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Research Article

Comparıson Of The Effect Of Dıfferent Pap Applıcatıons Applıed To Football Players On Blood Lactate Concentratıon After Repeated Sprınt Abılıty

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ABSTRACT

Purpose: The aim of this study is to compare the effects of different PAP applications on blood lactate measurements after RSA.

Materials and Methods: 20 amateur and 3rd league licensed football players between the ages of 18-25 in Eskişehir participated in this study. The repeated sprint ability tests of the athletes were determined by the running based anaerobic sprint test (RAST). The sprint was recorded with two wireless photocell devices (Witty, Microgate, Balzano, Italy) 35 meters apart. Blood lactate measurements after RAST were measured with a Lactate Scout brand portable lactate measuring device. All statistical calculations in the study were made using the SPSS statistical package program (SPSS 26.0. Armonk, NY: IBM Corp). Shapiro-Wilk test was applied for normality analysis. According to the normality analysis, a multiple comparison two-way ANOVA was used to test the effect of different PAP applications on performance based on the results obtained only after general warm-up, and "Bonferroni" post-hoc analysis, one of the multiple comparison tests, was applied to determine which application favored the performance.

Results: A statistically significant difference was detected in the LA variable (EB=.116 (large)) between the PAP groups according to the general warm-up of the volunteer athletes participating in the study ($p<0.05$). This difference was determined as PAP 1>GI.

Conclusion: Statistically significant differences were detected in the LA measurements taken after RSA with the PAP 1 (3 CMJ) protocol applied to amateur and 3rd League football players between the ages of 18-25 ($p<0.05$). However, no difference could be detected between PAP 2 (3 CMJ +10 m sprint) and general warm-up ($p>0,05$).

Key Words: PAP, repeated sprint ability, blood lactate

INTRODUCTION

Post-activation potential (PAP) is used to instantly improve the performance enhancement and activation of the muscle involved in the action during the second contraction after a muscle contraction (Maloney et al., 2014). This physiological phenomenon causes an increase in the speed of nerve impulse transmission to the muscle and an increase in the number of activated motor units and the coordinative mechanism of the contractile filaments through the effect of preconditioning the movements prior to the main movement to be performed. PAP causes an increase in performance due to changes in the neuromuscular system in skills requiring power, strength and speed (Batista et al., 2010; Macıntosh et al., 2012; Ceylan & Demirkan, E., 2017). Muscle performance is influenced by the contractile history of the muscle, and improved muscle recruitment leads to less force production in the neuromuscular system. Therefore, prior muscle activity can improve subsequent force production and increase power output (Kilduff et al., 2007; Rixon et al., 2007; Ceylan et al., 2016). The physiological processes involved in the PAP process are still unclear. The phosphorylation of the regulatory light chain and the increase in motor units offer 2 possible physiological events. First, the mechanism alters the structure of the myosin head by increasing the sensitivity of the actin-myosin interaction to Ca2+ released from the sarcoplasmic reticulum, resulting in the cross-bridges releasing more force (Rassier et al., 2000). Secondly, it has been suggested that preconditioning exercises may be responsible for improving the conductance of excitability at the synaptic junction and at the spinal cord level (Lima et al., 2014).

Soccer is a sport with explosive actions in a short time and few rest breaks. It requires individuals who are able to perform repetitive sprints in combination with low and medium intensity actions or short rest periods. In soccer, the ability to perform explosive movements that continue during competition plays an important role in performance (Turner et al., 2015; Tok et al., 2017; Karabıyık & Gurkan, 2023). Both aerobic and anaerobic energy systems are required to perform these movements (Impellizzeri et al., 2008). During a soccer competition, 90% of the movements performed by elite soccer players are aerobic and 8.6% are anaerobic (Bangsbo et al., 1991). During competition, the intensity of movements is between 85-90% of maximum heart rate and lactate responses vary between 2-10 mmol (Bangsbo, 1994).

