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Heart rate and blood lactate analysis among pentathletes after each event of modern pentathlon

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Abstract

The purpose of the study was to analyze the heart rate and blood lactate of pentathletes after performing each event of modern pentathlon. Seventeen elite modern pentathletes voluntarily participated in the study. Heart Rate and Blood Lactate were analyzed. One way repeated measures ANCOVA were used as a statistical technique. It was concluded that there was a significant difference among different modern pentathlon events on heart rate and blood lactate. The result shows the uniqueness of the sport - Modern Pentathlon as well as it indicates that how the physiological demand varies significantly among the each event. It is therefore recommended that pentathletes may use different recovery patterns or modalities after each event to enhance the recovery rate faster and the performance.

Keywords: modern pentathlon, fencing, swimming, riding and laser-run

1. Introduction

Performing different events requires enormous proficiency and skillfulness. Modern pentathlon is such a multidisciplinary sport which involves five different events, to be performed in a single day. Modern pentathlon is an Olympic sport which includes fencing, swimming, horse-riding and laser-run (Combined event of shooting and running) ^[1]. The modern pentathlon is an only event based on the military aspect of the ancient times, aided by Pierre de Coubertin (father of the Modern Olympics).

Few researches had been conducted on physiological aspects of modern pentathletes. Long back Ishiko (1967) ^[2] tested the fitness index of modern pentathletes by Harvard step test. The result showed that the modern pentathletes were fit and having lots of endurance, they were in the 3rd position among different sports behind marathon runners followed by fly bantam (boxing) ^[2]. Yann Le Meur (2010) ^[3] investigated the new combined event (Laser-Run) and concluded that shooting accuracy plays a major role in overall performance ^[3]. However, physiological testing was again investigated by Yann Le Meur (2011) on new combined event ^[4]. More researches on Modern Pentathlon are yet to conduct, physiological changes after each event of modern pentathlon was yet not investigated. The present study shows the physiological changes in modern pentathletes after performing the each event of modern pentathlon. The practical application of this study is to provide some recommended guidelines for modern pentathletes and coaches regarding different recovery interventions and modalities may be used to enhance the recovery rate faster if a physiological change varies after performing the each event of modern pentathlon.

2. Materials and Methods

2.1 Subjects

Seventeen National level elite modern pentathletes, age ranging between 19 to 25 years (Age 22.43 ± 2.19 years, BMI 18.16 ± 0.72) were purposively selected for the study. Subjects provided written, voluntary, informed consent prior to participation and they were volunteered to participate in the study. All were professional pentathletes; do training for 4 to 6 hours a day and having the training age of minimum 6 years.

2.2 Variables

Heart rate and blood lactate were investigated and selected as the physiological variables for

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the study.

2.3 Methodology

The modern pentathletes were tested on the day of the trial Run at India camp. The pentathletes were first tested initially before the first event (fencing) later on pentathletes were tested at the end of each event of modern pentathlon, overall 4 post-testing were conducted. All the calibrated instruments and trained investigator collected the data. Heart rate was measured through Omron HEM-7120 Automatic Blood Pressure Monitor and recorded the heart rate in beats per minute; and Blood lactate was measured through a blood lactate analyzer in mmol/l.

2.4 Statistical technique

Single group repeated measure design was used and

descriptive statistics – mean and standard deviation was analyzed. In order to find out the mean differences among different events of the modern pentathlon, repeated measures ANCOVA was applied and In case of significant result, post-hoc test Bonferroni was employed. SPSS 20.0 was used to analysis the data. Trend lines show the graphical representation of the data.

3. Results

3.1 Descriptive statistics

Physiological Variables – Heart rate and blood lactate was measured and descriptive statistics data represented in table 1 and fig 1 and 2.

Table 1: Descriptive statistics of heart rate and blood lactate after each event of modern pentathlon

Event	Heart Rate (Mean ± S.D.)	Blood Lactate (Mean ± S.D.)
Pre test before swimming event	57.88 ± 4.18	2.2 ± 0.43
Post test after swimming event	189.94 ± 4.26	10.08 ± 0.81
Post test after fencing event	133.64 ± 5.29	5.41 ± 0.64
Post test after horse-riding event	132.29 ± 4.85	6.02 ± 0.52
Post test after laser-run event	191.64 ± 4.45	13.75 ± 0.73

