



Effect of High Intensity Interval Circuit Training on the Development of Specific Endurance to Some of Essential Skills in Youth Badminton Players

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ABSTRACT

High intensity interval circuit training leads to a substantial increase in specific endurance to performance some of essential skills in youth badminton players. Interval training by circle style is an important training method for the badminton players. However, it is unclear whether high intensity interval training by circle style is sufficient to improve specific endurance (strength and speed) and some basic skills, for example, (Forehand and backhand shot). Therefore, our aim was to investigate whether high intensity interval training by circle style conferred any greater changes in skills performance and specific endurance. Sixteen local level badminton players completed a set of performance tests in the week before and after a 4-week training period. Performance tests consisted of forehand and backhand shot test, bench press for 30 second, abdominal muscles test for 30 second, run 180m, and jumping for distance by two foot. After pretesting, pair matched participants were randomly assigned into intervention group and control group. Both groups undertook regular national squad training consisting of 2-4 hours sessions per week. In addition, the experiment group completed a high intensity interval training consisting of 6 to 3 repeats of badminton-specific endurance three times per week. Control used their normal training program, the intervention training group reported improvements in all tests. However, there was no substantial difference in all tests of the study. High intensity interval circuit training appears to lead to worthwhile increases in forehand and backhand shot test, bench press for 30 second, abdominal muscle for 30 second, run 180m, and jumping for distance by two foot with national level badminton players. The paper provides information on the past status of the urban policy in Iraq and illustrate the new attitude that appeared after 2004 represented with the new principles of spatial planning. In conclusion, this research suggests a group of Proposals that could help to improve the urban policy to achieve urban development goals.

Keywords: High intensity interval circuit training, Specific endurance, Essential skills, and Badminton.

1. Introduction

Badminton is a highly competitive dynamic sport needing great demands on the cardiorespiratory and muscular systems. Heart rates have been informed to approach 100% of maximum heart rate and average 169 b.min⁻¹ during competition (Faccini and Dal Monte., 1996). Analysis of blood lactate concentrations during competition display values may reach 3 to 6 mmol.L⁻¹ (Majumdar *et al.*, 1997). Motion analysis of a typical badminton match exposes that there are many alterations in direction and points range in duration between 1 and 40 seconds, with the average point lasting 6.8 seconds and the rest period between points being only 5 to 10 seconds (Cabello-Manrique, and Gonzalez-Badillo., 2003). In addition, demands alternate between energy provision for bouts of high-intensity work (e.g., several strokes, quick changes of direction, short accelerations, and decelerations), via intramuscular phosphates and glycolysis, and replenishing energy sources and restoring homeostasis during the intervals in between (by oxidative metabolism) (Fernandez *et al.*, 2009; Glaister., 2005). Thus, it appears that the training of competitive players should focus on improving their ability to repeatedly perform high-intensity exercise and to recover rapidly from it (Fernandez *et al.*, 2009). For these reasons, it seems that badminton players should maximize their specific endurance (strength and sprint) capabilities to enhance their on court success. However, there is little information on whether forehand and backhand shot and specific endurance (strength and sprint) for badminton players is improved through high intensity interval training by circle style. High-intensity interval training is a form of interval training consisting of short bouts of all-out activity separated by rest periods of between 20 s and 5 min. It is a low-volume strategy for producing gains in aerobic power and endurance normally associated with longer training bouts (Christian., 2001). Several researchers have revealed that high intensity interval training has a positive effect on muscle buffer capability, maximal aerobic power, the rate of phosphate creatine resynthesis, and lactate tolerance, resulting in superior specific endurance performance (Glaister, 2005). However it is not possible to distinguish whether interval training confers any further benefit. Majumdar *et al.* (1997) demonstrated that high intensity interval training in on court technical training lasted for 40 to 50 seconds, a duration that is useful in improving specific endurance.

