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The Effect of Passive Rest and Sports Massage Recovery Methods on Blood Lactate Clearance After High-Intensity Exercise

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ORİGİNAL ARTICLE

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Abstract

The aim of this study is to determine the effects of passive resting and sports massage recovery methods on lactic acid concentration after high-intensity exercise. A total of 14 semi-elite football players with an age range of 18.14±.94 years, height 179±.06 cm, body weight 70.17±8 kg and sports experience 8.92±.91 years participated voluntarily. The research consisted of two stages and the Yo-Yo running test was performed at each stage. After the running test at each stage, the athletes were given 20 minutes of passive and sports massage to the lower extremity muscles. The lactic acid levels of the athletes at each stage were determined at rest, at the end of the exercise, in the middle of recovery, and at the end of recovery. Data were tested with a two-way analysis of variance (ANOVA) and Tukey post hoc tests were used for pairwise comparisons. Statistically significant results were found between the lactic acid values in the middle and end of recovery of passive resting and sport massage methods performed after the running test ($p<0.05$). When the difference between the methods was examined, it was determined that the lactic acid values in the middle and at the end of the passive rest method were statistically higher than the values in the sports massage method ($F= 38.28$; $p= 0.000$). As a result, it can be said that the sports massage method performed at the end of the high-intensity running test in this study is more effective on lactic acid than passive rest.

Keywords: Passive, Sports Massage, Recovery, Lactate.

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Yüksek Yoğunluklu Egzersiz Sonrası Pasif Dinlenme ve Spor Masajı Toparlanma Yöntemlerinin Kan Laktat Klerensine Etkisi

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Öz

Yüksek egzersiz yoğunluğu sonucunda laktik asit düzeyinin artması organizmanın iç dengesi bozarak yorgunluğun fazlasıyla hissedilmesine ve bunun bir sonucu olarak performansın da azalmasına neden olmaktadır. Araştırmaya konu olan laktik asit düzeyinin hızlı bir şekilde organizmadan uzaklaştırılması toparlanma açısından önem kazanmaktadır. Bu bağlamda bu araştırmanın amacı yüksek yoğunluklu egzersiz sonrası pasif dinlenme ve spor masajı toparlanma yöntemlerinin laktik asit konsantrasyonu üzerindeki etkilerini belirlemektir. Araştırmaya yaş aralığı 18.14±.94 yıl, boy 179±.06 cm, vücut ağırlığı 70.17±8 kg ve spor tecrübesi 8.92±.91 yıl olan toplam 14 yarı elit futbolcu gönüllü olarak katılmıştır. Araştırma iki aşamada gerçekleştirilerek her aşamada Yo-Yo koşu testi uygulanmıştır. Birinci aşamada koşu testi bittikten sonra sporcular 20 dakika pasif olarak dinlenirken, ikinci aşamada koşu testi sonrasında 20 dakika alt ekstremite kaslarına spor masajı gerçekleştirilmiştir. Sporcuların her aşamadaki laktik asit düzeyleri dinlenme, egzersiz sonunda, toparlanma ortasında ve toparlanma sonunda belirlenmiştir. Elde edilen verilerin normalliği ve homojenliği sırasıyla Shapiro-Wilk ve Levene testleri ile analiz edilmiştir. Veriler iki yönlü varyans analizi (ANOVA) ile test edilerek ikili karşılaştırmalar için post hoc testlerinden Tukey kullanılmıştır. Koşu testi sonrası gerçekleştirilen pasif dinlenme ve spor masajı yöntemlerinin toparlanma ortası ve sonundaki laktik asit değerleri arasında istatistiksel olarak anlamlı sonuçlar tespit edilmiştir ($p<0.05$). Yöntemler arasındaki fark incelendiğinde pasif dinlenme yönteminin ortasında ve sonundaki laktik asit değerlerinin spor masajı yöntemindeki değerlerden istatistiksel olarak yüksek olduğu belirlenmiştir ($F= 38.28$; $p= 0.000$). Sonuç olarak bu araştırmada yüksek yoğunluklu koşu testi sonunda gerçekleştirilen spor masaj yönteminin laktik asit üzerinde pasif dinlenmeye göre daha etkili olduğu söylenebilmektedir.

Anahtar kelimeler: Pasif, Spor Masajı, Toparlanma, Laktat.

