PRINT: ISSN 0972-0073 ONLINE: ISSN 2456-6802
Anthropologist, 19(1): 123-129 (2015)
DOI: 10.31901/24566802.2015/19.01.14

Comparison of Ice Massage versus Cold-Water Immersion on Muscle Damage and DOMS Levels of Elite Wrestlers

Bilal Demirhan[1, 4], Metin Yaman[2], Asim Cengiz[2], Nazmi Saritas[3] and Mehmet Günay[2]

[1]Ondokuz Mayis University, Yasar Dogu Faculty of Sports Sciences, Samsun, Turkey
[2]Gazi University, Department of Physical Education and Sports Ankara-Turkey
[3]Erciyes University, Department of Physical Education and Sports Kayseri-Turkey
[4]Kyrgyz-Turkish Manas University, PE and Sport Dept, Bishkek/Kyrgyzstan
E-mail: [1, 4]<bilaldemirhan55@gmail.com>,
[2]<metinyaman@gazi.edu.tr>, [2]<acengiz@studentsussa.edu>,
[2]<mgunay1966@gmail.com>, [3]<nsaritas@gmail.com>

KEYWORDS Pain. Recovery. Ice massage. Cryotherapy. Wrestlers

ABSTRACT The present study is aimed at comparing the effects of ice massage versus cold-water immersion on creatinekinase (CK) levels and delayed-onset muscle soreness (DOMS) values of elite wrestlers. To achieve the objectives of the research twenty elite wrestlers participated in the study. Participants were separated into two groups (ice massage vs. cold water immersion) of whose weights were equal. Between the sets, experiment group was applied ice message for 8 minutes while control group was given cold-water immersion. Blood samples of the subjects were taken before and after the exercises. Groups' differences were determined with "Repeated Measures Analysis of Variance". Significant differences were observed within both groups at all times (<0.001). DOMS (24 h), DOMS (48 h). There was no difference after 72 hours, and before exercise values in DOMS values for ice massage group (p>0.05). Including competition and training for athletes, ice massage as a recovery strategy is expected to shorten the recovery time in athletes.

INTRODUCTION

Many athletes become distanced to physical training at the season break and as a result delayed muscle pain (DOMS) shows up because these athletes lose the eccentric phase of their training routine at the beginning of the new season (Cheung et al. 2003). These pains are an unsolicited status which athletes experience after the medium and long injury periods. The possible reason of this pain is the edema in the muscle. Some studies also informed about the pressure being composed by the edema (Friden 1981).

Recent researches have exhibited that metabolic and non- metabolic factors play a part in acute tiredness, but nonetheless, muscle damages can lead to tiredness which continues for at least 24 hours (Skurvydas et al.1985; Joness et al. 1989). Muscle pains occurring after trainings can be explained by theories of lactic acid accumulating in the muscle, muscle spasm, inflammation and muscle pain mechanisms (Cheung et al. 1989).Thus, it is thought that high values of these parameters can delay the adaptation of the athlete in the trainings and also these parameters can affect their performances in a negative manner.

Muscle pain that starts after the training is a pain that occurs at the trauma conditions of skeletal muscles and it is a temporal pain. Damage occurring, as a result of the training, that the athlete is not familiar to be connected with muscle pain sensation evolving to delayed muscle pain (Armstrong et al. 1991; Smith et al. 1991). Damage that occurs as a result of the eccentric spasm, which the athlete is not familiar to, leads to disruption in the structure of myofibrils. Fracturing of myofibril skeleton accompanies especially in Z band (Friden et al. 1983).

Strenuous physical activity can result in exercise induced muscle damage (Hill et al. 2014).After exercises a cellular damage occurs in muscles. This damage takes part as micro trauma, and muscle damage (Smith et al. 2001). This damage can be explained with two main ways. First of them is unfamiliar exercise and the second is apprehending of some metabolic and chemical cases (Friden et al. 1983). These cases occur after tissue injuries.

Two main methods are used to determine the muscle damage. First one of them is visualization techniques (Friden 1981). Besides, the second one of them is based on the determination of enzyme activities' levels. Increasing levels of these enzymes play an important role in determining the tissue damage and rate of this damage (Roth et al. 2000). Blood plasma ratio of CK

levels, which is accepted as one of the indicators of muscle damage, increases during the muscle damage (Murray et al. 1988; Schwane et al. 2000). CK levels increases after the exercise and its peak time changes as to the type of the exercise, intensity of exercise and duration of exercise. It is informed that elevated CK stays at its maximum level after the 1-5 days from the exercise (Garrett and Kirkendall 2000; Clarkson et al. 1986; Newham et al. 1986).

