



Physiological Responses During Epee Fencing Fight in Junior Egyptian Fencers: An Indication for Fencing Training

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Abstract: The knowledge of physiological characteristics in fencers may support the development and monitoring the specific training programmes for optimal performance in fencing sport. The current study investigates the physiological responses in juniors Epee fencers during fencing fight. Four fencers of the Egyptian male junior's epee team were participated in current study, and their peak rates of physiological variables performed in the laboratory. In addition, their heart rate, oxygen consumption, ventilation, blood lactate and heart rate recovery were tested throughout a series of simulated fencing fight. Results showed that, maximum heart rate during simulated fight in range of previous studies, however peak mean of oxygen consumption observed relatively higher than to those reported for young men fencers. Consequently, intermittent exercise programs alternating high and low intensity aerobic training should be included in conditioning for fencing.

Keywords: Physiological Profile, Competition Demands, Epee Fencers

1. Introduction

Fencing is a high intensity intermittent sport that requires the fencers to compete in frequent, short bouts of high intensity exercise, followed by periods of low intensity activity and need both anaerobic and aerobic demands. Bounces, steps of different direction and lunges occur repeatedly during the competition for the purpose of hitting the opponent, which also puts considerable demands on the neuromuscular system [1-3].

In addition, epee fencing often involves small bouncing movements to enable the fencer to rapidly retreat or to close distance on their opponent during fencing fight [4]. However, there is a little attention toward the physiological responses during the fencing fight in epee and especially for juniors or sub elite fencers.

Previous studies has observed some physiological responses for fencers such as heart rate (HR), and reported range of 167 to 191 beats·min⁻¹ for 60% of the fencing duration during a Women's epee competition [3], and oxygen consumption (VO_{2max}) mean of 40.1 ± 2.3 for young men

French fencer [5], with respect to the difference training and test measurement methods.

Also recent studies focused on the importance of physiological examinations for fencers, [6] conclude that the interval periods between rounds do not allow for complete recovery. Given the incomplete recovery between bouts, it is important that athletes develop specific training programs able to improve this ability.

Introducing specific training that simulates the demands of a competitive bout could help develop the necessary fitness for competitive fencing, and can provide important training information, which be used as a baseline for future studies [1].

Few studies reported physiological responses of junior fencers [5]. However, some recent studies confirmed that determining the physiological responses of these athletes is also important for talent identification and the development of training protocols [1, 7-9].

The knowledge of the physiological characteristics of fencers may help to support the development and monitoring of specific training programmes for optimal performance in the fencing sport. To my knowledge, no such data have been

published with regards to the Egyptian Epee fencers, who competed at high levels of competitive such as African junior's champion. Thus the aim of current study is to investigate the physiological responses during fencing fight in juniors Epee fencers.

2. Methods

2.1. Participants

Four fencers of the Egyptian male junior's epee team were participated in current study, which took part in the 2014 African junior's fencing champion. The (Mean \pm SD) of anthropometric characteristics were; age 20.25 ± 0.50 years, height 1.75 ± 0.03 m, body weight 67.10 ± 1.42 and body mass index 22.06 ± 1.09 kg/m².

2.2. Procedures

All tests were performed for each fencer in 2 separated days, which beginning with standard warm up and stretching exercises. The same order of tests for all fencers was similar and begging in the first day in the laboratory and followed after three days with the simulated fencing fight in the club. Fencers were asked to not engage in any physical activity or training in both test days, and they consumed their breakfast 2 hours before the tests and the tests were performed at 10:00 am clock.

2.3. Peak Treadmill Test (PTM)

This test established to investigate the peak rate of fencers in physiological variables on treadmill machine in the laboratory. The fencers were tested according an incremental treadmill test protocol, which designed by study of [9]. The objective of this test was to determine the peak rate of (VO_{2max}), (HR_{max}), ventilation (VE), blood lactate maximum (Lac_{max}), heart rate recovery (HR_{rec}) and treadmill velocity (TV_{peak}). The fencers were tested according to a conventional test protocol, beginning at a speed of 6 km/h⁻¹ and a gradient of 1.5%. The speed was increased by 2 km/h⁻¹ every 3 min until exhaustion with a 30 s break between levels. Expired gas was analyzed via breath by breath system (Cosmed K4; Srl, Rome, Italy), which includes with a heart rate belt of (Sport Tester Polar 720i, Kemple, Finland).

