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Original Article

Use of innovative technical means to increase the training process effectiveness in handball

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Abstract.
Systematic testing enables coaches to analyze effectiveness of the training process. This paper deals with the usage of technical means in the context of handball training and presents a developed by us, innovative tehnology referred to as Light Trainer was introduced into the training process of ZTR handball team (Zaporizhzhia, Ukraine). The creativity has no limits and in the sports industry, innovation is constant. The use of technology is clearly the new trend in the sports sector. **The aim of our research** was to conduct a comparative analysis of the relevant indicators to determine the effectiveness of innovative technologies in the process of handball training (adequate selection of means, methods, and forms of trainings). **The object of the research** is training process in handball. **The subject of the research** is indicators of the physical preparedness level. **Material of research:** 24 handball players. **Methods of research:** theoretical (analysis, comparison, synthesis, systematization and consolidation of scientific and methodological data and Internet content) and empirical (pedagogical supervision, pedagogical experiment, pedagogical testing). **Results**: Dynamics of indicators of the handball players' physical preparedness throughout the research displays the statistically significant differences between the beginning and the end of the research in the control groupe in two tests out of eight (in standing triple jump and one-handed ball standing throwing for distance), and in the experimental groupe in five tests out of eight (in standing triple jump, one-handed ball standing throwing for distance, two-handed ball seated throwing for distance, 2x100 m shuttle run, and in integrated exercise). **Conclusions:** Taking into account all the information received during the research, it became obvious that innovative technical means are likely to provide unbiased data on the development of athletes as well as to accelerate their rates of improving physical qualities necessary for success in handball. That is why it is recommended to engage technical advances in handball training.
Keywords: handball players, special performance, coordination abilities, physical preparation.

Introduction

Pedagogical supervision is a system of measures checking the planned indicators of the training process to assess the means, methods and loads used. Its main purpose is to identify the relationship between the factors of influence (means, methods) and those changes that athletes undergo in terms of health conditions, psychological state, physical development, preparedness level, psychophysiological status, technical and tactical skills, etc. (Lisenchuk et al, 2019a; Tyshchenko et al, 2020). It is important for coaches to determine the level of athletes' physical preparedness in the most informative and accurate way for further solving numerous problems that is discovering the most effective means and methods of trainings, establishing informative and high-quality supervision methods, forming the starting line-up, implementing additional means to increase the special capabilities of athlets, etc. (Tyshchenko et al, 2018a; Barrera-Domínguez et al, 2021; Malikov et al, 2021).

As experience confirms, a handball player is likely to succeed in the future depending, on the one hand, on the development level of his/her physical qualities being high when starting the preparation, and on the other, on maintaining the rates of the physical qualities improvement throughout the sports career. That is why it is very important to get unbiased initial data on the handball player's potential (using tests). Success in sport is impossible to predict unless such data are obtained.

Testing is divided into preparedness testing to study particular aspects of preparedness (physical, technical, tactical, psychological one), ability testing to determine capacity for a certain sport, and competing readiness testing. In the light of the research subject intricacy and the variety of solutions to pedagogical problems, a unified testing methodology is not that one can count on. A single testing is not able to provide unbiased data even for solving a local problem. Therefore, it is necessary to define a set of tests when carrying out the process. Systematic observations and control tests (testing) provide information for the analysis and evaluation of the training process effectiveness (Bauer et al, 2020; Haddad et al, 2020; Van Den Tillaar et al, 2020). For example, often motor-gifted handballers manifest the gift only in one quality, with handball requiring

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a harmonious all-round physical development of athletes (Chaabene H. et al., 2021; Masanovic, Gardasevic, & Bjelica, 2021).

Pedagogical supervision is crucial in increasing the effectiveness of handball skills development, and is carried out by the coach at all stages of the training process. The sport industry is characterised by constant and rapid waves of technology innovation, which innovation plays a vital role in elite sport, emerging from the grass roots of sport rather than as a strategic programmed activity. Taking into account all the information received during the research, it became obvious that innovative technical means are likely to provide unbiased data on the development of athletes as well as to accelerate their rates of improving physical qualities necessary for success in handball. To address the challenge of improving the training process quality, extensive introduction of innovative information technologies into the system of sports training is necessary, which requires training sessions to be systematically upgraded, training methods to be updated, scientific and technical developments as well as advanced sports and pedagogical practices to be involved (Burić et al, 2019; Schwenkreis, 2019; Skejø, 2020; Host et al, 2020).

