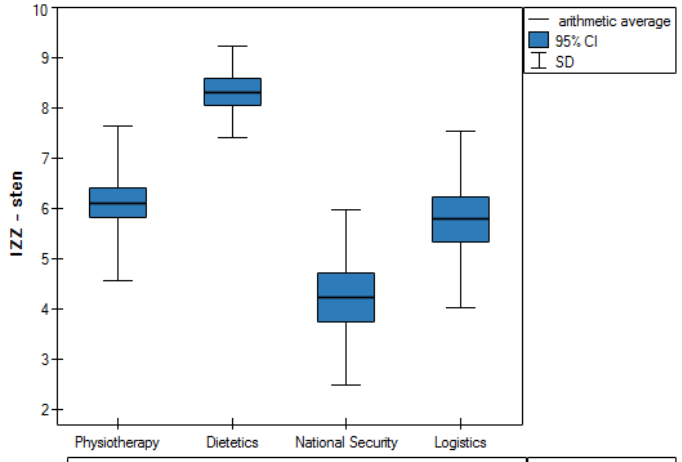

Figure 1. The box plot for comparison of the results of the IHB - sten between the students of different faculties

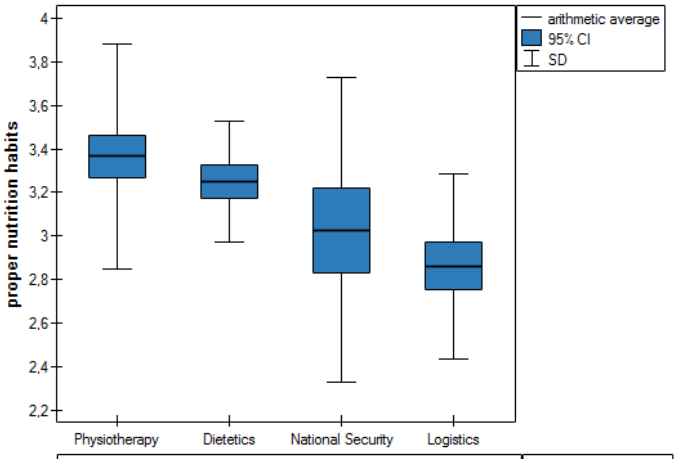

Figure 2. Box plot comparison of IHB results - proper nutrition habits between students of different faculties

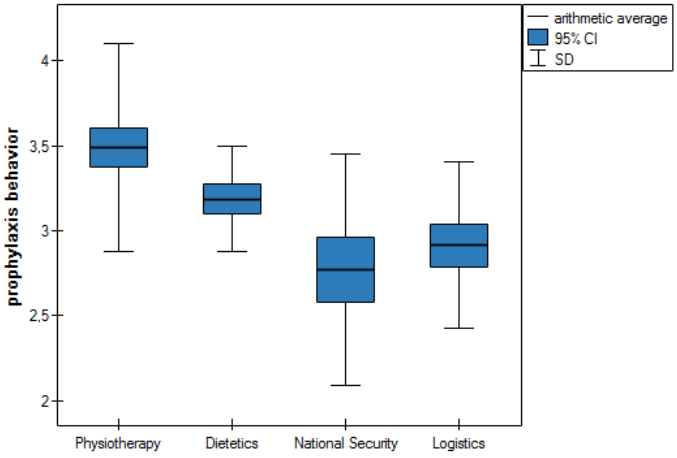

Figure 3. Box plot for comparison of IHB results - prophylaxis behavior between students of different faculties

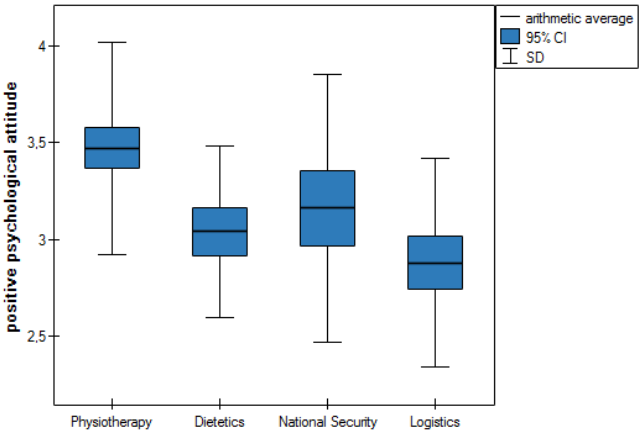

Figure 4. Box plot for comparison of IHB results - positive psychological attitude between students of different faculties

