ACUTE AND CHRONIC ANSWERS OF 12- WEEKS ANAEROBIC TRAINING ON THE LEVEL OF BLOOD LACTATE AND AND CREATIN KINASE IN MALE TAEKWONDO ATHLETES BETWEEN 14-16 YEARS OLD*

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ABSTRACT

Purpose:The aim of this study investigate the effects of 12- weeks anaerobic training of 14-16 year old taekwondo athletes on levels of blood lactate and creatin kinase.
Methods: 10 elite male taekwondo athletes (14,30±1.16 years old) who regularly training for at least three years were participated in this study. Measures were taken at the beginning and at the end of 12 weeks training programme. Venous blood serum lactate and creatine kinase levels were measured 4 times on an 8 ½ ml BD brand gum from the anterior arm. Varians analysises (ANOVA) test was used to define the differences among blood lactate and creatine kinase. Bonferroni multiple analysises were done in order to determine the terms which measure belongs to when they were different. Multiple linear regression was used to determine the relations between parameters. The results were evaluated on the importance level of 0.05.
Results:In result of research, the level of blood lactate and creatine kinase were different before and after acute training programme ($p<0.05$). There was no significant difference in resting levels before and after the program in both parameters ($p>0.05$). When the relations between creatine kinase and blood lactate were observed, a positive corelation was found ($r=0.72$, $p<0.05$).

Conclusion: At the end of the study, it was found that anaerobic training of taekwondo branch applied to high intensity caused a significant increase in blood lactate and creatine kinase levels due to especially muscle damage in adolescent athletes.

Key Words: Taekwondo, Creatin Kinase, Blood Lactate, Anaerobic Training

12 HAFTALIK ANAEROBİK ANTRENMAN PROGRAMININ 14–16 YAŞ ERKEK TAEKWONDOCULARDA KAN LAKTAT VE KREATİN KİNAZ DÜZEYLERİNE AKUT VE KRONİK CEVAPLARI

ÖZ

Amaç: Bu çalışmanın amacı; 14-16 yaşları arasındaki erkek taekwondocularda 12 haftalık anaerobik antrenman programının; kan laktat ve kreatin kinaz düzeylerine akut ve kronik etkisini araştırmaktır.

Yöntem: Çalışma spor yaşı en az 3 yıl olan üst düzey 10 elit erkek taekwondocu (yaş=14,30±1.16 yıl) sporcuların gönüllü katılımı ile gerçekleşmiştir. 12 haftalık antrenman programı başlangıcında ön - son ölçüm ve 12 haftalık antrenman programının bitiminde ön-son ölçüm olmak üzere 4 kez ön koldan 8 ½ ml'lik BD marka jelli tüplere alınan venöz kanda laktat ve kreatin kinaz seviyeleri ölçülmüştür. Ortalamalar arasındaki farkı belirleyebilmek için tekrarlayan ölçümlerde varyans analizi, ölçümler arasındaki farkın hangi dönemlerde olduğunu tespit edebilmek için de Bonferroni çoklu karşılaştırma analizi yapılmıştır. Parametreler arasındaki ilişkileye çoklu doğrusal regresyon (Multiple Linear Regression) analizi ile bakılmıştır.

Bulgular:12 haftalık antrenman önce ve sonrasında alınan akut kan laktat ve kreatin kinaz düzeylerinde anlamlı artışlar tespit edilmiştir ($p<0.05$). Her iki parametrede de program öncesi ve sonrası istirahat düzeylerinde anlamlı bir farka rastlanmamıştır ($p>0.05$). Kreatin kinaz ile kan laktat değerleri arasında pozitif korelasyon belirlenmiştir ($r=0.72$, $p<0.05$).

Sonuç: Araştırma sonunda yüksek şiddette uygulanan taekwondo branşına özgü anaerobik antrenmanların adolesan dönemdeki sporcuların kan laktat ve özellikle kas hasarına bağlı olarak kreatin kinaz seviyelerinde anlamlı bir artışa sebep olduğu görülmüştür.