Therefore, during the research it is essential to conduct a comparative analysis of the relevant indicators to determine the effectiveness of innovative technologies in the process of handball training (adequate selection of means, methods, and forms of trainings).

Materials & methods

Participants

The pedagogical experiment was conducted in ZTR handball team (Zaporizhzhia, Ukraine). The experimental (EG) and the control groupes (CG) one consisted of 12 athletes each, with overall 24 handball players engaged in the research. Comparative analysis of handball players' indicators was carried out at the beginning and at the end of the experiment.

The control group implemented conventional methods (Tyshchenko, 2017) while the experimental one tended to innovative technical means (plyometric boxes, BOSU platforms, rope ladders, ropes, ab wheels, SandBags) and groundbreaking exercise system called LTES. The exercises were applied for 20-25 minutes after warm-up, as well as in the main part of the training.

Goal, methods and procedures

The aim of our research was to conduct a comparative analysis of the relevant indicators to determine the effectiveness of innovative technologies in the process of handball training (adequate selection of means, methods, and forms of trainings).

1. Theoretical methods: analysis, comparison, synthesis, systematization and consolidation of scientific and methodological data and Internet content, aimed at identifying problems and contradictions associated with the training process in handball and the integration of the latest scientific achievements into the training system of athletes.

During the theoretical study of scientific and methodological literature, research data and practical experience of Ukrainian and foreign experts in the field of general theory and methods of sports training and, in particular, that of handball are analyzed. Analysis and synthesis are used to make the general idea of the handball training peculiarities more specific. The main focus is on the handball training process, the use of innovative means within its frames, and the methodology of physical qualities development of handballers.

2. Empirical methods:

— analysis of documentary materials; available methodological materials, and calendar plans being analyzed;

— pedagogical supervision is carried out to analyze the training process management and the implementation of innovative technical means during trainings, as well as to clarify the problem under study. Pedagogical supervision is subject-oriented, basic as to the program, open in terms of awareness, and overt in style;

— pedagogical experiment is conducted to check the interactive training means effectiveness in terms of influence on the level of handball players' physical preparedness;

— pedagogical testing is to determine the level of handball players' physical preparedness. The next standards are applied: 30 m running (s), 30 m dribbling (s), standing triple jump (cm), one-handed (1 kg) ball standing throwing for distance (m), two-handed (1 kg) ball seated throwing for distance (m), 2x100 m shuttle run (s), run-outs (s), integrated exercise (s).

Examples of exercises using innovative means:

Exercise for explosive strength of leg muscles. SP: kneeling on the mat with a medicine ball. Jump to seated position, pass a medicine ball and, maintaining the position, jump onto the plyobox. It is recommended to jump onto the plyobox holding a medicine ball every other time.

Exercise for strengthening upper limb girdle muscles. SP: prone lying on the forearms on the BOSU platform, holding a rope with the right hand, while the other end of the rope is fastened to the wall. Carry out wave-like movements with the right hand. In the next set the same is executed with the left hand.

Exercise for improving leg coordination during movement. SP: jumping exercises on a rope ladder. Jumping is performed with legs astride – legs closed and forward movement till the end of the ladder with a maximum frequency of movements and passing to a partner without delay. Backward movement implies dribbling acceleration or acceleration with shooting on goal.

Alternative exercise for strengthening upper limb girdle muscles. SP: kneeling, hands are on the ab wheel. Makes forward roll and slowly return to the starting position.

Exercise for strengthening stabilizers of back, thigh, glutei, and abdominal muscles. SP: standing on an inverted BOSU platform, holding a SandBag. Perform 90-degree squats, while maintaining balance.

Exercises with BOSU platform activate small interspinal muscles and stabilizer muscles.

Exercise for deep core muscles. It is necessary to turn the BOSU platform upside down to form a half-sphere, stand up, keeping the feet parallel on both sides of the platform, find balance. Do squats, pulling the pelvis back, as if you are trying to sit on a chair, and start rolling, helping yourself with the hands. One can make the exercise more complicated by adding handball and medicine ball passes.

Exercise for deep stabilizer muscles. It is necessary to turn the BOSU platform upside down to form a half-sphere. Jump onto and off, while maintaining balance. One can make the exercise more complicated by adding handball and medicine ball passes.

Exercise for back muscles. It is necessary to turn the BOSU platform upside down to form a half-sphere. Take up an outstretched arms support position on the edges of the platform, do a plank. Swing the platform energetically from side to side.

