Hysteresis Area of Psychobiological Variables. A New Non-Invasive Biomarker of Effort Accumulation?

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Abstract

The hysteresis area, which reflects the history-dependency of psychobiological parameters, has been recently suggested as a new non-invasive marker of exercise stress and tolerance. However, its promising applications are still underexplored. This study aims to test if the hysteresis area of the perceived exertion (RPE), heart rate (HR), and muscle oxyhaemoglobin concentration (muscle O_2Hb) are sensitive to effort accumulation over multiple bouts of running exercise. Ten physical education students performed five consecutive running bouts at maximal aerobic velocity. The consecutive bouts started when participants reported at least an RPE ≤ 11 (Borg's 6-20 scale). The hysteresis areas of RPE, HR, and muscle O_2Hb were calculated for each bout, and their magnitude was compared using Friedman ANOVA and Wilcoxon test. Effect sizes were calculated through Cohen's *d*. The hysteresis areas of all studied variables changed between the initial and final bouts: RPE and HR increased (between bouts 1-4: Z = –1.99, *p* = .04; Z = –2.19, *p* = .03, respectively), and muscle O_2Hb decreased (between bouts 1-4: Z = –2.80, *p* < .01). Large effect sizes (*d* = 1.22 - 1.81) were found in HR between bouts 1-4, 1-5, 2-4, 2-5, and muscle O_2Hb between bouts 1-4 and 1-5. The results showed that the hysteresis areas of RPE, HR, and muscle O_2Hb were sensitive to effort accumulation during repeated running exercises performed at maximal aerobic velocity. Despite further research is warranted, the hysteresis area of psychobiological variables points towards being a sensitive biomarker for monitoring acute fatigue.

Keywords: complex adaptive systems, fatigue, history-dependency, recovery efficiency, sports monitoring, training.