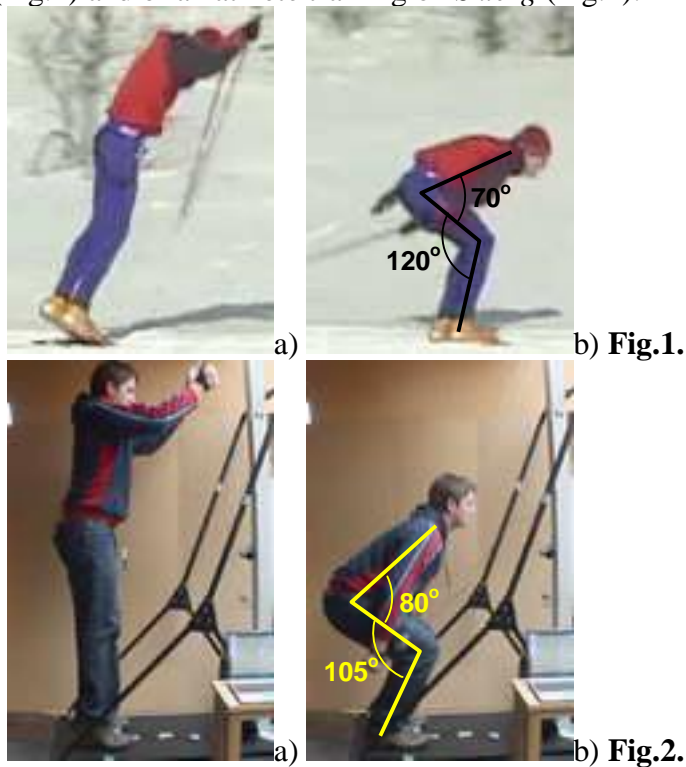


**Facts. Did you know that...**

...skiing is an excellent aerobic exercise that is often used by rowers as a cross training activity during the winter? Thanks to Concept2 *Skierg* this exercise is available indoor during all weather conditions. A workout on the *Skierg* replicates the movement of double poling, a specific propulsion method used by Nordic skiers to move on snow. At first glance, *Skierg* looks like it emphasizes arm work. However, our analysis reveals that less than half of the power is delivered by arms (on average 44%) and the rest is delivered by trunk and legs (56%).

To make our study comparable with real Nordic skiing we conducted a brief video analysis of a good skier executing the double poll movement on snow (Fig.1) and of an athlete training on *Skierg* (Fig.2).

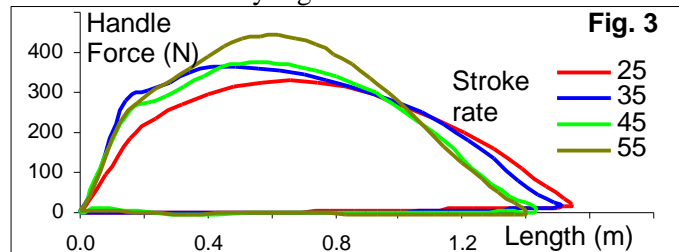


Positions at the drive start were very similar: handles were level the top of the head, legs were nearly straight and feet lifted on the toes. The only difference is forward body lean on-snow. This position results from body acceleration, which is absent on *Skierg*. Positions at the finish were also quite similar: feet on the heels, knee angle between 105-120deg, hip angle between 70-80 deg. Similar body positions are usually employed regardless of the type of Nordic skiing style.

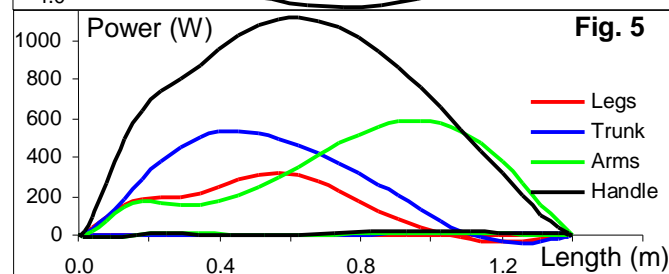
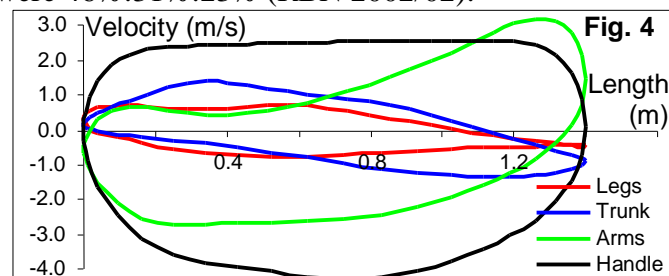
The *Skierg* was equipped with two force transducers installed between the handle and cable and three position transducers, which measured displacements of the handle, top of the trunk (*Th1-C7* level) and pelvis (*Sacrum*). Three athletes performed a set of 4 trials 1 min each at the target stroke rates 25, 35, 45 and 55 str/min. The data was sampled at 50 Hz and averaged over duration of whole trial.

Fig. 3 shows averaged force curves (sum of left and right handles) and their shapes were quite similar to the

shapes of force curves measured in rowing. The maximal peak force was a bit less than 500 N, average force was 280 N, which is 20-30% less than in rowing for similar athlete. Contrarily, stroke length was very similar to the length of the arc in rowing: at low stroke rate it was 1.55m and decreased at higher stroke rate down to 1.4m. Power production was quite comparable with rowing (about 400W), which was achieved by higher stroke rate.



Sequence of the body segments is also similar to rowing: legs and trunk dominate during the first half of the drive and arms finish the drive (Fig. 4 and 5 represents the highest stroke rate). Legs deliver about 20% of the total handle displacement, trunk – 32% and arms – the rest 48%. However, because the peak force coincides with the highest velocity of the trunk, their shares in power were 20%:36%:44% (legs/trunk/arms). This looks like a mirror to rowing, where segments' shares were 46%:31%:23% (RBN 2002/02).



Surprisingly, *quadriceps femoris* muscles are heavily loaded in the double poling exercise, because they are used in both drive and recovery phases and have practically no chance to relax. During the drive these muscles are used for hip flexion through their upper side connected to the pelvis. During the recovery phase quads are used for knee extension through their bottom side connected to the shin. Gravity force assists legs and trunk performing the drive, but during return phase this force must be overcome by action of muscles antagonists. These movements make a **workout on the *Skierg* a great full body exercise.**

**Best wishes for the Christmas and New Year 2011!**

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