Anahtar Sözlük: Taekwondo, Kreatin Kinaz, Kan Laktatı, Anaerobik Antrenman.

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INTRODUCTION

Taekwondo, despite originating from far east, is an Olimpic sport practiced widely around the world. As it is a fighting sport based on both defense and offense, having a high aerobic and anaerobic capacity is a significant performance criterion (1). Especially the technical practices requiring quick attacks and agility during the match necessitate a high anaerobic metabolism. Therefore, tolerance to the lactic acid formed during the anaerobic metabolism is a significant performance indicator for the athletes.

Lactic acid is a product formed during the anaerobic metabolism, and is formed as a result of glucose decomposition in an anaerobic environment. Lactate accumulation increases even further during intensive exercises, and causes exhaustion due to pH decrease (metabolic acidosis) (10).

Depletion of energy sources, and accumulation of metabolic residue products occupy a significant place in fatigue. This causes weakening of neural conduction and contractility. Residue product accumulation decreases the pH. And this causes a decrease in the ATP acquisition ratio through glycolysis by weakening the phosphofructokinase enzyme activation. Furthermore, the accumulated H^+ ions substitute calcium by binding to troponin C, and this decreases the contraction strength of the muscles by weakening the actomyosin bridge formation. As a result, a low pH value is the most significant limiter during short, intense activities.

CK increase, causing muscle damages as well as increases in the lactic acid after an intense training, can also result in a decrease in the performance, and increase the injury risk of the athletes. Skeletal muscle is where CK is most active. Creatine kinase spread in the muscle as a result of skeletal muscle damage is a qualitative indicator of the muscle damage (7,8).

Experiencing muscle damages as a result of intensive exercise is a common and normal thing (3). Athletes often feel discomfort in their muscles during 8 to 24 hours after exercising. Serum CK level peaks after around 48 hours (20).

As various pharmacological agents can be used for avoiding the exercise-caused damages, training status, warm-up and stretching exercises before the training, massage application after the exercise, and active cooling may reduce the damage (21). Furthermore, quantity of the damage varies depending on age, gender, ethnicity, contraction type, and especially the training status (11).

It is known that maximal strength training causes a significant level of muscle damage. It has been determined that a significant increase in muscle pains is experienced after strength training, and that such increase is directly related to muscle damage. Training the muscle in advance is a factor preventing damages (11). It is wondered whether this finding obtained in strength training will show similar results in highly intensive anaerobic training.

The aim of this study investigate the effects of 12- weeks anaerobic training of 14-16 year old taekwondo athletes on levels of blood lactate and creatin kinase.

MATERIAL AND METHOD

Research group: The study was conducted with the participation of high level taekwondo athletes who have not suffered serious disability in the last 6 months in Konya Metropolitan Sports Club and have at least 3 years of sports age. A total of 10 elite male taekwondo workers with a mean age of 14.30 ± 1.16 years participated as volunteers. Trainings Konya Ataturk Stadium Kayhan Aytar Taekwondo hall, blood analysis was conducted in Konya Başkent University Application Research Hospital Biochemistry Laboratory.

Height and Body Weight: The height of the athletes participating in the study was measured with a height scale of 0.01 cm sensitivity and body weights of 0.1 kg with a precision electronic scale. Obtained values were recorded in cm and kg.

Body Mass Index: The body mass index (BMI) formula (Body weight / Height²) was used to determine the body mass index (15).

Body Fat Percentage: To determine the Body Fat Percentage, a Holten brand skinfold caliper was used that calculated 10 g / sq mm pressure at each angle and was calculated according to the Lange formula.
Lange Formula: (bi+tr+sc+si+che+thi) x 0.097 + 3.64 (18).

Blood Analysis: 4 blood samples have been taken into 8 ½ ml BD brand gel tubes from the forearm, once in 10 hours before the phenomena, once at the start of the 12-week training program, and before and after the acute exercise. Blood samples taken have been centrifuged for 10 minutes at 4000 rpm after 1 hour. Serums obtained from the blood samples have been studied in Abbott brand C8000 biochemistry device and Abbott brand kits, adopting the NAC (N-acetyl-cysteine) method for CK test, and lactic acid pyruvate ISE; ion-selective electrode diluted (indirect) methods for lactic acid test.

