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Differentiation of muscular effort during stroke of high-level billiard players on game surfaces with different friction coefficients

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ABSTRACT

PURPOSE was to improve competitive performance of high-level billiard players by developing their stroke speed control. METHODS Twenty members of the national billiard sport team of Ukraine were studied. Methods of research: Theoretical analysis and generalization; an expert assessment in this study was conducted to determine the coordination capability of the most significant types of its components in mastering the techniques of the main techniques of the game (30 billiard coaches); pedagogical observation, which envisaged the registration and statistical accounting of the components of training high-level billiard players; pedagogical testing: specialized test for determining the differential threshold of muscular effort was made by billiard players without visual control during the performance of specific impacts of a given force on a cloth with different friction coefficients. Table speed is defined as 1/μeff(rolling); motion capture is the process of recording the movement of athletes. A performer wears markers near each joint to identify the motion by the positions or angles between the markers. This method was used to determine the optimal, modeling characteristics of technique and level of speed control of the stroke; methods of mathematical statistics. The correlation coefficient is determined by the Spearman formula: $p = \frac{\Sigma_i(x_1-\bar{x})(y_1-\bar{y})}{\sqrt{\Sigma_i(x_1-\bar{x})^2\,\Sigma_i(y_1-\bar{y})^2}}$

RESULTS It was developed a training program for athletes of the national team, which included exercises for special physical training with the obligatory performance of tasks on tables cloth with different friction coefficients. After two weeks of work on the proposed program, the results of the tests showed a significant reduction in the error in the dosage of impact force on different types of cloth. CONCLUSION Analysis of expert opinions (n=30) determined the differentiation of muscular effort as one of the most important coordination ability in billiard sport (W = 0.78). The main conceptual idea in developing the content of the program has been: the differentiation of types of loads, rest intervals, coordination complexity, number of strokes and the duration of concentration of attention in the strict regulation of the implementation of technical and tactical elements on game surfaces with different friction coefficients. The use of equipment from various types of billiards for high-level athletes in the special training program allows to increase their level of differentiation of muscular effort and, as a result – level of stroke speed control. After two weeks of training by the proposed program, the results of the tests showed a significant reduction in the error in dosing the force of impact on different types of cloth. It has been proved that in the formation of a comprehensive evaluation of athletes' preparedness the

leading roles are: the criteria characterizing technical preparedness (r = 0.81), level of differentiation of muscular effort (r = 0.79), concentration of attention (r = 0.76), interconnection with the indicators of competitive activities of high qualified billiard players.

Key words: program analysis, high level billiard players, pool, coefficient of friction, special physical training

Introduction

In the modern annual training plan for high-level billiard players, quantitative indicators of competitive loads have increased significantly in comparison with the past decades. The content of training programs to major billiards event was composed mainly of training load performance planning technical and tactical training without a differentiated approach to the development of physical qualities of highly skilled athletes (Nagorna, et al., 2016). The growth of duration and magnitude of static-dynamic loads in the competitive activity of highly skilled billiard players, changes of equipment and rules of games, necessitates the intensification of the process of preparation of athletes by means of special physical training. There is an urgent need to develop a program of special physical training of high-level billiard players as an independent structural unit in the system of multi-year sport improvement, which consists of a differentiated technique taking into account the individual characteristics and reserve capabilities of athletes, the predicted dynamics of sport results, structure, orientation and content training process in the annual cycle. The program of special physical training of athletes for the main competitions of the year should include the focus of the training process on eliminating disproportion in the structure of special physical training by developing the necessary components of motor function, such as special endurance and coordination abilities (Baić, et al 2014).

Coordination of motions, level of spatial and temporal exactness of motions, fineness of differentiation of muscular efforts, vestibular stability, speed of reactions, the level of developing physical flairs and possibilities of their realization is made basis of preparedness of high class sportsmen in such types of sport as billiards.

The criteria of estimation of level of development of different types of coordination capabilities are worked out for the high-level sportsmen in billiards, and also the most meaningful components of coordination capabilities are certain for these types of sport.

Purpose: to improve competitive performance of high level billiard players by developing their stroke speed control.

