Optimization Research on Proportional Control of Multi-Ball and Single-Ball for Badminton

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Abstract: Repetitive multi-ball and single-ball are two indispensable training methods in badminton training. The training ratio of multi-ball and single-ball is allocated reasonably, which can make training intensity and training effect reach the best. Five groups of training plans are preliminary formulated by orthogonal experiment considering the training form and exercise load factors. The training time is one semester. The heart rate fluctuation of athletes are monitored during training each stage and analyzed statistically, meanwhile combined with the results of singles confrontation between groups. The training method is evaluated and optimized. The results show that the fastest heart rate of athletes by repeatable multi-ball and single-ball training are 178bpm and 153bpm, respectively. That is to say, proper multi-ball training can increase the intensity of exercise load to effectively stimulate the physical activity of athletes. The ratio of multi-ball to single-ball training is controlled at 2:2, which can achieve better training intensity and training effect.

1. Introduction

With the continuous improvement of the technical and tactical level of badminton competitions, the competition for domestic badminton competitions has become particularly fierce, and the training methods have been continuously improved and innovated. Among them, high-quality batting technology integrates fast ball speed, accurate placement, clever lines, and changes. It is the key to the score of the game to mobilize the opponent to the greatest extent, create obstacles for the opponent, and force the opponent to fail to keep up with the rhythm [1, 2]. However, the quality of batting will be affected by factors such as the condition of the ball, the awareness of batting, and the technique of batting. In order to improve the comprehensive physical strength of athletes and the ability of rapid sensitivity and thinking judgment in the process of competition, repeated, continuous, multi-group and short-term intermittent multi-ball training can be carried out in unit time to strengthen technical action stereotypes and muscle endurance training [3]. The basic technical movements and pace coherence reach a certain level. According to the time structure characteristics of badminton competition, the training time and the interval time between groups are set up for multi-group attack and multi-group defensive combination ball road exercises to enhance the athlete sense of ball and space for badminton [4, 5]. That is to say, the single-ball path, reaction speed, stability and training technology are complementary to each other in improving the competitive ability of badminton. X. Q. Qian [6] believes that multi-ball training is more flexible, and coaches can better control the speed and placement of the ball, but it will reduce the tactical awareness ability of athletes. J. C. Wang [7] believes that reasonable load intensity and training volume can effectively stimulate the athlete ability and improve the training effect.

2. Research Object and Method

2.1 Research Object

Ten badminton players were randomly selected from the male students of Xing-ming physical education school from Ningbo, with an average age of (16.8±0.6) years, an average height of (178.3±2.4) cm, and an average weight of (70.1±3.2) kg. They were randomly divided into five groups.

2.2 Research Method

In this paper, the orthogonal experiment method is used to design the training plan considering the training form, training technology, single ball and multi-ball training ratio, as shown in Table 1. The training time is one semester, and the heart rate of the athletes during the training process is monitored in real time. The frequency is 10 seconds/time. Training content: 1-forehand and backhand high ball practice, 2-forehand hanging ball and forehand and backhand net front pick ball practice, 3-forehand smash and forehand and backhand rubbing ball, hook ball, push ball comprehensive practice.

Table 1 Training Arrangement.

Group	Training proportion (Single- and multi-ball ratio)	Training form	
		Single-ball	Multi-ball
A	4:0	1-2-3	-
B	3:1	1-2	3
C	2:2	2-3	1-2
D	1:3	2	1-2-3
E	0:4	-	1-2-3

The training content of each group is the same, the training form is different, and the proportion of single ball and multi ball training is different. In order to ensure the effectiveness of training, before the experiment, the coach made a training plan according to the physical quality and technical level of the players, according to the training load, the number of cyclic practice groups and the interval time between groups : times of single-ball training is 10min per group, one to three athletes of each group; two athletes for multi-ball training of each group, 30 balls for each group, the actual number of training groups depends on the stage of training time.

3. Results and Analysis

3.1 Heart Rate Monitoring

The five groups of athletes in the experimental design were routinely trained according to the training plan shown in Table 1, and the heart rate of the athletes during the training process was monitored. The results of single-ball or multi-ball training, single-ball and multi-ball coupling training were compared to analyze the training intensity of the athletes.

