

Examining Lactate Changes during High Intensity Spinning® Training

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Abstract The aim of the study was to examine the changes in the acute blood lactate levels of elite taekwondo players when carrying out high-intensity interval training on Spinning® bikes. Twenty elite-level taekwondo athletes participated in the study. The subjects were selected from athletes who had been competitors for at least six years. Their average age, height and weight values were determined to be 18.89 ± 2.07 years, 176.8 ± 8.73 cm and 70.59 ± 12.13 kg respectively. In the present study the subjects carried out high-intensity interval training using Spinning bikes based on the Tabata protocol. The loads were applied as a total of four sets of eight repetitions with the principle of 20 seconds of load followed by 10 seconds of rest with one-minute's rest given between sets. The subjects' lactate levels were measured from their fingers using the Accutrend Lactate portable lactate analyzer with the help of the strips provided. Lactate measurements were made five times: before training (Pre), after Set 1 (1S), after Set 2 (2S), after Set 3 (3S) and once the exercise was over (Post). The heart rates (HR) of the athletes were monitored by their coaches before and during exercise. The data were analyzed using One Way ANOVA in the SPSS 22 package program. A statistically significant difference was found among the baseline lactate levels, the 1S, 2S, 3S and post lactate levels in the study ($p < 0.05$). There was a statistically significant difference when the 1S lactate level was compared with all the time periods except for 2S ($p < 0.05$). The difference between the 3S and Post lactate levels was not statistically significant ($p > 0.05$). As a result of the study it was observed that Spinning® training carried out using the high-intensity interval training method caused a rapid increase in acute lactic acid accumulation. In the case of performance athletes, we can say that this exercise could be part of the lactate tolerance training used to counter fatigue.

Keywords Spinning, Lactate, Taekwondo

1. Introduction

Exercise is an enjoyable physical activity performed all over the world to lose excessive weight, to help prevent

cardiovascular diseases and to promote physical fitness. Numerous devices have been developed to make these activities more enjoyable and practical. Spinning® (a registered trademark of Madd Dog Athletics, Inc.) is a physical activity recommended in health centers today and which is enjoyed by many men and women of different ages and skill levels. Spinning®, which can be used for both aerobic and anaerobic exercises, is performed in groups in an indoor studio environment. In terms of ambient conditions, an indoor studio where there is no wind flow is preferred for this form of exercise. It is usually performed in dimly-lit studios and on stationary ergometers keeping up with the rhythm of music [1, 2]. Also, Spinning® can be modified in order to be used by performance athletes in addition to exercise performed for the maintenance of health.

High-intensity interval training has been a complementary component of athletic performance development programs since the early nineteenth century. It is an exercise system based on consecutively repeated very high-intensity anaerobic periods and shorter periods of rest for effective, short-duration training. It is described as short and intermittently performed physical exercises in which short rests or low-intensity exercises are added together with explosive movements [3, 4, 5]. It is a training method that enables more metabolic adaptation compared to normal endurance training and that increases strength, anaerobic power, motor skill performance and fat burning [6, 7].

Although it has become a very popular exercise method in recent years, to date very few studies have looked at Spinning® exercises in a laboratory environment. Therefore, the present study aims to examine the acute changes in lactate levels in a high-intensity training program adapted to Spinning®.

2. Materials and Methods

Subjects

Twenty elite male taekwondo athletes aged 14-17 years

who were trained and had been competitors for at least six years, participated in the study voluntarily. The World Medical Association Declaration of Helsinki was read to the subjects. The participants, their families and coaches were informed about the study in detail and their informed consents were obtained. The University Human Research Ethics Board ruled that this study was ethically sound and appropriate.

Table 1. The physical properties of the subjects

	n	Min.	Max.	Mean	Std. Dev
Age (yr)	20	17	22	18.89	2.07
Weight (kg)	20	64.43	81	70.59	10.82
Height (cm)	20	167	182	176.8	8.73
BMI(kg/m ²)	20	19.7	28.0	23.9	3.4

Exercise Protocol

A polar watch was used to measure heart rate. Heart rate at rest was measured after the athlete had lain flat for five minutes [9]. The maximal heart rate (HR_{max}) levels for the subjects were calculated using the Karvonen Formula. The athletes were asked to maintain a tempo of 90% of HR_{max} throughout the exercise. The high-intensity Spinning[®] training used as cardiovascular activity was carried out on a stationary ergometer in a Spinning[®] studio. It was designed four sets of eight repetitions each. Each repetition consisted of 20 seconds of load with a 10-second interval before the next one. A rest interval of one minute was applied between the sets [8].

Lactate Measurement

The subjects’ lactate levels were measured from their fingers using the Accutrend Lactate portable lactate analyzer branded with the help of strips. Lactate levels were measured five times: Once before the exercise (Pre), after Set 1 (1S), after Set 2 (2S), after Set 3 (3S) and after

the entire exercise was over (Post). In addition, the heart rates (HR) of the athletes were monitored by their coaches before and during exercise.

Statistical Analysis

The research data were analyzed using the SPSS package program 22. After the normality distribution of the data was analyzed, the statistical differences between the lactate values before exercise, after Set 1, Set 2, Set 3 and after exercise were determined using the One-way analysis of variance (ANOVA) with a value of p<0.05 considered significant.