Introduction

The human organism has been created according to the condition that organs and body systems work in a smooth and balanced way by providing the inner balance necessary for life. This functional work takes place with some organs working more or less. Today, in some sports branches where exercise intensity is high, athletes perform more than one difficult load during the day. Continuing loads or competitions in this way may cause a decrease in the athletic performance of the athletes (Amann et al., 2015; Taylor et al., 2016).

The rapid fatigue of the muscles in sports activities and the fatigue resulting from these activities are closely related to the accumulation of metabolic wastes in the body. Since there is not enough oxygen in the cells to break down glucose in high-intensity work, lactic acid starts to form from glucose that is broken down with less oxygen. In this sense, increased lactic acid at the beginning of exercise may reach peak levels with increasing exercise intensity (Leite et al., 2011). The decrease in pH may disrupt the energy balance by inhibiting the activity of the phosphofructokinase enzyme, which plays a role in ATP synthesis by preventing the binding of hemoglobin to oxygen in the lungs, and the myofibril ATP-ase enzyme in the muscles. This reduces muscle contraction and causes fatigue. Therefore, the rapid removal of lactic acid from the blood reveals one of the most important goals of the recovery process (Kitaoka et al., 2014). The removal of lactic acid from the blood takes place in the organism by various mechanisms. Studies have shown that most of the lactate is converted back to pyruvic acid by skeletal muscles and oxidized in the mitochondria via the Krebs cycle. In addition, recovery methods applied after exercise are known to quickly reduce or remove lactic acid (Nalbandian and Takeda, 2016).

Rapid recovery is very important for athletes who perform high-intensity loads in many sports. It is thought that the success of the athlete is closely related not only to his good performance but also to his ability to recovery (Micklewright et al., 2006). In this sense, the recovery process is a stage that allows the athlete to get rid of the fatigue that occurs at the end of training or competition and to restore their energy metabolism (Bishop et al., 2008). There are important methods that support the relationship between the use of recovery methods after high-intensity exercise and improvements in various physical performance indicators. These methods, in general, have been shown to be effective in the recovery of athletes in various sports branches such as passive rest, sports massage, active recovery, cold water immersion, compression garments and foam rollers (Henderson et al., 2021; Kirby et al., 2021).

The most commonly used method after exercise is passive rest. Passive rest, means that the athlete does nothing out of the ordinary after training or competition and usually remains still. This

recovery method is used to return the organism to its internal balance faster. Studies have shown that passive rest increases blood lactate recovery, but is less effective than active recovery (Malone et al., 2014; Cochrane and Teo, 2015). Yoon and Kim (2015), reported that lactic, ammonia and free radical values of passive rest after high-intensity exercise tests are more significant than active recovery method. In another study, it was stated that the blood lactates of the athletes who performed the passive rest method instead of active recovery were higher (Hinzpeter et al., 2014).

Another popular recovery method is sports massage. Massage, known as an effective recovery after exercise, is used as a recovery method in which different hand movements are used rhythmically on soft tissues. In this method, there may be a slight increase in the temperature of the muscle tissues and blood flow with massage. In addition, the stiffness in muscle tissues decreases, the secretion of endorphin hormone from the endocrine system increases and the pain threshold may decrease (Kuruma et al., 2013; Zhong et al., 2019). One of the biggest known effects of massage is the thought that it removes lactic acid from the organism. Baydil et al., (2017), examined the effects of classical massage and passive rest after exercise in their study to determine the effect of massage on post-exercise recovery. As a result of the recovery methods, it was stated that the massage method is a more effective method than passive rest in removing lactic acid. In another study, Wiltshire et al., (2010), reported that massage increases blood flow and removes lactic acid. In a study comparing the massage method and passive rest after intense exercise, it was stated that the massage method decreased the heart rate and lactate concentration. They stated that this may be due to the fact that the massage method passively increases blood circulation and ensures rapid removal of blood lactate (Sarı et al., 2016). Sports massage is generally used to recover quickly after exercise. Studies examining its effect on athletic performance appear to be limited. In this sense Bayer and Eken (2021), stated in their research that pre-exercise massage is effective in increasing physical performance such as flexibility, horizontal and vertical jumping.