Exercise for abdominal muscles, biceps, small interspinal muscles. It is necessary to turn the BOSU platform upside down to form a half-sphere. The starting position is the same as in the previous exercise. Only push-ups need to be added. At the lowest point, exhale and make four hand-hand rolls.

Alternative exercise for deep stabilizer muscles. It is necessary to turn the BOSU platform upside down to form a half-sphere. Spread your feet, put one foot on the platform. The other foot remains on the floor. Jump over the BOSU platform so that the foot on it is changed. One can make the exercise more complicated by adding handball and medicine ball passes.

Rope ladder exercises were used together with handball and medicine ball passes.

Hopscotch exercise is one of the simplest exercises for developing agility. It is necessary to hop forward with both feet and land on the left foot in the first square of the ladder. Hop forward on the left foot, but land on both feet. Hop forward again with both feet and land on the right foot. Hop forward on the right foot and land on both feet. This is one cycle that should be repeated till the end of the ladder.

Side-stepping exercise. SP: at the bottom left square of the ladder. Begin by placing the left foot in the first square and then immediately the left foot (jump-in). After that, take a lateral step to the right with the left foot and then with the right foot. Step to diagonal left and up, again with the left foot and then with the right. Move to the left, outside of the ladder, first with your left foot and then with the right. Keep moving till the end of the ladder. While re-exercising, start moving from the opposite side of the ladder, so that the leading leg changes regularly.

Five steps exercise. SP: feet shoulder-width apart in front of the ladder in the center. Begin by placing your right foot to the right of the first square of the ladder, almost at the same time putting your left foot in this square. The right foot joins the left, then the left foot moves to the second square (that is, steps forward), and the right foot follows the same route. The movement consists of 5 steps, forming the first phase. The second phase almost repeats this pattern, but the leading leg is changed.

During the research, innovative technical means referred to as Light Trainer (LT) was introduced into the training process of ZTR handball team (Zaporizhzhia, Ukraine). It is an easy-to-install and easy-to-use wireless device with laser sensors that transmit red and green light utilized to activate or deactivate movement. Lights are on thanks to the random numbers software (Tyshchenko, Chernenko & Serdiuk, 2015).

The exercise time is determined by the coach, depending on the task or necessity to develop certain physical qualities. Different modes, difficulty level and duration of exercise can be programmed. This mobility function allows one to benefit from all kinds of exercises, which can become more complicated by adding handball and medicine ball passes.

1. *Light Trainer Single Exercise* (LTSE). The proposed exercise allows increasing the level of specific working capacity together with the speed of shifting the focus of the athlete, who is actively selecting useful information.

In the middle of the 9-meter line, there are 5 stands with LED lights used as signal stimuli during the exercise. The distance between the stands is 1 m, and the distance from the athlete to the stand is about 3 m. At the signal of the coach, the athlete makes a standing start jerk to the stand where light appears, and after touching the stand he returns to the starting location.

This exercise enhances the handball player's response time, as the duration of data retrieval, i.e. the interval between the situation emergence and the beginning of action implementation. In terms of the accuracy, coordination and speed of the exercise, coaches can come to reasonable conclusions about the level of the athlete's psychomotor skills.

2. *Light Trainer Double Exercise* (LTDE). Four stands are situated on the 6-meter line, and other six stands with LED lights are on the 9-meter line. There are two players in the center. At the signal of the coach, the athletes make standing start jerk to the stand where green light appears, and after touching the stand they return to their starting location (6-meter line). When the red light is on, handballers stand still.

The LTDE significance is revealed in competitive activity situations associated with movements of defenders when screening attackers, intercepting, carrying out offensive and defensive technical and tactical actions, etc.

3. *Light Trainer Shooting Exercise* (LTShE). LTShE is beneficial in increasing corresponding preparedness indicators, which are manifested in game situations related to active offensive actions in positional attack, during counterattacks, etc.

This control exercise provides for activation of the key result-oriented indicators by handball players. The indicators encompass changing the direction of movement and the way of movement (face and back forward, sidestep and cross-step movement), passing the ball, shooting the ball on goal.

The exercise consists in the alternate regulated shooting on goal by handball players (after getting a pass). The starting point is 12 m from the middle of the baseline. After side-to-side moving, the athlete alternately shoots from the 9-meter line only on that goal square where the light appears. The total exercise time is 3 minutes, with time being recorded from the moment of the first shot. Throughout the time, only those goals are counted that have reached the corresponding squares.

