Original Article

Adaptation of the training process of highly qualified women's basketball teams based on indicators of competitive intensity and calorie consumption during official games

RAISA I. ANDRIANOVA[1], DMITRY V. FEDOSEEV[2], VADIM P. CHICHERIN[3], EVGENY A. LUBYSHEV[4], ARSENTY A. KRASILNIKOV[5]
[1,3]State University of Management, Moscow, RUSSIA
[2]Southern Federal University, Rostov-on-Don, RUSSIA
[4,5]Moscow City University, Moscow, RUSSIA

Abstract:
The authors investigate the problem of the effectiveness of the training process of highly qualified women's basketball teams in conditions of increased competition at official national and international competitions. The aim of the study is to analyze the game loads and calorie consumption of the women's basketball team of super League 1 "Rostov-don-SFU" for several seasons and to adapt the training process to the modern requirements of the game in accordance with the results obtained. The empirical study was conducted from August 2018 to May 2020. Research sample – 10 female basketball players of the women's super League 1 team "Rostov-don-SFU". The average age was 23±3 years, the average height was 183.9± 8.7 cm, and the average weight was 70.7 ±9.7 kg. 47 games of the Russian basketball championship in the 2018-2019 season and 42 games of the 2018-2019 season were analyzed. The study found that the maximum heart rate of all basketball players in the 2019-20 season decreased in comparison with the previous season. At the same time, for most players of the Rostov-don-SFU team in the 2019-2020 season, the playing time spent in the maximum load zone and the expenditure of calories per game significantly increased while maintaining high statistical indicators. The authors identified exercises that are as close as possible to the game situation, when performing which the player's pulse reaches the highest value, and justified their application in practice. The conducted research has proved that the performance of highly qualified basketball teams at official competitions is closely related to the level of adaptation of the intensity of training process loads to the requirements of the game. The obtained data will help to better adapt the training process and improve the functional capabilities of highly qualified basketball players.
Key Words: heart rate indicators, consumption of calories, intensity of training and competitive loads, software and hardware complex "POLAR Team System", zone of maximum intensity.

Introduction

Modern professional women`s basketball is notable for its dynamicity and high speeds. Competitive activities, due to extreme complexion, often place significant demands on sportswomen. It is necessary that professional players meet the requirements of functional training and be terrific at all techniques of the game. To achieve a high level of fitness of basketball players and achieve the best physical, technical and tactical form, it is necessary to adapt the training process as accurately as possible in accordance with the indicators of competitive intensity and calorie consumption in official games. Based on the current scientific literature, the functional readiness of female athletes can be assessed in terms of physiological responses (for example, heart rate, metabolic parameters) and physical actions performed (for example, frequency and duration of actions, distance traveled, player load) (Fox et al., 2017; Stojanovic et al., 2018).

The present data point to the fact that ever-greater number of researches is focused on quantitative assessment of the external requirements faced by basketball players during competitive games (Ferioli et al., 2020; Vázquez-Guerrero at al., 2019). Nevertheless, there is practically no information in scientific sources about the adaptation of the training process in accordance with the obtained digital data. Indices of physiological changes during the game and training activity provide obvious insight into the energetical, system and physical principles of movement in team sports and can be used in optimizing the training for official competitions (Ben Abdelkrim et al., 2007, 2010; Scanlan et al., 2011, 2015; Povarechenkova & Kozlov, 2013). When planning the work-out session, it is necessary to take into consideration the physiological characteristics of the load for the better adaptation of basketball players and for the development of the necessary endurance training status of players, the amount of playing time and the availability of playing schedule (Scanlan et al., 2018).