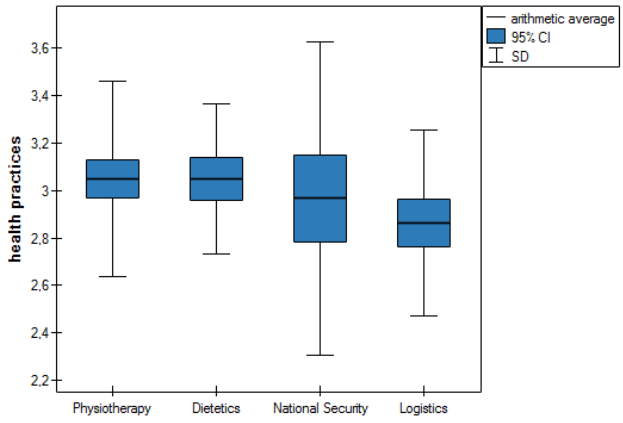

Figure 5. Box plot for comparison of IHB results - health practices between students of different faculties

In the next stage of the research a comparison of the results obtained in questionnaire IHB between women and men has been made. The results are presented in table 3.

Table 3. Results

Variable		Descriptive statistics					t-Student	
		n	$\bar{x}$	SD	Min	Max	t statistic	P
IHB - sten	WOMEN	124	6.74	1.86	3	10	5.228769	< 0.000001
	MEN	148	5.53	1.92	1	10		

n – number of observations; $\bar{x}$ - mean arithmetic; Min - minimum; Max-maximum; SD – standard deviation; p – level of probability

Figure 6 shows graphical interpretation of these results.

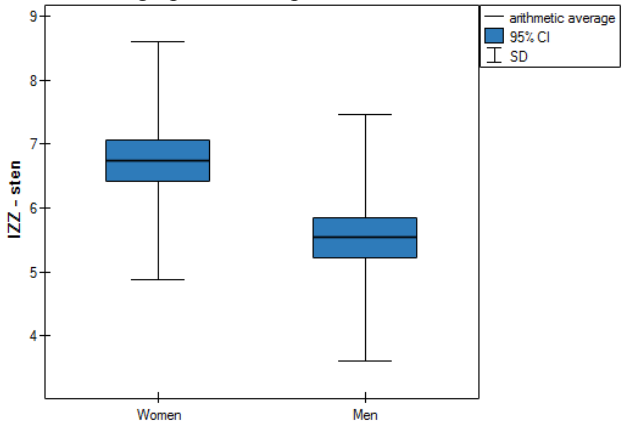

Figure 6. Box plot for the comparison of IHB results - questionnaire between women and men

Discussion

The research has shown that the level of health-related behavior in the test group of students is at the upper limit of the average results (6.13 sten). Analysis of health-related behavior's different categories (see Tab. I) showed very close results, furthermore they are lower than the results of the standardization groups, which can be found in the psychology textbook *The measure tool in psychology and health promotion*. What seems interesting is the comparison of the results of health behavior between the students of different faculties (table II). The highest level of health behavior has been shown in students of dietetics (8.32 sten) and at the same time, this is the result indicating a high level of health-related behavior. Physiotherapy students and logistics have obtained results that are in the upper limit of the average results - 6.11 respectively and 5.79 sten. On the other hand, the results of national security students were slightly lower (4.23 sten). When analyzing the different categories of health-related behavior, it should be noted that in almost all categories (except "positive psychological attitude "), medical students (physiotherapy, nutrition) have obtained higher scores, compared with the results of the non-medical students (logistics, national security). Similar results can be observed in studies of other authors. RAM and Stock [34] have assessed the health behaviors among the students of computer science and management trainees higher school in the fields of public health and information technology. The studies used the Inventory of Health Related Behaviour by Juczyński. The results have shown significantly higher levels of health behaviors of students of

