



Effect of HiHiLo on autonomic nervous system and body functional status of excellent female rowers

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Objective 12 female rowing athletes of Shanghai as research object of this study. 7 weeks of hypoxic experiment will be carried out on the study subjects. Monitoring of HRV and functional indexes of athletes during this period. To explore the effect of 3 weeks of *Living High Training High Training Low* (HiHiLo) training of female rowers ANS and functional status, and discussion on the relationship between ANS and functional status of athletes in HiHiLo.

Methods 12 Shanghai elite female rowers for 3 weeks HiHiLo training. Simulated altitude from 2500m to 3200m, A total of seven weeks of HRV and biochemical function indexes were tested before and after hypoxia training. In addition, the HRV test of the athletes in a hypoxic exposure. According to the change characteristics of each index, analysis of the change of the athletes ANS in acute hypoxic exposure, and the evaluation of the effects of HiHiLo on ANS and functional status.

Results 1. The results of HRV test showed that there was no significant difference in time domain and frequency domain between normal condition and low oxygen environment, But SDNN in hypoxia environment in higher than normal environment, RMSSD slightly lower than the normal environment, indicate that hypoxic environment for athletes of cardiovascular ANS regulation will change and PSNS tension decreased; TP decreased and LF/HF increased, but the change was not significant. 2. The detection of the three stages of the athletes found that there were no significant changes in the indicators of HRV. However, the SDNN、RMSSD and PNN50 indexes showed a certain change trend, that settled low oxygen, time domain index increased, and in hypoxia exposure within three weeks are maintained at high levels and hypoxia after the end of each indicator of the level of decline, as well as the domain indexes, the frequency domain indexes HF、LF and LF/HF also showed obvious change tendency. 3. After the beginning of the experiment, Hb、RBC continued to rise, and after three weeks of hypoxia reached the highest value, compared with before the experiment was increased by 7.7%, 5%, RBC and the experiment was significantly different ($p < 0.05$), Hct increased 5.3% after 3 weeks of hypoxia. Hypoxia after the end of the experiment, RBC, Hb and Hct showed a downward trend, at the end of experiment were decreased by 5%, 3.4%, 3.5% ($p > 0.05$); In this experiment, the BU, CK of the Shanghai women's rowing athletes at each stage in the normal range, there was no significant difference, but there is a clear trend of change; There was no significant difference in the T of the athletes in the seven week test, but the change trend is obvious. The C was significantly decreased ($p < 0.05$) in the second week after hypoxia exposure, and the follow-up period was significantly lower than that before the experiment ($p < 0.05$) at second weeks. T/C value was significantly increased in the second week of hypoxia ($p < 0.05$), the trend of change is roughly the same as T. The correlation analysis between biochemical function index and HRV was found that the correlation coefficient between PNN50 and T/C was 0.672 ($p < 0.05$), before hypoxia, LF/HF and T/C were negatively correlated with -0.825 ($p < 0.01$), LF/HF and T correlation coefficient -0.789 ($p < 0.01$); During the 3 week HiHiLo training, CK was significantly correlated with SDNN, HF and LF, respectively, and the correlation coefficients were -0.425 ($p < 0.05$), -0.43 ($p < 0.05$), -0.496 ($p < 0.01$), LF/HF and T were negatively correlated with -0.42 ($p < 0.05$); The tracking period athletes T were significantly positively correlated with SDNN, RMSSD, PNN50, HF in HRV index, correlation coefficients were 0.378 ($p < 0.05$), 0.443 ($p < 0.01$),

0.341($p < 0.05$), 0.371($p < 0.05$). In addition, the correlation coefficient between PNN50 and C was 0.411($p < 0.05$).

Conclusions 1. The ANS of Shanghai female rowers will change in acute hypoxic exposure, SNS would be enhanced. 2. Three weeks of longer periods of hypoxia training will enable the athletes to enhance the PSNS activity of the ANS, and may make the ability of the regulating equilibrium state from SNS and PSNS, the changes of the ANS regulation of the athletes to the PSNS activity were enhanced, this may be the result of long time hypoxia stimulation and training, to a certain extent, it shows that the level of athletes' performance has been enhanced. 3. Functional status index of Shanghai women's rowing athletes was well in 3 week HiHiLo training, Part of the improvement of the functional status indicators shows that the effect of the hypoxic training is obvious, The functional status of athletes showed a rising trend. 4. In the different stages of the experiment, there was a significant correlation between the HRV partial indexes and some biochemical indexes. This shows that there is a certain relationship between the ANS and functional status in the hypoxic training. Detection and evaluation of autonomic nervous function in hypoxic training can reflect the functional level of the body to a certain extent. This suggests that it is necessary to strengthen the research and application of ANS function evaluation in hypoxic training.