Repetitive sprinting ability (RSA) is an important skill, especially in team sports such as soccer and basketball. In soccer, movements such as consecutive sprints, jumping, changing direction, and kicking the ball are performed anaerobically (Wragg et al., 2000). In addition, RSA has been validated as the ability to repeat a maximal short sprint with incomplete recovery in elite male soccer players (Rampinini et al., 2007). Short sprints and the ability to recover afterwards are important to maintain the athlete's performance over time. In soccer, it has been shown that players with a high TSI are better able to perform sprints without falling over throughout the game than players with a lower TSI (Bishop et al., 2001). The main reasons for performance losses in TSR are gender, age, the position played by the players, lactate levels and aerobic capacity (Mujika et al., 2009).

Nowadays, many researchers use different PAP applications to improve performance in strenuous movements such as sprinting, repetitive sprinting, jumping, weightlifting and throwing, etc. However, there is no clear information on which application provides the optimal performance enhancement. The number of studies conducted to ensure that fatigue occurs less after RSA performance, which is an important characteristic for football, is very small (Tunar et al., 2017; Sanchez et al., 2018).

In this context, the aim of our study was to evaluate the effects of 2 different PAP applications (1-Counterjump (CJ) and 2-CJ+10 m. Sprint) on blood lactate concentration after RSA.

METHOD

Research Group

The population of this study consists of male football players aged 18-25 years in amateur and 3rd league in Turkey. The sample group of the study consisted of 20 football players from Eskişehir province with an average age of 18.70±0.73 years, an average height of 179.45±6.91 cm, an average weight of 69.19±5.83 kg and a sports age of 8.50±2.01 years. The anthropometric measurements of the athletes are shown in Table 1. Licenced athletes were checked to see if they had undergone the required health check and obtained a licence. They were allowed to participate in the tests after verifying that these health check documents and licences were still active. This study was approved by the Clinical Research Ethics Committee of T.C. Marmara University Faculty of Medicine with protocol code 09.2022.655 on 01/04/2022. The athletes were subjected to 3 days of testing. On the 1st day, after the general warm-up, an anaerobic sprint test (RAST) was performed on a running basis and blood lactate measurements were taken immediately afterwards. On day 2, after the general warm-up, a 5-minute break and 3 counter-movement jumps (CMJ) (PAP 1) were performed and the LA test was carried out after a 5-minute break. On the last day of testing, after the general warm-up, 5 minutes of rest, 3 CMJ + 10 m sprint (PAP 2) and 5 minutes of rest, the CAST test was performed, followed by the LA test.

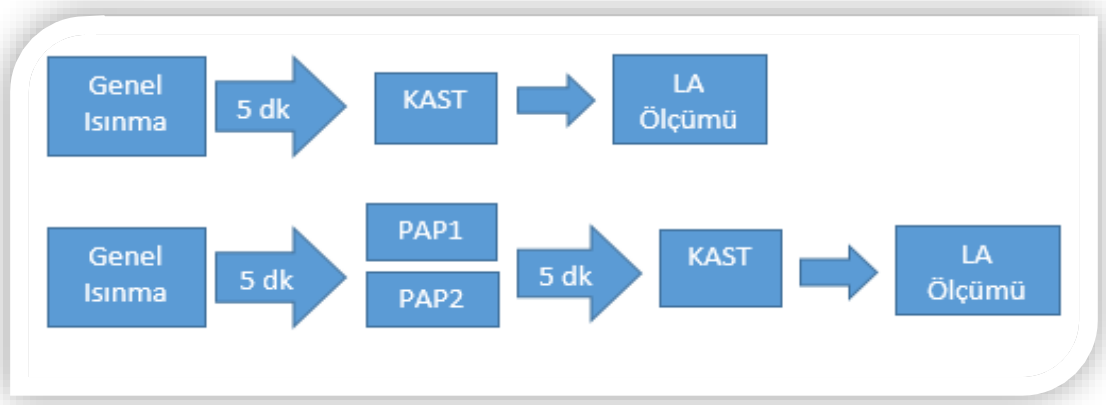

Figure 1. Study design

Data Collection Tool and Method

Height Measurement

The height of the athletes participating in the study was measured in 'cm' using a stadiometer (Seca 320), which measures height with an accuracy of 0.1 cm when the subjects were in anatomical position, barefoot and with their heels together (Taşkın, 2013).