Training Program: In the study, intensive internal training method have been applied, and the training intensity has been determined to be 85% according to the Karvonen method, tracking pulse rates of the participants on Polar RS800 monitors. Based on the efficient resting principle, pulse rates of the participants were allowed to decrease down to 125-130 pulses/minute during 8-minute training intervals, which were been proceeded with 8-minute training periods repeatedly. The program has been applied so that it covers a 12-week period, 4 days a week, each unit training lasting 120 minutes. Phases of the training have been arranged to consist of; 20-minute warm-up phase, 90-minute main phase, and 10-minute cooling phase.

Table 1: Training Content

1 Week	Technical training	7 Weeks	Technical training
2 Weeks	Special technical training on safeguard	8 Weeks	Combined technical training,
3 Weeks	Combined technical training	9 Weeks	Special technical training on safeguard
4 Weeks	Technical training	10 Weeks	Technical training
5 Weeks	Fast technical training on glove	11 Weeks	4-5 best of 3 matches, 2 minutes each
6 Weeks	4-5 best of 3 matches, 2 minutes each,	12 Weeks	Fast technical training on glove

Statistical Analysis: Data obtained from the measures have been recorded immediately after each measure. One Way ANOVA for Repeated Measures test has been used in order to determine the differences between the mean blood lactate and creatine kinase values before the 12-week program and after the training applied after the program, a Bonferroni multiple comparison analysis has been performed in order to determine in which period the differences occurred, if there had been any. And the difference between the physical suitability parameters measured on the 12-week before and after resting levels has been determined with the Wilcoxon signed ranks test. Multiple Linear Regression has been used in determination of the relationships between the parameters. Error level has been taken as 0.05.

FINDINGS

Table 2 Wilcoxon test results of variables of body weight, height, percentage of body fat and body mass index of athletes.

Variable	Test	X±Sd	z	p
Weight (kg)	Pre Test	51.47±10.66	1.13	0.26
	Post Test	51.60±10.46		
Height (cm)	Pre Test	163.40±8.40	2.53	0.01*
	Post Test	163.99±8.39		
Body Fat (%)	Pre Test	7.37±0.34	1.78	0.07
	Post Test	7.35±0.31		
BMI kg/m^2)	Pre Test	19.02±2.13	2.66	0.05*
	Post Test	19.44±2.15		

*p<0.05.

A significant increase in body height and body mass index was found (p<0.05), while no significant difference was found in the athletes' body weight and body fat percentage averages after a 12-week program.