3.1.1 Single- or Multi-Ball Training

Single-ball and multi-ball training are playing an important role in badminton training. By continuously sending repetitive multi-ball training with different speeds, different positions and different rotations, the coach can effectively improve the athlete technique and action rhythm. In terms of technical and tactical response to singles ability and ball path variability, it is necessary to pass single-ball multi-beat training closer to actual combat. In order to analyze the timeliness of single-ball training and multi-ball training in the training process, the players in group A and group E were trained in single-ball training and multi-ball training respectively. The heart rate fluctuation of athletes during training was monitored in real time by a smartphone heart rate detector. Figure 1 is the heart rate fluctuation and statistical histogram of athletes in a small training cycle.

(a)Heart rate fluctuation curve of single-ball or multi-ball training.

(b) Heart rate statistical histogram of single-ball training.

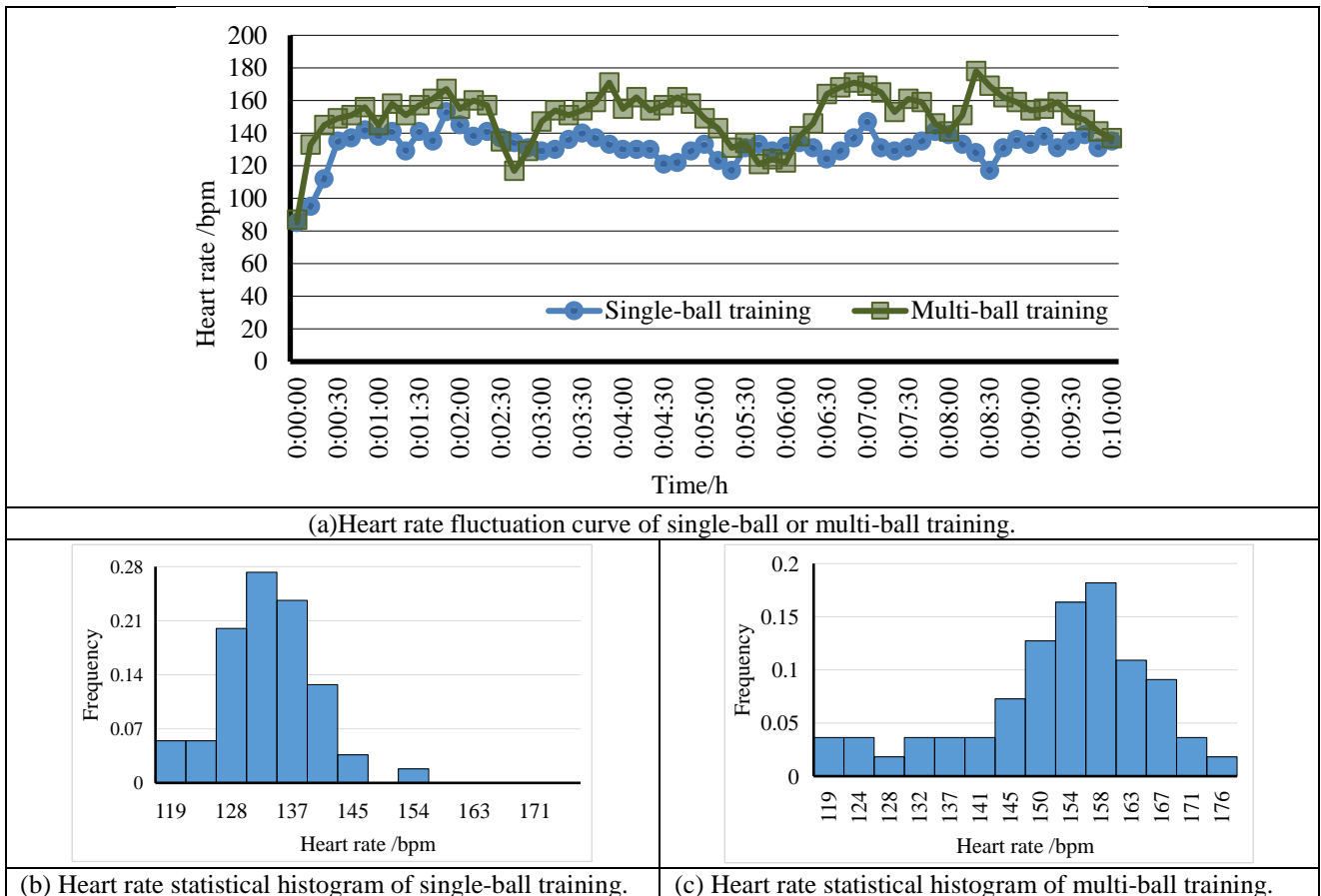(c) Heart rate statistical histogram of multi-ball training.