Methods

Contingent of research: national billiard team of Ukraine, a total of 20 athletes. Methods of research:

- Theoretical analysis and generalization.
- Expert assessment in this study was conducted to determine the coordination capability of the most significant types of its components in mastering performance of the main techniques of the game (30 billiard coaches).
- Pedagogical observation, which envisaged the registration and statistical accounting of the components of training high level billiard players.
- Pedagogical testing: specialized test for determining the differential threshold of muscular effort was made by billiard players without visual control during the performance of specific impacts of a given force on a cloth with different friction coefficients. Table speed is defined as 1/μeff (cue ball rolling).
- Motion capture is the process of recording the movement of athletes. A performer wears markers near each joint to identify the motion by the positions or angles between the markers. This method was used to determine the optimal, modeling

characteristics of technique and level of speed control of the stroke.

• Methods of mathematical statistics. The correlation coefficient is determined by the Spearman formula:

$$p = \frac{\Sigma_i(x_1-\bar{x})(y_1-\bar{y})}{\sqrt{\Sigma_i(x_1-\bar{x})^2\,\Sigma_i(y_1-\bar{y})^2}}$$

Results

The World Confederation of Billiards Sports is the umbrella organization that represents the three sports of Pool, Carom and Snooker.

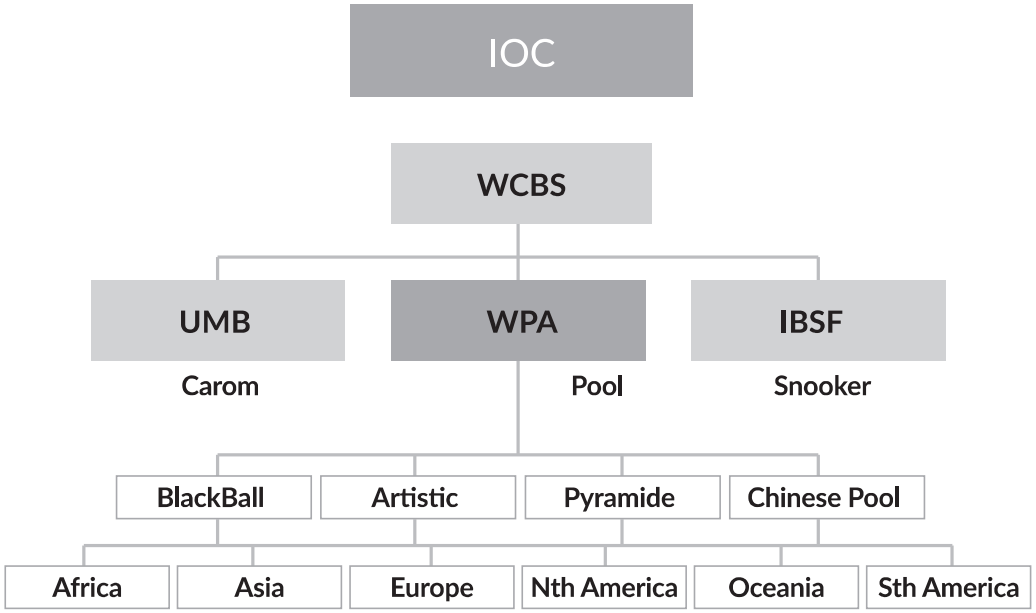

Figure 1. The comprehensive organizational structure of the worldwide associations in billiard sport (2018).

Very often, high-level athletes who specialize in one type of billiards, take part in tournaments for other types of billiards. And even achieve high results with a change in specialization: Pool, Snooker, Carom, Pyramide, BlackBall or Chinese Pool. And this is not surprising, because in all the games of billiards are sufficiently similar technical and tactical elements. Only the rules of games and equipment distinguish the types of billiards.

Chinese Pool was recognized by World Pool Association in 2017. Ukrainian national team was invited to participate in Chinese 8-Ball World Championship 2018. Chinese 8-ball uses standard eight-ball equipment, and similar rules, except with snooker-style pockets, rails and cloth. The change of one equipment to an absolutely different one with its effective use requires the manifestation of a high level of coordination qualities of the athlete. So there was an urgent need to introduce coordination exercises in the training programs of high level billiard players that affect specific coordination abilities, in order to increase the efficiency, quality and economization of movements in order to maximize the individual capabilities of the athlete in the competition.