Delayed onset of muscle soreness (DOMS) is defined as the pain that includes the increasing of sensibility of the muscle and the hardening (Smith1991; Camus et al.1994).One of the main factors that cause the muscle pain after the exercise is the decreasing of blood plasma volume that can cause ischemia (Appell et al. 1992).

There are many strategies being used for preventing delayed onset of muscle soreness and decreasing the tiredness to its minimum level. Submersion to cold water and cold applications are generally used after the exercises (Bleakley et al. 2012). Cryotherapy is a method that is used for decreasing the volume of the damages with the effect of the cold. Ice massage is also a cryotherapy method and easy to apply, provides cooling of superficial and deep tissues from a relatively short application period when compared with some other methods found that a single treatment with ice massage had an immediate but short-term beneficial effect on muscle soreness following eccentric exercise (Howatson and Sameron 2003). Cryotherapy in the form of ice massage is used to reduce inflammation after acute musculoskeletal injury or trauma (Geeta and Majumi 2014). The potential damaging effects of ice massage on proprioception are unknown, in spite of equivocal evidence supporting its efficiency (Geeta and Majumi 2014). Many studies have not investigated the effects of ice massaging versus cold-water immersion on recovery of elite wrestlers.

Objectives of the Study

The present study is aimed at comparing the effects of ice massage versus cold-water immersion on CK levels and DOMS values of elite wrestlers. The results of the study will help sedentary people who are affected by muscle damage and pain.

MATERIAL AND METHODS

To achieve the objectives of this study, twenty elite wrestlers participated in the study voluntarily. Subjects separated into two groups (ice massage vs. cold water immersion) of whose weights were equal. By explaining the importance of study to the participants, written and oral consent from each of the participants were obtained at the beginning of the study because they were informed of any potential risks from the experiment. The Ethics Committee of the University approved the experimental protocol.

Experiment Design

Measurements of the subjects were taken at the first training at the beginning of the season after long resting period. To standardize the same level of fatigue for the groups, a circuit training protocol (with three repetitions), which composed of 8 different exercises, was implemented at the first training day. During two resting periods between the sets, experiment group was applied ice message for 8 minutes while control group had cold-water immersion that consisted of 30 seconds for lower extremities and 30 seconds for upper extremities in total time of 8 minutes. To determine, the CK levels, blood samples of the participants were taken before and after the exercises. Besides, the (DOMS) values of subjects were determined with a rating scale and CK levels and DOMS values were compared between the groups for pre exercise levels, after 24, 48 and 72 hours of the training. The effects of the ice message and cold-water immersion were analyzed based on these measurements.

Exercise Protocol

Circuit training was designed for subjects. The circuit training is composed of 8 station and 3 sets. Each break between the 8 stations was 20 seconds and each break between the sets took 10 minutes. The circuit training was based on specific techniques and strength exercises specific to wrestling.

Measurements of Weight and Height

Weights of participants were measured with Tanita BIA device. Participants were barefootedduring the measurements and they only wore wrestling suit. Besides, heights of participants were measured with a height scale of which accuracy degree was 0.1.

Measurement of CreatineKinase (CK)

A sample of 5mL blood was taken from the right vein; serum is separated by centrifugation at 5000 rpm for 8 minutes. After taking the blood, it was instantly frozen for later analysis. A spectrophotometer (Diasis Brand) and DDS brand with the help of automatic pipettes SOCOREX brand were used to determine serum CK concentrations. Creatinekinase analysis were made and recorded as (CK) (U/L).

Massaging Method

The massages were implemented after 1 minute from the circle training. These massage types were groundling and deeper pugging, Friction and Vibration. Expert masseurs applied all of these message types to subjects. These massages were implemented to arms (for 4 minutes) and legs (for 4 minutes). In experiment group ice was used and in control group ice was not used during the massaging procedure.

Water Immersion Method

The participants were in a bucket filled with water in a sitting position each time for 30 -second for the lower and upper extremities.

Statistical Analysis

The statistical analysis of the findings was evaluated by a computer program (SPSS 20.0 package), and the average and standard deviation of all parameters were calculated. In order to determine the homogeneity of the data "Shaphiro –Wilk" test was applied. Groups' differences were determined with "Two Way Repeated Measures Analysis of Variance", to determine whether if there is "Minimum Significance Difference". Group analysis were made with Tukey HSD if differences found between groups and ($P<0.05$) was considered statistically significant different.

