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Original Article

Management of athletic form in athletes practicing game sports over the course of training macrocycle

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Abstract.
The main problem of athlete training process is the management of athletic form. It is important to determine the criteria which may be used to establish the dynamics of athletic form over the course of training macrocycle. *Purpose of study***:** to provide experimental foundation for methods of athletic formdetermination in athletes of team game sports over the course of a training macrocycle. *Materials and methods.* 46 elite athletes participated in the study, they represented basic lineups of Ukrainian Higher League field hockey teams of "Dinamo-ShVSM" (Vinnytsia) and "Olympia-Kolos-Sequoia" (Vinnytsia). *Research methods:* theoretical analysis and generalization of literary and Internet data; pedagogical observation; methods of functional diagnostics; modeling methods; pedagogical experiment; methods of mathematical statistics. *Results and conclusions.* In order to effectively manage the dynamics of athletic form in athletes over the course of training macrocycle one must effectively control the magnitude and direction of training influences. It has been established that the coefficient of magnitude of training load during the phase of acquisition of athletic form in elite field hockey athletes must fall in the range between 5,4 and 8,5 point·min^{-1}. The phase of stabilization of athletic form in hockey players is characterized by the magnitude of training influences during mesocycles from 8,2 up to 8,8 point ·min^{-1}. The coefficient of training load must be at its lowest point during the phase of temporary loss of athletic form, and namely around 4,2 point·min^{-1}. The level of physical and functional preparedness of athletes may be determined by using the developed 10-point scale. The following values were determined for the purpose of forming three phases of athletic form in elite field hockey athletes over the course of the training macrocycle: 4,1-5,7 points during acquisition phase; 5,7-5,9 points during stabilization phase; 3,5 points during temporary loss phase.
Key words: mesocycle, period, elite athletes, field hockey, athletic form.

Introduction.

Management in the system of athlete training is a difficult process based on multifactor structure of sports activity (O. Shynkaruk, 2013). V. Platonov (2015) regards management as a system regulation, i.e. bringing the system in correspondence with objective regularities governing this sphere of activity. In a more narrow sense management means bringing any system into the desired state (V. Zatsiorskyi, 1982, B. Shustin, 1995) or a purposeful influence of management on the managed object for the purpose of its effective functioning (V. Kostiukevych, 2014).

The main problem of athlete training process is the management of athletic form. One of the founders of the theory of periodization and sports training, L.P. Matveyev (2000), regards athletic form as the state of optimal preparation for sports accomplishments achieved by an athlete as a result of respective preparation at each new phase of athletic form improvement.

It should be noted that many athletes regard athletic form as an optimal athlete condition (V. Issurin, 2008; N. Batista, 2007; T. Bompa, 2006, D. Memmert, 2010). The results of experimental study confirm that the process of athletic form development is characterized by phases (A. Bondarchuk, 2005; V. Platonov, 2013). Physical Athletic form is characterized by three phases: a – acquisition; b – stabilization, c – temporary loss (A. Bondarchuk, 2005; L. Matveyev, 2000; V. Platonov, 2013). Based on three phases of athletic form in theory and practice of sports the training process over the course of a macrocycle is divided into preparatory, competitive and transition period (V. Platonov, 2015; T. Bompa, 2006; R. Johnson, E. Haskvitz, B. Breht, 2009). Phases of athletic form in cyclic sports alternate in a certain succession depending on the structure and contents of the training process (A. Bondarchuk, 2005, V. Issurin, 2008). As a rule, acquisition phase in game sports is achieved during the preparatory period, stabilization phase is achieved during the competition period and the phase of temporary loss of athletic form is planned for the transition period (Y. Doroshenko, 2013; V. Kostiukevych,

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2011). At the same time, though in cyclic sports the dynamics of athletic form can be determined by competition results, in game sports this problem is much more complicated (Zh. Kozina, 2009; S. Tiulenkov, 2007; Y. Fedotova, 2007; S. Chernov, 2006). That is why it is important to determine the criteria which may be used to establish the dynamics of athletic form over the course of training macrocycle (V.Kostiukevych, Y.Imas, O.Borysova, 2018; Zn.Kozina, K.Prusik, K. Görner, I. Sobko, 2017). Our experimental study is dedicated to this very problem and its results are set forth in the article below.

