

SUMMARY

Title: The energy cost of ski mountaineering.

Aim: The aim of study was determine effect of speed and slope on energy expenditure during ski mountaineering.

Methods: Twelve athletes (mean age 30 ± 8 years,) took part in the study. This was random intragroup experiment. The energy expenditure was determined by spiroergometry based on the ratio of O_2 and CO_2 exhaled. The anthropometric values and individual ventilation parameters was measured and followed individual warming up. The study was undertaken on the treadmill (Saturn HP Cosmos, Germany) allow to walking with specially adapted roller skis and poles modified for ski mountaineering. The test was initiated by a warm-up lasting for 4 minutes at speed at $3.5 \text{ km}\cdot\text{h}^{-1}$ and 16% slope. The next measurements consisted of 4 parts: walking at 24% gradient and speed $3.5 \text{ km}\cdot\text{h}^{-1}$, 20% gradient and speed $4.2 \text{ km}\cdot\text{h}^{-1}$, 16% gradient and speed $5.1 \text{ km}\cdot\text{h}^{-1}$ and 12% slope with a speed $6.8 \text{ km}\cdot\text{h}^{-1}$. The load lasted for 8 minutes 30 seconds in order to achieve the elevation 200 m. The passive recovery for 20-25 minutes was administered between each measurement.

Results: When the body was after the warm-up on load, the average energy expenditure nonlinearly increased with decreasing slope and increasing speed. The average energy expenditure at 24% slope and speed $3.5 \text{ km}\cdot\text{h}^{-1}$ was $15,7 \text{ kJ}\cdot 0,5 \text{ min}^{-1}$ end totally average expenditure was $266,1 \pm 46,2 \text{ kJ}$. At the 20% slope and speed $4,2 \text{ km}\cdot\text{h}^{-1}$ was average energy expenditure $16,0 \text{ kJ}\cdot 0,5 \text{ min}^{-1}$ end totally average expenditure was $272,5 \pm 42,9 \text{ kJ}$. At the 16% slope and speed $5,1 \text{ km}\cdot\text{h}^{-1}$ was average energy expenditure $17,4 \text{ kJ}\cdot 0,5 \text{ min}^{-1}$ end totally average expenditure was $295,3 \pm 57,1 \text{ kJ}$. At the 12% slope and speed $6,8 \text{ km}\cdot\text{h}^{-1}$ was average energy expenditure $19,6 \text{ kJ}\cdot 0,5 \text{ min}^{-1}$ end totally average expenditure was $324,2 \pm 43,4 \text{ kJ}$. Time duration of all tests was 8 minutes and 30 second Three athletes had problem with completion of the last test at 12% slope and speed $6,8 \text{ km}\cdot\text{h}^{-1}$ for reasons of high demands on the technique of motion at such high speeds.

Average values of heart rate was 24% slope of $144.9 \pm 17,7 \text{ beats}\cdot\text{min}^{-1}$. At the slope of 20% $147,3 \pm 19,8 \text{ beats}\cdot\text{min}^{-1}$ At the slope of 16% $152.3 \pm 21,9 \text{ beats}\cdot\text{min}^{-1}$ and at the slope of 12 % $167,8 \pm 15,3 \text{ beats}\cdot\text{min}^{-1}$.

Key words: ski mountaineering, energy cost, slope, speed, elevation, time.