RESULTS

Subject characteristics of the wrestlers are presented in Table 1. It was determined that there were significant differences between the groups.

CreatineKinase (CK) levels of Ice Massage and Cold Water Intervention groups were presented in Table 2. There were some differences between the groups. There are no significant differences between pre and post CK levels of the groups ($p>0.05$). However, significant differences were observed within both groups in all times (<0.001) (Table 2).

Table 1:Subject characteristics of wrestlers

Variables	*n*	*Groups*	*Mean±SEM*
Age (Years)	10	IM	22.00±0.86
	10	CWI	21.50±0.91
Height(cm)	10	IM	174.40±2.08
	10	CWI	173.90±2.34
Weight (kg)	10	IM	76.00±3.44
	10	CWI	76.60±3.62
BMI (kg/m²)	10	IM	24.80±0.65
	10	CWI	25.19±0.60

IM: Ice Massage CWI: Cold Water Immersion, Mean± SEM: Standard error of mean

There is no difference between the resting DOMS values of two groups ($p>0.05$), but DOMS (24 h), DOMS (48 h), DOMS (72 h) values were significantly different from each other ($p<0.001$). There is no difference after 72 hours, and before exercise values in DOMSvalues for ice massage group ($p>0.05$), while there were differences amongst before exercise, 24 h, and after 48 h of-DOMS values (Table 3, Fig. 1).

There were differences amongst ($p>0.05$), before exercise and 48 h and 72 h after exercise

Table 2: CK(U/l) levels of Ice Massage(IM) and Cold Water Intervention(CWI) groups

Variables	*IM (n=10) Mean±SEM*	*CWI (n=10) Mean±SEM*	*Time*	*Groups*	*Time x Groups interaction*
CK (Pre-exercise)	123.00±16.53^{a1}	128.80±17.27^{a2}	<0.001	0.652	0.923
CK (Post-exercise)	255.10±19.69^{b1}	280.40±32.85^{b2}			
CK (24 hours)	311.40±17.78^{c1}	326.70±34.45^{c2}			
CK4 (48 hours)	220.10±17.49^{d1}	225.00±15.76^{d2}			
CK5 (72 hours)	179.80±13.50^{e1}	184.10±11.52^{e2}			

IM: Ice Massage CWI: Cold Water Immersion, *Mean± SEM:* Standard error of mean
Intra-group: abcde: the same letters in the same groups does not indicate significance.
*Different groups:*1,2

Table 3: Doms values of Ice Massage(IM) and Cold Water Intervention(CWI) groups

Variables	*IM (n=10) Mean±SEM*	*CWI (n=10) Mean±SEM*	*Time*	*Groups*	*Time x Groups interaction*
DOMS (Resting)	1.20±0.33^{a1}	1.10±0.31^{a2}	<0.001	<0.001	<0.001
DOMS (24 hours)	6.10±0.31^{b1}	8.20±0.29$^{b2\#}$			
DOMS (48 hours)	5.30±0.26^{b1}	7.60±0.27$^{b2\#}$			
DOMS (72 hours)	1.60±0.16^{a1}	4.90±0.23$^{c2\#}$			

IM: Ice Massage CWI: Cold Water Immersion, Mean± SEM: Standard error of mean
Intra-group: abc: the same letters between the groups does not indicate significant differences. Inter group:#
Different groups: 1,2