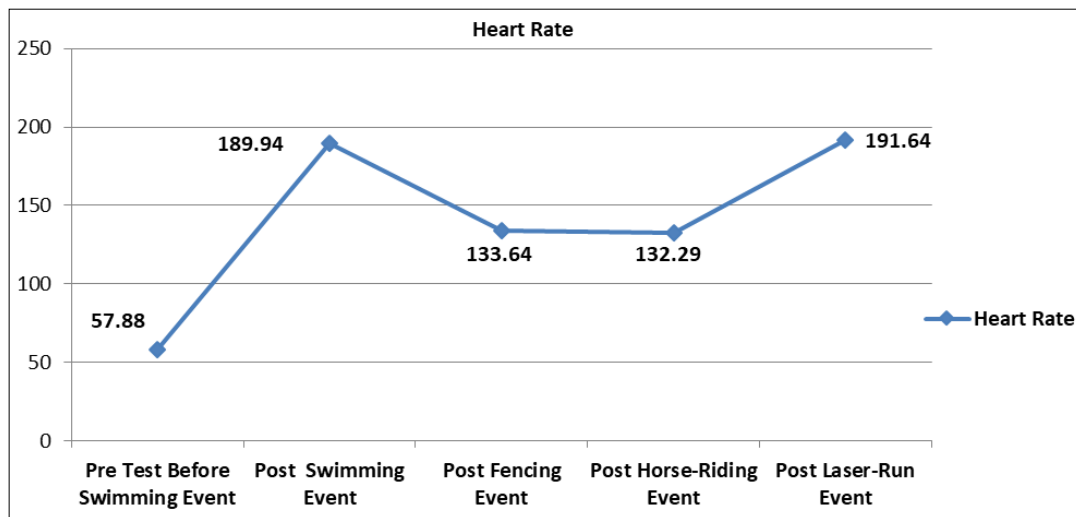


Fig 1: Trend lines of Heart Rate after each event of Modern Pentathlon

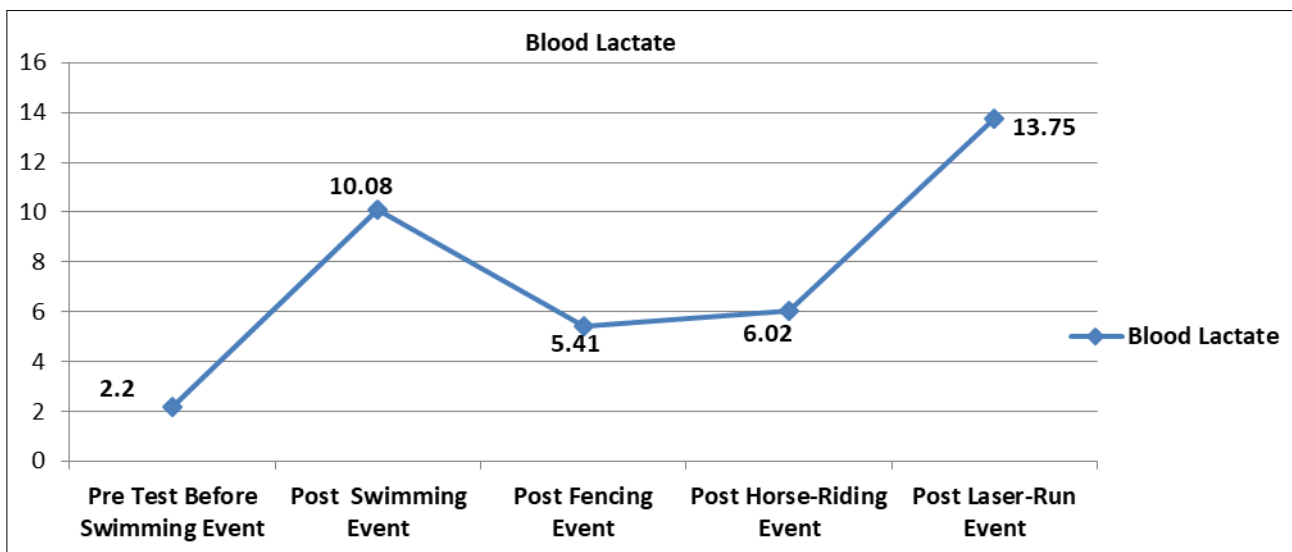


Fig 2: Trend lines of blood lactate after each event of modern pentathlon

3.2 Inferential statistics

Inferential statistics – One way repeated measures analysis of co-variance (ANCOVA) was applied because one dependent variable was assessed after each event of modern pentathlon and pre data was considered as covariate as it can affect the results of a study. All the assumptions to apply one way repeated measures analysis of co-variance (ANCOVA) was tested and all the assumptions were fulfilled to apply the

repeated measures ANCOVA.

3.2.1 Mauchly's test of sphericity

To test the significant differences among the different events, repeated measures ANCOVA was employed, but to check the sphericity of the data, Mauchly's test was applied and presented in table 2.

Table 2: Mauchly's Test of Sphericity

Within subjects effect	Mauchly's W	Approx. chi-square	df	Sig.	Epsilon	
					Greenhouse-geisser	Huynh-feldt
Heart Rate	.673	5.432	5	.366	.779	.993
Blood Lactate	.466	10.476	5	.063	.718	.898

Table 2 presented that the sphericity assumption was not violated. Therefore, we can conclude that there were no variances of the differences among the different events on Heart rate and Blood lactate.