Speed endurance and strength endurance based training is characterized by performing repeated sprints and forces with minimal recovery between sprint and forces bouts (i.e., 8–4 maximal sprints or strength of #10 seconds, with brief recovery periods (#60 seconds); work: rest ratio of 1:4 – 1:6) (Glaister, 2005). Therefore, for badminton players, improving specific endurance by circuit training sessions are used to build strength and endurance at the same time, strength and cardiovascular circuit training session is designed primarily to strengthen the arms and legs, and improve range of motion. Most circuit exercises work multiple muscle groups while providing cardiovascular workouts with higher intensity than normal exercise sessions.

High intensity interval circuit training is not a new concept, but it is growing in popularity because of its efficiency and practicality for a time-constrained society. The combination of aerobic and resistance training in a high-intensity, limited-rest design can deliver numerous health benefits in much less time than traditional programs (Gibala *et al.*, 2006; Little *et al.*, 2010). When body weight is used as resistance, it eliminates the limiting factors of access to equipment and facilities. However, despite the growing effectiveness from the above-mentioned training strategies for badminton sports, to the authors' knowledge, no studies have focused on the effects of high-intensity interval circuit training on specific endurance in badminton players. Therefore, the aim of this study was to investigate whether high intensity interval circuit training conferred any greater changes in skills performance and specific endurance.

2. Methods

2.1 Experimental Approach to the Problem

In this investigation, 16 male elite youth badminton players from Akaad club were randomly assigned into 2 treatments: high intensity interval circuit training group and a control group that supplemented regular training with coach program. A test of forehand and backhand shot, bench press for 30 second, abdominal muscle test for 30 second, run 180m, and jumping for distance by two foot were performed before and after completion of 4 weeks of training. In experiment group, participants trained 3 times per week for 4 weeks, and each session lasted approximately 1 to 2 hours. In control group, participants completed a regular training that supplemented by coach four times a week.

2.2 Subjects

Sixteen members of the Akaad club elite badminton squad volunteered to participate in this study in the pre competition training phase. The participants had the following characteristics: age = 16 -17years; height = 174-177cm; mass = 77-79kg, table (1) shows characteristics of the participants. The athletes provided written informed consent, and the study was approved by the human research ethics committee of the University of Salahaddin.

Table (1) shows characteristics of the participants

Variables	Control group		Experiment group		T test	Significant
	Mean	SD	Mean	SD		
Age \ year	16.75	0.707	17.37	0.744	1.72-	0.109
Height \ cm	177	5.45	174	7.67	0.71	0.489
Mass \ kg	77.9	11.8	79.5	12.1	0.27-	0.790

Table (1) appears that differences are no significant among two groups in age, height, and mass and the results (0.790) (0.489) (0.109) respectively are greater than (0.05). It means that participants are homogenous.

And we made the equal between participants as demonstrated in table (2).

Table (2) appears the equal among participants in physical tests.

Variables	Control group		Experiment group		T test	Significant
	Mean	SD	Mean	SD		
Bench press for 30s	18.38	1.13	19.50	1.77	1.15	0.271
Abdominal muscles test for 30 s	15.13	1.55	14.88	1.28	0.37	0.718
Run 180 m	35.94	1.32	36.69	1.13	1.62	0.128
jumping for distance by two foot	14.5	1.90	13.9	1.30	0.16	0.878

The results are significant at the level of (0.05).

Table (2) seems that differences are no significant among two groups in physical tests.

Table (3) demonstrates the equal among participants in skill tests.

Variables	Control group		Experiment group		T test	Significant
	Mean	SD	Mean	SD		
Forehand Test	13.4	1.85	14.8	1.67	0.99	0.337
Backhand Test	14.5	0.86	14.9	0.67	1.23	0.241

The results are significant at the level of (0.05).

Table (3) shows that differences are no significant among two groups in skill tests.

2.3 Measurements

2.3.1 Skill tests

- **Forehand and backhand tests:** (Ray Collins and Patrick., 1978).
- Tests purpose: Measure the ability of a player's skill in the Forehand and Backhand in badminton.
- Tests applied: Applied on samples of institutes and faculties and for males and females.
- Tools: Rackets, shuttlecocks, court as shown in Figure (1).

