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Research article

HEART RATE AND BLOOD LACTATE RESPONSES TO *CHANGQUAN* AND *DAOSHU* FORMS OF MODERN *WUSHU*

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ABSTRACT

The development of specific training designed to enhance physiological aspects of performance relies heavily on the availability of accurate and validity physiological data. In the combat sport of *Wushu*, *katas* are used to develop aerobic fitness. It is arguably important to assess and monitor heart rate (HR) and lactate (La) responses when designing effective training programs. The aim of this pilot study was to investigate heart rate and lactate responses to forms execution among *Wushu* combatants. Male elite modern *Wushu* athletes (n = 4) from a South Brazilian regional team participated in the study. Athletes were aged 22.5 ± 2.08 years old and had at least eight years of *Wushu* experience. Athletes carried out the *Changquan* and *Daoshu* forms in random order, HR and La were measured pre- and post-exercise. Results indicate that HR was 176 ± 3 and 176 ± 2 bpm and La was 4.38 ± 1.3 and 5.15 ± 1.07 $mmol \cdot l^{-1}$ for *Changquan* and *Daoshu* forms, respectively. There were no significantly differences in HR and La between the two forms. HR values represent 89.2 ± 1.1 and 89.1 ± 1.8% of age-predicted maximal heart rate and lactate was near of 4 $mmol \cdot l^{-1}$ point. In conclusion, training programs to *Wushu* combatants could target the range of physiological values cited above with no differences between two forms.

KEY WORDS: Kung-fu, training, combat sports.

INTRODUCTION

Evaluation of performance is important for both athlete and coach, thus information about physiological capacity is critical. These data allows more effective training program design and its comparison with reference values. In addition, it could provide base for athletic approach as one can identify athletes' potentials and limitations.

Specificity is one of the physical training principles and it is critical to training program design. The specific exercise promotes adaptations that generate sport-specific effects of training (Hewson and Hopkins, 1996; Hill et al., 1998). Within combat sports, some studies have demonstrated that *katas*- or forms-based training could cause aerobic training effects (Schmidt and Royer, 1973; Shaw and Deutsch, 1982; Pieter et al., 1990; Zehr and Sale, 1993). However, it is necessary to distinguish specific physiological characteristics of that sport to design this type of training. For a specific training program design, the determination of workload is not only critical, but attaining the necessary metabolic demand, heart rate (HR) (Shaw and Deutsch, 1982) and blood lactate (La) are also key parameters (Hetzler et al., 1989; Zehr and Sale,

1993; Ohkuwa et al., 2002).

Taking in account the need of specific training programs' design and that heart rate and blood lactate have been used to evaluate combat sports, the aim of this pilot study was to verify heart rate and lactate responses before and after the execution of *Changquan* and *Daoshu* forms of modern *Wushu*. In addition, there are no studies that evaluate physiological responses to modern *Wushu*, and this sport probably will be inserted in the next Olympic Games from Beijing, China, 2008.

METHODS

Participants

Four male volunteers (age = 22.5 ± 2.08 years, weight = 62.1 ± 9.01 kg, height = 1.73 ± 0.08 m) of the *Wushu* regional team from south of Brazil participated of study. They had, at least, 8 years of training experience and gave their written informed consent before participating in the study. The protocol was approved by UFRGS' Ethical Committee. An acknowledged limitation of the present study is the relatively small sample size. It should be noted that all elite athletes of *Wushu* regional team volunteered to participate in this study and clearly future research should use a larger size.

Experimental protocol

Heart rate and blood lactate were measured before non-standardised 10-min warm-up. The athletes were asked to perform the same warm-up exercises from your training workout consisting of static and dynamic stretching exercises, and 10-min after warm-up HR and lactate were measured. Post-exercise HR and 5-min post-exercise La were registered. To mimic the competition effort, a simulated competition mode was used motivating combatants. The tests were performed at morning on two separate days with 48 h interval in a randomized order. Athletes were fasted and blood samples were collected from ear lobe in a seated position. The HR was measured through a cardio-tachometer (Polar S610, USA) and blood lactate using a Lactate Analyzer (Roche Accusport, GER).

Statistics

Data are expressed as mean ± SD. Mann-Whitney test was used for comparisons of HR and La between forms. The level of significance was set at $p < 0.05$.