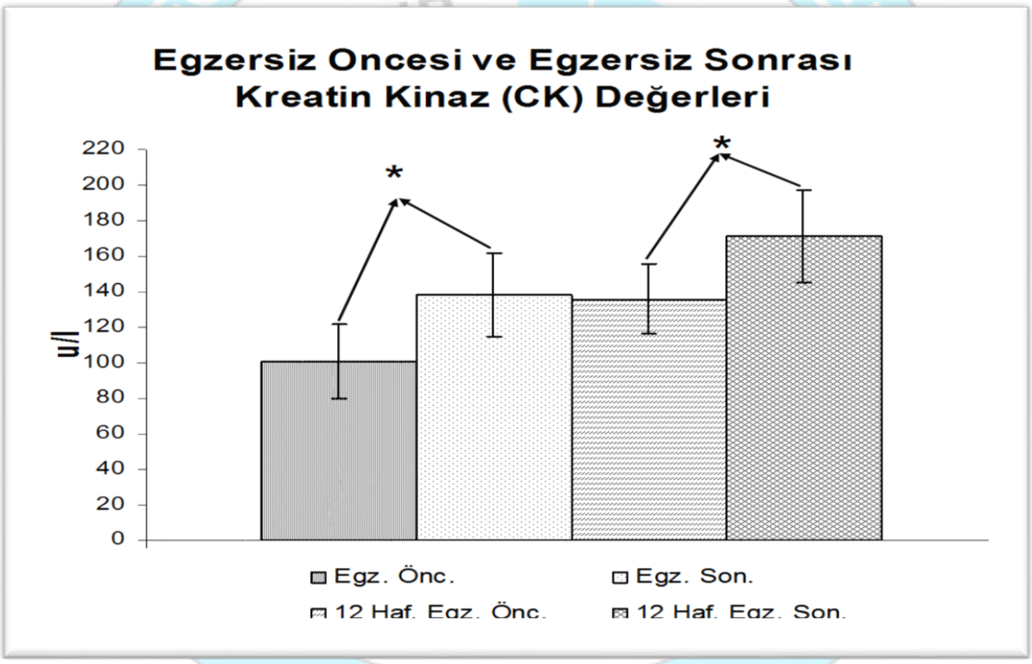

Figure 1. Creatine kinase levels before and after a 12-week exercise program.

In Figure 1, significant differences are seen when the creatine kinase values are evaluated before and after exercise (F=4.77, p<0.05). At the beginning and end of the 12-week training program, the pre-acute CK mean(101.1±20.83) was significantly lower than the post-exercise CK average(138.3±23.5), and the CK pre-exercise average (136±19.9) at 12 weeks was significantly lower than the post-exercise CK average(171.2±25.8) (p<0.05).

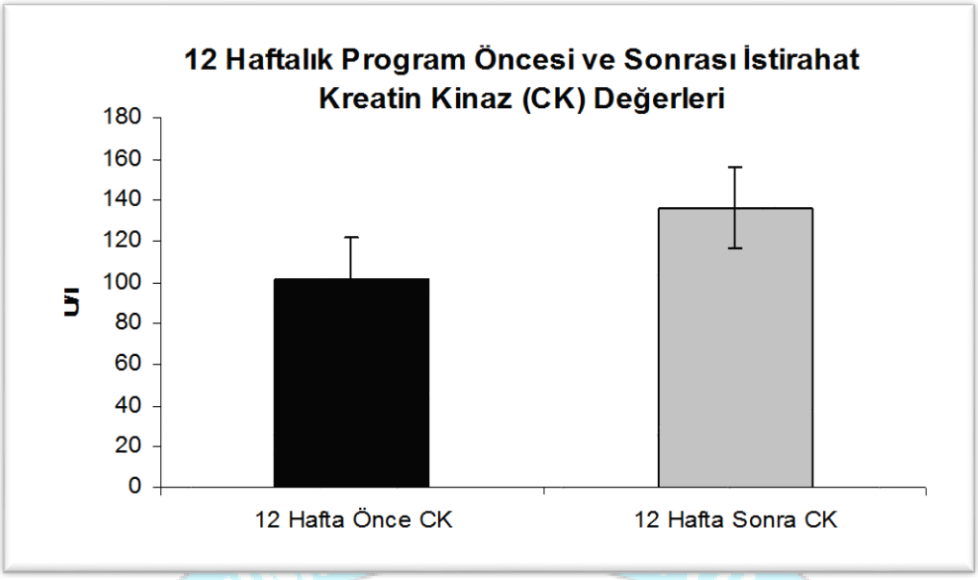

Figure 2: Resting creatine kinase levels before and after 12-week acute exercise program.

There was no statistically significant difference between resting CK levels (101.1±20.83) before the 12-week training program and resting CK levels (136±19.9) after the 12-week program ($p>0.05$).