public health in relation to appropriate health behavior computer science students. Smoker [35] evaluated the health behavior of students of the four fields of study: education, physiotherapy, physical education and tourism and recreation. The highest level of health behavior has been shown in students of physiotherapy. Misiarz et al. [36] assessed the nutrition behavior of students of medical and non-medical of Świętokrzyski region. The research tool was the original questionnaire surveys. Better results have been obtained in a group of medical students. Also Fedotov and Dentys [37] showed a favorable trend for the nutrition ways of students related to the protection of health. This begs the question, whether the study faculty actually determines the level of health-related behavior, or maybe, vice versa – young people with more knowledge of these behaviors choose appropriate courses. It would be advisable to carry out diachronic tests, involving the examination of first year students and repeating these tests in the final year of study.

While analyzing the results of the general level of health-related behavior based on gender (table III), we have found a higher level of health-related behavior in women. Numerous studies support the idea that women more often and more eagerly pay attention to health [38-42]. Korprowicz [43] analyzed the Polish health behavior of women and men on the basis of the data from the literature. Among negative behaviors for health, differentiating both sexes, we can enlist more frequent smoking of cigarettes, alcohol and drug use by men. While women have better diets and are more eagerly use outpatient specialist care, rehabilitation services and dental services. Women try more than men to prevent disease, which causes that the above 65-year-old women are less likely to get sick.

Conclusions

The results of personal research and research findings of other authors demonstrate that there is a need for implementation of programs of health promotion and health education in all fields of study.

Conflict of interests

The authors declare that there is no conflict of interests.

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ANTHROPOMETRICAL PROFILE AND BIO-MOTOR ABILITIES OF YOUNG ELITE WRESTLERS

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Abstract. *Aim:* This study investigated the association between motor performance and somatic type, anthropometric, body composition, physiologic and physical fitness profile in young wrestlers.
Material: 16 young wrestlers aging 16–19 with a 4–year–experience of taking part in national championships were selected for the study. Following the standard methods in the testing center of Alborz province some tests like aerobic power, muscular endurance, flexibility and agility speed tests and 1RM were taken to integrate the participants. Also, it should be noted that the participants' height, weight, the girth of thigh, elbow, calf and arm and skin thickness were measured.
Results: Somatotype, Somatotype Attitudinal Distance (SAD), Height Weight ratio (HWR) were calculated according to Carter and Heath anthropometric method. Body Fat Percentage (%BF), HWR and SAD resulted in 10.90±1.64, 43.27±0.87 and 0.94±0.87 respectively. Somatotype Standard Deviation and mean regarding endomorphic, mesomorphic and ectomorphic components were 2.16±0.46, 5.20±0.77 and 2.88±0.64 respectively. Physiologically, wrestlers VO_{2MAX} (kg/min) were 49.31±4.22 and their Resting Heart Rate (bpm) were 68.31±6.64.
Conclusion: As the present study illustrates, Somatotype of the Endomorphs, Mesomorphs and Ectomorphs were the same. As a result, coaches can plan wrestlers' training programs and review of techniques based on anthropometric and physiologic data driven from their sports performances.Besides, wrestlers could be well-informed about their performance. Moreover, aforesaid information could be beneficial to wrestling federations and all other organizations contributing the wrestling federation while holding talent identification programs and recognizing young wrestlers.
Key words: somatotype, wrestling, talent, test, physical.

Introduction

Wrestling is one of the most challenging competitive and anaerobic sports because of its stress on metabolic systems [1]. Therefore, the intensity of the wrestling match can determine muscle energy resources and the amount of all three resources consumed. Anthropometric and Physiologic features are considered as crucial concepts regarding athletes' performances among all sports [2]. The obtained capabilities and distinctive features could indicate the athlete's current condition and also could facilitate the comparison process of his previous and current results [3].