RESULTS

Resting HR was 76 ± 7 and 78 ± 9 bpm for *Changquan* and *Daoshu*, respectively. Pre-exercise HR was 82 ± 5 and 83 ± 7 bpm for *Changquan* and *Daoshu*, respectively. There were no significant differences between resting and pre-exercise HR for both forms. Immediately after the forms execution, HR values were 176 ± 3 and 176 ± 2 bpm for *Changquan* and *Daoshu*, respectively. This result represents 89% of age-predicted maximal heart rate (220-age). Post-exercise HR was significant greater than resting and pre-exercise values for both forms. Resting blood lactate values were 1.80 ± 0.36 and 1.33 ± 0.43 $mmol \cdot l^{-1}$. Pre-exercise blood lactate values were 2.05 ± 0.21 and 1.80 ± 0.24 $mmol \cdot l^{-1}$. There were no significant differences between resting and pre-exercise HR for both forms ($p < 0.05$). Five minutes after forms execution, La values were 4.38 ± 1.63 and 5.15 ± 1.07 $mmol \cdot l^{-1}$ for *Changquan* and *Daoshu*, respectively. Post-exercise La was significant greater than resting and pre-exercise La for both forms ($p < 0.05$). There was no significant difference for HR and La between two forms.

DISCUSSION

The American College of Sports Medicine (ACSM, 1990) recommends 3 to 5 days/week, 60 to 90% of maximal HR (HRmax) or 50 to 85% of maximal oxygen uptake (VO_2max) and 20 to 60 min of continuous aerobic activity to development of cardio-respiratory fitness. The studies of combined and selected techniques from *katas* (Schmidt and Royer, 1973; Shaw and Deutsch, 1982; Pieter et al., 1990) that evaluates HR without VO_2 measure, suggest that karate exercises could raise HR to the level for enhance cardiovascular fitness. Findings from the present study demonstrate that athletes performing modern *Wushu* forms attained 89% of age-predicted Hrmax, a level of workload that is in the range recommended by ACSM and, thus, suggests its use for training.

Zehr and Sale (1993) evaluated the efficacy of *Chito Ryu Seisan Kata* like aerobic power training method. HR and VO_2max were evaluated continuously through *katas* execution in moderate and intense paces. The HR was, respectively, 93 ± 6 and 101 ± 3% of HRmax obtained in maximal cycle ergometer test. There were no differences between paces. Karate *katas* could cause desired effects of cardiovascular training when performed in intense pace. However, Shaw and Deutsch (1982) inicated that a training program should not use only one *kata,* but importantly, they indicated that higher HR were associated with high intensity *kata*. Among a sample of professional karate athletes, Schmidt and Royer (1973) demonstrated an average HR of 144.5 (138-152) bpm which means 80% of their Hrmax. Interestingly, the protocol used by Pieter et al. (1990) lends support to using a similar form of

training method, showing *taekwondo* athletes reported increased HR to 80% of age-predicted HRmax.

The present study also demonstrated that blood lactate increase to 4.38 ± 1.63 and 5.15 ± 1.07 $mmol \cdot l^{-1}$ for *Changquan* and *Daoshu* forms, respectively. Anaerobic threshold have been considered like 4 $mmol \cdot l^{-1}$ (Heck et al., 1985). Zehr and Sale (1993) also measure blood lactate during C*hito Ryu Seisan Kata* performed in moderate and intense paces. The results represent 11.5 and 22.2%, respectively, of peak values from maximal cycle ergometer test. Faster pace produces significant higher response. Blood lactate responses to beginning level form (*Ki Cho I*) of *Moo Duk Tkow*, a *taekwondo* subdivision, was investigated by another study (Hetzler et al., 1989), and lactate value increases to 3.23 ± 1.56 $mmol \cdot l^{-1}$. Blood lactate levels changes with exercise intensity, but another factors can contribute. In the present study, there were no significant differences between *Changquan* and *Daoshu* (the late performed with sword). This means that the use of sword does not increase workload.

CONCLUSIONS

Present study demonstrates that modern *Wushu* athletes attained 89% of age-predicted HRmax and 4.0 to 5.0 $mmol \cdot l^{-1}$ of blood lactate after performing *Changquan* and *Daoshu* forms. In addition, there were no significant differences between forms. However, it's important more studies that analyze physiological responses of *Wushu* combatants to this sport. If these parameters will be confirmed, specific training could be developed to enhance aerobic fitness in the combat sport of *Wushu*. The *Wushu katas* could be used to develop aerobic fitness with these reference values serving to training goal.

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KEY POINTS

- Heart rate and lactate responses are not significantly different between *Changquan* and *Daoshu* forms for *Wushu* combatants.
- The *Wushu katas* could be used to develop aerobic fitness.

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