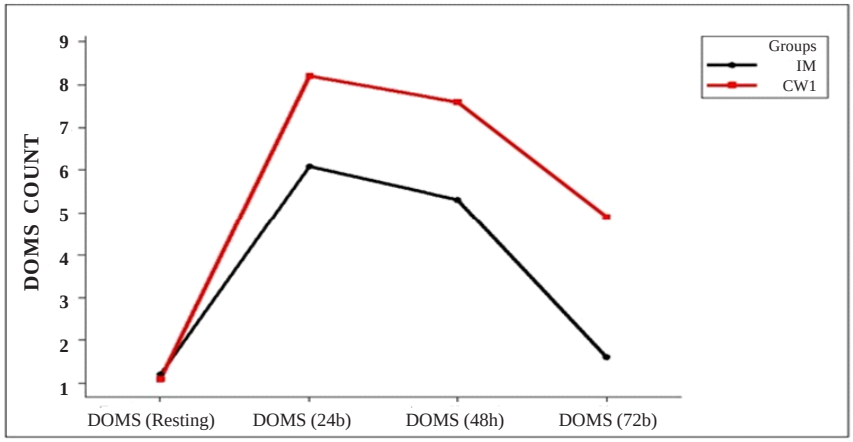

Fig. 1. Variations of DOMS values in time for Ice Massage(IM)and Cold Water

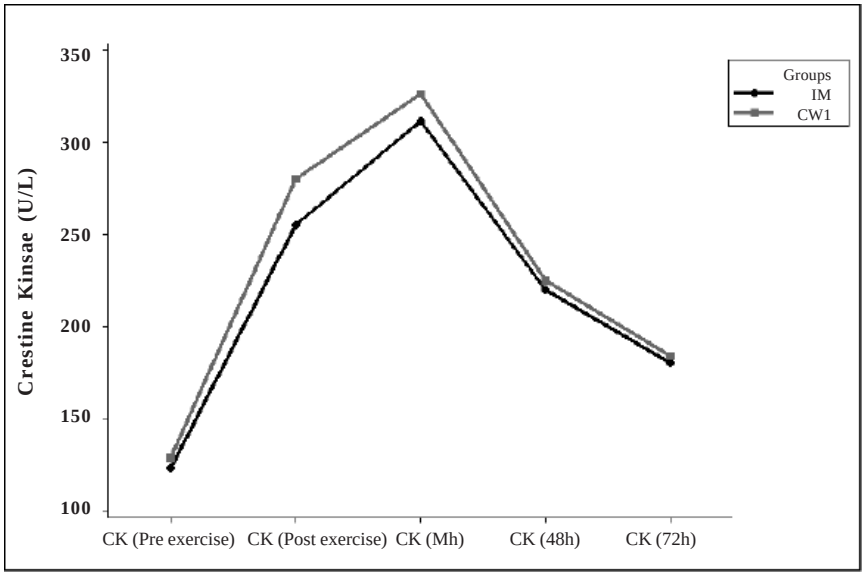

Fig. 2. Values within the Ice Massage (IM)and Cold Water Intervention(CWI)

DOMS values of ice water intervention group (Table 3, Fig. 1).

DISCUSSION

The damage in skeletal muscle after exercise cause muscle-specific components of the leads to pass into the bloodstream membranes ruptures. CreatineKinase is the most known components that are lost from the muscle. To assess skeletal muscle damage, many studies observed the changes in the concentration of this enzyme, thus; the level of CK lost is the most significant reference of muscle damage (Korkmaz 2010; Clarkson and Hubal 2002; Totsuka et al. 2002; Young 1984). Limited recovery time and increased travel hinder the implementation of many recovery strategies (Taylor et al. 2014).

In this study significant difference was not observed in resting CK levels between the groups. The highest CK levels in both groups were detected after 24 hours of the exercise. CK levels after 48 hours of measured values significantly higher than all the other measurements except at the 24-hour CK measurements. Measured CK levels after 72 hour have begun to show a downward trend compared to the CK levels after 24 and 48 hours of the exercise, but it was still significantly higher compared to the resting values.

In this study, CK levels before and after exercise is considered the result of the exercise induced muscle damage (Thompson et al.1999). Study indicated a 90-minute period of 20 m shuttle run test increased plasma CK levels for 48 hours and marked increase was 24 hours after the exercise**.**Similarly, Walsh et al. (2005)assessed 13 healthy male subjects' CK levels on their 30 minutes of high-intensity eccentric exercise, and it was found that CK levels after 48 hours were the highest. Twist et al. (2005), assessed 10 male sprinters and indicated that CK levels were increased gradually up to 48 hours after exercise and started declining after 72 hours of the exercise. Similar findings were observed in several studies (Bobber et al. 1986). In the present study the researchers obtained increased CK values that are parallel with the findings of other researchers. However, CK levels after exercise, ice massage applied group had lower values compared cold-water immersion group even it was not significant difference were observed (Table 3). The highest difference between the groups was observed right after exercise. The same difference was observed at 24 and 48 hours but after 72 hours, CK levels began to decline. However, none of these values were statistically significant from each other. The reason for this (Staubli et al. 1985) is that the short-term intensive exercise eccentric muscle contractions cause serum CK levels to increase. High serum CK values are result of damage at thin membrane that surrounds muscle fibers. The damage of membrane is dependent the intensity and the duration of contractions. The highest level of was observed after 24 hours of exercise; even the CK levels after 48 and 72 hours are still high.

