

LACTATE AND RATE OF PERCEIVED EXERTION RESPONSES OF ATHLETES TRAINING FOR AND COMPETING IN A MIXED MARTIAL ARTS EVENT

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ABSTRACT

Lactate and rate of perceived exertion (RPE) was monitored in 6 male subjects training for and competing in a mixed martial arts event held in Butte, Montana, to determine 1) the metabolic demands of the sport and 2) the effectiveness of the prebout interval training programs chosen to help prepare the competitors for this event. The training lactate measurements ranged from 8.1 to 19.7 mmol·L⁻¹, and the training RPE levels ranged from 15 to 19 on Borg's Category Scale of perceived exertion, the scores of which ranged from 6 to 20. The postbout lactate measurements ranged from 10.2 to 20.7 mmol·L⁻¹, and the post-bout RPE measurements ranged from 13 to 19. Of the 4 subjects that had both training and postbout lactate measurements, 3 had obtained lactate levels during training that exceeded lactate levels immediately after the bout. This indicated that, when using lactate measurements as a benchmark, the conditioning training was effective for these 3 athletes. When we used RPE scores as a benchmark, the conditioning was effective for all 4 subjects because all subjects reached 18–19 during their training, which was at least as high as their reported post-bout RPE levels.

KEY WORDS MMA, interval training, conditioning, lactic acid

INTRODUCTION

Mixed martial arts (MMA) is a sport that combines the Olympic sports of boxing, wrestling, judo, and tae kwon do to comprise a sport as exciting as any other in the world today. There are 2 general branches to training athletes competing in MMA: skill training, and strength and conditioning. The goal of the conditioning training is to create a metabolic environment that mimics the worst-case scenario in actual competition.

The work demand of various sports has been the focus of many studies; researchers have studied lactate production of athletes competing in the sports of rugby (1), wrestling (7), gymnastics (3), skiing (5), and more, but a comprehensive literature search produced no results focusing on the relatively new sport of MMA. To individualize strength and conditioning programs for athletes, researchers suggest tailoring strength and conditioning programs to the metabolic needs of specific sports (2,4).

METHODS

Experimental Approach to the Problem

The purpose of this nonexperimental descriptive study was to examine blood lactate concentrations and perceived exertion of athletes training for and competing in an amateur MMA event held in Butte, Montana, to determine 1) the metabolic demands of the sport and 2) the effectiveness of the prebout interval training programs chosen to help prepare the competitors for this event. The research questions included:

- Will interval training specific to mixed martial arts develop similar lactate levels seen during the actual competition?
- Will interval training specific to mixed martial arts develop rates of perceived exertion (RPE) similar to what is experienced during the actual competition?

The training would be considered successful if the lactate and RPE measurements during training exceeded their respective levels immediately following the bouts.

Subjects

Four male subjects ranging in age from 21 to 41 years training for an MMA event participated in this study; 2 additional male subjects, ages 23 and 26 years, contributed to the pre- and postbout lactic acid data, but we were unable to monitor their training sessions. All the athletes profiled had experience in other sports, including boxing, wrestling, judo, karate, and football, and only 1 of the 6 subjects had previous competition experience in an MMA style event. Each athlete provided written informed consent, and all procedures followed in this study were approved by an institutional review board.

Procedures

The subjects were instructed on the proper use of Borg's Category Scale for rating of perceived exertion ranging from

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22(2)/645–647

Journal of Strength and Conditioning Research
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TABLE 1. Lactate and RPE results (lactate measures are mmol·L⁻¹).

Subject number	Age	Rest lactate levels	Cycle lactate	RPE	MMA lactate	RPE	Sparring lactate	RPE	Post bout lactate	RPE	End
1	41	4.3	8.1	18–19	17.7	18	16.1	17–18	10.5	13	1:31 R1 Sub
2	21	3.5	16.3	17	15.6	17	18.0	18	12.2	15	1:39 R1 Sub
3	23	2.4	—	—	13.0	19	13.3	17	20.7	19	Decision
4	22	4.8	13.8	19	19.7	17	14.5	15	18.7	18	Decision
5	26	3.8							10.2	19	3:13 R1 KO
6	23	3.8							19.0	15	2:36 R1 Sub

Cycle = cycle ergometer interval training; MMA = mixed martial arts specific training; Sparring = actual freestyle sparring; Sub = bout ended in submission; Ko = bout ended in a knockout; END = time and how bout ended.

6 to 20. An Accutrend Lactate Monitor (Roche Diagnostics, Indianapolis, IN) was used to measure lactate levels of the subjects during training sessions 3 weeks prior to the event, and immediately after their bouts. Six training sessions were observed and during the training sessions the athletes participated in three forms of interval training. Lactate and RPE levels were measured within 2 minutes of completing the interval training sessions and the MMA bout. The RPE rating was obtained while lactate was being measured.

One interval training approach included MMA-specific actions (shadow striking and shadow wrestling) combined with higher-intensity movements/exercises, including push-ups, pull-ups, sit-ups, wrestler's bridge, jump squats, lunges, barbell curls, mountain climbers, and tuck jumps. The second form of interval training included two 4-minute rounds MMA-specific sparring with a 1-minute rest between rounds. The third form was based on Tabata's cycle ergometer protocol that involved 20 seconds of pedaling on a cycle ergometer at maximal levels followed by 10 seconds of submaximal work for eight repetitions, or a total of 4 minutes of work time (6).