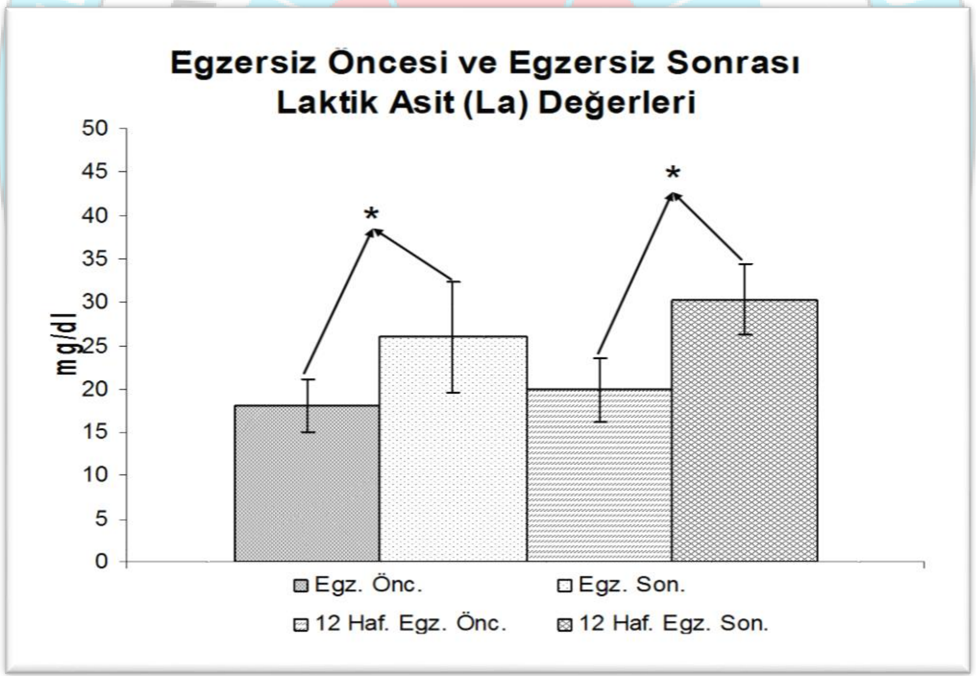

Figure 3: Lactate values before and after 12 weeks of exercise program.

A significant increase in lactate levels before and after acute exercise was observed at the beginning and end of the 12-week training program($F=21.72$, $p<0.05$). The pre-program acute training La average (pre=18.1±3.06 mmol/l, post=26±6.35 mmol/l) and post-program training averages (pre=19.9±3.72 mmol/l, post=30.3±4.08 mmol/l) were significantly increased in both periods after training ($p<0.05$).

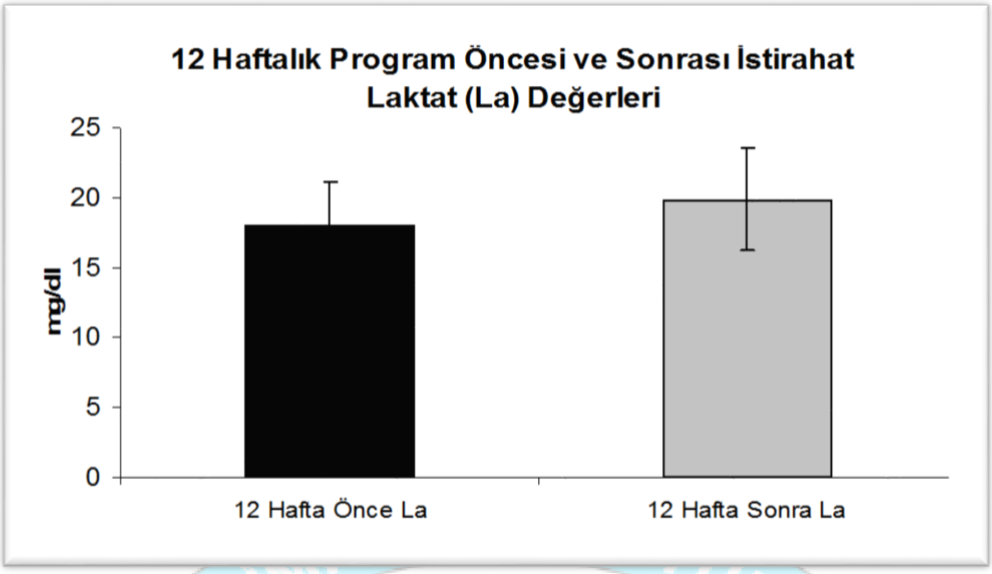

Figure 4: Resting lactate values before and after a 12-week exercise program.

