Effects of badminton training with competitive motivation on the physical fitness of middle-aged men and women

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Summary

The present study investigated the effects of one year of badminton training with competitive motivation on the physical fitness of middle-aged men and women. For men, all measurements, except for sit-and-reach, improved, and for women, most measurements improved. At the beginning of training, the mean duration of 5-point doubles was 4 minutes. This duration increased to 5.5 minutes one year later. The reason for this improvement was considered to be physical adaptation to exercise intensity, exercise frequency, quick movements unique to badminton, and repetitive exercise, such as basic hitting strokes. Furthermore, it was considered that competitive motivation based on monthly scores allowed the members to continue to exercise.

Ⅰ Introduction

In order to maintain and promote health, we formed a badminton club for faculty members to train and play during lunch breaks and after work (basic training and doubles games). Initially, we played doubles with regular scoring; however, because we could not always secure enough courts, some members could not play a sufficient number of minutes. Therefore, we experimented with the scoring system so that each member could play for a duration that maintains and promotes health. We found that 5-point games were effective for allowing the members to play for 20 to 30 minutes, reaching a mean exercise intensity of 54% HRmax reserve[15]. Previous studies have demonstrated that this level of exercise intensity allowed individuals who were not physically fit to improve their cardiopulmonary function [1,5]. While various sports activities improve physical fitness [2,5,6], the continuation of an exercise program is an important issue and is difficult for middle-aged men and women and people who do not exercise regularly.

We have continued the regular activity of the badminton club for more than one year. Rather than simply practicing and playing badminton, we maintained records of our games and tabulated monthly scores. We consider that this stimulation motivated the members to train harder and facilitated their continued participation in the exercise program. By investigating the members of the badminton club, the present study investigated the effects of one year of training with competitive motivation on the physical fitness of middle-aged men and women.

Ⅱ Methods

1. Subjects

Subjects were healthy middle-aged individuals (4 men and 3 women) who provided informed consent to

Table 1 Age and physical characteristics of subjects

Variable	Mean ± SD	Range
Age(yr)	47.1 ± 9.4	30 - 57
Height(cm)	166.4 ± 7.0	152.6 - 172.0
Weight (kg)	64.3 ± 8.5	52.0 - 75.0
Fat(%)	25.3 ± 4.8	19.5 - 30.6
Fat(kg)	16.2 ± 3.7	11.6 - 22.0
FFM(kg)	48.1 ± 7.4	37.4 - 60.4

n=7(men=4, women=3)

participate prior to the start of the study (Table 1). All subjects were beginner badminton players.

2. Frequency and contents of training

Generally, the club met for approximately 40 minutes during lunchtime three to five days per week and for approximately 2 hours after work twice per week. In addition, once per month, the club held a 2-hour practice in the morning and a 3-hour practice in the afternoon.

After properly warming up, members generally practiced basic hitting strokes (high clear, drive, drop shot, and smash) for 15 to 20 minutes and then played doubles.

3. Rules and game time

In order to allow many members to play doubles, 5-point games were played [15]. Games were videotaped using a digital video camera (Sony Handycam DCR-PC300K, Tokyo) at the beginning of the training program and one year later in order to compare the duration of games.

4. Monthly scores

In order to motivate the members to practice, individual scores were recorded, and monthly scores were calculated for each member (total score in a month divided by number of games played). The members were ranked according to monthly scores. The aim of this ranking system was to allow the members to compete to improve not only their scores, but also their skills.

5. Physical fitness measurement

Grip strength (mean for left and right sides), sit-ups (number of times), sit-and-reach (distance), side step (number of times), 20 m shuttle run (number of times), and standing long jump (distance) were measured. These measurements were collected according to the methods established by the Ministry of Education, Culture, Sports, Science and Technology [7].

Table 2 Physiological intensity, rating of perceived exertion, and duration of a doubles game in 5-point system(beginning of training)

	Mean ± SD	Range
Heart rate(bpm)	126.1 ± 16.9	99.3 - 139.7
%HRmaxreserve	56.5 ± 14.7	31.9 - 71.4
RPE	11.3 ± 0.5	11 - 12
Duration(min)	3.6 ± 1.2	2.3 - 5.3

n=7(men=4, women=3)
The mean values were calculated from the mean of each game.

