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Physiological profile of French Mixed Martial Art athletes

Research Brief

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Abstract
With average fight duration exceeding 10 minutes and the high intensity intermittent nature of Mixed Martial Arts (MMA), a high physiological demand is placed on aerobic energy system in order to maintain and repeat high intensity efforts. With MMA legalization coming in France in 2020, we thought that it would be interesting to provide practitioners with the first data on physiological profile of French MMA athletes. The present study evaluated the physiological characteristics in 4 professionals and four amateur males MMA fighters. Aerobic and anaerobic capacity were estimated through measurement of VO2max and anaerobic threshold on a treadmill. In comparison to the available literature on MMA, the subjects presented in average lower VO_{2max}, similar VO2 and percentage of VO_{2max} at anaerobic threshold. In comparison with available UFC data, the subjects presented lower values. In comparison to the available literature on other French combat sport athletes, the subjects presented in average lower VO_{2max}.

Key Words: Physiological Characters, Aerobic Capacity, Anaerobic Capacity

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Introduction

Mixed martial arts (MMA) is a unique and complex combat sport which uses a wide range of kicking, punching, and grappling techniques found in more traditional martial arts such as kickboxing, wrestling, Brazilian jiu-jitsu and karate.
Since his introduction in 1993, the sport of MMA has evolved and offers now a large number of professional organizations worldwide. National and internationals federation across the globe organizing amateur competitions. Despite the fact that MMA is becoming an increasingly popular combat sport, the quantity of studies investigating this athletes profiles remains thin in regards of more traditional and ancient combat sports[1,2,15,16,17,18,19,20].

The duration of the fight is over 10 minutes on average[2], composed of high intensity epochs of activity for approximately 6-14 secs interspersed with period of lower intensity activity, with a 1:4 ratio of high:low intensity work[3]. Given the average fight duration and the high intensity intermittent nature of the sport, the energy supply of MMA has been suggested to be similar with repeated sprints[12].
Those short duration of high intensity actions, indeed, highly stresses the lactate energy system. However, if the lactate energy system is stressed too early and/or too much, it may lead the athletes to "gas out". Potentially caused by an accumulation of metabolites[14] and subsequent acidosis[13].
Therefor a high physiological demand is placed on aerobic energy system[4,5] in order to sustain an intensive competition, even though anaerobic capacity is very important.

With legalization coming in France, finally, in 2020, we thought that it would be interesting to provide practitioners with the first data on physiological profile of French MMA athletes.

The measurements of breathing parameters during an exhaustive incremental test enables the assessment of two ventilatory thresholds: VT1 and VT2[7,8,9]. The first ventilatory threshold (VT1) is called "aerobic threshold"[10]. The second ventilatory threshold (VT2) is called: "anaerobic threshold" [8,9].
In the present study, a group of 8 active male MMA athletes were tested. The tests included both aerobic and anaerobic systems. As well to VO_{2max}, the values of VO2 at anaerobic threshold and percentage of VO_{2max} are important parameters to take in consideration in evaluating aerobic capacity. High VO2max level with low threshold indicates recruitment of the lactate energy system too early and too much. In contrast, high VO_{2max} level and high threshold will delay the need of the anaerobic system, thus, prolonged highly intensity fight.

We intended firstly to provide a physiological profile of French MMA athletes. Secondly, to compare the test results obtained with the available literature on MMA and other French combat sports.

Methods

Participants
8 subjects 4 professionals and 4 amateurs male MMA fighters (Age = 25,4 ± 6,7 years / Experience = 8 ± 10,8 fights / weight = 70,7 ± 5,9 kg).

None of the participants had a family history of cardiovascular disease or was using any medication.

Protocol
Physiological evaluation on the 8 subjects was performed at the start of their respective fight camps. All tests were conducted in MMA Stratégie at Lisses Sport Académie, Lisses, France.
To measure VO2max, VO2 and heart rate at threshold level, the subjects were asked to run on treadmill. After a short standardized warm up, the subjects started running on a treadmill (Technogym, Run Excite 500, Italy) with a start speed of 5 km/h. The speed was increased by 1 km/h for every two min till exhausted. Personal absolute and relative VO2max and maximal heart rate were recorded during the running. Levels of VO2 and heart rate were measured at threshold level using, ventilation switch point for CO2 (VO2 at AnT, Wasserman)[11].
Ventilation was measured using mixed chamber analyzer (Cosmed Quark, Italy). Heart rate was measured using a heart rate monitor (Garmin).

Statistical Analysis
Statistical analyses were performed using R Studio Cloud (R studio, Boston, USA). Data is presented as mean ± SD.

Results
Group values of maximum heart rate (HR_{max}) VO_{2max} , and VO2 and heart rate at anaerobic threshold level, respective percentage of VO2max and HR_{max} at anaerobic threshold level measured with treadmill are shown in Figure 1.

Table 1. Threshold values using treadmill.

	M ± SD **(N = 10)**
MAX HEART RATE (BPM)	196 ± 5,9
RELATIVE VO_{2MAX} (ML/MIN/KG)	50,6 ± 7,3
FC@ANT (BPM)	164,6 ± 12,1
VO2MAX@ANT (ML/MIN/KG)	40,3 ± 4,7
%FC@ANT (%FCMAX)	84,1 ± 4,8
%VO_{2MAX}@ANT (%VO_{2MAX})	80 ± 7,7

Data are Means ± SD

Subjects obtained a maximum heart rate of 196 ± 5,9 bpm, a relative VO_{2max} of 50,6 ± 7,3 ml/min/kg , a HR at anaerobic threshold of 164,6 ± 12,1 bpm, a VO_{2max} at anaerobic threshold of 40,3 ± 4,7 ml/min/kg, a percentage of maximum HR of 84,1 ± 4,8 bpm at anaerobic threshold, and a percentage of VO2max of 80 ± 7,7.

Discussion

The present study revealed the physiological characters of French MMA athletes.

In the study, the relative VO_{2max} for the 8 subjects was around 50,6 ml/min/kg. Currently, there 6 studies on MMA to compare our results on treadmill[1]. 5 of them display higher VO_{2max} values (52-62 ml/min/kg) and 1 lower values (44 ml/min/kg). In addition, UFC male fighters exhibit higher VO2max average values (58-66 ml/min/kg)[2].

This results are higher than French judo athletes[21,22]. But lower than French junior wrestler [24] , French elite-amateur boxers[25] and French karate athletes[23].

In our results, the VO2 at anaerobic threshold for the 8 subjects was around 40.3 ml/min/kg. Approximatively similar values from Oliveira SN[15] (37ml/min/kg). But mainly lower than UFC male fighters' values (36-51 ml/min/kg) and values from Tutal & col[20]. Finally, the percentage of VO_{2max} at anaerobic threshold for the 8 subjects was around 80%. More or less close values as in previous studies[15,16,20]. Slightly lower than UFC male recommendations (>86% VO_{2max})[2].

Conclusions

In summary, the subjects in the study presented above average aerobic capacity levels compared with MMA elite pro athletes, other MMA competition level, and other French combat sports athletes. The subjects presented above average threshold levels compared with MMA elite pro athletes but similar compared with other MMA competition level. Reader should be reminded that France do not recognize MMA as other traditional and Olympic combat sports. Therefore MMA athletes usually don't have access to a lot of training resources including a full training staff and a standardized on/off season as other sports. This probably exerts high impact on the test results.

Fighters should consider as a necessity to incorporate more effective aerobic conditioning programs into the training routine. The author recognized the very diverse level of competition and the low numbers and of subjects as a limitation of the study design.

Media-Friendly Summary

First information on physiological profile of French MMA athletes.

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