Therefore it is important to apply the best recovery methods in eliminating the physical and physiological fatigue that athletes are exposed to after vigorous exercise. Although research on passive rest and sports massage recovery methods has been carried out for many years, such research is needed because there is still no consensus. Therefore the aim of this research is to determine the effects of increasing lactic acid concentration in the organism after high-intensity exercise on passive rest and sports massage recovery methods.

Materials and Methods

Ethics of Research

All procedures of this study were approved by Aksaray University Clinical Research Ethics Committee with the number 99-SBKAEK on 23.06.2022.

Participants

Fourteen male athletes competing in the Amateur League of the Turkish Football Federation participated in the research voluntarily. Participants were informed about the risks and benefits of the tests and training program to be applied during the study, and the voluntary consent form was approved. Demographic characteristics of the participants; age, height, body weight and sports experience are given in Table 1.

Table 1

Demographic Characteristics of the Participants

Participants	N	Minimum	Maximum	Mean	S.D.
Age (year)	14	17	20	18.14	.94
Height (cm)	14	168	186	179	.06
Body Mass (kg)	14	56	82	70.17	8
Experience (year)	14	8	11	8.92	.91

The age of the participants was the lowest 17, the highest at 20 and an average of 18.14±.94 years, their height between 168 cm and 186 cm, an average of 179±.06 cm, body weight between 56 kg and 82 kg, with an average of 70.17±8 kg. In addition, the sports experience of the participants was determined as 8.92±.91 years, with a change between 8 and 11 years.

Procedure

The test methods performed by the participants were carried out in two stages. A seven-day rest period was given between testing phases. In the study, the single recovery method, which is a cross-patterned model, was used because the same participants participated in passive rest and sports massage recovery methods. In this method, 14 athletes participating in the research were randomly distributed to passive rest and sports massage recovery method groups. During this period, they were

advised not to participate in any physical activity and not to consume dense and fatty foods at least two hours before the test. Before the tests, warm-up exercises were allowed for 20 minutes.

Test Protocol

After the resting lactic acid levels of the participants were determined, they were subjected to the running test. Following the end of the test, the lactic acid levels at the end of the exercise were determined and they entered the recovery process. In this process, half of the participants were given passive rest and the other half was given 20 minutes of sports massage recovery. The lactic acid values of the athletes during the recovery processes were determined in the middle (10th minute) and at the end (20th minute) of the recovery methods. In the second stage, the running test and lactic acid determination times continued in the same way. At this stage, sports massage was performed to the passive rest group, and passive rest was performed to the sports massage group.

Lactic Acid Measurement

The lactic acid values of the participants at rest, end of the exercise, in the middle of and end of recovery were determined as follows. First, the fingertips were cleaned with alcohol cotton and then the piercing was done with a needle pen. Then, 0.2 µl of blood coming out of the skin surface was contacted with the kits in the Lactate Scout device, and values in mmol/L were determined in a short time.

Physical Performance Test

Yo-Yo Test

Participants perform 2X20 meter shuttle runs at increasing speeds back and forth between the start, return and finish lines. Between each shuttle run, there is an active rest period of 10 seconds during which the participant walks or runs within a 5-meter range. The running speed at the time of the test is determined by automatically controlled beeps from the CD player. Funnels are used to identify running lanes 2 m wide and 20 m long. Each lane has another funnel located 5 m behind the starting line, and this area indicates the active recovery zone. When the athlete runs out of power or fails to reach the finish line twice, the test ends and the total running distance in the test is calculated as the test result (Castagna et al., 2006, Thomas et al., 2006).

Recovery Methods

Passive Rest

Passive rest is the process of resting motionless in a sitting or lying position. Participants performed passive recovery for 20 minutes in a sitting position following the end of the test.

Sports Massage

The massage method, which is performed after high-intensity loads, is frequently preferred by athletes to accelerate the resting of the body and the recovery of the muscles. In this method, the sports massage recovery method was performed by sports masseurs to the lower extremities of the participants for a total of 20 minutes, five minutes each of effleurage, petrissage, friction and effleurage. Data Analysis

Analysis of Data

Descriptive statistics and statistical differences of data were calculated using the SPSS 23 package and results were presented as means ± standard deviations (SD). The normality of data was assessed using the Shapiro-Wilk test. The homogeneity of variance between the two groups was examined with Levene's test. The significance test of the difference between the recovery methods was analyzed with Anova, one of the parametric tests. The importance of recovery methods on lactic acid was evaluated by calculating Cohen's d effect size. The effect size (ES) was considered as trivial (< 0.2), small (0.2–0.59), medium (0.60.1.19), large (1.2–1.99) and very large (≥ 2.0) changes [22]. The level of significance for all data was considered as $p< 0.05$.

