



Custom built ergometer for analysis of upper body power in cross country ski

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Introduction

Several factors have contributed in the last few years to increase the importance of double poling (DP) technique in cross country ski. Evaluation and training of upper body power is usually performed by means of a traditional strength training apparatus even if the movements performed on this equipment are however quite different from the specific motion. A custom built upper body ergometer has been developed in order to reach a better reproducibility of the DP ski gesture (Pellegrini B. et al. 2005). A personal computer controls a motor that act as a load when athlete pull the cable rolled up in a pulley. In this solution the force is required only during concentric phase and each pulling cycle starts by a not-null velocity. The reliability of this equipment were assessed by the good correlation between ski performance and power evaluate with the ergometer (Bortolan L. et al. 2005).

Trough the 2005 forty-nine high level athletes (33 M, 16 F) asked to be tested with this equipment to get a specific measure of their upper body power. The data collected from three cross country ski national team were analyzed in this study to compare summer and autumn session in order to evaluate the effect of training on upper body power.

Methods

30 well trained cross-country skiers (20 males B.W. 73.6 ± 5.0 kg; 10 females B.W. 58.0 ± 5.0 kg), competing at international level, members of three different teams were considered in this study. The athletes underwent to two testing sessions, the first one in summer and the following in autumn. Each session were composed by two different test with a rest period of at least 15 minutes:

1- five incremental load sets of 10 pulls repetition performed at the maximal intensity. Between each set the athletes were requested to rest for three minutes. Force and velocity of each arm has been measured; from these data a post processing software calculates the mean power of each cycle to determine the load by which the athlete produced maximal power.

2- 50 seconds exercise of continuous pulls with maximal intensity, the load was set at the value previously calculated. Mean power obtained during this test was considered as it has been demonstrated to be able to predict double poling ski performance. Velocity of execution of the poling cycle were also reported.

Results

The most evident result is the significant increase from summer to autumn session of the power values normalized to body weight for both sex. The amount of this increase calculated on all the athletes was quite high as it was quantified to be 26% for male and 29% for female skiers.

Considering each team separately, this difference is maintained significant for male athletes in all teams and for the female in team 1. The numerosity of female in the other two teams didn't allow to apply statistical tests.

The mean velocity of execution of the poling show a tendency to increase from summer to autumn. The increase is significant on the whole group where the velocity went from 2.5m/s to 2.8m/s for male and from 2.2m/s to 2.5m/s for female.

Male	Summer session		Autumn session	
	P [W/kg]	V [m/s]	P [W/kg]	V [m/s]
Total	9.19 ±1.03	2.5 ±0.3	11.63 ±1.69**	2.8 ±0.3**
team 1	9.07 ±0.87	2.5 ±0.3	11.64 ±1.72**	2.9 ±0.2*
team 2	8.75 ±0.49	2.3 ±0.2	10.77 ±0.96**	2.6 ±0.3
team 3	9.84 ±1.47	2.8 ±0.3	12.63 ±2.05**	2.9 ±0.2

Female	Summer session		Autumn session	
	P [W/kg]	V [m/s]	P [W/kg]	V [m/s]
Total	6.26 ±0.67	2.2 ±0.2	8.17 ±0.80**	2.5 ±0.3*
team 1	6.16 ±0.63	2.1 ±0.1	7.90 ±0.68**	2.4 ±0.1*
team 2	6.51 ±0.99	2.0 ±0.2	8.54 ±1.11	2.5 ±0.5
team 3	6.08 ±0.30	2.5 ±0.0	8.39 --	2.5 --

* = p<0.05, **=p<0.005 autumn vs. summer

Discussion and Conclusion

The availability of this special equipment give the possibility to the skiers to monitor their upper body power training results in the specific double poling ski gesture.

The comparisons of the test performed in two different periods has allowed an evaluation of the performance trough the season. The data analysis has demonstrated a significant improvement of power in athletes performance.

The values showed a great increase of the power in the autumn session accompanied by an increment of the velocity of poling phase that shows the increased ability of the athletes to express high force level in shorter periods.

A more deep analysis of the result could taken into account other parameters like the force symmetry between left and right side and the decrease of power during the 50 seconds exercise. These parameters could be reconsidered together with the trainer in order to provide indications for the future training programs.

References

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