RESULTS

The results are discussed here in a descriptive case study format for 2 reasons. First, there are a limited number of subjects. We recognize this as a limitation of the study and recommend future researchers use more subjects, which would make quantitative analysis of the data more appropriate. Second, only 2 of our subjects finished their bouts in regulation time; all of the other subjects' bouts ended early, and at different times, as the result of knockout or submission.

The lactate measurements demonstrate the high metabolic demands of training for and competing in the sport of MMA. The training lactate measurements ranged from 8.1 to 19.7 mmol·L⁻¹, and the training RPE levels ranged from 15 to 19. The postbout lactate measurements ranged from 10.2 to 20.7 mmol·L⁻¹, and the postbout RPE measurements ranged from 13 to 19 (Table 1).

DISCUSSION

The goal of the conditioning training for these athletes was to create a similar metabolic environment that would be developed during the actual bout. There were limitations in our study design that we readily acknowledge. Limitations include the small nonrepresentative sample, lack of a control group, and the large age range of 21–41. However, the lack of a large sample allowed us to more closely analyze each subject's lactate and RPE responses during training and the actual bout, despite how the bout ended.

This event was considered a national level event with competitors attending from across the country; it is not uncommon for bouts in MMA to end before normal regulation time. In fact, of 17 bouts at this event, 14 ended in the first round. The times these bouts ended included, from shortest to longest: 9 seconds, 44 seconds, 51 seconds, 1:21, 1:31, 1:34, 1:39, 1:52, 1:54, 2:23, 2:36, 2:50, 3:13, and 4:42. In MMA, bouts can be won by submission, knockout, or by decision. Submissions are usually the result of joint locks or strangles. The opponent signals a submission by "tapping out," i.e., repeatedly tapping to signal the end of the bout. Submitting is basically equivalent to saying "uncle" to prevent injury or loss of consciousness.

Of the 4 subjects that had both training and postbout lactate measurements, 3 had obtained lactate levels during training that exceeded lactate levels immediately after the bout. This difference indicated that, when using lactate measurements as a benchmark, the conditioning training was effective for these 3 athletes. Of course, those athletes whose bouts ended early due to knockout or submission are expected to have lower lactate and RPE levels.

Using RPE levels as a benchmark, the conditioning was effective for all four subjects because all subjects reached 18–19 during training; at least as high as post-bout RPE levels. Overall then, strength and conditioning specialists can be relatively sure that well thought out training and conditioning programs can be effective in replicating the metabolic environment created in the sport of MMA.

Of the athletes involved in the bouts that ended early, before the end of regulation time, one of them won (subject 2) and the other lost (subject 1). On the basis of lactate and RPE results, conditioning was not a factor for the athlete that lost, but that is not to say that it couldn't have been later in the fight. For this athlete the strength and conditioning specialist would recommend more focus on skill-related training to prevent the loss by submission. For the athlete that won the bout (subject 2), the strength and conditioning coach would recommend to continue to focus on skill-related training but, again, we don't know if conditioning would have been a factor later in the fight. Therefore, effective strength and conditioning should still be a vital part of the training. For the athlete that won a decision and was successful in generating lactate and RPE levels as high during training than in the bout, the strength and conditioning specialist would recommend to continue conditioning with a similar approach, but to improve skill-related technique which would improve the probability of ending the bout early.

Subject three's highest lactate measurement during training was approximately $13 \text{ mmol}\cdot\text{L}^{-1}$; more than $7 \text{ mmol}\cdot\text{L}^{-1}$ lower than his lactate level immediately after the bout. Subject three's rate of perceived exertion was 19 for the MMA interval training, and his postbout RPE was 19, but during a postbout conversation with subject 3, he stated that in retrospect, he would lower his training RPE scores if he had the chance. Indicating that his prebout RPE score of 19 was actually more like a 17–18 after his MMA experience. He simply had never worked that hard before.

PRACTICAL APPLICATIONS

The training and conditioning sessions used by these mixed martial artists were effective in increasing lactate to levels as high as levels measured during 3 of 4 MMA bouts and interval training was effective in increasing RPE as high as RPE levels during 4 of 4 MMA bouts. The results of our study provide initial insight into the metabolic demands of the sport of MMA.

Also, this study gives feedback to the athletes and coaches of MMA athletes on effectiveness of the 3 different methods of interval training these athletes used in preparation for their bouts. These results indicate that supplemental interval training sessions can replicate the metabolic demands of the sport and suggest to MMA athletes and/or strength and conditioning specialists working with these athletes that interval training designed to increase lactate levels can be effective and should be a part of their comprehensive training programs.

ACKNOWLEDGMENTS

We would thank the undergraduate students who helped in the data collection for this study, including Jennifer Dobb, Dan Kleckner, Lucius McGillivray, Sam Rauch, Tanner Smith, Sarah Thielen, and Shelli Vicars.

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