A distinctive feature of billiards is that the player does not perform the stroke action directly with his hand, but with the help of a special device – cue. That makes the increased requirements for muscular and tactile sensitivity and the ability to objectively perceive and analyze their own movements, to plan specific ways of performing movements in strict accordance with the nature of the assigned motor task. There are around 60 types of strokes in billiard games. But the most difficult action in billiard is speed control, especially on game surfaces with friction coefficient that differs from regular.

First step of our research was to determinate regular friction coefficient of pool table surfaces. The dimensionless quantity table speed is defined as 1/μeff(rolling) and is similarly independent of ball mass. With this definition of table speed, a very slow table is in the range of 50-70. Normal table speed is 80-100. A very fast pool table might have a speed higher than 120. The cloth on a carom table is usually finer and smoother than that on a pool table, and a fast billiard table might have a speed over 150. The force due to rolling resistance is much smaller than that due to sliding friction (Ron Shepard, 1997).

The official rules specify a billiard cloth that is predominantly wool, namely Simonis 860; it may be noted that this is a relatively fast pool table cloth that results typically in table speeds from 100 to 130 when newly installed.

To determine in the structure of the coordination capabilities of the most significant species an expert assessment was conducted, which determined the profile types of coordination abilities for billiard sport: the differentiation of muscular effort, the ability to maintain the stability of the posture (equilibrium) and the coordination of movements (W = 0.78). The survey of the best specialists in the field of billiards, analysis of expert opinions and the need for training for a new kind of billiard, resulted to improvement the preparation program of national billiard team. The content of the program includes author's technical and tactical exercises, and exercises that were developed by leading pool trainers in Europe. The main conceptual idea in developing the content of the program has been: the differentiation of types of load, rest intervals, coordination complexity, number of strokes and the duration of concentration of attention in the strict regulation of the implementation of technical and tactical elements on game surfaces with different friction coefficients. For this purpose, in the billiard club of the National University of Physical Education and Sports of Ukraine, was installed on pool tables a cloth with different friction coefficients, with this definition of table speed is in the range of 90-110-125-145.

The performance of a specialized test for determining the differential threshold of muscular effort was made by billiard players without visual control during the performance of specific impacts of a given force on a cloth with a different friction coefficient. After two weeks of work on the proposed program, the results of the tests showed a significant reduction in the error in dosing the force of impact on different types of cloth, Figure 2.