Hypothesis. To determine the dynamics of athletic form over the course of a macrocycle using the criteria for controlling the level of preparedness of athletes and, on that basis, to improve the efficiency of management influences on the training process.

Purpose of study: to provide experimental foundation for methods of athletic form determination in athletes of team game sports over the course of a training macrocycle.

Materials and methods.

Participants. 46 elite athletes participated in the study, they represented basic lineups of Ukrainian Higher League field hockey teams of "Dinamo-ShVSM" (Vinnytsia) and "Olympia-Kolos-Sequoia" (Vinnytsia). Level of sports skills of all players: Masters of Sports of Ukraine. The average age of field players (n=40) was 23,4±4,54 years ($\bar{x}$±S) and the average age of goalkeepers was (n=6) 24,4±4,95 years. Every participant gave informed consent for participation in this experiment.

Organization of research. The study was conducted from 2007 to 2013 at the bases of Sports Complex for Olympic Training of Athletes in the city of Vinnytsia; Vinnytsia State Pedagogical University named after Mykhailo Kotsiubynskyi; science research laboratories of the National University of Physical Education and Sports of Ukraine (the city of Kyiv).

Research methods. Theoretical analysis and generalization of literary and Internet data; pedagogical observation; methods of functional diagnostics; modeling methods; pedagogical experiment; methods of mathematical statistics.

Problems of acquisition of athletic form in athletes during training cycles were studied on the basis of theoretical analysis of literary sources and Internet data.

Magnitude and direction of training loads were analyzed in the process of pedagogical observation; the parameters of training influences were recorded.

A method for controlling training work in field hockey was developed for research purposes, and namely to determine the dynamics of athletic form during the macrocycle.

On the one hand, control of types and components of training work is necessary to determine the magnitude and direction of training load, and, on the other hand, it is needed to distribute the means for training hockey players during separate training sessions and in the process of building microcycles.

The means of training work are divided into nonspecific and specific means. Nonspecific means include the means of general and special preparation directed towards the development of physical preparedness of hockey players: their strength (athleticism), speed, speed and strength qualities, general endurance and speed endurance, flexibility and motor coordination.

Specific means include special preparatory, preliminary (auxiliary) and competitive exercises. Special preparatory exercises help to develop and improve such components of special physical preparedness of hockey players as, for example, speed in connection with special dexterity, special speed and strength qualities (hitting the ball, staying ahead of the competitor, knocking out the ball, effective moves in martial arts etc.), special speed.

Preliminary (auxiliary) exercises are oriented towards the improvement of components of technical and tactical preparedness in hockey players in correlation with playing techniques.

Competitive exercises are used to achieve integral preparedness for games and competitive activities.

All exercise performed in field hockey can be conditionally divided into three modes of coordination complexity (MCC).

The first MCC includes the exercises performed while standing in one spot or moving at comfortable speed of movement. The second MCC includes the exercises performed while moving with limitations in time and space. The third MCC includes the exercises performed in conditions of active resistance from competitor's side. This mode also includes difficult gymnastic and acrobatic exercises.

The magnitude and direction of training load in field hockey is determined by using such components as the duration of training, coefficient of training load and coefficient of training load intensity.

Coefficient of training load magnitude is determined according to the following formula:

$$CLM = \sum_{i=1}^{n} t_i \cdot I_i, \quad (1)$$

where as CLM is a coefficient of training load magnitude (points);

t_I is the duration of separate training exercise (minutes);

I_I is the intensity of certain exercise depending on heart frequency (points (table 1).