Corresponding Author: RAISA I. ANDRIANOVA, E-mail: andrianova_r_i@rambler.ru

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The heart rate (HR) is seen as an objective index of the load intensity (Conte et al., 2016; Dalen et al., 2016; Sannicandro et al. 2016; Schelling & Torres, 2016). Now the HR monitor in team sports during the training activity and official games is a source of necessary information (Berkoff et al., 2007; Holienka, 2016; Cuberek et al., 2017; Puente et al., 2017; Babic et al., 2018). After analyzing the scientific sources of literature, it was concluded that the issue of adapting the training process of women's basketball teams in accordance with the indicators of competitive intensity and calorie consumption in official games is not sufficiently developed. Modern requirements of the game are such that basketball players need to maintain a high pace of play, while not reducing the quality of game performance.

Analysis of the playing load of basketball players during controlled games revealed the main parameters that should be used by coaches in preparation for competitions. These parameters should be reflected in the training exercises.To build an optimal training process for women's basketball teams, it is advisable to justify the effectiveness of training exercises depending on the intensity and calorie consumption.
The goal of research was in deciding the intensity of competitive loads and adapting the work-out session of high-qualification women`s basketball team based on the data obtained for the achievement of the best functional status and run of success.

Research methodology
10 women basketball players of "Rostov-Don-SFU" of Super League 1 were the participants of this research. The average age was 23 ± 3 years, the average height — 183.9 ± 8.7 cm, the average weight — 70.7 ± 9.7 kg. 47 games of the Russian Championship in basketball in 2018-2019 season and 42 games of 2018-2019 season have been analyzed.
During official games and training activity the functional status of sportswomen was monitored based on "POLAR Team System" in combination with HR sensors H10 with the updated algorithm and the highest accuracy of heart rate measurements. The data obtained for each player were recorded and carefully analyzed.
The HR monitor in basketball has 3 main applications: (a) monitoring the exercise intensity; (b) assessment of the player`s tiredness level; and (c) quantitative assessment of internal training load (Berkelmans et al., 2018).
The major share of playing time was accounted for seven basketball players amongst ten players who participate in the study - those are players who spent on the court more than 13 minutes on average per game in 2018-2019 and 2019-2020 seasons. The indices of this particular group of basketball players are of the greatest interest.
The team "Rostov-Don-SFU" since 2017-2018 season occupies the leading position in the Championship of Russia of 1 Super League. The high result of the performance was achieved largely due to the purposeful work on the development of endurance in the players and a clear planning of the training process, which is based on the optimal combination of exercises in different intensity zones (Andrianova et al., 2019).

Results
As a part of the study, it was found that the maximum heart rate indices of all basketball players who spent on the court more than 13 minutes per game in the 2019-20 season decreased by 10.4 b/min an average of the group and vary from 185 to 193 b/min (from 188 to 216 b/min in the 2018-19 season). It should be noted that Table 1 shows the average data obtained from the analysis of all games for two seasons (Table 1). During the monitoring, it was recorded for one of players the reduction of the maximum heart rate by 13.5% on average for the season.
The high level of heart rate indices indicates the intensity of loads and is reflected in the loss of kilo-calories per game. In comparison with the 2018-19 season, 6 amongst 7 basketball players became to spend more kilo-calories per game (2018-19 season - from 759 to 966 kcal per game, 2019-2020 season – from 854 to 1030 kcal per game).

During the data analysis obtained with the use of software-hardware package "POLAR Team System", it was possible to calculate the expenditure of kilo-calories per minute of playing time (Lenshina et al., 2019). This index also increased for 6 amongst 7 test persons in the 2019-20 season in comparison with the previous one. The largest change from 32 to 42.9 kcal per minute of playing time on average per season was recorded for one of basketball players.
It should be considered that one of the most significant factors affecting the intensity of physical activity of team sports representatives is the player position, the observed differences being probably significant [Abdelkrim et aal., 2007; Matthew & Delextrat, 2009; Abbott et al., 2018). Thus, the differences in the requirements for playing activity are explained by the higher concentration of blood lactate and HR reaction observed in defensive players in comparison with forwards and centers (Stojanovic et al., 2018).