Physical fitness test results mark wrestles' weak points, strengths through wrestling matches and all the requirements for their future accomplishments. High capacity of aerobic and anaerobic, strength, power, agility, and flexibility in upper body and lower body are all considered as the most important physical fitness factors required to succeed in wrestling competitions [4,5].

Nowadays one of the most distinctive issues in sports is the process of discovering talented athletes. In other words recognizing, training and evaluating talented athletes at their early ages would help them constitute impressive future achievements. Sports instructors should dedicate the whole majority of their time and energy to elite athletes since they have potentials to succeed otherwise the presence of instructors would be inefficient. Thus most talented athletes with special aptitudes should be considered as the target goal of the instructors [6].

Following Carter and Heath, Somatotype provides significant information on special sports achievements [7]. Also Bloomfield et al. believe that Somatotype data can predict athlete's success in all fields of sport [8]. According to the analysis of the athletes' performance through international matches and Olympic Games, in order to succeed in competitions athletes should be equipped with bio-motor, anthropometry, structure and body compositions. By virtue of the data driven from the analysis, the evaluations on Somatotype features and comparing them with elite athletes' test results are regarded as a method to predict prominent athletes' success [9, 10]. Interestingly, the information achieved through aptitude and anthropometric tests play a crucial role in screening process [6, 9].

One of the most important criteria through the process of talent identification is the evaluation of somatotype information. Due to its variety, there have been several studies done on somatotype criteria. According to the analysis done on studies, there is a close relationship between the somatotype information of young and adult athletes' similarities and consistency of their somatotype features through all their lives [7]. Regarding the

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point that somatotype features are greatly influenced by genetic factors rather than other factors such as practice and diet [2, 11, 12]. The obtained information are so eminent in identifying talented athletes. The key factors to achieve success in various athletic fields are anthropometry, structure evaluation, and physical features [13].

The present study aims at providing anthropometric features, body composition, somatotype, physiologic and body fitness factors contributing to young wrestlers' performance. The result of the study would provide a profile for young wrestlers in the different age range in order to devalue the comparison of adult wrestlers' talent aptitude test results and young wrestlers' results.

Material and methods:

Participants: The present study follows a field descriptive method. Also, the aim of the present research is categorized as a functional and practical research. The subjects were 16 young elite wrestlers aging 16–19 years old. It is necessary to mention that the participants had the experience of practicing wrestling and being the champion for 4 years.

Research Design

All the tests and measurements were done during the same time in 6 days. In order to homogenize participants and measure their aerobic power, a physical fitness tests including Bruce test, Trunk lift flexibility, Shoulder flexibility, Sit and Reach Test, Muscle Endurance (Curl up, Pull up), Bench Press Maximum Strength, Squat based on Brzycki [14] formula, speed (36 m) and agility (4×9 m Test) were held.

The Brzycki (1993) equation is as follows while recording anthropometric measurements, the number of practice sessions was reduced. All the measurements over anthropometric features, body structure, and other variables were taken according to an international association of ISAK while the wrestlers were resting. Somatotype was analyzed and calculated with Somatochart software (version 1.2). Body density (BD) was estimated using the method of Jackson and Pollock [15]. BD was transformed to %BF by the Brozek's equation [16].

Statistical Analysis

To analyze the data, descriptive statistic methods were used.

Results

Table 1 the results of the present research on Anthropometric features and body composition are presented; in table 2 Somatotype and table 3 bio-motor ability among of young elite wrestlers are shown.

Table 1. Anthropometric and body composition characteristics of young elite wrestlers