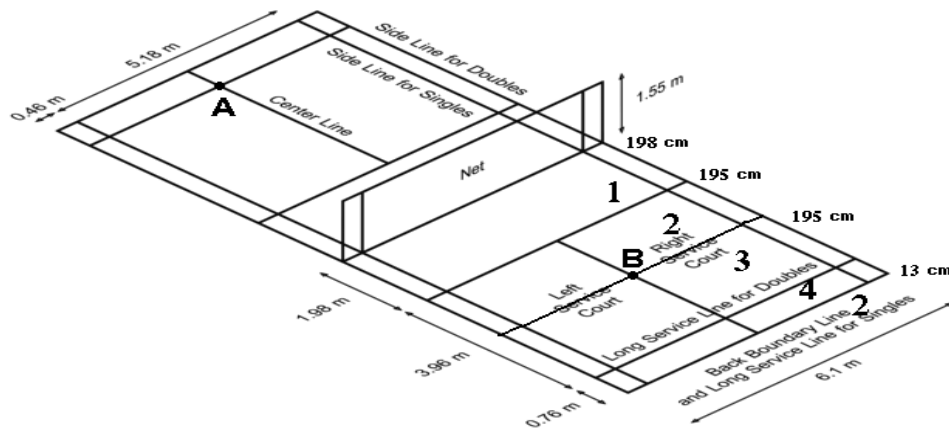


Figure (1) shows badminton court

- Procedure: Five Zones were marked as shown in Figure – 1. Tester served high from the right service court towards the forehand or backhand side of the subject. Player being tested stood in the right court and smashes it into the target area across the net and tried to score maximum points.
- Scoring: The score was awarded according to the point where the base of the shuttle struck the floor. Shuttles falling on a line were awarded higher point values. Shuttles going out bounds or falling short of the scoring zones scored no points. The subjects were given 12 trials of 12 chances each. The sum of the best of the 10 trials was the score of the subject.

2.3.2 Physical tests

- Bench press test for a duration 30s:

- Test purpose: Measure of arms speed endurance:
- Tools: Testing doesn't need to tools due to it is performed on the floor.
- Procedure: Lie on your abdomen with your feet flat on the floor and the player has to be straight, starts to push by his arms and then bend his arms until 30 second.
- Scoring: Count the correct performance of push and bend arms. Figure (2) shows the test.

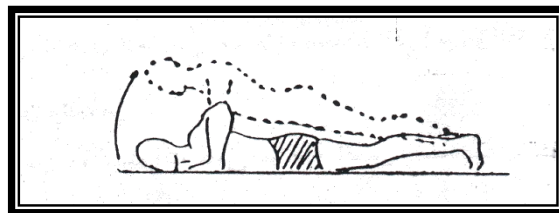


Figure (2) shows bench press test for a duration 30s

- Abdominal muscles test for 30 second: (Site 1).

- Purpose: Measure of speed endurance for abdomen muscles.

- Tools: Carpet and timer clock.

- Procedure: Lie flat on your back on the floor. Take a deep breath, suck in your stomach, keep your eyes focused on the ceiling, and raise your upper body off the ground until it is at a 45-degree angle with the floor. Don't pull on your neck, as this can lead to forward head posture, neck pain and, in extreme cases, migraine headaches. Slowly return to the starting position. Perform for duration of 30 second.

- Scoring: Recording only correct performance during (30s) figure (3) shows abdominal muscle test.

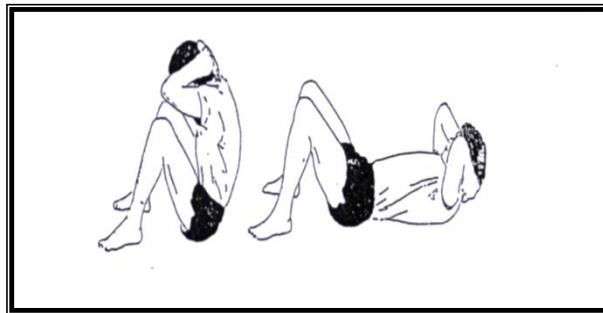


Figure (3) shows abdominal muscle test.

- Run 180m test:

- Purpose: measure of speed endurance of legs.

- Tools: Stop watching, four signs, and measure tape.

- Performance: Player run from first sign to second one and then return to starting after that run to the third sign and return to starting then run to the forth sign and return to starting.