4. *Light Trainer T-type Exercise* (LTTtE). The athlete reaches the I cone at maximum speed, touch it with the right hand, make a movement towards the II or III cone, depending on the spot where the light appears.

For example, if the light above the II cone is on, handballer moves and touches it with the left hand. Then the athlete moves to the III cone, touches it with the right hand (if there is a light). After that, (s)he goes back to the I cone, touches it and accelerate to the starting location.

5. 2x100-meter shuttle run + LTShE. Shuttle running is the main way of movement in handball, since there is a multitude of game situations including sprint with abrupt deceleration and changing the direction of movement. Repetitions of sprint optimally simulate game conditions, since the handball player's activity on the playing field is situation-dependent, mixed one (short sprint is changed to a low-intensive load).

The distance should be passed as follows: starting from the middle of one of the baselines, the athlete accelerates to the 6-meter line which limits the goalkeeper's line, then accelerates to the 9-meter line (active defense line), to the centre of the field (20 m), to the 9-meter line and to the 6-meter line. After each corresponding acceleration, the athlete returns to the starting location.

The exercise time is over after shooting to that goal square where the light appears. Thus, the total distance of the exercise is 6 m x 2+9 m x 2 + 20 m x 2 + 9 m x 2 + 6 m x 2 = 100 m.

6. *Light Trainer Foot Exercise* (LTFE). Three light indicators are located on the field. The first indicator is at a 50 cm distance from the starting line, the second one and the third one is at the same distance (15 cm) to the left and to the right of it. It is necessary to step on the indicator where the light appears and return to the starting position.

This exercise is used to increase the foot response time. The LTFE significance is revealed when carrying out defensive technical and tactical actions, such as backup, parallel movements in defense, freeing from pivot defenders, intercepting a pass to the line, etc.

Statistical Analysis

Statistical processing of experimental data is used to analyze the empirical data of the pedagogical experiment utilizing the STATISTICA 10.0 computer program. Mathematical processing of the study results was carried out with assistance of the statistical software and the evaluation of the traditional parameters: the arithmetical mean (x), the error in the mean (m), t – the Student's t-test.

Results of research

At the beginning of the research carried out to assess the effectiveness of the experimental methodology of physical qualities development using the innovative devices in the training process of handball players, the preparedness level in CG and EG was analyzed. Such an analysis is a prerequisite for objective interpretation of the experiment results. To lay the foundation for innovative device usage, it is necessary to conduct a comparative analysis of the indicators of handball players' physical preparedness. For this reason, the indicators of all athletes at the beginning of the research should not have a statistically significant difference. It is the requirements that have been adhered to throughout the experiment.

Parallel and sequential schemes, representing two basic structures of experimental research, found an application. The parallel structure implied the selection of athletes for EG and CG to be examined, with the results obtained being compared with each other both at the beginning and at the end of the research. It enabled us to compare the initial data with the final results to prove the experiment effectiveness. To increase objectivity of the research results, the sequential structure also came into usage, providing for a comparison between the initial data and the final results of physical preparedness indicators both in the EG and CG.

At the beginning of the experiment, it was not possible to register statistically significant differences in the values of physical preparedness of athletes from the EG and CG. Comparative analysis made it possible to highlight their relative homogeneity. Modern handball is a dynamic athletic game that requires considerable motor and physical capabilities of athletes. In a match, handball player is subject to significant dynamic strength loads of different values. In the playing activity, active and passive phases interchange every 3-20 seconds. During a match, field player covers a 6000-8000-meter distance, carries out about 30 jumps, and actively interacts with opponents at least 40 times, using various movement methods. The playing activity intensity is constantly changing. Accordingly, some positive changes are obvious.

According to the scheme chosen for the experimental data analysis, in order to prove the selection of means, methods, forms of training in ZTR handball team in terms of the athletes' physical preparedness, a comparative analysis of the corresponding indicators of athletes from the CG and EG was conducted (CG: Figure 1; EG: Figure 2).