Variable	Mean	Std. Deviation	Maximum	Minimum
Age (years)	17.43	1.15	19	16
Experience (years)	4.21	1.35	7	2
Anthropometric				
Weight (kg)	66.70	8.48	87.50	57.40
Height (cm)	173.25	5.79	184	165
BMI (kg/cm^2)	22.14	1.68	25.84	20.44
Sitting height (cm)	88.53	3.79	94	81
Skin-fold (mm)				
Chest	2.50	1.83	5	3
Axilla	3.76	2.65	7	5
Triceps	4.32	3.23	10	5
Subscapular	5.89	4.39	15	8
Abdomen	5.11	4.04	14	6
Suprailium	5.04	4.47	16	4
Front thigh	6.12	4.48	11	5
Biceps	2.03	1.43	4	2
Calf	3.55	2.70	8	4
Sum of 9 skin-fold (mm)	38.32	2.80	54	29
Body fat (%)	10.90	1.64	15	7.90
Lean body mass (kg)	58.96	7.10	73.90	50.20
Lengths (cm)				
Arm span	174.40	6.18	185	166
Humerus	74.06	4.58	85	64
Femur	105.75	8.71	118	93
Girths (cm)				
Flexed arm	28.79	1.90	33	26
Waist	73.75	5.06	87	67
Hip	91.40	4.39	101	86.20
Calf	35.35	2.26	40.50	32

Table 2. Somatotype variables of young elite wrestlers

Variable	Mean	SD	Maximum	Minimum
Endomorphy	2.16	0.46	2.9	1.4
Mesomorphy	5.20	0.77	6.5	3.3
Ectomorphy	2.88	0.64	3.7	1.8
SAD*	0.94	0.87	2.03	0.13
HWR*	43.27	0.87	44.1	41.53

* SAD (Somatotype Attitudinal Distance); HWR (Height to Weight Ratio).

Table 3. Bio-motor ability of young elite wrestlers

Variable	Mean	Std. Deviation	Maximum	Minimum
		physiologic		
Aerobic power				
VO_{2MAX} (kg/min)	49.31	4.22	59	42
VO_{2MAX} (l/min)	3.17	0.49	4	2.39
MET*	14.05	1.19	16.80	12
Heart Rate (bpm)				
Resting Heart Rate	68.31	6.64	78	57
Maximum Heart Rate	198.68	8.63	218	186
Flexibility (cm)		**Physical fitness**		
Sit and reach	41.93	5.45	55	35
Trunk	46.81	7.72	58	31
Shoulder	29.56	7.70	47	16
Muscular endurance (number of repetitions)				
Poll ups	11.18	3.31	18	6
Sit and reach	49.25	5.25	60	40
Maximal strength (kg)				
Bench Press	72.88	13.73	103.64	50.63
Squat	100.27	18.07	145.18	77.14
Speed (seconds)				
36 m.	4.26	0.26	4.91	3.93
Agility (s)				
4×9 m	8.86	0.48	9.72	8.10

*Metabolic Equivalent

The calculated somatotype was achieved through anthropometric features of height, weight, femur breadth, elbow breadth, calf girth, flexed arm girth, body composition. Also, their triceps skinfold, subscapular, suprailium and calf skinfold were calculated in two- dimensional based on Heath – Carter's method [2]. In order to do the analysis, the researcher used the Somatochart software (version 1.2) which is presented in figure 1. As the schematic figure illustrates, the mean is 2.2 – 5.9 – 2.9.