Body Weight Measurement

Body weight was measured with an accuracy of 0.01 kg while the athletes wore sportswear, were barefoot and in anatomical position, and the results were recorded (Kutlu, 2014).

Repeated Sprint Test

The running-based anaerobic sprint test (RAST) was used as a repeated sprint test. The test consists of 6 sprints on a 35 meter track. There is a 10 second break between each sprint. The time for each sprint was recorded by two wireless photocells (Witty, Microgate, Balzano, Italy) located 35 meters apart. The photocells were positioned at the start and finish points. The athletes stood at attention behind the photocell and performed their sprint with a 3-2-1 start command (Rampinini et al., 2007).

Laktat Ölçümü

The blood lactate values of the athletes participating in the study were measured using a portable Lactate Scout lactate meter. The athletes were measured according to the RAST test. For the blood collection from the athletes, the surface was disinfected with pure alcohol before the fingertips were pricked. A lancet was then used to puncture the fingertip and the first drop of blood was wiped off. Then the second drop of blood from the same site was placed in the Lactate Scout blood analyzer and the data was recorded (Hazır et al., 2010).

Data Analysis

All data obtained during the study were analyzed by computer. All statistical calculations were performed using the SPSS statistical package (SPSS 26.0. Armonk, NY: IBM Corp). After calculating the mean (X) and standard deviation (SD) as descriptive statistics, the Shapiro-Wilk test was applied for normality analysis of the study. After the normality analysis, a two-way ANOVA with multiple comparisons was applied to test the effects of the different PAP practices on performance using the results obtained only after the general warm-up, and a "Bonferroni" post-hoc analysis was performed to determine which practice favored performance. For better interpretation of the data, significance was set at $p<0.05$. Effect sizes (ES) were interpreted as small (0.20-0.49), medium (0.50-0.79) and large (>0.80) (Cohen, 1988).

FINDINGS

Table 1. Descriptive statistics of the anthropometric characteristics of the athletes participating in the study

	n	$\bar{X}$	Sd.	Min.	Max.
Age	20	18,70	0,73	18	20
Height (cm)	20	179,45	6,91	167	195
Body Weight (kg)	20	69,10	5,83	57	77
Sport Age (years)	20	8,50	2,01	6	13

$\bar{X}$: Average; Sd: Standart Sapma; cm: centimetre; Kg: Kilogram; Min: Minimum; Max: Maksimum

When Table 1 was analyzed, the average age of the athletes was 18.70±0.73 with a minimum age of 18 and a maximum age of 20 years, the average height was 179.45±6.91 with a minimum height of 167 cm and a maximum height of 195 cm, the average weight was 69.19±5.83 with a minimum weight of 57 kg and a maximum weight of 77 kg, and the average athletic age was 8.50±2.01 with a minimum of 6 years and a maximum of 13 years.

Table 2: Descriptive statistics of the LA measurements of the athletes participating in the study according to general warm-up and PAP groups

	n	$\bar{X}$	Sd.	Min.	Max.
General Warming	20	12,84	2,56	9,70	18,10
PAP 1	20	11,10	2,17	8,30	16,50
PAP 2	20	11,27	1,61	9,30	14,80

PAP 1; Countermovement Jump; PAP 2; Countermovement Jump +10m sprint
Table 2 shows that the average LA of the athletes was 12.84±2.56 after the general warm-up (GI), 11.10±2.17 after PAP 1 and 11.27±1.61 after PAP 2.