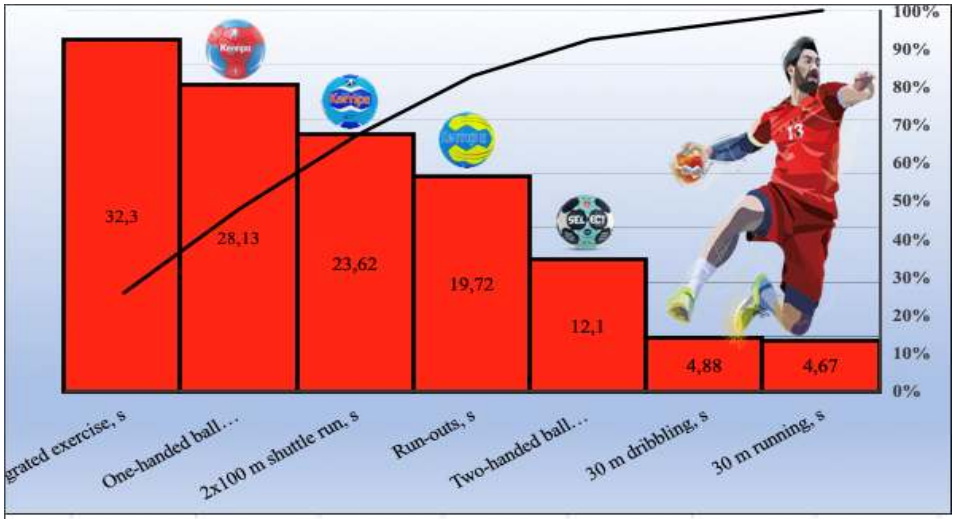

Figure 1. Dynamics of indicators of the CG handball players' physical preparedness throughout the research

Thus, statistically significant differences between the beginning and the end of the research in the CG are evidenced only in standing triple jump (718.3±8.2 cm at the beginning; 737.9±5.1 cm at the end) and one-handed (1 kg) ball standing throwing for distance (28.13 ± 0.6 m at the beginning; 29.6±0.3 m at the end) (Figure 1). Improvement trend is manifested in the rest of the testing results.

When analyzing the initial data and the final results in the EG (see Figure 2), shifts are observed, indicating the effectiveness of the innovative means usage. The Student's t-test has discovered the difference being statistically significant according to the results of standing triple jump (715.6±7.21 cm at the beginning; 765.8±5.3 cm at the end) and one-handed (1 kg) ball standing throwing for distance (28.1±0.5 m at the beginning; 30.9±0.4 m at the end).

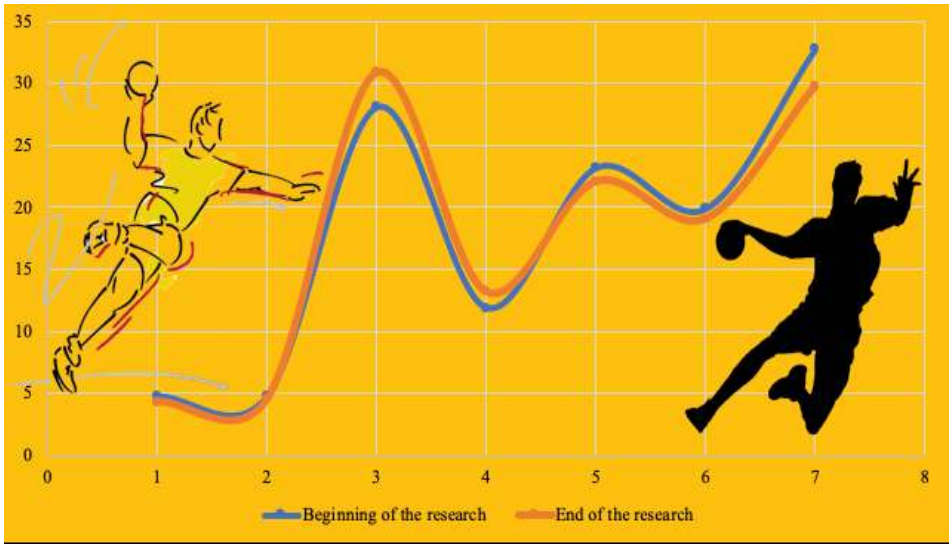

Figure 2. Dynamics of indicators of the EG handball players' physical preparedness throughout the research

The results of two-handed (1 kg) ball seated throwing for distance have also significantly improved throughout the research (11.9±0.3 m at the beginning; 13.2±0.2 m at the end). A statistical trend of changes is recorded in aspect of 2x100 m shuttle run (23.2±0.3 s at the beginning; 22.1±0.3 s at the end) and integrated exercise (32.8±0.5 s at the beginning; 29.8±0.52 s at the end). For the rest of the control exercises (30 m running, 30 m dribbling, run-outs) it is true that the positive changes in indicators are of extremely tendentious nature, that is, there are no statistically significant differences (see Figure 2).