Fig.1 Heart Rate Monitoring and Statistical Analysis of Athletes by Training of Single- or Multi-Ball.

As shown in Figure 1, the fastest heart rate of athletes for single ball training is 153 bpm, and the average heart rate is 133 bpm (ignoring the heart rate fluctuation of 20s after the beginning and end of training); the fastest heart rate of athletes for multi-ball training is 178bpm, and the average heart rate is 152bpm. The heart rate of athletes for single-ball training is lower than that of multi-ball training. The main reason is that multi-ball training can reduce some objective factors affecting training. At the same time, the coach is responsible for serving and stimulating the athletes to achieve the best training state. In single-ball training, if the player makes more mistakes unilaterally, the practice density of both sides will decrease.

3.1.2 Single- and Multi-Ball Coupling Training

Through effective training methods to improve the performance of athletes to achieve competitive goals, the experiment considers the proportion of single-ball and multi-ball training, and designs three groups of athletes to train according to the B, C, and D training plans shown in Table 1. The heart rate fluctuation of athletes during the training process is monitored in real time, and the training effect is analyzed. Figure 2 shows the heart rate fluctuation curve and statistical histogram of single-ball and multi-ball coupling training athletes.
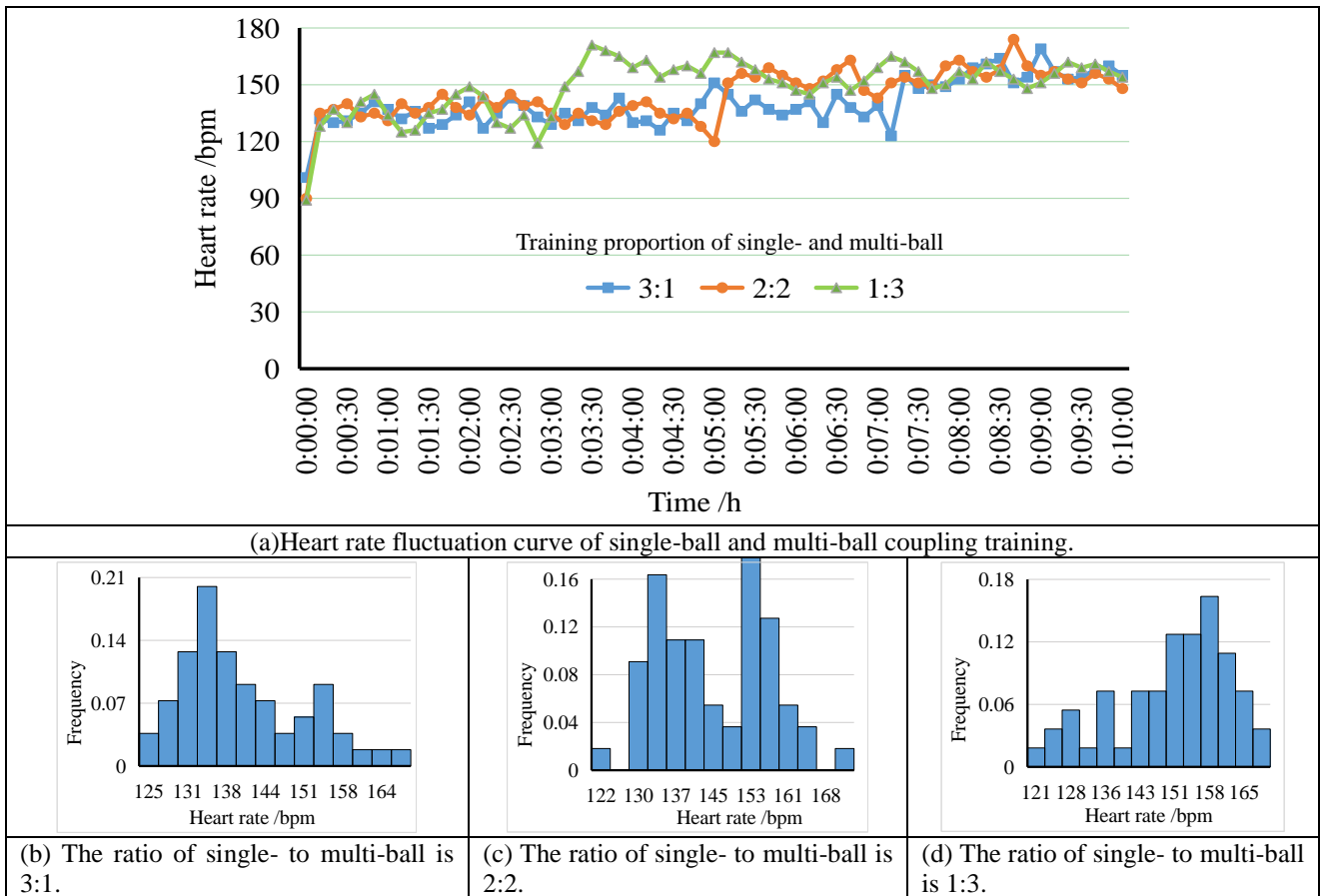
Fig.2 Heart Rate Monitoring and Statistical Analysis of Athletes by Training on Coupling of Single- and Multi-Ball.