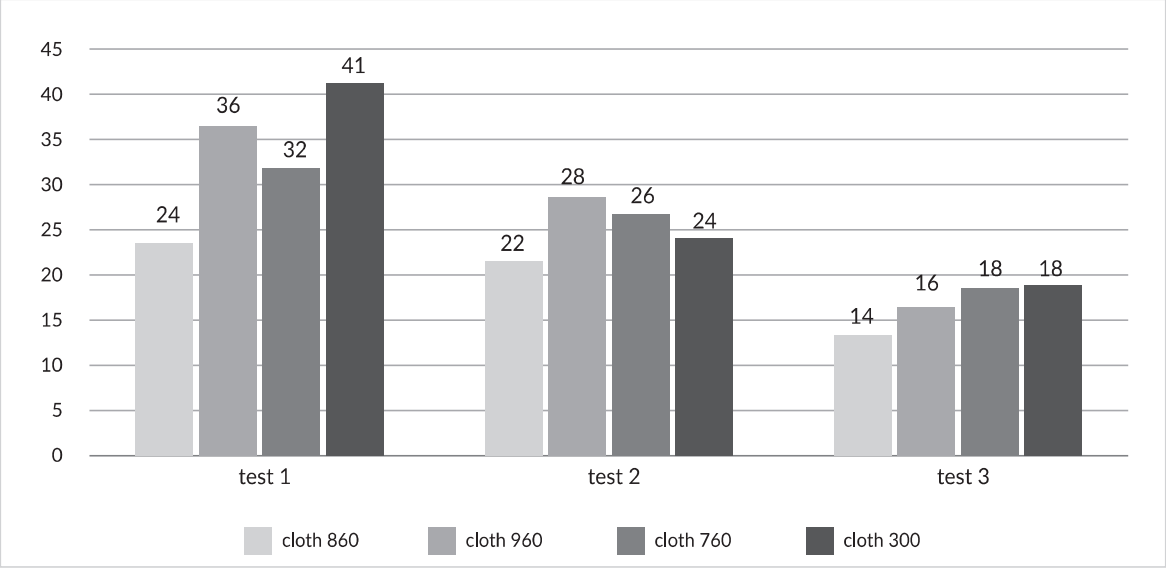

Figure 2. Error in differentiation of speed-strength indicators of high level billiard players (n = 20) after 1 day, 1 week and 2 weeks of training on a special program.

The decreased error in force dosing of stroke on pool tables with different speed characteristics indicates a significant improvement in the quality of differentiation of muscular effort.
It has been proved that in the formation of a comprehensive evaluation of athletes' preparedness the leading roles are: the criteria characterizing technical preparedness (r = 0.81), level of differentiation of muscular effort (r = 0.79), concentration of attention (r = 0.76), interconnection with the indicators of competitive activities of high-level billiard players.

Discussion

Our previous studies proved that the program of special physical training of high-level billiard players should include the special physical training by developing the necessary components of motor function, such as coordination abilities (Baić, et al 2014; Nagorna, et al 2016; Nagorna, et al 2018). Received data indicated the decrease error in dosing the force of stroke on pool tables with different speed characteristics with help of developed training program for athletes of the national team, which included exercises for special physical training with the obligatory performance of tasks on tables with different friction coefficients.
The training program to World Chinese Pool Championship 2018, was composed for high-level billiard players (pool) as an independent structural unit in the system of multi-year sport improvement, which consists of a differentiated technique taking into account the individual characteristics and reserve capabilities of athletes, the predicted dynamics of sport results, structure, orientation and content training process in the annual cycle. The program of special physical training of athletes for the main competitions of the year should include the focus of the training process on eliminating disproportion in the structure of special physical training by developing the necessary components of motor function, such as special coordination abilities. The equipment from various types of billiards that was used in the training program allows increasing the level of coordination abilities of high-level athletes.

Conclusion

Analysis of expert opinions (n=30) determined the differentiation of muscular effort as one of the most important coordination ability in billiard sport (W = 0.78). The main conceptual idea in developing the content of the program has been: the differentiation of types of load, rest intervals, coordination complexity, number of strokes and the duration of concentration of attention in the strict regulation of the implementation of technical and tactical elements on game surfaces with different coefficients of friction. The use
of equipment from various types of billiards for high-level athletes in the special training program allows to increase their level of differentiation of muscular effort and as a result - level of stroke speed control. After two weeks of training by the proposed program, the results of the tests showed a significant reduction in the error in dosing the force of impact on different types of cloth. It has been proved that in the formation of a comprehensive evaluation of athletes' preparedness the leading roles are: the criteria characterizing technical preparedness (r = 0.81), level of differentiation of muscular effort (r = 0.79), concentration of attention (r = 0.76), interconnection with the indicators of competitive activities of high-level billiard players.
In addition, these innovations have significantly helped to achieve good results of the national team's performance at the championships of Ukraine, European and World Championships of Pool, Snooker, Pyramid and Chinese Pool.

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Conflict of interest: Authors state no conflict of interest.

Anthropological features and comparison of the best junior-cadet water-polo players

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ABSTRACT

AIM of this study was to compare the somatotype and to describe the morphological characteristics of competing young male water-polo players. The water-polo players of two clubs were playing the final final match of the final tournament of the Croatian Championship for Junior Cadets. Anthropometry and somatotype data were collected from 27 young water-polo players (age M = 12.29, SD = 0.46 years) before the final match. This kind of information helps us to condust a more accurate selection of athletes. The Jackson and Pollock method (1985) of skinfolds measuring in seven places was used. The RESULTS showed no significant differences in somatotypes between the two clubs. The difference