Tab. 1. Dynamics of changes in average heart rate and kilo-calories consumption among basketball players of "Rostov-Don-SFU" in 2018-2019 and 2019-2020 seasons

Players	Average heart rate, beats/min		Max. Heart rate, beats/min		Number of kcal per game		Number of kcal/min		Play time	
	2018-2019	2019-2020	2018-2019	2019-2020	2018-2019	2019-2020	2018-2019	2019-2020	2018-2019	2019-2020
Mir-va I. (defender)	141	144	205	193	759	854	36.1	38.3	21	22.3
Gun-ko E. (forward)	136	141	192	183	800	1026	32	42.9	25	23.9
Mak-va A. (defender)	147	144	198	189	950	976	35.2	39.5	27	24.7
Kir-na A. (center)	127	139	216	187	771	1030	35	50.9	22	20.2
Zai-va A. (forward)	145	147	190	187	966	1009	38.6	36.9	25	27.3
Kart-ich A. (center)	135	129	190	185	938	923	67	70.4	14	13.1
Osip-va E. (center)	133	138	188	185	946	990	47.3	49.5	20	23.6

Insufficient development of physical qualities increases the duration of forming the special skills when taking possession of given sports techniques and decreases the efficiency of their use in competitive games (Koryahin et al., 2019). In this regard, it is advisable to pay attention to the development of the functional capabilities of sports players at all stages of training. The coaching staff of "Rostov-Don-SFU" for supporting the game high tempo during several seasons was at work upon the persistency of basketball players. In the training process of the team, a large amount of exercises with high and maximum intensity of load were present.

As a result, for most players of the "Rostov-Don-SFU" team in the 2019-2020 season, the playing time spent in the maximum intensity zone has significantly increased compared to the previous year. Figure 1 shows that in the 2018-2019 season, women basketball players spent an average of 3% to 25% per game in the red zone, while in the 2019-2020 season the same indicator varied from 16% to 27%. For one of basketball players, there was an increase from 3% to 27% (Gun-ko E.)(Figure 1).
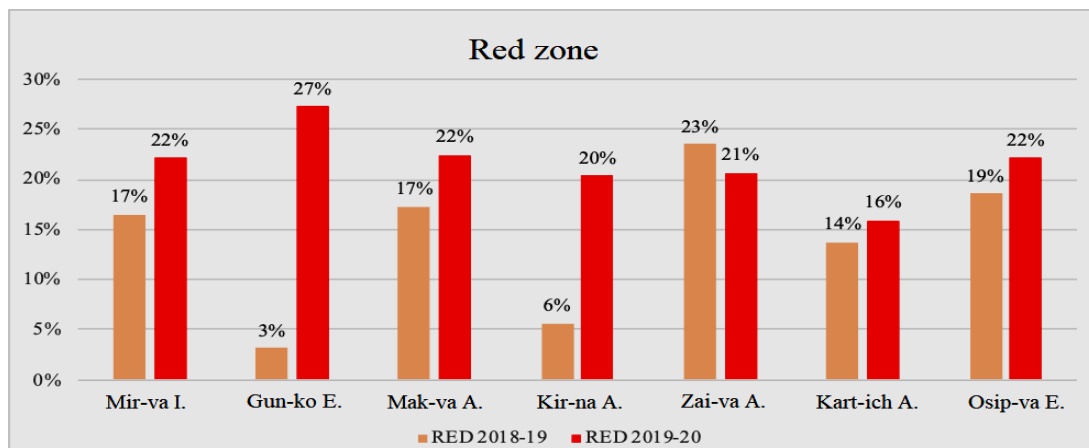

Fig. 1. Dynamics of changes in the time spent in the red zone of the load power of the players of "Rostov-Don-SFU" in the seasons 2018-2019 and 2019-2020.