Table 1

Exercise intensity (Hodik, 1980)

Exercise intensity according to heart frequency indicators (beats per minute $^{-1}$)	Priority orientation	Grade in points
114	Aerobic	1
120		2
126		3
132		4
138		5
144		6
150		7
156	Aerobic – anaerobic	8
162		10
168		12
174		14
180		17
186	Anaerobic	21
192		25
198		33

Coefficient of training load intensity is determined according to the following formula:

$$CI_{t.l.} = \frac{CLM}{T}, \qquad (2)$$

where as $CI_{t.l.}$ is the coefficient of training load intensity (point ·min^{-1});
CLM is a value of load magnitude coefficient (points);
T is the duration of training session (minutes)

The load magnitude during a separate training session is determined according to the values *CLM, CI* as well as the level of fatigue in athletes.

Physical conditions of athletes were determined by using the following tests: 30 meter run from the high start with registration of initial speed; standing long jump with registration of speed and strength qualities; 180 meter shuffle run (Figure 1); Cooper test with registration of general endurance.

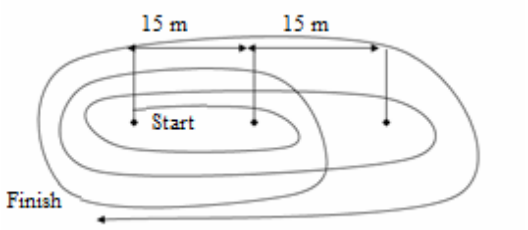

Fig. 1: Scheme for performing 180 meter shuttle run test

Microgate system for automatic measuring was used to measure the speed of running during the tests, such as 30 meter run from high start and 180 meter shuttle run.

Indicators of functional preparedness of athletes, such as physical ability to work, maximum and relative oxygen intake, were determined by using instrumental complex "Cardiolab+velo" which consisted of bicycle ergometer, electrocardiograph, computer, electronic seconds counter.

Statistical analysis. Statistical processing of study results was performed according to the average value method. The following main properties of samples were determined: $\bar{x}$ *; S; m; V*. The accuracy of difference between sample values was determined by Student's *t*-criteria. Shapiro-Wilky and Mann-Whitney consent criteria were used to confirm the hypothesis about the normal division of measurement results. The research data were processed by using computer software «EXCEL», «Statistica».

Results.

Determination of control criteria according to types and components of the training work made it possible to coordinate the dynamics of training influences at various phases of the process of training elite field hockey players during the macrocycle (Figure 2).

The highest values of the coefficient of training load intensity ($CI_{t.l.}$) are registered during basic mesocycles of the preparatory period and during competitive mesocycles of the competitive period. Specifically, $CI_{t.l.}$ makes 7,9 point·min^{-1}, during BDM and 8,5 point·min^{-1}during BCPM. During competitive mesocycles $CI_{t.l.}$

fluctuates between 7,3 and 9,1 point·min^{-1}. $CI_{t.l.}$ must be at its lowest point during the transition period (around 4,2 point·min^{-1}).

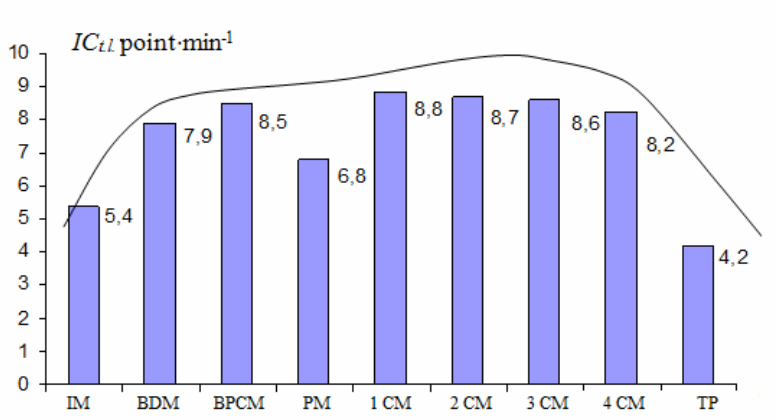

Fig. 2. The dynamics of athletic form in elite field hockey athletes during an annual macrocycle based on indicators of functional preparedness:

IM means introductory mesocycle; BDM means basic developing mesocycle; BCPM means basic control and preparation mesocycle; PM means pre-competition mesocycle; 1 CM means first competitive mesocycle; 2 CM means second competitive mesocycle; 3 CM means third competitive mesocycle; 4 CM means fourth competitive mesocycle; TP means transition period

One of the tasks of our study depending on the magnitude and direction of the training load was to determine the dynamics of athletic form of players over the course of annual macrocycle based on the indicators of physical preparedness (Figure 3) and functional preparedness (Figure 4).