6. Physiological intensity and rating of perceived exertion during a doubles game

In the present study, the physiological intensity and rating of perceived exertion (RPE)[8] were measured during a doubles game of badminton. During the exercise, heart rates (HR) were continuously measured at one-minute intervals using a 64-Kbyte heartbeat memory device (TAKEI, Niigata, Japan). In addition, %HRmax reserve was obtained using the following equation:

%HRmax reserve
= (HRexercise − HRrest)/(HRmax- HRrest) × 100

where HRexercise is the heart rate during exercise, and HRrest is the heart rate at rest. HRmax was predicted using the following formula: HRmax = 210 − 0.8 Age.

7. Measurement of body composition

Percent body fat, fat mass and fat-free mass were measured using an Omron body composition measuring instrument (Omron, HBF-300, Tokyo).

8. Statistical analysis

Measured values were expressed as mean ± standard deviation. A paired t-test was used to compare game duration before and after training. Statistical significance was established at the $p<0.05$

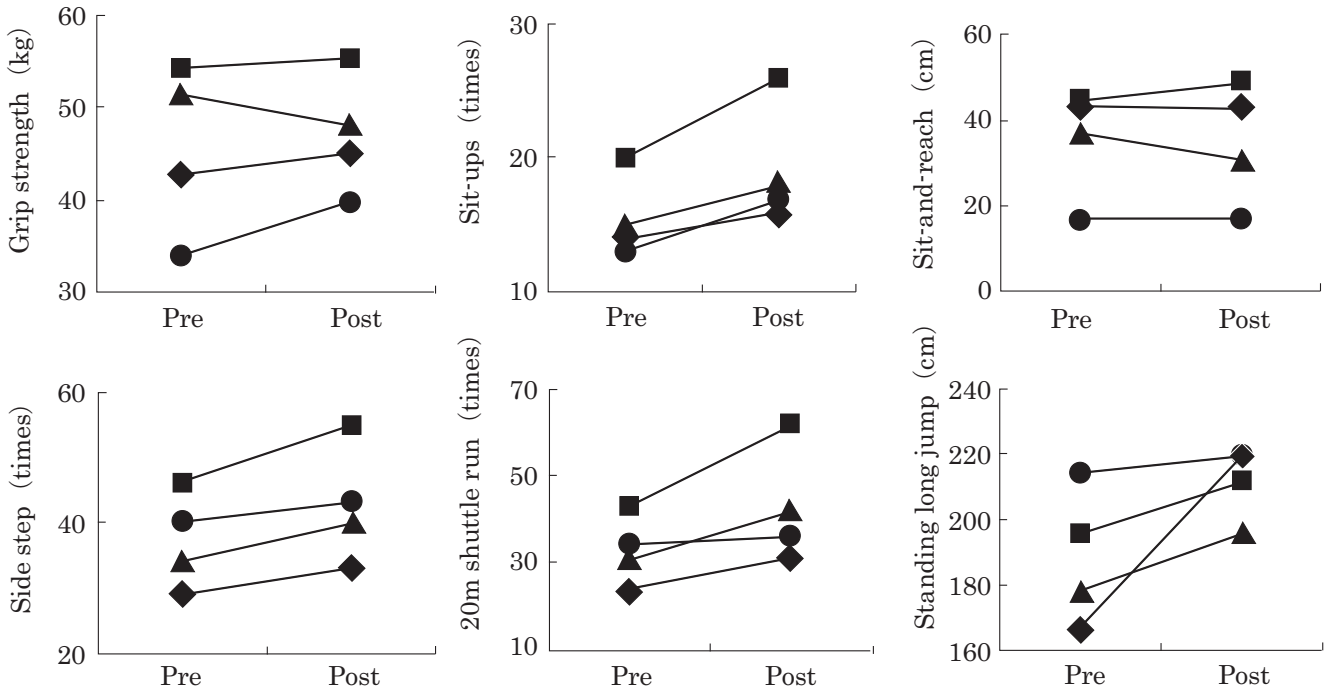

Fig.1　Changes in physical fitness after one year of badminton training in men

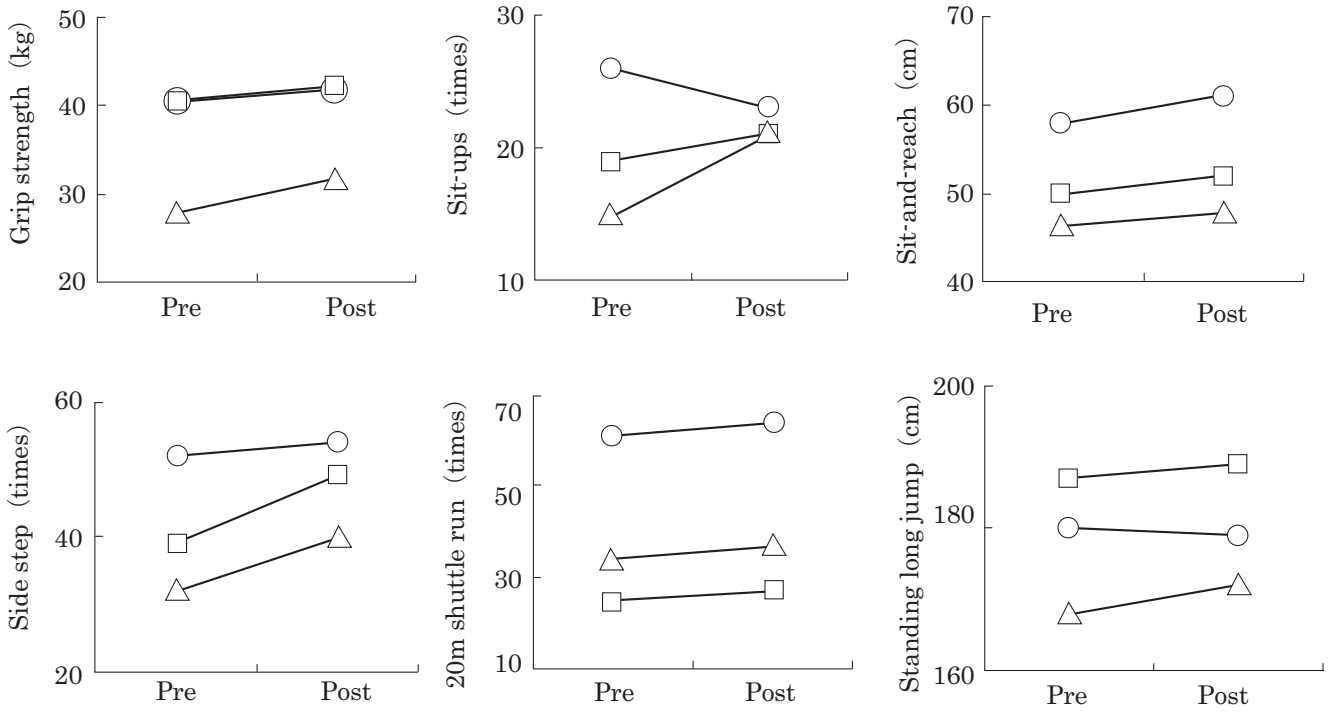

Fig.2　Changes in physical fitness after one year of badminton training in women

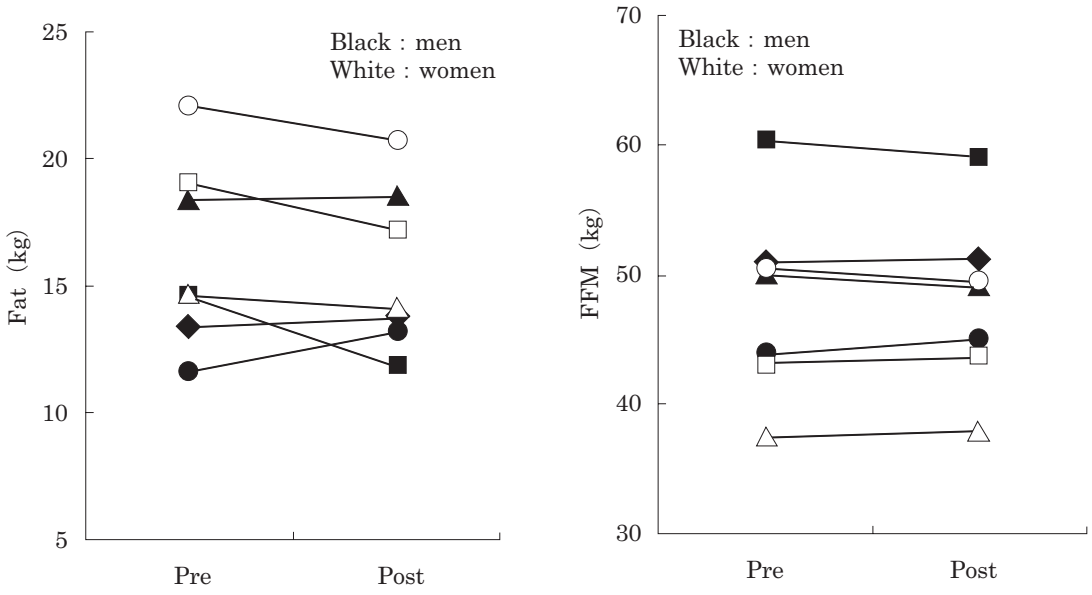

Fig.3 Changes in body composition after one year of badminton training in men and women

level.