It can be seen from Figure 2 that the fastest heart rate of athletes with a single-ball and multi-ball training ratio of 3:1 is 169 bpm, and the average heart rate is 140 bpm. The fastest heart rate of athletes with a training ratio of 2:2 is 174 bpm, and the average heart rate is 145 bpm; the fastest heart rate of athletes with a training ratio of 1:3 is 171 bpm, and the average heart rate is 150 bpm; with the increase of the proportion of multi-ball training, the average heart rate of athletes increases. That is to say, the intensity of multi-ball training is larger, which can improve the intensity exercise load and improve their performance of athlete.

3.2 Adversarial Training

In the five groups of athletes in the experimental design, one player was randomly selected from each group for singles cycle confrontation, and the training intensity and training effect were evaluated by the maximum heart rate value and the confrontation result of the athletes in the confrontation process. The results of singles confrontation are shown in Table 2.

Table 2 Athletes Rankings Of Singles Badminton Match.

	A(163bpm)	B(165bpm)	C(171bpm)	D(168bpm)	E(165bpm)	Rank
A	-	21 :17	16 :21	15 :21	18 :21	4
B	17 :21	-	18 :21	19 :21	18 :21	5
C	21 ;16	21 ;18	-	21 :20	21 :19	1
D	21 ;15	21 :19	20 :21	-	21 :18	2
E	21 ;18	21 :18	19 :21	18 :21	-	3

It can be seen from Table 2 that the experimental design according to group C (2:2) and group D (1:3) training athletes against the results of better, more can affect the athletes in the game play and performance; combined with Fig.2 (c), the heart rate of group C routine training athletes fluctuated between 135 bpm and 155 bpm. During the training process, the fatigue caused by exercise was properly alleviated, the physical function was improved, and the recovery of the body was

accelerated.

4. Conclusions

(1) Experimental design The maximum heart rate of athletes was 171 bpm during routine training and adversarial training.

(2) The training effect of single-ball depends on the error frequency and practice density between athletes, plus uncertain factors. With the increase of the proportion of multi-ball training, the average heart rate of athletes gradually increases, which is easy to stimulate the performance of athletes.

(3) When the ratio of single-ball and multi-ball training is 2:2, the training intensity of athletes is moderate and the training effect is the best.

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