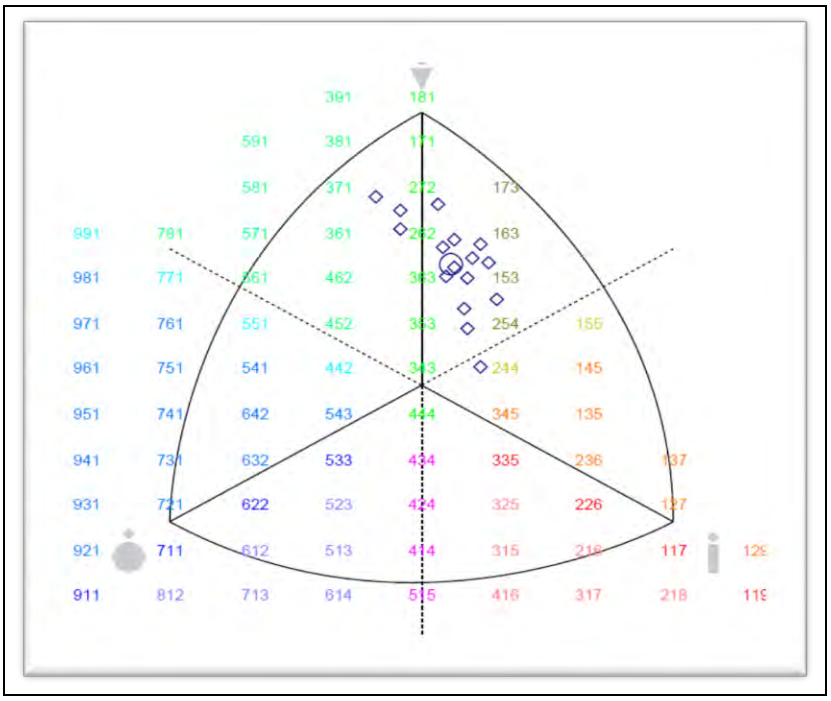

Figure 1. Somatotype features of young elite wrestlers. O = somatotype mean (2.16 – 5.9 – 2.9)

Discussion

One of the scientific aims of training is to use laboratory experiments to predict the athletes' performances. It has been proven that when athletes have the minimum amount of Body Fat %, they have the highest amount of Oxygen intake [13]. Mirzaei and Sadeghi did a study on the introduction to the state of physical fitness among adult wrestlers in freestyle wrestling national team. Based on their findings, VO_2Max was 50.6 ± 5.7 ml/kg/min and the amount of body fat% was 11.5±5.3 [17]. According to all researches done on wrestlers, one of the most important criteria that wrestling coaches should consider is Cardio Vascular Endurance. Additionally, the wrestler should have anaerobic power, agility, flexibility endurance and 1Repitation Maximum. Besides all these factors, the anthropometric variables increase as wrestlers aging 10–14 grow older and it would lead to advance in physical fitness records of the wrestlers [18].

Therefore, it is better to consider the age range of wrestlers while the talent identification process is being held since the obtained results would be more generalizable to evaluate the profiles. Robinson Ramirez-Velez reported VO_2Max as 49 ml/kg/min [19]. Also through other fact-findings VO_2Max counted as 45.9 ml/kg/min [12, 20], and 41.2 ml/kg/min among American wrestlers [3]. The concordance failure might be due to variety of athletes' practicing methods, body weight and fitness level of their body while doing the test or even because of environmental differences such as height, temperature and so forth [19].

The present study measured wrestlers' resting heart rate (68.31 bpm). The mean of resting heart rate was 60-100. Arslanoglu Erkan conducted a research on Turkish young wrestlers' resting heart rate. However, Arslanoglu's report on resting heart rate (63.2 bpm) did not concur with the result achieved by the present study [21]. On the other hand, according to Yoon's research, the maximum amount of elite wrestlers' heart rate was 197.5 [22] which was concurrent with the findings of the present study (198.68).

Based on the results achieved through the present study, the mean amount for the sit and reach test was 41.93 cm which follows the national norm of Iranian wrestlers [17]. Mirzaei et al. stated that the flexibility record among various weight range was very close to each other [3]. However, in a case study Mirzaei et al. reported the sit and reach test as 45cm [23]. In contrast, some experimental researches concluded that when the wrestlers' muscle strength increases, their flexibility does not decrease [22]. Following the statement mentioned above, many types of research done on wrestlers' physical fitness, the most prominent factor is muscle strength [17]. One of greatest features of wrestlers is the strength of upper and lower body (1RM) chest press and squat were 72.88 and 100.27 kg respectively. All the aforesaid amounts were less than Mirzaei et al.'s findings [23] and followed the national norm of Iran [3].

In the present study 4×9 m test, the agility was 8.86 seconds which was in accordance with the national norm of Iran. Based on researchers' agility is one of the most influential features of a successful wrestler. Due to

the point that wrestling is associated with fast directional changes, body performance, and frequent flounce, what is required to fulfill the goal is a sharp reaction in the meantime [4].

