Speed versus Intensity of Training

Jim Galanes 2004

The necessity for basic speed and speed/power endurance in cross-country skiing is critical for high-level performance. Further, without speed improvements future improvement in aerobic capacity may be limited or stagnated.

I am presenting a theory that will discuss the need to develop sufficient *speed prior to increasing the loads* in cross-country ski training. Loads can be increased in at least one of two ways. One, externally, by increasing the difficulty of the terrain, and two, internally, by improving neuromuscular function, the ability to produce power. I feel that an increase in the external loads without adequate power output has in our experience not resulted in improved performances or any measureable improvements in aerobic capacity in spite of so-called improved training.

We all know an unfit or less well-trained athlete can walk up a hill and reach near maximal heart rates. Certainly we have observed this in many of our athletes, particularly the younger juniors. Often just walking, skiing or running uphill very slowly results in quite high heart rates. Is the likely cause of this a lack of aerobic capacity or inadequate ability to produce power? In all cases it is probably some of both. For some of our older athletes with whom we have not observed improved performance in spite of long-term training and increased training loads, yet we still see increasingly high rates even at slow paces on the uphills, this has to be a primary consideration.

What this means is that early in the training season or early in athlete development speed, efficency, and power-endurance should be the primary focus, prior to any attempts to increase aerobic capacity (VO2max) or muscular power-endurance b utitlizing increased external loads, harder terrain, in training. Our observations and assessment of past training has shown this to be the case. We have consistently observed athletes in uphill skiing, running, and bounding intervals slowing speeds while heart rates continue to increase even at high intensity.

We have also had repeated cases of athletes overtraining in spite of well-planned and controlled training. The assessed causes were too high intensity in distance training. Too high lactate levels for the pace of distance training, and inefficient power production. Again, I will point to the inability to produce enough power or to produce it efficiently enough. Simply the cost of every uphill is too great and both heart rate and lactate increase dramatically in spite of relatively low and slowing speeds.

The improvement of basic speed this summer through extensive speed training lead to as much as a 7% gain in a couple of individuals in the calculated workload on a ramp treadmill protocol. Corresponding with the increase capacity we also saw lower lactates at each increasing wokload. In other words, they were able to run at a significantly high grade and longer duration at the same relative intensity. This has to point to improved aerobic capacity. This data is not based on a large enough group of athletes to be conclusive, but it is interesting nonetheless.

Using Balke or ACSM formula one can calculate the approximate oxygen cost of a given section of terrain, using know factors of length, grade and speed. The oxygen cost calculation does not take into consideration the effect of different training activities or whole body exercise. However, I believe it can give us a general sense of effectiveness and as assessment of training.

For example, I have evaluated our skiers on a 500m uphill maximal test and a 3000m test on the same hill. Our top male skiers are able to sustain a top oxygen cost of 70-72ml/kg/min for the 3000m test. While over the 500m test the range was much broader from 83-92 ml/kg/min. The top performers across the board are those with the greatest power production over the 500 meters.

So what do we see by the following classic roller ski test? The top skiers, both male and female, have high power outputs over the 500m test, 80 ml/kg/min or greater for the men, and 75 ml/kg/min or greater for the women. The three kilometer time trial represents the portion of VO2max that is sustainable. This test was done in the summer, so the top skiers' sustainable values are only 80-85% of their max.

So what do we learn from this data?

1. The 500m O2 cost reflects the athlete's ability to produce power. If this value is not high enough, aerobic capacity cannot be improved. This is because the speed is not sufficient to create a great enough stress/demand on the oxygen transport system.

2. If the 500m O2 power outputs are close to sustained power outputs, it is unlikely to see significant increases in VO2max. This is most likely because the speed cannot be maintained for long enough duration.

3. Lower level racers have peak 500m power values that are within 5-10% of the longest uphill test. These skiers need to focus on specific speed because no amount of hard training will allow them to increase their VO2max without increasing their neuromuscular function, the ability to produce power.

4. Hard uphill intervals for those with lower maximal power outputs will not help skiers with inadequate power ooutputs/speed since they will not be able to increase speed.

5. Those who are able to sustain to sustain a very high percentage of their VO2max yet have a low 500m capacity are unlikely to be able to improve performance further, since they are already working at close to a maximal level, without improving power outputs.

6. While uphill training is critical to cross-country skiing success, I think the primary driver should be for speed to create the load and not the terrain. If movements in all training (distance and interval) are not clean, crisp, and quick, then either the load is too great, or the athlete's ability to produce neuromuscular power is inadequate. In this case we are only loading the system and not the optimal muscle function.