Ⅲ Results and Discussion

Figures 1 and **2** compare physical fitness measurements before and after badminton training. Because the number of subjects was low in the present study, individual data are shown. For men, all measurements, except for sit-and-reach, improved (**Figure 1**). For women, most measurements improved; however, the sit-up score for one woman decreased due to lumbar pain. Thus, after one year of training, such motor ability indicators as side step, 20 m shuttle run, and standing long jump, improved for both men and women. The reason for this improvement was considered to be physical adaptation to exercise intensity (**Table 2**), exercise frequency, quick movements unique to badminton, and repetitive exercise, such as basic hitting strokes. Furthermore, it is possible that physical fitness improved due to reduced body fat (**Figure 3**). Therefore, excess body fat negatively affects physical fitness and motor ability [3,4,9,13,14], while reduction in body fat is beneficial to physical fitness and motor ability. In the present study, side step scores improved significantly for one man and one woman who lost 2.8 kg and 1.8 kg of body fat, respectively. These findings suggest that training improved physical function and reduced body fat, which lead to improved physical fitness.

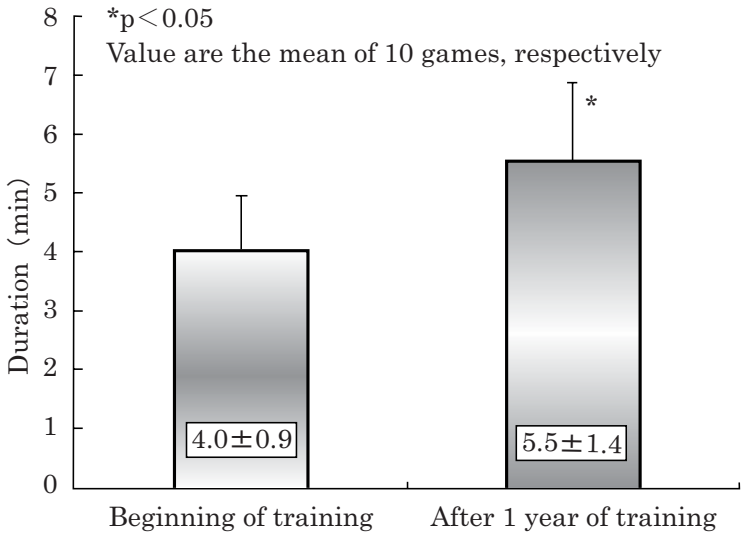

Fig.4 Comparison of duration of duobles games at the begining of training and after one year of training

In the present study, the duration of doubles games was measured by observing videotapes (**Figure 4**). At the beginning of training, the mean duration of 5-point doubles was 4 minutes. This duration increased to 5.5 minutes one year later. In the present study, since motion analysis was not conducted, skill changes could not be ascertained; however, we

consider that the competition among the members to improve their monthly scores had some effect. In the future, it will be necessary to closely analyze changes in body movements using motion analysis.

For middle-aged men and women, changes in aerobic power or muscle endurance in daily living are important health indicators [12]. In the present study on middle-aged men and women, the effects of badminton on physical fitness were ascertained, and the results showed improved physical fitness for both men and women after one year. Similarly, regular exercise appears to improve health, in terms of aerobic power [1,2,5,11], and muscular strength and agility[10], even for middle-aged men and women. However, in each situation, it is necessary to devise a method for encouraging and facilitating the continuation of an exercise program. In the present study, competitive motivation based on monthly scores allowed the members to continue to exercise and improve their skills. In order to improve physical fitness and prevent obesity in not only middle-aged men and women, but also in children, it is important to utilize competition to motivate people to continue to exercise.

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中年男女の体力に対する競争的動機づけをともなうバドミントンの効果

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本研究は、中年男女の体力に対する競争的動機づけをともなうバドミントンの 1 年間の効果について検討した。男性の体力は、長座体前屈以外の項目で改善が見られた。女性に関しては、ほとんどの項目で改善がみられた。ダブルスゲームの持続時間は 5.5 分に増加した。これは、運動強度や運動頻度、バドミントンに特有の迅速な動き、さらに基礎打ちの反復運動による身体適応と考えられた。さらに、毎月のスコアに基づく競争的な動機づけがメンバーの運動を継続させているものと考えられた。

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