The objective of this study was to investigate the effect of prolonged exercise in extreme conditions on physical performance and heart rate variability.

A group of seven men completed a 55 day unsupported ski expedition to the North Pole. The subjects had all the needed equipment and food with them in sledges (mass of the sledge about 140 kg in the beginning). The daily food ration contained energy about 5500 kcal of which 60 – 65 % was fat. Body composition, orthostatic reaction (OR), maximal voluntary isometric force of different muscle groups (MVC), counter-movement jump height (CMJ), squat jump height (SJ) and performance during a progressive Nordic walking exercise test on a treadmill (NW-tread) were measured two weeks before (2WB), two weeks after (2WA) and two months after (2MA) the expedition. Heart rate variability (HRV) was measured during the OR and NW-tread tests. The average body mass decreased 3 kg in 2WA, but returned to the baseline in 2MA. There was also a significant change in the lean body mass, which was 65 +/- 5 kg in 2WB, 62 +/- 4 kg in 2WA and 63 +/- 5 kg in 2MA (p < 0.05).

In the OR test the diastolic blood pressure in supine position (71 +/- 11; 66 +/- 11; 83 +/- 13 mmHg, p < 0.05) and the heart rate acceleration index (40 +/- 5; 35 +/- 6; 43 +/- 11 %, p < 0.05) had significant changes. No significant group mean changes in HRV indices were noted in the OR. The MVC values were all somewhat decreased in 2WA and returned to baseline in 2MA. However, the only statistically significant change was found in the body flexion MVC test (95 +/- 23; 78 +/- 17; 91 +/- 20 kg, p < 0.05). The expedition also had a significant effect on both CMJ (39 +/- 1; 30 +/- 2; 33 +/- 2 cm, p < 0.05) and SJ (36 +/- 6; 28 +/- 2; 31 +/- 2 cm, p< 0.05). There were no statistically significant changes in the VO2max values (3.9 +/- 0.5; 4.1 +/- 0.3; 4.3 +/- 0.4 l/min, p = 0.472), although five subjects of seven reached their personal best after the expedition. Energy expenditure during the first and second load in the NW-tread was significantly elevated in 2WA (0.34 +/- 0.03; 0.41 +/- 0.03; 0.35 +/- 0.02 J/kg/min, p < 0.05 and 0.42 +/- 0.02; 0.49 +/- 0.04; 0.45 +/- 0.02 J/kg/min, p < 0.05) and the portion of fat oxidation also had a significant change at the lowest workload (28 +/- 4; 23 +/- 14; 44 +/- 11 %, p 8804; 0.05). In addition, a significant decrease was found in the low frequency power of HRV (0.04 – 0.15 Hz, LF) in the first workload (41.9 +/- 35.2; 10.7 +/- 8.2; 47.8 +/- 46.6 ms2, p 8804; 0.05). Certain changes in HRV (e.g. in LF) at both supine and standing position correlated with the change in the maximal workload of the NW-tread test.

In conclusion, the expedition induced the greatest impairments on the economy of movement and explosive strength (CMJ and SJ), which did not recover fully even in two months. The HRV, especially at low intensity exercise and