No statistically significant difference was found between the resting La level (18.1±3.06 mmol/l) before the 12-week training program and the resting La level (19.9±3.72 mmol/l) after the 12-week program (p>0.05). Although there was no increase in La level by 9.9%, this difference was not significant.

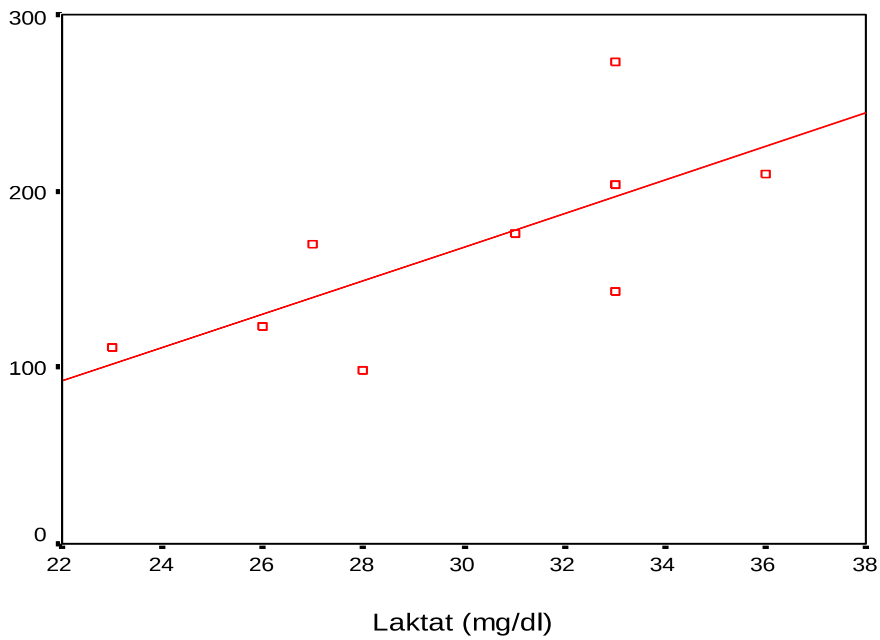

Figure 5: A positive correlation was found between creatine kinase and blood lactate values after 12 weeks of exercise program (r=0.72, p<0.05).

DISCUSSION

Findings obtained in this study, conducted to determine the acute and chronic effects of 12-week anaerobic training on blood lactate and creatine levels of male taekwondo athletes in the adolescence period, have been assessed through association with the existing literature.

While the mean blood lactate values of the taekwondo athletes were 18.1±3.06 mmol/l, 26±6.35 mmol/l at the start of the 12-week training program and after the acute training, respectively, these values have been determined to be 19.9±3.72

mmol/l and 30.3±4.08 mmol/l after the 12-week program, and the difference after both acute trainings have been considered to be statistically significant ($p<0.05$). However, upon assessment of resting lactate level values before and after the 12-week program, no significant difference has been detected ($p>0.05$).

McKenna et al. (1997) applied a 7-week training program to healthy young males and determined the mean blood lactate values to be 1.5±0.2 mmol/l and 11.5±2.1 mmol/l at the start of the program, and 1.7±0.2 mmol/l and 12.0±3.3 mmol/l after 7-week program, before and after the exercise respectively, and stated that such difference is statistically significant. It is stated in another study that the blood lactate level significantly increased after an exercise applied with the intensity of 95% maxVO_2 (17).

Bouhlel et al. (2006), in a study conducted among 8 elite taekwondo athletes with an age average of 20±1, recorded the blood lactate level after a shuttle run to be 12.81±1 mmol/l 20-meter, and to be 10.2±1.2 mmol/l after the match.