Dynamics of indicators of the handball players' physical preparedness throughout the research (both groups) (see Table 1) displays the statistically significant differences between the beginning and the end of the experiment in the CG in two tests out of eight (in standing triple jump and one-handed (1 kg) ball standing throwing for distance), and in the EG in five tests out of eight (in standing triple jump, one-handed (1 kg) ball standing throwing for distance, two-handed (1 kg) ball seated throwing for distance, 2x100 m shuttle run, and in integrated exercise).

Table 1 – Dynamics of indicators of the handball players' physical preparedness throughout the research (both groups)

Indicators	Control group				T beg-ecg	Experimental group				T beg-eeg	T bcg-beg	T ecg-eeg
	Beginning of the research		End of the research			Beginning of the research		End of the research				
	X	m	X	m		X	m	X	m			
30 m running, s	4,67	0,3	4,46	0,2	0,58	4,72	0,3	4,3	0,1	1,33	0,12	0,72
30 m dribbling, s	4,88	0,2	4,74	0,2	0,49	4,8	0,2	4,5	0,1	1,34	0,28	1,07
Standing triple jump, cm	718,3	8,2	737,9	5,1	**2,03**	715,6	7,1	765,8	5,3	**5,67**	0,25	**3,79**
One-handed (1 kg) ball standing throwing for distance, m	28,13	0,6	29,6	0,3	**2,19**	28,1	0,5	30,9	0,4	**4,37**	0,04	**2,60**
Two-handed (1 kg) ball seated throwing for distance, m	12,1	0,3	12,4	0,2	0,83	11,9	0,3	13,2	0,2	**3,61**	0,47	**2,83**
2x100 m shuttle run, s	23,62	1,1	23,3	0,6	0,26	23,2	0,3	22,1	0,3	**2,59**	0,37	1,79
Run-outs, s	19,72	1,76	19,5	1,5	0,10	19,9	1,5	19,1	0,4	0,52	0,08	0,26
Integrated exercise, s	32,3	0,8	32,1	0,4	0,22	32,8	0,5	29,8	0,52	**4,16**	0,53	**3,51**

NB: beg – beginning of the research experimental group; eeg – end of the research experimental group; bcg – beginning of the research control group; ecg – end of the research control group

Moreover, the statistical probability analysis of the testing results indicated a considerable statistical significance of the obtained indicators in the EG in four tests out of five: in standing triple jump, one-handed (1 kg) ball standing throwing for distance, two-handed (1 kg) ball seated throwing for distance, as well as in integrated exercise ($p<0.001$).

Comparative analysis of the final data of the CG and EG reveals significant changes in four tests out of eight: in standing triple jump ($p<0.01$), one-handed (1 kg) ball standing throwing for distance ($p<0.05$), two-handed (1 kg) ball seated throwing for distance ($p<0.01$), integrated exercise ($p<0.01$) (see Table 1).

Since success in handball depends not only on the initial level of the athlete, but also on his/her rates of sports mastery maintaining or enhancing, it is crucial to provide handball players with different methods of improving skills within the frames of training sessions.

There is a number of technical means available for upgrading physical qualities such as plyometric boxes, BOSU platforms, rope ladders, ropes, ab wheels, SandBags, with the Light Trainer Exercise System considered to be the most game-changing one. The LTES introduction into the training process and its combination with other technical devices opens up space for the potential of handballers to be analyzed and further improved, proceeding from the results obtained.

As a result of the research conducted in ZTR handball team, where the initial indicators of handball players' physical preparedness level were compared with the final ones, it was found out that the experimental group (implementing new technologies) succeeded more in terms of physical development. Statistically significant differences between the beginning and the end of the experiment were observed in the CG in two

tests out of eight (in standing triple jump and one-handed (1 kg) ball standing throwing for distance), and in the EG in five tests out of eight (in standing triple jump, one-handed (1 kg) ball standing throwing for distance, two-handed (1 kg) ball seated throwing for distance, 2x100 m shuttle run, and in integrated exercise).

Discussion

Training process consists of a combination of multidirectional means and methods, which, provided that coach works together with athletes systematically and persistently, should be beneficial in tackling the main task that is in achieving high sports results. It is control that plays a special part within this framework (Tyshchenko et al, 2019), indicating the athletes' preparedness level, being a means of optimizing the training process and competitive activity based on the objective assessment of the development of various qualities, functional and physiological state and the integral preparedness level (Yuriy et al, 2016; Evhen & Valeria, 2017; Malikov et al, 2019).