3.2.2 One way repeated measures of ANCOVA

One way repeated measures of ANCOVA was applied and presented in Table 3.

Table 3: 'F' table for testing the significance of within subjects effect of performance after each events on heart rate and blood lactate

Sources		SS	df	MSS	F	p value
Heart Rate	Sphericity Assumed	370.66	3	123.55	5.488	.003*
Blood Lactate	Sphericity Assumed	11.49	3	3.83	20.62	.000*

*The mean difference is significant at the 0.05 level

It was indicated from the above table that heart rate and blood lactate were found significant ($p < 0.05$) among the different events. To further analyze, Pairwise mean comparison analysis was applied by using Bonferroni test in the table 4.

Table 4: Multiple comparisons

Variables	(I) Events	(J) Events	Mean Difference (I-J)	Sig. ^a
Heart rate	Swimming	Fencing	56.294*	.000
		Horse-Riding	57.647*	.000
	Fencing	Swimming	-56.294*	.000
		Laser-Run	-58.000*	.000
	Horse-Riding	Swimming	-57.647*	.000
		Laser-Run	-59.353*	.000
	Laser Run	Fencing	58.000*	.000
		Horse-Riding	59.353*	.000
Blood Lactate	Swimming	Fencing	4.676*	.000
		Horse-Riding	4.059*	.000
		Laser-Run	-3.671*	.000
	Fencing	Swimming	-4.676*	.000
		Horse-Riding	-.618*	.009
		Laser-Run	-8.347*	.000
	Horse-Riding	Swimming	-4.059*	.000
		Fencing	.618*	.009
		Laser Run	-7.729*	.000
	Laser Run	Swimming	3.671*	.000
		Fencing	8.347*	.000
		Horse-Riding	7.729*	.000

In table 4, it is evident that there were significant differences among the different events on both the selected variables.

4. Discussion

The aim of the present study was to investigate and compare

the significant differences among modern pentathletes after performing the each event on heart rate and blood lactate. The findings of the study show that, there was a significant difference between different events of the modern pentathlon on heart rate and blood lactate as p value was below 0.05. To further investigate the multiple comparison, bonferroni test was applied and it was found that the heart rate was significantly higher in post Laser-Run than post fencing and post horse-riding, Simultaneously, post swimming was significantly higher than post fencing and post horse-riding. No significant difference was found between post swimming and post laser-run as well as between post fencing and post horse-riding. It was also found that blood lactate was significantly higher in post laser run followed by post swimming, post horse riding and post fencing. The results might be due to the intensity and duration of the event.

Earlier studies show that the average heart rate maximum and blood lactate concentration after 3 epee fight in the junior Egyptian fencer was 169 ± 8 and 3.1 ± 0.2 , respectively [5], similarly in the elite female fencers it was reported on a range of 149 to 175 beats/min and 2.4 to 3.8 mmol/l [6]. However, in the modern pentathlon the fencing event is continuous in nature and heart rate and Blood Lactate enhanced significantly due to more no. of fights, and spending more time and energy in the arena.

Good aerobic capacity is one of the factors which determine the riding performance in competitions [7]. However, in the systemic review article on horse riding/equestrian it was concluded that heart rate and oxygen consumption increases as the horse progresses through the gaits, similarly the performance determines more on the higher levels of tonic muscular contraction particularly of the trunk [8].

Blood Lactate concentration after 200 meters freestyle in elite swimmer was found 14.1 ± 1.7 [9]. However, in the present study it was found 10.08 ± 0.81 , it might be due the difference between the events, i.e. 200 meters free style individual event and 200 meters freestyle event of modern pentathlon. There was a difference in the performance also between both the events mentioned above.

Laser Run is a new combined event which requires a lot of endurance and shooting accuracy. In fact, shooting accuracy plays a significant role for better performance [3]. The heart rate and blood lactate concentration were more after the laser-run event; it might be due to two reasons. First, laser-run is a high intensity event; secondly, it is a last event of the modern pentathlon, so all the accumulated fatigue also has the effect on heart rate and blood lactate [4].

It is clearly seen that there is a significant difference between the events of modern pentathlon and different training methodologies, patterns as well as recovery modalities and

interventions can be used to enhance the recovery rate faster as well as the performance.

5. Practical applications

It is recommended that pentathletes may use different training methodologies, patterns as well as recovery modalities and interventions after each event to enhance the recovery rate faster as well as the performance.

6. Conclusion

It was concluded that there were significant differences between different modern pentathlon events on heart rate and blood lactate. The result shows the uniqueness of the sport - Modern Pentathlon as well as it indicates how the physiological demand varies significantly among each event.

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