- Scoring: Recording the time that player completes the test.

- Jumping for distance by two foot test:

- Purpose: Measure of strength endurance for legs.

- Tools: Stop watching and two lines to determine of starting and ending.

- Performing: Player stand back up of starting line and starts jumping for one minute.

- Scoring: Records the distance covered player from the starting line until the end of the period of time prescribed figure (4) shows jumping for distance by two foot test.

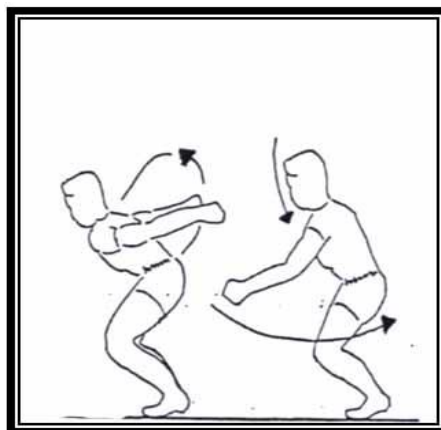


Figure (4) shows jumping for distance by two foot test

2.4 Pre-tests

Forty eight hours before reporting to each laboratory session, Tests were hold on November 17, 2013 in Akaad club, each participant was demanded to sleep a minimum of 8 hours, and drink adequate fluid to ensure a hydrated state. Upon reporting to the national badminton training center in Iraq (ambient temperature 30 to 32°C), participants initially completed a warm up protocol consisting of 7 minutes of stretching of the leg muscles and light jogging. On preformation of the warm up, the participants achieved a badminton specific test of forehand and backhand. The bench press for 30 second, abdominal muscles for 30 second, run 180m, and jumping for distance by two foot tests required the participant to perform tests on a badminton court.

2.5 Training approach

After pretesting, pair matched participants were randomly assigned into experiment and control groups. Both groups undertook regular national squad training consisting of 2-4 hours sessions per week, 12 training unit, three units a week (Saturday, Monday, and Wednesday), four weeks duration training. In addition, the experiment group required to complete a high intensity interval circuit training consisting of 6 to 3 repeats of badminton-specific endurance. Control used their normal training program.

2.6 Post-tests

Participants completed the post tests on December 19-20, 2013 in the same order, at the same time of day, with the same recovery duration between each test. In addition to the post tests, the tests were repeated on a further occasion 72 hours after the multistage fitness test to establish the reliability (test retest error) of the test.

2.7 Statistical analysis

Study used following statistics:

- 1- Percentage.
- 2- Mean.
- 3- Standard deviation.
- 4- T-test of dependent samples.
- 5- T-test of independent samples.

3. Results and discussion

The results obtained for the control group before training are presented in Table (4). The maximum (mean (SD)) forehand, backhand skill tests, bench press for 30 second, abdominal muscles for 30 second, run 180m, and jumping for distance by two foot tests recorded during the tests were 13.4(1.76), 14.5(0.86), 18.38(1.13), 15.13(1.55), 35.94(1.23), 19.15(1.90) respectively. Mean (SD) values for control group at the study variables after training were 24.56(1.75), 22.08(1.44), 22.25(1.88), 33.22(1.77), 18.33(1.23), 20.21(1.22) respectively. T-test calculated on the basis of these data is presented in Table (1). T-test coefficients were compared with the corresponding coefficients derived from the rank order list. There was a low improvement between pre and post training ($P > 0.05$).

The baseline characteristics and performance for experiment group are depicted in Table (5). There were in substantial differences in performance in both forehand and backhand skill tests between pre and post training. However, there were moderate to high improvements in each of bench press for 30 second, abdominal muscles for 30 second, run 180m, and jumping for distance by two foot tests in the same group.

The baseline features and performance for both groups in post-tests are described in Table (6). There were in significant differences in current study variables. However, forehand, backhand, bench press for 30 second, abdominal muscles for 30 second, run 180m, and jumping for distance by two foot tests were improved in experiment group more than control group.

Table (4) shows pre and post-tests for control group in study variables.