Control allows analyzing and estimating the implementation of training programs for athletes at different stages, to distinguish possible imbalances between the model level and the actually achieved one, upon which adjustments to the training programs are made. It is common knowledge that training process is built on standard principles and on the regularities of the development of physical qualities. A number of scientists have identified means and methods of control in team sports (Valeria et al, 2017; Lisenchuk et al, 2019b) to address current issues of improving physical, psychological, technical and tactical preparation (Korobeynikov et al, 2019; Krahenbühl et al, 2019). Also, criteria for assessing various aspects of athletes' preparedness have been established. Physical preparedness control makes it possible to analyze the development level of special physical qualities including explosive strength, flexibility, endurance, coordination qualities, speed, speed-strength and strength ones. Many handball professionals treat significant expenditures at the level of speed and strength qualities as fundamental in handball (Tyshchenko, 2017; Wagner et al, 2019). Despite testing results provide possibilities to determine the running speed or tempo in handball training (proportioning the range and intensity of running load), coaches' interest in endurance testing for handball players is rather insignificant due to the low usefulness of testing results and their applied relevance in endurance training arrangement.

According to the expert opinion, 30-meter running exercises reproduce the competitive activity situations of the team transition from defensive to offensive. Considering that the length of the court is 40 m, its useful part for players falls within the range of 28-30 m. In addition, the opposing team starts carrying out active defensive actions from the 9-meter line. Thus, most of the accelerations when performing quick attacks and counterattacks imply covering distances of 25-32 m by handballers. The standard therefore involved 30m running and 30m dribbling testing. As it has been revealed by the experts, informative indicators of speed development encompass accelerations over a 5-meter distance, so it is absolutely objective to apply to such acceleration-targeted testing or training exercises (Tyshchenko, 2017). Some exercises are used to determine the level of coordination abilities development, denoting the level of speed endurance development in a way (number and distance of segments, work intensity). They include 2x100-meter shuttle run, integrated exercises (covering an 88-90 m distance). Another expert opinion is that development of athletes' speed-strength qualities manifested in non-ball motor actions (jumps, accelerations) and those with the ball (shots, passes) is of crucial importance in handball. According to a number of authors (Valeria et al, 2017), manifestation of handballers' specific qualities (explosive strength) is highlighted by utilizing a 1 kg ball, more than twice exceeding characteristics of the ball that finds application in competitive activity (420-450 g).

To control athletes' technical preparedness, scientists designed the IGL-1 ergometer equipped with sensors that record the following mechanical parameters of the athletes' movements: three parameters of efforts, three parameters of movements, as well as acceleration of the apparatus. Testing procedure includes three one-minute exercises (rest interval is until recovery) (Doroxov, 2004). The next innovative device is the «Concept-H» ergometer for monitoring the athletes' functional preparedness. It was upgraded by adding force sensors on the handle and its movement option (Vodlozerov, 2003). Information is fed into a computer, processed and then data on the rate and power of motor activity is displayed on the screen.

Another groundbreaking tool that can be used in the control system of athletes in team sports is the «AKSON» expert system. Its knowledge database comprises information on general, sports and developmental physiology, sports anatomy and morphology, biochemistry, sports medicine, theory and methodology of physical training. The database contains the results of the top-rank athletes. In the scheduling block, the expert system asks the user about the competition schedule in the upcoming sports season and offers him/her an option of planning the training load for the annual cycle and its distributing at the first stage of the cycle (Ivanov, 1987). According to Yu. Portnov, handball, along with other team sports, is featured by the possibility of conflict game situations (tough psychological and physical counteracting of the opponent); continuous flow of disembodied information in a strictly limited time; multitude of moving objects (ball, partners, opponents); rapidity of suddenly arising and constantly changing game situations; a relatively large area for the match, implying the ability to estimate how remote the objects are; necessity to shoot not only quickly and precisely, but also with all efforts; necessity to choose from various alternatives.

As evidenced by the analysis of scientific and methodological literature, such aspects in handball have been studied as physical qualities of players (Stafeeva et al, 2019), standards of specific and physical preparation (Valeria & Olexander, 2015; Wagner et al, 2019), some questions on technique and tactics of the game (Antonis et al, 2019). The practical activity results on the control arrangement over the training plan implementation for improving the physical preparation of highly qualified handball players in various structural parts of the annual training cycle are presented (Tishchenko, 2016). The researchers have focused more on physical characteristics (e.g. height and weight) and less on physiological ones (e.g. jumping ability and anaerobic power), while some of them observed differences between playing positions (Karcher & Buchheit, 2014). According to the preliminary studies, indicators of handball players' physical preparedness differ in terms of average values and variability.

