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This item was submitted to Loughborough University's Institutional Repository by the author.

Citation: LLOYD, A. ... et al, 2015. The interaction between temperature and hypoxia on the rate of neuromuscular fatigue development. 62nd ACSM Annual Meeting, World Congress on Exercise is Medicine, and World Congress on the Basic Science of Exercise Fatigue, San Diego, California, 26th-30th May 2015

Additional Information:

• This is a non-final version of an article published in final form in the journal Medicine and Science in Sports and Exercise, 47: 5(S) and can be found at: http://dx.doi.org/10.1249/01.mss.0000466118.29837.67

Metadata Record: https://dspace.lboro.ac.uk/2134/18157

Version: Accepted version

Publisher: American College of Sports Medicine

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THE INTERACTION BETWEEN TEMPERATURE AND HYPOXIA ON THE RATE OF NEUROMUSCULAR FATIGUE DEVELOPMENT

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ABSTRACT: High altitude is often comprised of both hypoxia and thermal stress. Independent exposures to these stressors are suggested to impair neuromuscular function and thereby performance; however relatively little research has investigated neuromuscular responses to hypoxia and thermal stress in combination. PURPOSE: To determine the interactive effect of temperature and hypoxia on neuromuscular fatigue rates and subsequent task failure in the knee extensors. METHODS: Six (preliminary data) active males were exposed to three ambient temperatures (5, 23, 43°C; COL, NEU, HOT, respectively) at two levels of oxygen concentration (0.21, 0.13 FIO2; CON, HYP, respectively). Following a 40-min rest period, participants carried out dynamic knee extension exercise at a fixed intensity (34 ± 10W) until task failure. At every 2-min interval, participants performed a single maximal isometric voluntary contraction with twitch interpolation (0.2-ms, square wave doublet; 125 ± 22 mA) to discern the rate of voluntary and peripheral fatigue development. Regression analysis was used to define the relationship between time and various fatigue markers. To test for significance, a three-way (time x FIO2 x temperature) repeated measures ANOVA was used. RESULTS: Rectal, muscle and mean skin temperature were all significantly (p<0.05) affected by HOT and COL ambient temperatures. The rate of peripheral fatigue development (resting twitch force) over time significantly increased during HOT (p<0.05), COL (p<0.05) and HYP (p<0.001). Peripheral fatigue rates were further increased during combined HYP-COL and HYP-HOT; however the results showed no interaction (p=0.8 & 0.4 respectively). Similarly, independent exposure to HOT (p<0.05), COL (p<0.01) and HYP (p<0.05) significantly reduced exercise time (34 ± 17, 23 ± 5 and 54 ± 18% respectively), which was further decreased during combined HYP-COL (66 ± 13%) and HYP-HOT (66 ± 17%) showing no interaction (p=0.5 & 0.1 respectively). Volitional (central) fatigue declined with time (p<0.05), but was not significantly affected by condition. CONCLUSION: The results indicate that both temperature and hypoxia induce significant increases in the rate of muscle fatigue development. Additionally, fatigue is further increased when hypoxia and extreme ambient temperature are combined, however the effect is not interactive.

Accepted for Publication in: Medicine & Science in Sports & Exercise on 02/02/15

Published in: Medicine & Science in Sports & Exercise on 31/05/15