Results

During the current research, the "Higher Education Institutions Scientific Research and Publication Ethics Directive" has been acted upon. The average lactic acid results of the athletes participating in the study according to passive resting and sports massage recovery methods are shown in Table 2.

Table 2

Blood Lactate Concentrations in Passive Rest and Sports Massage Recovery Methods

Methods	**Rest** (mean±sd)	**Post-Test** (mean±sd)	**Mid-Recovery** (mean±sd)	**Post-Recovery** (mean±sd)	**ES**	**Group x Time Interaction**	
						F	**P**
Passive Rest (mmol/L)	1.19±.17	16.6±.92	13.9±.74	10.51±.86	.90	38.28	.000*
Sports Massage (mmol/L)		16.57±.84	12.32±.86	8.87±.7	.91		

ES= Effect Size.

* $p<0.05$.

In the present study, the normal distribution of the data and the homogeneity of the variances were confirmed. A significant difference was found between the recovery methods for the participants' resting, post-exercise, mid-recovery, and post-recovery lactic acid values (F= 38.28; p<0.05). When the lactic acid values in both recovery methods were compared, an improvement was found in terms of differences in passive rest (ES= .90) and sports massage recovery (ES= .91) methods. When the source of the difference between the methods was examined, it was seen that the lactic acid value in the middle and end of the passive rest method was significantly higher than the values in the sports massage recovery method (p<0.05).

Table 3

In Passive Rest and Sports Massage Methods, Lactic Acid Changes are Offered at the End of the Exercise, in the Middle of Recovery, and at the End of Recovery

Methods	**Post-Test (mean±sd)**	**Mid-Recovery (mean±sd)**	**Post-Recovery (mean±sd)**	**F**	**P**	**η**
Passive Rest (mmol/L)	16.6±.92[a]	13.9±.74[b]	10.51±.86[c]	1187,2	.00[*]	.98
Sports Massage (mmol/L)	16.57±.84[a]	12.32±.86[b*]	8.87±.7[c*]	1104,8	.00[*]	.98

[a, b, c] It is different for each row (p<0.05).

[*] It is different for each column (p<0.05).

The lactic acid values of the participants at the end of the exercise increased by 16.6±.92 mmol/L in the passive resting method. It was determined that these values decreased by 13.9±.74 mmol/L in the middle of recovery and 10.51±.86 mmol/L at the end of recovery in relation to the end of the exercise. Lactic acid values in the sports massage recovery method increased by 16.57±.84 mmol/L at the end of the exercise. It was determined that these values decreased by 12.32±.86 mmol/L in the middle of recovery and 8.87±.7 mmol/L at the end of recovery in relation to the end of the exercise. It was determined that the lactic acid values of the participants at the end of the exercise, in the middle, and at the end of recovery in both passive rest (F= 1187,2; p<0.000; η= 0.98) and sports massage (F= 1104,8; p<0.000; η= 0.98) recovery methods were statistically significantly different from each other.