It is known that lactate production is caused by the rapid glycogen decomposition, and can be formed in anaerobic environments as well as in aerobic environments. Lactate production exists during resting and in exercises of all intensity levels, and the difference between production and elimination determines the existence of lactate accumulation in the blood. During resting, lactate concentration is at 1 mm/kg muscle or 1 mmol/l blood level. In exercises with an intensity level lower than 40% MaxVO2, lactate concentration varies slightly, or none at all. As the intensity exceeds this level, lactate concentration increases in the muscle and blood. It has been determined that the blood lactate level is approximately 17 mmol/l after 30-60 seconds, and that it increases up to 33.1 mmol/l even after 3 one minute exercises (5).

CO_2 and lactate production in the active skeletal muscle through the bicarbonate reaction increases the lactic acid oscillation in blood vessels. And this increases the plasma blood lactate levels during exercise (17).

It is known that exercise changes the heartbeat, plasma protein and lactic acid concentration (13*).* Increase of blood lactate and heartbeat rate throughout the match indicates that anaerobic metabolism is a significant performance criterion in taekwondo.

Steinacker et al. (2000) have represented the CK, training intensity at the start of the training camp. The fact that CK level decreased despite the increased duration of the highly intensive training during the transition period between the 1st Phase and the 2nd Phase indicates the adaption of the muscle to the training.

Ehlers et al. (2002) applied a maximal loading to 12 college football players on the 1st, 4th, 7th and 10th days of a 10-day camp period, and read the CK levels. They reported that CK levels on the 4th and 7th days had been significantly higher than those of the 1st day, and that CK levels on the 10th day had been lower than those on the 4th and 7th days. As a result, they determined that applying a highly intensive training program to football players in order to increase the anaerobic strength and anaerobic capacity may protect the players from muscle damages.

It is suggested that there may be a relationship between CK levels and sports injuries. In a study conducted on this subject, it is stated that branch-specific contractions without an intensive load do not significantly increase the CK level, thus reducing the injury risk. It has been reported that CK level of an athlete injured as a result of muscle overload during a match was dramatically higher than the CK level of the previous day (14).

Brown et al. (1999) determined in the study conducted on the effect of knee muscle on eccentric contraction, repeat numbers and muscle damage that serum CK level increased as the repeat number increased. Çolakoglu et al. (2016) researched the effects of isotonic sports drink supplement on the post-competition muscle damages in elite orienteering athletes, and found that CK values of the placebo group had been significantly higher than the isotonic sports drink group, and determined that there had not been a significant difference between the LDH levels.

It has been reported in a study, in which the effect of maximal strength training on the muscle damage and muscle pain, and the relationship between the pain and damage had been researched, that maximal strength training caused a significant level of muscle damage. It has been determined that a significant increase in muscle pains is experienced after strength training, and that such increase is related to muscle damage (12).

In our study, mean CK values before and after the exercise have been determined to be 101.1±20.83 mmol/l and 138.3±23.5 mmol/l respectively at the start of the 12-week training program, and to be 136±19.9 mmol/l and 171.2±25.8 mmol/l after the 12-week training program. The difference between the CK values before and after the 12-week training program has been considered to be significant ($p<0.05$).

It is considered that highly intensive anaerobic training increases the muscle damage-related creatine kinase level.

It increases in plasma CK activity muscle injuries, after acute myocardial infarction, and when proteins are used as energy metabolism. Additionally, in the event of an exercise-related muscle damage, activity of the intracellular enzyme CK in the plasma and serum increases (19).

CONCLUSION

As a conclusion, it has been determined that the taekwondo branch-specific highly intensive acute anaerobic training causes a significant increase in the blood lactate and muscle damage related creatine kinase levels of adolescent athletes, and that there is a positive correlation between these two parameters.

Age, gender, branch, individual performance, environmental factors, weather conditions, type and intensity of the exercise, physical, physiological and psychomotor properties can be determinant in the quantity of lactate and muscle damage. As various pharmacological agents can be used for avoiding the exercise-caused damages, it is considered that the training status, active cooling, as well as massage applications after the exercise may reduce the damage.

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