

NOCTURNAL HEART RATE AND HEART RATE VARIABILITY BASED TRAINING LOAD MONITORING, A CASE STUDY OF AN ELITE JUNIOR XC SKIER DURING A GLACIER TRAINING CAMP

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INTRODUCTION

- Training camps on glacier are common among cross country (XC) skiers because camps allow to carry out ski training on snow year-round.
- Because exposure to high altitude is an environmental stressor itself [1], it is important to monitor training load and recovery in these high altitude camps.
- Recent studies [e.g. 2] suggested that nocturnal heart rate (HR) and HR variability (HRV) could be used as a tool for monitoring training load.

- **Purpose:** To investigate the changes in nocturnal HRV of an elite junior XC skier during a glacier training camp.

METHODS

- 19-year old elite junior XC skier ("first timer" at high altitude) collected nocturnal RR-intervals with Suunto Memory belt before, during and after the 10-day glacier training camp.
- Living altitude: 1800 m
- Training altitude
 - Mornings skiing on glacier at 2700m
 - Afternoons dry land training mainly at 700 – 1100 m

- Nocturnal HRV was analyzed with frequency domain method (Firstbeat Technologies Ltd, Jyväskylä, Finland) for 4-hour time period starting 30 min after going to bed.
- Variables
 - Average heart rate (HR)
 - Low frequency power (LFP)
 - High frequency power (HFP)
 - Total power (TP = LFP + HFP)
 - Recovery index (RI = combination of HR and HRV) [3].

RESULTS

- Nocturnal HR increased by 16 %, while TP and RI decreased by 37 and 28 %, respectively, from the base level before the camp to the second night (after moderate training) during the camp (table 1, figure 1).
- Nocturnal HR, TP and RI values returned close to the base level after a resting day.
- Nocturnal HR increased again by 10 % and TP and RI decreased by 22 % and 20 %, respectively, during the last two nights of the camp (after moderate training).
- After returning home, all values returned to the base level.

DISCUSSION

- The changes in nocturnal HR and HRV data during the beginning of the high altitude training camp suggested increased sympathetic activity which may be related to acclimatization processes of the body.
- The findings at the end of the camp suggested cumulative fatigue.
- The skier seemed to recover quite rapidly after a resting day in the middle of the camp and after returning home although he has no earlier experience of altitude training.
- The HR and HRV based analysis seemed to be a practical tool to monitor training and acclimatization induced stress in endurance athlete during altitude training camp.
- However, the scale of RI and HR/HRV responses to training and altitude exposure are individual.

Table 2. Individual recovery index history of the skier from previous 3 months.

After recovery day/period	200 - 225
After hard training day/period	150 - 160
Lowest measured value (fever)	125

REFERENCES

- [1] Mazzeo R. Sports Med 38:1-8, 2008.
 [2] Hynynen et al. Int J Sports Med 31: 428-32, 2010.
 [3] Kettunen & Saalasti. Patent publication US7330752, 2004.



Figure 1. Changes in recovery index and training during the training camp.

Table 1. Nocturnal HR and HRV variables during the training camp.

Night	HR (bpm)	LF (ms ²)	HF (ms ²)	TP (ms ²)	RI	Training
pre1	47	12035	8814	20849	197	Moderate
1	52	8155	5524	13679	169	Rest/travelling
2	54	7895	5297	13192	142	Moderate
3	48	8047	6067	14115	196	Moderate
4	51	10665	6624	17289	176	Light
5	53	11038	4876	15913	156	Heavy
6	44	11180	7892	19072	193	Rest
7	49	10650	5388	16038	175	Heavy
8	49	10853	5713	16566	174	Light
9	52	11843	5835	17678	146	Moderate
10	51	10000	5540	15540	162	Moderate
post1	46	11390	8531	19922	198	Rest/travelling