2.4. Simulated Fencing Fight (SFF)

The simulated fencing fight was performed in a separated day and after three days of the laboratory test to avoid any physical overload between the both days of measurements. Every fencer completed three fights with the other 3 opponents of subjects in the current study and with 10 minutes rest period between the 3 fencing fights. Every fencing fight includes 3 bouts with 1 minute rest, and the bout ended if a fencer had scored 5 touches or the time limit of 3 min was reached. The simulated fencing fight procedures were established in current study correspond the rules of epee fight in an international competition.

The physiological responses during the fencing fight were examined by suunto memory belt, which monitored the (HR) continuously during the whole fight. The physiological variables (VO_{2max}, HR_{max}, VE and HR_{rec}) were calculated by the software (Suunto Training Manager), which used for the data collection from the fencers during the 3 fights. Capillary blood samples were collected from the finger to determine the blood lactate concentration with a hand-portable lactate analyser (Accusport, Boehringer, Mannheim, Germany) at the end of each fencing fight and after reached exhaustion in the laboratory test on the treadmill.

2.5. Statistical Analysis

The distribution of the data was analyzed using the Kolmogorov-Smirnov test, which showed a normal distribution of the data. Standard descriptive statistics involved the calculation of mean and standard deviations, which calculated for each physiological responses variable. The data were analyzed using SPSS 17.0 (SPSS) software. The statistical significance level was $P < 0.05$.

3. Results

The mean and standard deviations of physiological variables during the incremental exercise treadmill test are presented in (Table 1), and the physiological responses variables during simulated fencing fight are presented in (Table 2).

Table 1. Physiological responses of fencers on peak treadmill test.

Variables	F1	F2	F3	F4	Total Fencer
HR _{peak} (beat.min)	197	190	189	192	192 \pm 3.56
VO _{2peak} (mL.kg.min)	56.4	57.4	58.5	55.7	57 \pm 1.22
VE _{peak} (L.min)	155.5	123.4	111.1	135.2	131.30 \pm 18.90
Lac _{peak} (mmol.L)	9.62	6.80	6.31	8.14	7.72 \pm 1.49
TV _{peak} (km/h)	12	14	16	14	14 \pm 1.63

* F = Fencer

The results in (Table 1) demonstrate a mean (\pm SD) of HR_{peak}, VO_{2peak}, VE_{peak}, Lac_{peak} and TV_{peak} obtained in the laboratory test; 192 ± 3.56 beat.min⁻¹ (range; 189 to 197), 57 ± 1.22 ml.kg.min⁻¹ (range; 55.7 to 58.5), 131.30 ± 18.90 L.min (range; 111.1

to 155.5), 7.72 ± 1.49 mmol.L (range; 6.31 to 9.62) and 14 ± 1.63 km.h⁻¹ (range; 12 to 16), respectively.

Table 2. Descriptive statistics mean (\pm SD) and % peak physiological responses of fencers in total 3 epee fights.

Variables	F1	F2	F3	F4	Total Fencer
HR _{max} (beat.min)	165.3	173	160.3	178.3	169.3 \pm 8.0
% HR _{max}	84	91	85	93	88.17%
VO _{2max} (mL.kg.min)	48.3	51.3	44	42.7	46.6 \pm 4.0
% VO _{2max}	86	89	75	77	81.74%
VE _{peak} (L.min)	76.3	89.3	70.7	95.3	82.9 \pm 11.4
% VE _{peak}	49	72	64	71	63.90%
Lac _{peak} (mmol.L)	2.9	3.2	3.1	3.4	3.1 \pm 0.2
% Lac _{peak}	30	47	49	42	42.04%
HR _{rec1min}	150	159	143	165	154 \pm 9.7
HR _{rec2min}	129	140	130	149	137 \pm 9.4
HR _{rec3min}	111	128	119	132	123 \pm 9.3

* F = Fencer

The results in (Table 2) demonstrate a mean (\pm SD) of HR_{max}, VO_{2max}, VE_{max}, Lac_{peak} and HR_{rec} at three different recovery periods obtained during fencing fights; 169.3 ± 8.0 beat.min⁻¹ (88.17% HR_{peak}), 46.6 ± 4.0 ml.kg.min⁻¹ (81.74% VO_{2peak}), 82.9 ± 11.40 L.min (63.90% VE_{peak}), 3.1 ± 0.2 mmol.L (42.04% Lac_{peak}) and (154 ± 9.7 ; 137 ± 9.4 ; 123 ± 9.3) beat.min⁻¹, respectively.