A wrestler's anthropometric feature plays a crucial role in determining his/her potentials to succeed in matches. Specific physical features and anthropometric profiles are required in order for the maximum performance of the athletes in special sports. In addition to physiologic features mentioned through the present research, young elite wrestlers' anthropometric features, somatotype features, and body composition should be perused. According to Yoon, the appropriate amount of body fat % for wrestlers is 7 to 10 and in order to balance this measurement the wrestler must go on a specific diet and do suitable aerobic exercises [22]. Zakani also studied Italian national team wrestlers anthropometric features and their body compositions. There were 32 wrestlers aging 18-33 taking part in his study. Through his study some variables such as anthropometric weight, height, sitting height, some girth and body composition were measured and the minimum amount of body fat % was 5 [1,18]. Mirzaei et al. described the freestyle young elite wrestlers' profile and calculated their body fat % as 10.6±3.8 [3]. They resulted in the agreement between Iranian young elite wrestlers' physiologic profile and young elite wrestlers physiologic profiles of other countries. Sterkowize et al. studied the somatotype of heavyweight and finally they concluded that heavyweight wrestlers are either mesomorph or endomorph [24]. However, through this research, the somatotype of young wrestlers weighing about 66.70 ± 8.48 was considered as a mesomorph. Based on their findings it is clear that weight classes among lighter wrestlers were more like mesomorph and their body fat % were lower.

Robinson Ramirez-Velez did a research on 21 national Colombian wrestlers Mesomorph – ectomorph – somatotype mean (3.8– 5.3–1.6) of the wrestlers were analyzed by a related software which is shown in Figure 2 [19]. Data- driven from diagram 2 do not concord with the results of the present study. It is obvious that the mesomorphy is dominant and endomorph and ectomorph are equal (or the measured difference is only half a unit). In order to identify each body composition and compare various factors, the researcher must take special anthropometric girth into account and also include data mentioned in present research as a reference. Additionally, the present study would be advantageous for practical purposes as well as electing elite wrestlers and design their practicing plans through future researches and talent identification programs.

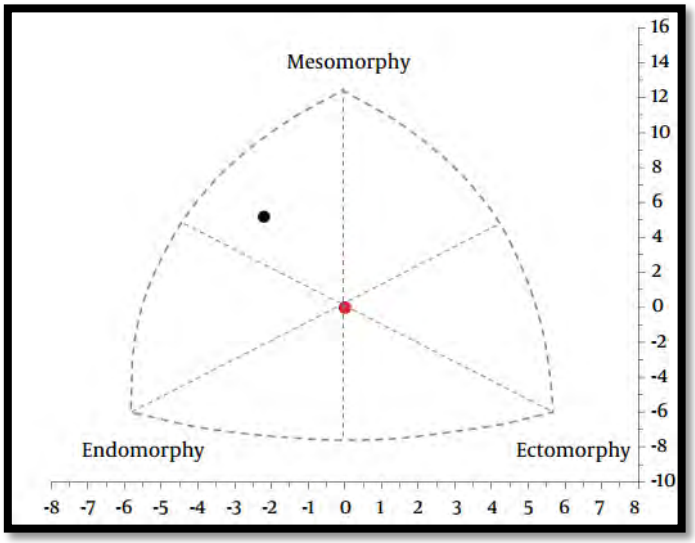

Figure 2. Somatotype average characteristics of Columbia wrestlers' national team. O = somatotype mean (3.8 – 5.3 – 1.6), [19].

Conclusion

The results of the present study would provide wrestling coaches with anthropometric features, body composition and somatotype profile of elite wrestlers. Such information including relative physiologic factors and body fitness could help wrestling coaches to balance wrestlers' practice schedules based on anthropometric profile and their sports performances. It is important not to ignore the role of energy resource in wrestling matches since they are more anaerobic but energy producer especially while wrestlers' recovery through taking aerobic system pathway. Therefore, information such as high VO_{2MAX}, low resting heart rate, agility, 1RM, high speed and flexibility would be beneficial.

Also considering anthropometric characteristics of lightweight tend to be more mesomorph, medium height and have low BMI and low body fat % could help young wrestlers to analyze performance information and appropriate practicality of such information themselves. Moreover, sports associations and wrestling federation

could use driven information from the present study for talent identification plans and identification of elite wrestlers at their early ages.

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Conflict of interests

The authors declare that there is no conflict of interests.

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