Exercise immediately after the first signs of damage is loss of functions as the reduction in force, and pain, and it is elevated at the highest levels in 24-48 hours after exercise. Therefore, this situation is defined as the delayed muscle soreness (Friden et al. 2001). Pre-exercise DOMS values were similar between groups in our study ($p>0.05$),24, 48.However, the values were significantly lower in favor of ice massage group ($p<0.05$). Both groups' DOMS values were the highest after 24 hours ($p <0.05$) while these values are similar after 48 hours ($p>0.05$). While measurements taken after 72 hours of exercise were detected significantly higher in cold water immersion group ($p<0.05$) ice massage group's DOMS values measured at 72 hours is returned to the rest values ($p>0.05$). In this study, ice massages and water immersion groups after 24 and 48 hours had high pain levels as reported, delayed muscle fatigue caused pain after the 24 - 48 hours of the exercise (Szyman 2000). However, the present study supports the previous findings.

Similar results (Skurvydas et al. 2006), were declared that after 24 and 48 time period, the subjects felt muscle pain and their blood CK levels significantly increased' but after the cold water immersion therapy, many muscle damage-markers' (CK, muscle pain, loss of strength, neuromuscular performance) effect disappeared. Besides, (Bleakley et al. 2012), as a result of exercise, delayed onset muscle soreness and fatigue was minimized at least 15 ° C like cold water immersion and reported that cold water immersion is the one most popular strategies (Bleakley et al. 2012). This study has similar methods, and effects comparable with other studies while (delayed muscle pain) after 24,48,72 DOMS values,

ice massage group compared to the cold-water immersion group have been observed to return to normal levels in less time.

It was reported that (Bleakley et al. 2012) exercise type; water immersion temperature, duration, and frequency application were differed in studies. Fourteen trials with passive intervention methods based on immersion in cold water for 48 hours, and 24 hours after the workout in favor of cold water immersion showed statistically significant effects. Cold water after exercise reduces delayed onset muscle soreness as proven by in many study results. Nevertheless, the necessity of further research in this area is reported.

CONCLUSION

As a result, ice massage applications helps muscle relaxation and delayed muscle pain (DOMS) as well as preventing the accumulation of edema. Consequently, the ice massage application results in less pain sensation than water immersion method.

RECOMMENDATIONS

Cold water immersion should be used more frequentlyas a recovery strategy by the athletes and crowded training groups compared to ice immersion application.

REFERENCES

Appell HJ, Soares JM, Duarte JA 1992. Exercise, muscle damage and fatigue. *Sports Med*, 13: 108-115.

Armstrong RB, Walren GL, Walren JA 1991. Mechanisms of exercise induced muscle fiber injury. *Sports Med*, 12: 184-207.

Bleakley C, McDonough S, Gardner E, Baxter GD, Hopkins JT, Davison GW 2012. Cold-water immersion (cryotherapy) for preventing and treating muscle soreness after exercise. Cochrane Database of Systematic Reviews, 2.DOI:10.1002/14651858. CD00 8262.pub2.

Bobbert MF, Hollander AP, Huijing PA 1986. Factors in delayed onset muscular soreness of man. *Medicine and Science in Sports and Exercise*, 18: 75–81.

Camus G, Deby-Dupond G, Duchateau J, Deby C, Pincemail J, Lamy M 1994. Are similar inflammatory factors involved in strenuous exercise and sepsis. *Intensive Care Med*, 20: 602-610.

Cheung K, Hume P, Maxwell L 2003. Delayed onset muscle soreness: Treatment strategies and performance factors. *Sports Med*, 33: 145-164.

Cheung K, Hume P, Maxwell L 2003. Delayed onset muscle soreness: Treatment strategies and performance factors. Comp *Biochem Physiol C Toxical Phamacol*,134: 199-206.

Clarkson PM, Byrnes WC, McCormick KM, Turcotte LP, White JS 1986. Muscle soreness and serum creatinekinase activity following isometric, eccentric, and concentric exercise. *Int J Sports Med*, 7: 152-155.

Clarkson PM, Hubal MJ 2002. Exercise-induced muscle damage in humans. *Am J Phys Med Rehabil*, 81: 52 -69.

Friden A 1981. Morphological study of delayed muscle soroness. *Experientia*, 37: 506-507.

Friden J, Lieber RL 2001. Eccentric exercise-induced injuries to contractile and cytoskeletal muscle fibre components. *Acta Physiol Scand*, 171: 321-326.

Friden J, Sjostrom M, Ekblom B 1983. Myofibrillar-damage falloving intense eccentric exercise in man. *Int Sports Med*, 4: 170-176.