Table 3: Cross-group comparison of the LA results of the athletes participating in the study

	Group	N	X ± Sd.	F	P	Significance
LA mmol/L	GI[a]	20	12,84±2,56	3,317	**0,024**	**b>a**
	PAP 1[b]		11,10±2,17			
	PAP 2[c]		11,27±1,61			

GI: General warming; PAP 1: 3 Countermovement Jump; PAP 2: 3 Countermovement jump + 10 m sprint

When Table 3 was examined, a statistically significant difference was found for the LA variable (EB=.116 (large)) and a statistically significant difference ($p<0.05$). This difference was determined as PAP 1>GI.

DISCUSSION AND CONCLUSION

This study investigated the effects of two different PAP protocols on blood lactate after RSA. Two different methods were used in the study. These are: PAP 1; 3 times Countermovement Jump (CMJ); CMJ performance is an important indicator for many sports. The CMJ test is a popular tool for monitoring athletes, providing a simple and practical assessment of neuromuscular function and fatigue (Twist & Highton, 2013). The CMJ test has been used to demonstrate neuromuscular changes due to acute and chronic fatigue in both acute and long-term situations (Cormack et al., 2013; Cormack et al., 2008). PAP 2; 3 times CMJ + 10 m sprint; In combined movements (CM), a resistance exercise is performed before a biomechanically similar plyometric exercise (Matthews and Comfort, 2008; Robins et al., 2009). Some researchers have found that combined exercises have acute effects on the development of strength and power in both the lower and upper extremities (Baker 2003; Matthews and Comfort, 2008). HR, supported by PAP, is a near maximal voluntary contraction or conditioning activity that theoretically increases force and power output (Hodgson et al., 2005; Tillin and Bishop, 2009).
This study investigated the effects of two different PAP protocols on blood lactate after RAST. Two different methods were used in the study. These are: PAP 1; 3 times Countermovement Jump (CMJ); CMJ performance is an important indicator for many sports. The CMJ test is a popular tool for monitoring athletes, providing a simple and practical assessment of neuromuscular function and fatigue (Twist & Highton, 2013). The CMJ test has been used to demonstrate neuromuscular changes due to acute and chronic fatigue in both acute and long-term situations (Cormack et al., 2013; Cormack et al., 2008). PAP 2; 3 times CMJ + 10 m sprint; In combined movements (CM), a resistance exercise is performed before a biomechanically similar plyometric exercise (Matthews and Comfort, 2008; Robins et al., 2009). Some researchers have found that combined exercises have acute effects on the development of strength and power in both the lower and upper extremities (Baker 2003; Matthews and Comfort, 2008). HR, supported by PAP, is a near maximal voluntary contraction or conditioning activity that theoretically increases force and power output (Hodgson et al., 2005; Tillin and Bishop, 2009).
Yaicharoen et al. (2012) found a statistically significant difference between the PAP methods and LA measurements in their study on the effect of warm-up at different intensities on sprint performance and blood parameters in 9 male soccer players. In this respect, our study is parallel to this study.
Lagrange et al. (2020) divided 40 ice hockey players into two groups as control and experimental groups and investigated the effect of PAP with combined movements and found no significant difference after LA in their study. This result is in line with the results of the PAP 2 protocol in our study.
De Freidas et al. (2021) investigated the effects of different PAP protocols on muscle strength and performance in athletes with a history of 10 resistance training sessions and found a significant difference in LA measurement after sprinting between different PAP protocols. The results of LA measurement after RSA are consistent with the results obtained in our study.
As a result, different PAP applications in 18-25 year old football players were found to have an effect on blood lactate measurements after RAST. This effect can be attributed to the ASP 1 protocol. Considering these results, it can be assumed that 3 countermovement jumps performed after the general warm-up at half-time or before the game have a positive effect on delaying athletes' fatigue so that they are able to perform repetitive and high-intensity movements, which are important for football, for a longer period of time.

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