The results of above tables (1, 2) indicate that, the HR_{max} during treadmill test was predominantly in the heart rate zone 189-197 beat.min⁻¹ whereas during epee fights showed lower in the zone of 160.3-178.3 beat.min⁻¹. In addition, the other physiological variables such as VO_{2max}, VE_{max}, Lac_{peak} observed also higher during laboratory test than epee fencing fights. In context of HR_{rec} values during fencing fight, the results in (Table 2) demonstrate heart rate zones 123 to 154 beat.min⁻¹.

4. Discussion

The mean value HR_{max} (169 ± 8) of fencers during simulated fencing fight in current study was \sim 88% HR_{peak} (192 ± 3.56), and blood lactate concentrations (3.1 ± 0.2) was \sim 42% Lac_{peak} (7.72 ± 1.49). The HR_{max} during simulated fights showed in range of study by [1], who reported HR_{max} to be in range of 149 to 175 beat.min with exercise intensity between 76.3 to 90, 2% HR_{peak}, and lactate concentrations in range of 2.4 to 3.8 mmol.L.

The HR_{max} value of fencers during simulated fencing fight suggests that fencing performance, even if characterized by intermittent patterns of activity, has high physiological demands. It must also be indicate that, regardless of the intermittent character of the exercise load, the HR during fencing fighting was relatively closed to maximum values of fencers in laboratory environments.

The Lac_{peak} value during the fencing fight showed normal at the end of the fight when compared to available studies, which reported lactate concentrations in range of 2.4 to 3.8 mmol.L [1]. The lactate response in fencing fight indicates that fencers were estimate a moderate level of energy

production from anaerobic glycolysis, and this noted that blood Lactate concentration tends to underestimate muscle Lactate concentration.

The mean values of HR_{rec} during the recovery periods after simulated fencing fight were (154, 137 and 123 beats.min) after 1, 2, 3 minutes, respectively; which showed higher than to those reported for fencers (148, 123 and 109 beats.min) in study by [1].

The HR_{rec} values of fencers during fencing fight showed relatively higher in current study, when compared to previous studies [3, 10], but there are many factors such as fitness training level, psychological stress and the environmental conditions could affect the variability of HR_{rec} values in Egyptian fencers.

The mean value VO_{2max} (46.6 ± 4.0) of fencers during simulated fencing fight in current study was \sim 82% VO_{2max} peak (57 ± 1.22), which performed on the treadmill in the laboratory. The VO_{2max} value during simulated fencing fight was higher than to mean value of elite female (36.6 ± 2.9) [1, 7] and regarding the VO_{peak} value of them, also showed higher than to those reported previously for young fencers (46.3 ± 0.9) [5].

The mean value of VO_{2max} during fencing fight suggest a high capacity level in this physiological variable, however this finding could be explained by age mean of participant when compared to elite players [3] and woman elite fencer [1]. In addition, the fencers in current study reached to mean value of (14 ± 1.63 km.h⁻¹) during the maximum VO_{2peak} test, and this indicate that aerobic endurance of fencers may be increased which aid recovery between bouts during fencing fight.

The mean value of VE (82.9 ± 11.4) of fencers during simulated fencing fight in current study was \sim 64% VE_{peak} (131.30 ± 18.90) in the laboratory test, and the VE_{peak} value in current study was lower than young fencers who reported (139.70 ± 27.60 L.min) [11]. The results regard the VE during the fencing fight indicate moderate level capacity; however one fencer reached about 151 L.min in the laboratory test. This VE result suggests that, even during the

peak performance in the fencing fight, the physiological responses did not reach to peak values. Thus, one minute rest between bouts during fencing fight may be affect the VE effort of fencers, which not observed a high physiologic response of fencers in current study.

The results of current study suggest that most of fencing fight times; fencers perform close to their maximum intensity, as estimated by the observed HR_{max} values during fencing fight. Moreover, Lac_{max} values indicate that a large side of energy needed for achievement during U21 fencing fight is structured by anaerobic system. Thus, the finding results of current study suggest that the emphasis in training for fencing should be on performance of high-intensity intermittent exercises.

5. Conclusions

In overview, the study concludes that success in fencing fight may be somewhat dependent on cardiorespiratory fitness parameters, which appear to emerge a substantial factor in explaining the variance in fencing success. In addition, the results provide coaches and fencers with beneficial information on intensity of fencing fight that may be used for the preparation of general and specific training programmes, because this type of training would elevate aerobic fitness as well as reduce factor such as body fat, which is also a possible influencing factor in fencing. Consequently, intermittent exercise programmes alternating high and low-intensity aerobic training should be included in conditioning for fencing.

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