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Fifteen years of nocturnal heart rate variability, a case study of a four-time Olympian

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INTRODUCTION:
Heart rate (HR) and heart rate variability (HRV) measurements are used in monitoring athlete's recovery status [1]. Aging is known to decrease, and good aerobic fitness to increase HRV [2], but what happens to HRV of an endurance athlete during a career of four Olympic Games?
METHODS:
Subject of this case study was an elite-level race walker (main event 50 km), who recorded his nocturnal RR-intervals (RRI) regularly during his career to monitor his recovery status. RRI recordings were started when going to bed to sleep and stopped after waking up in the morning. RRI recordings were analyzed by using Firstbeat Sports software (ver. 4.7.3.1) and retrospectively studied on yearly basis. Recordings that had less than four hours of clean data were omitted, and 4 242 recordings were included in this study. Lactate thresholds and maximal oxygen uptake (VO2max) were analyzed 2-4 times per year on an indoor track in 7×1000 m test at gradually increasing speed. Annual average HR and HRV indices as well as annual average lactate thresholds and VO2max were further studied in relation to age of the athlete (23-37 yrs). A repeated measures ANOVA with Tukey post-hoc tests were used to detect changes between the years and Pearson's correlation coefficients were used to detect relationships between variables.
RESULTS:
Annual average nocturnal HR was found to stay relatively stable, increasing from 51 ± 3 bpm at the age of 23 yrs to 53 ± 2 bpm ($p<0.001$) at the age of 37 yrs. Much greater changes were seen in HRV indices over the years, as RMSSD declined from 97 ± 10 ms at the age of 23 yrs to 55 ± 6 ms ($p<0.001$) at the age of 37 yrs. Age was found to correlate negatively with annual average RMSSD ($r=-0.962$, $p<0.001$) and positively with HR ($r=0.592$, $p=0.020$). No correlation was found between age and VO2max ($r=-0.029$, $p=0.920$), but age was found to correlate positively with the speed at first lactate threshold ($r=0.661$, $p=0.007$). Speed at first lactate threshold correlated also negatively with RMSSD ($r=-0.609$, $p=0.016$).
CONCLUSION:
As shown previously in cross-sectional studies [1], gradual decline in nocturnal HRV was also found in present elite athlete between the age of 23 and 37 suggesting reduced vagal activity. Physical fitness has been found to positively correlate with HRV, but in the studied elite athlete, improvement in the speed at the first lactate threshold suggests improvement in physical fitness over the 15 years of follow-up. It seems that for monitoring athlete´s recovery status [2] the reference values of individual HRV indices should be updated on yearly basis.
REFERENCES:
[1] Buchheit M. (2014) Monitoring training status with HR measures: do all roads lead to Rome? Front Physiol 5, 73.
[2] De Meersman R. & Stein P. (2006) Vagal modulation and aging. Biol Psych 74: 165-173.

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