Variables	Pre-test		Post-test		T test	Significant
	Mean	SD	Mean	SD		
Bench press for 30s	18.38	1.13	20.21	1.22	3.43	0.000
Abdominal muscles test for 30 s	15.13	1.55	18.33	1.23	2.45	0.003
Run 180 m	35.94	1.23	33.22	1.77	4.50	0.000
jumping for distance by two foot	19.15	1.90	22.25	1.88	5.18	0.001
Forehand Test	13.4	1.76	22.08	1.44	3.09	0.011
Backhand Test	14.5	0.86	24.56	1.75	2.55	0.000

Significant at level of (0.05).

Table (5) demonstrates pre and post-tests for experiment group in study variables.

Variables	Pre-test		Post-test		T test	Significant
	Mean	SD	Mean	SD		
Bench press for 30s	19.50	1.77	30.12	1.95	4.30	0.004
Abdominal muscles test for 30 s	14.88	1.28	20.11	1.07	8.52	0.000
Run 180 m	36.69	1.13	30.01	0.65	6.89	0.000
jumping for distance by two foot	13.9	1.30	19.02	1.52	8.66	0.000
Forehand Test	14.8	1.67	29.9	1.22	5.11	0.000
Backhand Test	14.9	0.67	28.08	1.65	4.43	0.000

Significant at level of (0.05).

Table (6) appears post-tests for both groups in study variables.

Variables	Control group Post-test		Experiment group Post-test		T test	Significant
	Mean	SD	Mean	SD		
Bench press for 30s	20.21	1.22	30.12	1.95	3.67	0.003
Abdominal muscles test for 30 s	18.33	1.23	20.11	1.07	2.97	0.010
Run 180 m	33.22	1.77	30.01	0.65	2.47	0.027
jumping for distance by two foot	22.25	1.88	29.02	1.52	2.61	0.021
Forehand Test	22.08	1.44	29.9	1.22	3.14	0.002
Backhand Test	24.56	1.75	18.08	1.65	2.44	0.001

Significant at level of (0.05).

Badminton needs the performance of effort in the nature of starts, jumps, stops, leaps, rapid changes of direction, lunges, sprints twists and turns and a variety of strokes (Dewney and Brodie., 1980). To be an elite badminton player, the fitness, capability and ability requirements are quite specific. Over the previous little years, badminton as played in Iraq has focused a greater emphasis on fitness and ability especially in terms of speed endurance and strength endurance (Reilly *et al.*, 1990). Improved specific endurance and badminton skills due to our training program may indicate that there are other important factors besides general training by the coach, which are essential for success in top level badminton competitions. The aim of this study was to determine whether the addition of 4 weeks of high intensity interval circuit training eased a greater change in an athlete's skills and specific endurance. A three game match of badminton can last from 35 min to over 1 h in an international competition. It consists of short bursts of activity followed by short rest periods. It has been assessed that 30% anaerobically and 60-70% of the energy during play is consequent aerobically (Lei *et al.*, 1993). For this reason, high intensity interval training method is very important to develop physical level thus improve energy expenditure that helps to preformation continuous and then results in improve badminton skill, for example, forehand and backhand skills. My main finding was that high intensity interval circuit training substantially improved experiment group as determined by a greater accumulation of reference points (approximately 5%) in the performance test after training. Control training did not change the indicators of specific endurance and skills of badminton over time. My findings indicate that a substantial training effect in specific endurance and skills of badminton can occur with only after a 4 week period. Researcher referred to that training program was very effectiveness due to it was structured on right scientific way and taking into account the privacy of the training phase.

Investigators found that high intensity interval circuit training may improves specific endurance (Mohamad., 2010; Jassim., 2008). These findings are in agreement with another interval training study, conducted on a badminton court which informed that high intensity interval training results in develop physical level and players' skills (Gregson., 2009). For highly skilled badminton athletes, Ammar has observed that specific endurance improving leads to improve badminton skills generally (Ammar *et al.*, 2008).

4. Conclusion

Researcher believes that high intensity interval circuit training appears to lead to worthwhile increases in forehand and backhand shot test, bench press for 30 second, abdominal muscle for 30 second, run 180m, and jumping for distance by two foot with national level badminton players in experiment group but no improved was seemed in control group.

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