The SHVSM computer program for express assessment of the athletes' functional preparedness level is often taken advantage of in studies in the field of physical education and sports. The program turned out to be quite effective when working with athletes of various sports, in particular with handballers (Malikov et al, 2019). However, a lack of standardized comprehensive assessment of functional preparedness for highly qualified handball players in such studies is obvious.

An automated diagnostic technique has been developed to calculate the level of theoretical knowledge, tactical thinking of handball players and to maintain the results for further analyzing their dynamics at a certain stage of preparation. The proposed method of test psychophysical assessment makes it possible to quantitatively estimate the speed of shifting the focus of the athlete who is actively selecting useful information. Its introduction into the training process will allow to create such conditions for sensory reflection of reality for athletes that the movement patterns during technical and tactical actions being inapproachable under conventional activity arrangement will be objectively identified in a short time (Frolova, Hlazyrin, 2009; Sokolova et al, 2019).

To determine the individual properties of higher nervous system and sensor-motor functions of highly qualified athletes, the Diagnost-1 computer system was applied (Makarenko, 1999). Studying a simple visual-motor reaction is as follows: an athlete must press the right button on the remote control quickly when a stimulus appears on the screen. The latent period of the visual-motor reaction of choosing two out of three stimuli differed from the previous one in that the person subject to testing had to press the right button with his right hand quickly when a square (geometric figure) appeared on the screen.

In team sports, simulators are also widely utilized (Shepherd et al, 2018; Cieślicka et al, 2018), virtual reality to assess and train (Faure et al, 2020) for teaching throwing movements (Koopmann et al, 2020), developing the technique of long passing (Charikova, 2012) and spikes (Artem`ev, 2018), as well as for assessing special coordination abilities (Tyshchenko, Chernenko, Serdiuk, 2015). To address the challenge of improving the handball training quality, extensive introduction of innovative information technologies into the system of sports training is necessary, which requires training sessions to be systematically upgraded, training methods to be updated, scientific and technical developments as well as advanced sports and pedagogical practices to be involved.

Conclusions

Handball players' physical qualities are developed and increased in an optimized way, which not only improves the emotional background, but also accelerates the development process or enhances certain skills. Light Trainer (LT) was developed from an extensive review of innovation and management best practice from the literature and draws on successful examples of innovation in sport. This LT applied to a handball demonstrating its utility as an tool for planning for training process and of best sport practice. Therefore the Light Trainer Exercise System can be effectively implemented in the training process to improve agility, speed and response time. Such technical means enable handball players to focus more on trainings and achieve more significant results.

Until the level of athletes' physical preparedness is determined, is it possible to face a variety of challenges the training process offers. They encompass discovering the most effective means and methods of training sessions, establishing informative and high-quality supervision methods, forming the starting line-up, implementing additional means to increase the special capabilities of handball players. To level-up this key part of handball players' development, it is necessary to introduce innovative technologies into the system of sports training and estimate their outcome by testing.

Thus, the proposed exercises for the quantitative assessment of the response time and specific working capacity level of the athlete, who is actively selecting useful information, can be extensively used at all stages of the development or improvement of sports mastery, since the technology reproduces real game conditions in the sports training.

Analysis of the initial and the final results in the control groupe are established in standing triple jump and one-handed ball standing throwing for distance. Significantly improved throughout the research in the experimental groupe are observed according to the results of standing triple jump, one-handed ball standing throwing for distance, two-handed ball seated throwing for distance, 2x100 m shuttle run and integrated exercise

have also. Comparative analysis of the final data of the control and experimental groupes reveals significant changes in standing triple jump, one-handed ball standing throwing for distance, two-handed ball seated throwing for distance, integrated exercise.Statistically significant differences between the beginning and the end of the experiment were observed in the control groupe in two tests out of eight (in standing triple jump and one-handed ball standing throwing for distance), and in the experimental groupe in five tests out of eight (in standing triple jump, one-handed ball standing throwing for distance, two-handed ball seated throwing for distance, 2x100 m shuttle run, and in integrated exercise).

Future research can be rehabilitation-oriented, revealing the implementation issue of the innovative means for functional training during athletes' rehabilitation period.

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