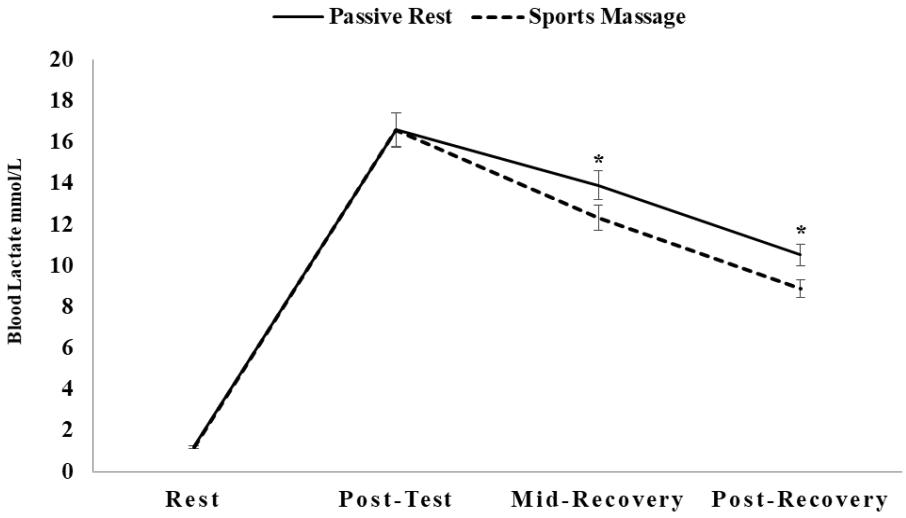

Figure 1. Blood lactate responses during in passive rest and sports massage recovery modalities.
Note: **=p<0.05. It is significant according to the end of exercise values.*

While the resting lactic acid level of the participants was 1.19±.17 mmol/L in the passive rest method, this value reached 16.60±.92 mmol/L at the end of the test. In the passive rest method, the lactic acid value decreased by 13.9±.74 and 10.51±.86 mmol/L in the middle and end of the recovery, respectively. Significant differences were observed in the middle and end of recovery compared to the end of exercise in the passive rest method ($p<0.05$). In the sports massage recovery method, the resting lactic acid level of the participants was 1.19±.17 mmol/L, while this value reached 16.57±.84 mmol/L at the end of the test. It was observed that the lactic acid value decreased gradually during sports massage recovery, to 12.32±.86 and 8.87±.70 mmol/L in the middle and end of the recovery, respectively. Significant differences were observed in the middle and end of recovery compared to the end of exercise in the sports massage recovery method ($p<0.05$).

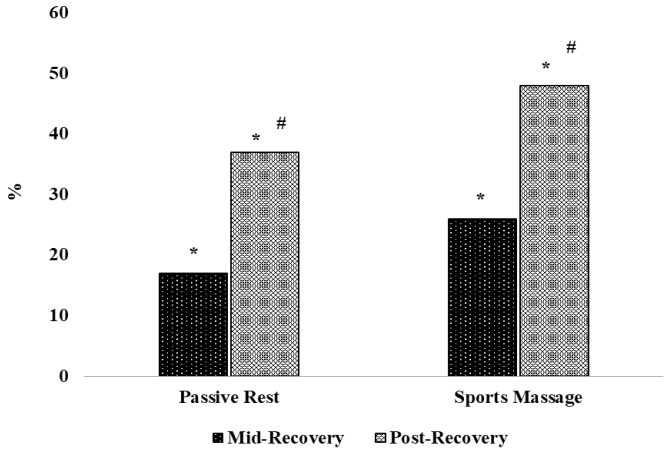

Figure 2. Recovery rates according to post-exercise values.
Note: **=p<0.05. It is significant according to the end-of-exercise values.*
Note: *#=p<0.05. It is significant according to the mid-recovery values.*

It is observed that the lactic acid levels of the participants, which increase with the exercise, decrease by 17% in the middle of the recovery and by 37% at the end of the recovery compared to the end of the exercise in the passive rest method ($p<0.05$). In the sports massage recovery method, it was determined that these values decreased by 26% in the middle of the recovery and by 48% at the end of the recovery, and there were significant improvements ($p<0.05$).

Discussion

In this study, recovery methods applied after high-intensity running test were found to be significantly effective on lactate clearance ($p<0.05$). It is seen that lactic acid levels determined in the middle and end of recovery compared to the end of exercise in both methods decreased significantly ($p<0.05$). When the source of the difference between the methods was examined, it was determined that the sports massage method was more effective in reducing the level of lactic acid than the passive resting method ($p<0.05$). The reason for the difference in sports massage method can be explained as follows. In the passive resting method, the athletes recover only in the sitting position, while in the sports massage method, both lying down and massage are performed. The positive effect is thought to be due to this reason. In addition, due to the pressure applied to the muscles during a sports massage, mechanical blood flow increases and is thought to remove blood lactate, a waste substance.

In the study, lactic acid levels of the athletes decreased by 17% in the middle of recovery and 37% at the end of recovery compared to the end of the exercise in the passive resting method. These values were found to be significant according to the end of the exercise ($p<0.05$). Yoon and Kim (2015), reported that after the high-intensity exercise test in which 27 athletes participated, passive rest gave significant results on lactic acid values. In another study Jemni et al., (2003), investigated the effects of passive rest and combined recovery methods on blood lactate after high-intensity functional training on 12 male gymnasts. The researchers, who stated the resting lactic acid level as 2.2 mmol/L and at the end of the exercise as 11.6 mmol/L, reported that 10 minutes of passive rest in sitting position was more effective than the combined recovery method in reducing blood lactate They stated that this effect was due to the continuation of physical activity in the combined recovery method compared to passive rest.