In order to determine the level of physical and functional preparedness based on three-sigma rule we established a ten-point scale for each indicator of testing hockey players. According to three sigma rule, the interval from $\bar{x}$ +3S to $\bar{x}$ –3S which includes 99,73 % of all values of random variables was divided into 9 equal spans. The value of $\bar{x}$ –3S corresponded to 1 point and the value of $\bar{x}$ +3S corresponded to 10 points. The value $\bar{x}$ –3S plus the value of one interval corresponded to 2 points, the value of $\bar{x}$ +3S minus the value of one interval corresponded to 9 points etc.

As you can see on the Figure 3, during the preparatory period the phase of acquisition of athletic form based on the indicators of physical preparedness of players is characterized by positive dynamics ranging from 4,1 to 5,7 points (28,1 %).

During the competitive period the indicators of physical preparedness of players fluctuate between 5,7 and 5,9 points (3,4 %) which corresponds to the phase of maintenance of athletic form.

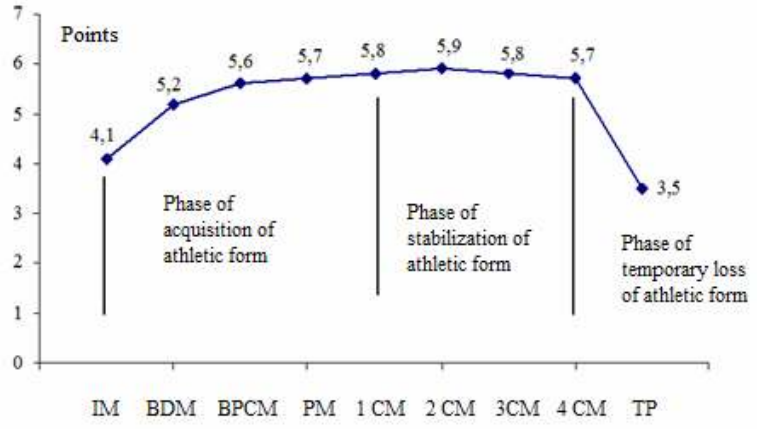

Fig. 3. The dynamics of athletic form in elite field hockey athletes over the course of an annual macrocycle based on indicators of functional preparedness:

IM means introductory mesocycle; BDM means basic developing mesocycle; BCPM means basic control and preparation mesocycle; PM means pre-competition mesocycle; 1 CM means first competitive mesocycle; 2 CM means second competitive mesocycle; 3 CM means third competitive mesocycle; 4 CM means fourth competitive mesocycle; TP means transition period

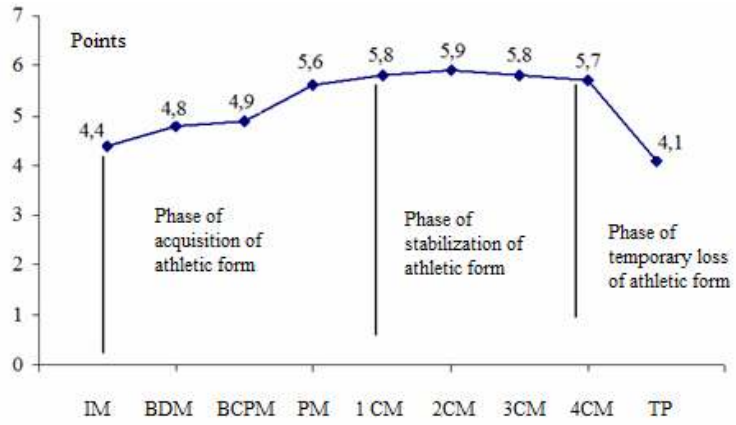

Fig. 4. The dynamics of athletic form in elite field hockey athletes over the course of an annual macrocycle based on indicators of functional preparedness:

IM – introductory mesocycle; BDM – basic developing mesocycle; BCPM – basic control and preparation mesocycle; PM – pre-competition mesocycle; 1 CM – first competitive mesocycle; 2 CM –-second competitive mesocycle; 3 CM – third competitive mesocycle; 4 CM – fourth competitive mesocycle; TP – transition period

The lowest values of physical preparedness in players were established during the transition period, i.e. 3,5 points, which corresponds to the phase of temporary loss of athletic form.