Despite the increase in the intensity of basketball matches, it was possible to maintain a high level of quality in the actions of sportswomen. In the 2019-2020 season, Rostov-Don-SFU players showed a record-high implementation of two-point shots (48.5%) and foul shots (77.6%), active play on rebounds (49 rebounds per game). This fact indicates that sportswomen began better withstand the high pace of the game, while the game performance did not decrease. A similar situation turned out for one of the leaders of the team - Mak-voy A. who in 2019-2020 season 22% of playing time spent in the maximum intensity zone, which is by 5% higher than in the previous season. The playing load analysis for basketball players during controlled games revealed the main parameters that shall be used by coaches in preparation for competitions (Lubyshev, 1999; Nopin & Koryagina, 2016; Zakirov et al., 2019; Vala at al., 2019).

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The Rostov-Don-SFU team on the 8th and 9th of February played games with MBA-2 on the opponent's court. (65:90 and 61:72). On 18th and 19th of February, the team had a responsible series of matches with one of the main rivals for the Super League championship-1 – the NIKA-Syktyvkar team.

"Rostov-Don-SFU" players spent from 16% to 34% of the playing time in the maximum intensity zone. In particular, Mak-va A. spent 17: 34 minutes (19% of the time) on February 8 and 16:04 minutes (19% of the time) on February 9 in the red zone of intensity in games with MBA-2.

In the Super League-1 championship, doubles matches are held with a break of 7-10 days between the series. According to the proposed method, in the period between games, in addition to rest days, individual and throw training, 1-2 training sessions in an intensity mode similar to the game should be included. In the period under review between the series of matches from February 8-9 and February 18-19, it was necessary to rationally build the training process in order to approach the upcoming matches in optimal shape. According to the method of the coaching staff of "Rostov-Don-SFU", in the middle of the pre-game microcycle (February 14), a training session was organized, during which the basketball players had to spend an average of 15% to 25% in the zone of maximum intensity. All of 10 basketball players who were monitored worked in the required heart rate range (Figure 2).
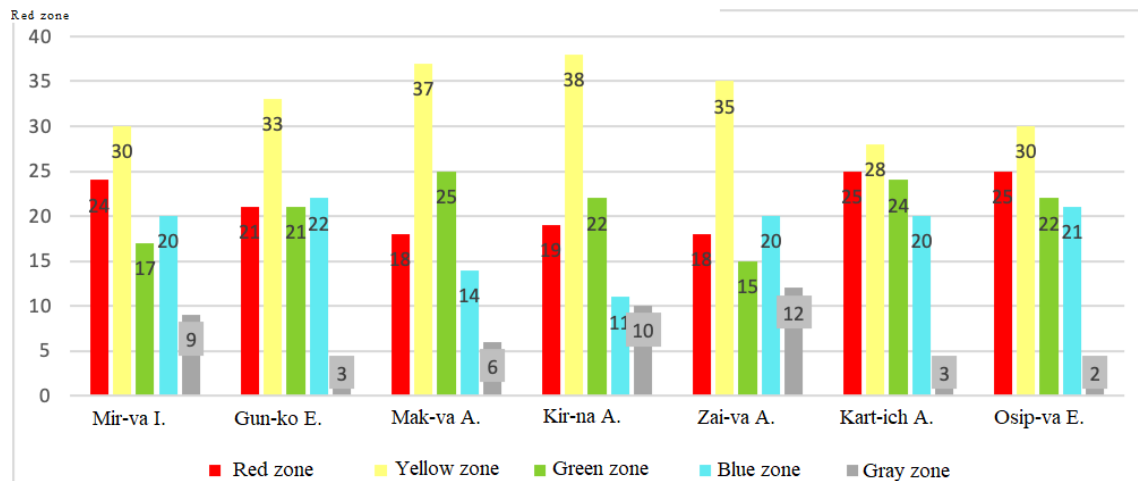

Fig. 2. The value of heart rate in zones of the load intensity of players "Rostov-Don-SFU" in training from 14.02.2020.

The basketball players of "Rostov-Don-SFU" were offered 14 training exercises, each of which had a certain functionality. According to the pulse curves of the basketball players, it was possible to trace what intensity zones each training task corresponded to (Figure 3).