3. Results

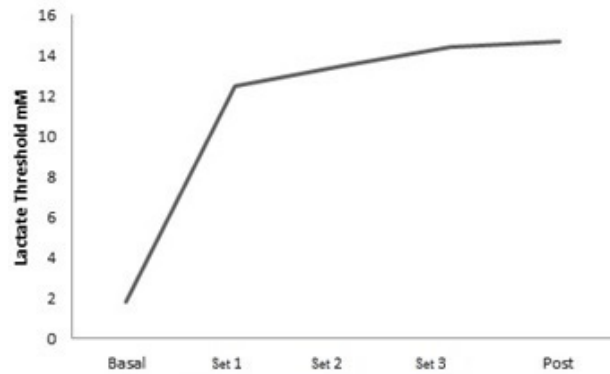


Figure 1. Changes in lactate levels during the exercise

During the study the heart rates of the athletes were found to be 64.20±11.16 beats/min at rest, 187.95 ± 9.78 beats/min after Set 1, 188.44 ± 7.57 beats/min after Set 2, 189.12 ± 5.20 beats/min after Set 3 and 189.51±4.02 beats/min after the exercise. The lactate levels were found to be 1.78 ± 0.86 mmol/L at baseline, 12.47 ± 2.80 mmol/L after Set 1, 13.48± 2.90 mmol/L after Set 2, 14.42±2.88 mmol/L after Set3 and 14.71±2.32 mmol/L after the exercise (Figure 1).

Table 2. Differences in blood lactate and HR levels during the modified Spinning[®] exercise.

Sets	n	Lactate Levels (mmol/L)		Heart Rate (beats/min)	
		Mean ± Std. Dev.		Mean ± Std. Dev.	
Basal	20	1.78±0.86		64.20±11.16	
1 st Set	20	12.47±2.80		187.95±9.78	
2 nd Set	20	13.48±2.90		188.44±7.57	
3 rd Set	20	14.42±2.88		189.12±5.20	
Post	20	14.71±2.32		189.51±4.02	
Comparison of lactate levels		t	p		
Basal & 1 st Set		-15.539	0.00 ★		
Basal & 2 nd Set		-17.510	0.00 ★		
Basal & 3 rd Set		-17.796	0.00 ★		
Basal & Post		-21.983	0.00 ★		
1 st Set & 2 nd Set		-1.563	0.13		
1 st Set & 3 rd Set		-2.882	0.01 ★		
1 st Set & Post		-3.352	0.00 ★		
2 nd Set & 3 rd Set		-2.523	0.02 ★		
2 nd Set & Post		-2.759	0.01 ★		
3 rd Set & Post		-0.688	0.50		

★ p<0.05.

A statistically significant increase was seen in the blood lactate levels at all the time periods compared to the baseline with the initiation of exercise ($p < 0.05$). A statistically significant increase in blood lactate levels was seen at all time periods after Set 1 except for the level after Set 2 ($p < 0.05$). A statistically significant difference in blood lactate levels was noted at all time periods in terms of the blood lactate level in Set 3 ($p < 0.50$) with the exception of the blood lactate level at the end of the exercise ($p = 0.05$) (Table 2).

4. Conclusions

High-intensity interval exercise describes physical exercise that is characterized by brief, intermittent bursts of vigorous activity interspersed with periods of rest or low-intensity exercise [12]. It is a frequently used form of exercise in training programs that aim to develop maximum oxygen consumption and improve anaerobic capacity [10, 11]. Performance and physiological improvements related to these exercises vary depending on the intensity of the exercise, the recovery methods and the durations. When we examined other studies made using an ergometer or Spinning® bike many of them indicated that these exercises had an aerobic aspect and that they could be used as a workout method that appeals to every segment of society [13, 14, 15, 16]. Hausken and Dyrstad [17] used Borg's scale of exertion to compare spinning exercises to Zumba workouts having a similar workload [18]. As a result the subjects found spinning to be 30% more tiring compared to Zumba. Another study, which the intensity of Spinning® training was at 71.1% of HR_{max} , reported that there was a weak relationship between the Borg's scale and HR. Also, the researchers stated that the Spinning® training that they made the subjects perform was an ideal exercise for carrying out at sub-maximal levels for subjects who had only recently started to exercise [15].

In their study conducted on diabetes patients Iscoe et al. [19] reported a drop in blood glucose levels as a result of a spinning training performed at 60% of HR_{max} . In another study conducted with a mean oxygen consumption level of 32.8 ± 5.4 mL/kg/ min in sedentary men and of 30 ± 9.9 mL/kg/min in women, the metabolic responses to a 50-min Spinning® session were examined. According to these metabolic responses, Spinning® training at that particular intensity was considered ill-advised for sedentary people, especially for middle-aged and elderly individuals [20].

The present study demonstrated that the blood lactate level started to accumulate very rapidly with a load of 90% of HR_{max} even at the end of Set 1. The blood lactate level of 4mmol, which is considered to be the level at which anaerobic metabolism gets activated, seems to be exceeded before Set 1 is completed. Blood lactate accumulation, which was gradual and statistically significant in the exercise's other sets, revealed just how intense Spinning®

training was. In addition to this, the increase in HR, which did not continue parallel to blood lactate levels after Set 2, better expressed the intensity of the exercise. The limitation of the study was that it determined the intensity of exercise according to HR_{max} . Monitoring the intensity of exercise according to $MaxVO_{2nd}$ could yield more accurate results.

In conclusion, the data of the present study indicates that this high-intensity exercise program adapted to Spinning® is a good lactate tolerance exercise that could be incorporated into the training programs of performance athletes. Also, the aspect of Spinning® exercise that sets it apart from conventional training methods for promoting athletes' anaerobic performance is that it can be carried out in a format accompanied by music in an enjoyable manner regardless of weather conditions. Thus, this exercise can be recommended for all performance athletes in all branches in which anaerobic performance is important.

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