Garrett WE,Kirkendall DT 2000.*Exercise and Sport Science*. Philadelphia: Lippincott Williams and Wilkins.

Geeta S, Majumi MN 2014. Effect of ice massage on lower extremity functional performance and weight discrimination ability in collegiate footballers.*Asian Journal of Sports Medicine*, 5: 23184

Howatson G, Someren KA 2003. Ice massage, effects on exercise-induced muscle damage. *J Sports Med Phys Fitness*, 43: 500–505.

Hill J, Howatson G, van Someren K, Walshe I, Pedlar C 2014. The influence of compression garments on recovery following marathon running. *Journal of Strength and Conditioning Research/National. J Strength Cond Res*, 28: 2228-2235.

Joness DA, Newham DJ, Torgan C 1989. Mechanic influences on long lasting human muscle fatigue and delayed-onset pain. *Journal of Physiology*, 412: 415-427.

Korkmaz SG 2010. *Muscle Fatigue Damage in the Long Term Athlete Relations*. PhD Thesis. Adana: Çukurova University.

Murray RK, Granner DK, Mayes PA, Rodwel VW 1998. *Biochemistry of Harper.* 24th Edition. Istanbul: Baris Bookstore.

Newham DJ, Jones DA, Edwards RH 1986. Plasma creatinekinase changes after eccentric and concentric contractions. *Muscle Nerve*, 9: 59-63.

Roth SM, Martel GF, Ivey FM, Lemmer JT, Metter EJ, Hurley BF, Rogers MA 2000. High-volume, heavy-resistance strength training and muscle damage in young and older women. *J Appl. Physiol*, 88: 1112-1118.

Schwane JA, Buckley RT, Dipaolo DP, Atkinson MA, Shepherd JR 2000. Plasma creatinekinase responses of 18- to 30-yr-old African American men to eccentric exercise. *Medicine Science Sports Exercise*, 32: 370-378.

Simith LL, Miles MP 2000. Exercise induced muscle injury and inflammation. In: WE Garrett, DT Kirkendal (Eds.): *Exercise and Sport Science*. Philadephia: Lippincott Williams and Wilkins, pp. 401-411.

Skurvydas A, Sipaviciene S, Krutulyte G et al. 2006. Cooling leg muscles affects dynamics of indirect indicators of skeletal muscle damage. *Journal of Back and Musculoskeletal Rehabilitation*, 19: 141-151.

Skurvydas VS, Mickeviciene SK, Stanislovaitis A, Mamkus G 1985. Effect of age on metabolic fatigue

and on indirect symptoms of skeletal muscle damage after stretch-shortening exercise. *Journal of Sports Medicine and Physical Fitness*, 13: 889-894.

Smit L 1991. Acute Inflamation: The underlying mechanism in delayed onset muscle soreness. *Med Sci Sport Exerc*, 23: 542-551.

Staubli, M, Roessler B, Kochli HP, Peheim E, Straub PW 1985. Creatinekinase and creatinekinase MB in endurance runners and in patients with myocardial infarction. *Eur J Appl Physiol Occup Physiol*, 54: 40-45.

Szyman DJ 2000. Recommendations for the avoidance of delayed onset muscular soreness. *Strength and Conditioning Journal*, 23: 7-13.

Taylor T, West DJ, Howatson G, Jones C, Bracken RM, Love TD, Cook CJ, Swift E, Baker JS, Kilduff LP 2014. The impact of neuromuscular electrical stimulation on recovery after intensive, muscle damaging, maximal speed training in professional team sports players. *Journal of Science and Medicine in Sport*,14: 1440-2440.

Thompson D, Hompson CW, Williams NC 1999. Muscular soreness following prolonged intermittent high-intensity shuttle running. *Journal of Sports Sciences*, 17: 387-395.

Totsuka M, Nakaji S, Suzuki K, Sugawara K, Sato K 2002. Break point of serum creatinekinase after endurance exercise. *J Appl Physiol*, 93: 1280-1286.

Twist C, Eston R 2005. The effects of exercise-induced muscle damage on maximal intensity intermittent exercise performance. *Eur J Appl Physiol*, 94: 652–658.

Walsh B, Tonkonogi M, Malm C, Ekblom, B, Sahlin K 2001. Effect of eccentric exercise on muscle oxidative metabolism in humans.*Medicine andScience in Sports and Exercise*, 33: 436-441.

Young A 1984. Plasma creatinekinase after the marathon a diagnostic dilemma. *Br J Sports Medicine*, 18: 269-272.