HEART RATE VARIABILITY, MAXIMAL OXIGEN UPTAKE AND ANAEROBIC THRESHOLD

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INTRODUCTION: The VO2max and the Anaerobic Threshold (AT) are two parameters widely known and used in the field of physical exercise either from a focus on sports performance or health (Scribbans et al., 2016), but to know them objectively, complex and expensive techniques are required. Heart Rate Variability (HRV), represented by several indicators, is an easy and inexpensive method to assess the sympathetic and parasympathetic activity of our autonomic nervous system (ANS), which is responsible for controlling variables like heart rate (HR) (Draghici et al., 2016). Therefore, the aim of this study is to estimate the VO2max and the HR at AT from mathematical models that include HRV parameters.

METHODS: In our study we used 25 volunteers trained men (25-45 years). To assess VO2max and HR at AT we used the Gold Standard (GS) method, a maximum stress test on treadmill with gas analyzer; and to assess HRV parameters (HRM, PLF, PHF, LF/HF, FR) we used a spectral analysis of R-R intervals recorded in a resting phase of 5 minutes with a commercial HR monitor.

We use regression analysis to elaborate two models that can predict the VO2max and the HR at AT, and finally we analyse the reliability and heteroscedasticity of the models with Bland Altman plots.

RESULTS: The results show that in our sample it´s possible to estimate the HR at AT from the HRV using a mathematical model that explains 69.6% ($p<0.05$) of the variability, but it is not possible to estimate the VO2max because the mathematical model resultant is not statistically significant ($p>0.05$). Both mathematical models present a significant heteroscedasticity.

CONCLUSION: The possible results could have innumerable and innovative practical applications, but we are aware that in this case they are subject to certain bias and limitations that will have to be solved in future investigations before using those results in a real application.

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THE DYNAMICS OF NOCTURNAL HEART RATE (VARIABILITY) IN TRAINING LOAD MONITORING

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INTRODUCTION: Heart rate (HR) and heart rate variability (HRV) measurements are used in monitoring athlete's recovery status (Buchheit 2014). Theoretically, recordings during night sleep may represent the best disturbance-free condition for this. The effects of training load of the preceding day may be seen especially in the early hours of sleep. As the nocturnal sleep is not just a stable period of recovery, the aim of this study was to identify the underlying relationships between nocturnal HR and HRV in different segments of the night sleep.

METHODS: Nocturnal RR-interval (RRI) recordings of 60 recreational endurance runners after two consecutive "stress-free" days were included in this study. RRI recordings were started when going to bed to sleep and stopped after waking up in the morning. First six hours of the RRI recordings were analyzed as 45-min periods (T1-T8) by using the Firstbeat Sports software. Sample correlation coefficients were calculated among the periods of HR and high frequency power (HFP). Exploratory factor analysis was used to study whether there are unobserved dimensions (factors, latent variables) underlying the observed periods of HR and HFP (factor indicators). Based on the results of the exploratory factor analysis, confirmatory factor model was specified for nocturnal HR and HFP at both measurement points (night 1 and night 2).

RESULTS: Correlations among periods of HR ranged from 0.655 to 0.946 and among periods of HFP from 0.720 to 0.912. The highest correlations were observed between the adjacent measurement periods and the correlations were lower between early and late periods of nocturnal sleep. In exploratory factor analysis the two-factor model showed the best fit to the data. According to the estimation results of the model, the four earliest periods of HR (T1-T4) and the two earliest periods of HFP (T1-T2) loaded on the Factor 1, while the six latest periods of HR (T3-T8) and the five latest periods of HFP (T4-T8) loaded on the Factor 2. Confirmatory factor model for early (T1-T2) and late periods (T5-T8) fitted the data well at both measurement points (two consecutive nights).

CONCLUSION: The results suggest that nocturnal HR and HRV indices should not be analyzed as one period, but separately for early and late periods of the night sleep. First 90 min contains different information than later periods of the night sleep. Previous studies have shown that early hours of nocturnal HRV are reflecting the training load (Buchheit 2014), but further research is needed to confirm the value of the HRV during the late hours of nocturnal sleep.

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POST-EXERCISE HYPOTENSION AFTER SIMULATED VOLLEYBALL TRAINING

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INTRODUCTION: Post-exercise hypotension (PEH) is the reduction in systolic (SBP) and/or diastolic blood pressure (DBP) below control levels and is usually observed after a single bout of continuous exercise of submaximal intensity (50-70% VO2max) and prolonged duration (30-60 min) (1). There are few studies in the literature comparing PEH between interval and continuous exercise (2), but none for a team sport. The aim of the present study was to investigate whether volleyball, as a type of interval exercise, causes PEH. Thus, arterial pressure values measured during recovery after simulated volleyball training (VT) were compared with those measured after a continuous cycling exercise protocol (CC).

METHODS: Ten female, normotensive, experienced volleyball players, 23.6±3.89 yrs, performed a 60-min volleyball training (30 min active time) with continuous monitoring of heart rate (HR) and, on a separate day, a 30-min protocol of continuous cycling at the same intensity (as judged by HR) as the VT. Baseline and post-exercise values of BP and other cardiovascular parameters [HR, cardiac output (CO), stroke volume (SV), total peripheral resistance (TPR)] were monitored noninvasively (Finometer) for 30 min before and 60 min after the exercise protocols.

RESULTS: SBP was lower during the first minutes of recovery compared to baseline in both conditions, but the drop was larger (-16±4 vs. -8±4 mmHg) and longer (10 vs. 5 min) following VT than after CC ($p<0.01$). DBP remained at baseline values in recovery from CC, but after