Fig. 3. The value of the heart rate of the player "Rostov-Don-SFU" in training from 14.02.2

As part of the study, it was found that the following exercises can be considered as maximum similar ones to the game intensity when the heart rate achieves the largest value (Table 3):
1)   the game 3 against 3 for the entire court (*time on the pulse curve 33:15 – 53:20*). It is performed in threes with 2 baskets (3 threes) The three attacks a defensive tandem, the third defender joins with her team when the three crosses with a ball the center line. After a hoop, the defense team passes into the attack and

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makes attack on the opposite basket on a new three players and the attack team remains under the basket and passes into the defense. Time to complete – 15-20 minutes.

2)   hoops in threes in motion (*time on the pulse curve 54:00 - 1:07:20*). One player makes hoops from acceleration to the center and back to the basket for 45 seconds, two players rebound. Each player performs a task of 2 series. *The time required for action - 10-12 minutes.*

3)   game exercise in threes (*time on the pulse curve 1:13:20 - 1:33:40*). It is performed in threes with two baskets (3 threes). During three minutes, each team performs the same role. The first team attacks from the center to the second team, after the attack remains in defense under the basket. The second team, having played in defense against the first one, runs to attack the opposite basket. The third team stands on the front and after the attack of the first team catches up with the second team to play defense. It is possible pick up and finish off - for points. *The execution time is 15-20 minutes.*

In both matches against NIKI-Syktyvkar, the home team managed to win (80: 75 and 76:57), which was largely due to the high pace of the game. In both matches, the basketball players managed to spend from 13% to 34% of the playing time in the maximum intensity zone, while maintaining a high level of quality of the main indicators.

Thus, to develop and maintain the endurance of players in the training process, it is advisable to include intensive game tasks in threes with an attack on two rings, as well as variations of throwing tasks in high-intensity movement.

Conclusion

The study noted the positive dynamics of the results of basketball players who took part in the experiment in relation to competitive activity during two seasons. As a result of the experiment, for the majority of players of the Rostov-Don-SFU team in the 2019-2020 season, the playing time spent in the maximum intensity zone increased significantly compared to the previous year (from 3% to 25% per game in the red zone in the 2018-2019 season; from 16% to 27% per game in the red zone in the 2019-2020 season). Despite the fact that the players of the test team began to spend more playing time in the maximum load zone, the game performance did not decrease, it was possible to maintain a high level of quality in the actions of the athletes. In the course of the study, it was proved that in the process of preparing for competitive matches, it is advisable to conduct training sessions, during which basketball players spend an average of 15% to 25% in the zone of maximum intensity. This is necessary to maintain a high intensity of training loads, comparable to the game mode.

As part of the study, it was found that the following exercises can be considered as close as possible to the intensity of the game, when the heart rate reaches the highest value:

1) the game 3 against 3 for the entire court. It is performed in threes with 2 baskets (3 threes) The three attacks a defensive tandem, the third defender joins with her team when the three crosses with a ball the center line. After a hoop, the defense team passes into the attack and makes attack on the opposite basket on a new three players and the attack team remains under the basket and passes into the defense.

2) hoops in threes in motion. One player makes hoops from acceleration to the center and back to the basket for 45 seconds, two players rebound. Each player performs a task of 2 series.

3) game exercise in threes It is performed in threes with two baskets (3 threes). During three minutes, each team performs the same role. The first team attacks from the center to the second team, after the attack remains in defense under the basket. The second team, having played in defense against the first one, runs to attack the opposite basket. The third team stands on the front and after the attack of the first team catches up with the second team to play defense. It is possible pick up and finish off - for points.

With the help of data obtained on the basis of the software and hardware complex "POLAR Team System", it was possible to experimentally prove that the consumption of calories depends on the intensity of the match and the level of endurance of the player. It was found that at the stage of preparation it is advisable to maintain a high intensity of training loads, comparable to the game mode.

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