With touch, an increase in capillary, venous, and lymph circulation may occur as a result of mechanical effects under the skin. As a result of this situation, massage can increase the diffusion potential by releasing the hydrostatic pressure inside the cell. Thus, blood lactate exchange can occur from inside the cell to the outside of the cell. In the study, the lactic acid levels of the athletes decreased by 17% in the middle of recovery and 37% at the end of recovery compared to the end of

the exercise in the sports massage method. These values were found to be significant according to the end of the exercise ($p<0.05$). Rasooli et al., (2012), examined the effects of passive resting and sports massage recovery methods on blood lactate after swimming at 200 meters maximum speed on 17 professional male swimmers in a similar study. The researchers found the blood lactate to be 10.94 mmol/L in the passive resting method after exercise and 7.10 mmol/L in the sports massage method and stated that there were differences between the recovery methods ($p=0.001$). When the source of the difference between the methods was examined, it was shown that sports massage was more effective than the passive resting method in removing blood lactate ($p<0.05$).

Gladwell and Micklewright (2006), investigated the effects of passive rest, sports massage and combined recovery methods on blood lactate levels after the Wingate test on athletes. They stated that blood lactate levels decreased significantly by 19% in the middle of recovery and by 24% at the end of recovery compared to post-exercise values. These levels were significantly reduced by 8% and 41% in the middle and end of the sports massage method, respectively and by 18% and 53% in the combined method ($p<0.05$). When we look at the source of the difference between the methods, it has been reported that sports massage management is more effective than passive rest, and the combined method is more effective than sports massage ($p<0.05$). In addition to Zebrowska et al., (2019), reported that manual lymphatic drainage massage performed by cage fight athletes after intense arm exercises significantly reduced blood lactate.

Baydil et al., (2017), examined the effects of 15-minute passive rest (control group) and sports massage (experimental group) recovery methods after the exhausting Wingate test in their study on young athletes. In the passive resting group, blood lactate, which was 17.74 mmol/L at the end of the exercise, decreased to 13.37 mmol/L at the end of the rest and decreased significantly by 25% ($p<0.05$). In the sports massage group, blood lactate, which was 15.31 mmol/L at the end of the exercise, decreased to 7.41 mmol/L at the end of recovery, significantly decreasing by 52% ($p<0.05$). As a result, when the methods were compared, it was stated that the massage method was a more effective method than passive rest in reducing the blood lactate level at the end of the exercise ($p<0.05$). It is possible to encounter conflicting results regarding lactic acid removal. In general, when the literature is examined, there are few studies claiming that massage after exercise has no effect on reducing lactate levels (Pınar et al., 2012; Ce et al., 2013). With touch, an increase in capillary, venous, and lymph circulation may occur as a result of mechanical effects under the skin. As a result of this situation, massage can increase the diffusion potential by releasing the hydrostatic pressure inside the cell. Thus, blood lactate exchange can occur from inside the cell to the outside of the cell.

Conclusion

This research revealed that methods performed after high-intensity strenuous exercise can accelerate recovery. In this sense, recovery methods performed on athletes effectively reduced lactate clearance. In general, the positive effects of passive resting and sports massage recovery methods on lactic acid were determined after the high-intensity running test. Among the methods, it was seen that the sports massage recovery method was more effective than the passive resting method. Therefore, this research can provide useful information to sports physiotherapists, sports masseurs, trainers, and athletes to the point that massage performed after strenuous exercises is more effective than the passive resting method. Finally, we thank the athletes who participated in the research.

Ethics Committee Permission Information

Ethics Review Board: Aksaray University Clinical Research Ethics Committee Presidency

Date of Ethics Assessment Document: 23.06.2022

Issue Number of the Ethics Evaluation Document: 99-SBKAEK

Statement of Researchers' Contribution Rates

The entire study was conducted by the sole author of the study.

Conflict Statement

The author does not have a conflict statement regarding the research.

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