Discussion.

The main purpose of the process of athlete training is to achieve high sports results during competitions. These results are possible if an athlete is in optimal physical condition, i.e. in the phase of athletic form stabilization. It has been established that in cyclic sports during a macrocycle the athletic form in athletes may be developed in three variations: a – acquisition-stabilization-temporary loss; b – temporary loss-acquisition-stabilization, c – stabilization – temporary loss – acquisition – stabilization – temporary loss (L. Matveyev, 2000, Bondachuk, 2006). In team game sports the athletic form in athletes is developed in the following succession: acquisition phase – stabilization phase – temporary loss phase (V. Platonov, 2003; V. Kostiukevych, V.Stasiuk, N. Shchepotina, A. Dyachenko, 2017; T. Bompa 2006; Y. Imas, O. Borysova, O. Shlonska, I. Kogut, V. Marynych, V. Kostiukevych, 2017). First of all, it depends on the schedule of competitions in team game sports with the competitive period lasting from 3-4 to 6-8 months (Zh. Kozina, 2009; V. Platonov, 2013; O. Mitova, 2016; M. Lames, 2006).

Our study confirmed the periods of athletic form development in athletes of team game sports during the training macrocycle (V. Platonov, 2013; T. Bompa; V. Shamardin, 2013; Johnson et al). The phase of acquisition of athletic form lasts for 8-9 weeks; stabilization phase lasts for 16-18 weeks and temporary loss phase lasts for 3-4 weeks (Kostiukevych, 2014; Y. Fedotova, 2007).

Our study showed that the indicators of physical and functional preparedness of elite athletes in field hockey in the phase of acquisition of athletic form fluctuate around 21,5-28,1 %. In the phase of stabilization of athletic form these fluctuations are significantly lower and make only 3,1-3,9 %. Therefore, in case of effective management of athlete training process the phase of stabilization of athletic form can be maintained for 16-18 weeks of the competitive period.

Conclusions.

Analysis of scientific sources allows us to affirm that the management of dynamics of athletic form in athletes over the course of training macrocycle is the main problem of the general system of sports training.

In order to effectively manage the dynamics of athletic form in athletes over the course of training macrocycle one must effectively control the magnitude and direction of training influences.

It has been established that the coefficient of magnitude of training load during the phase of acquisition of athletic form in elite field hockey athletes must fall in the range between 5,4 and 8,5 point·min^{-1}. The phase of stabilization of athletic form in hockey players is characterized by the magnitude of training influences during mesocycles from 8,2 up to 8,8 point ·min^{-1}. The coefficient of training load must be at its lowest point during the phase of temporary loss of athletic form, and namely around 4,2 point·min^{-1}.

The level of physical and functional preparedness of athletes may be determined by using the developed 10-point scale. The following values were determined for the purpose of forming three phases of athletic form in elite field hockey athletes over the course of the training macrocycle: 4,1-5,7 points during acquisition phase ; 5,7-5,9 points during stabilization phase; 3,5 points during temporary loss phase.

The developed structural and systematic approach to management of the dynamics of athletic form in athletes of team game sports allows for more purposeful programming of the training process over the course of a macrocycle.

Gratitude. The study was conducted according to Summary research plan prepared by the Ministry of Science, Youth and Sports of Ukraine for 2011-2015 entitled "Theoretical and methodical foundation of individualization in physical education and sports" (state registration number 0112U002001) on the subject of "Theoretical and methodical foundations of programming and modeling of training in athletes of different skill levels» (state registration number 0116U005299).

Conflict of interest. The authors state that there are no conflicts of interest.

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