<u>CompassSport Series - Fitness for Orienteering</u>

<u>Part 1 – Understanding the Physiological Demands of the Sport</u>

This series of articles over the next year is aimed at helping the orienteer, irrespective of their age, ability or ambition, to develop their understanding of the fitness aspects of the sport and to help increase their enjoyment of orienteering through a logical approach to fitness development.

The first part of the series concentrates on examining the underlying physiological requirements of the sport, through analysis of the scientific research that currently exists in orienteering, so that we may develop a foundation on which to build our fitness programmes.

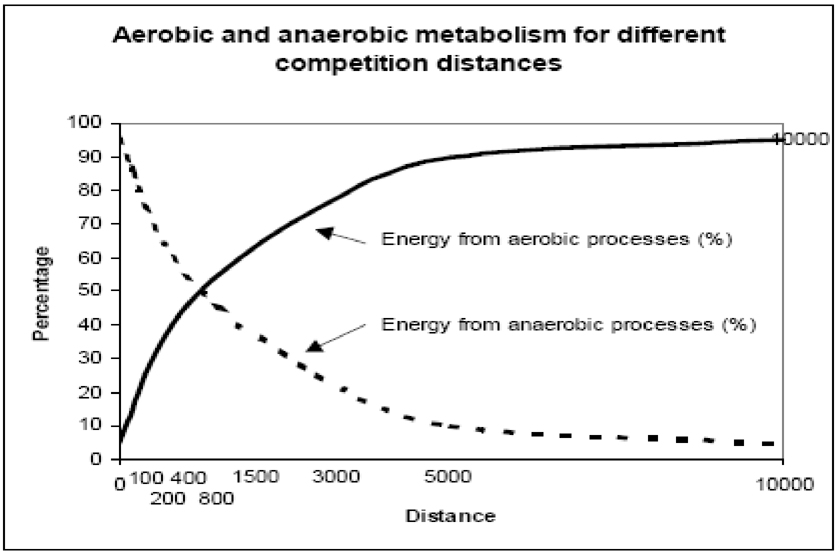
General Profile

As orienteers, we know from experience that the demands of the sport can be extremely varied. The range of events on offer to the orienteer nowadays is far removed from the origins of the sport, where classic long distance orienteering across rugged terrain was the norm. Modern orienteering offers participants the chance to engage in a host of different events, extending from sprint and urban racing, where the test is on decision making and route choice options executed quickly and efficiently, through middle distance events, where the emphasis is on an unremitting technical navigational challenge, up to the traditional longer distance orienteering, where the ability to maintain mental accuracy and focus whilst coping with increasing physical fatigue is the ultimate examination.

However, irrespective of the style of event, there are physiological similarities linking the disciplines that allow us to draw certain conclusions about the demands of the sport.

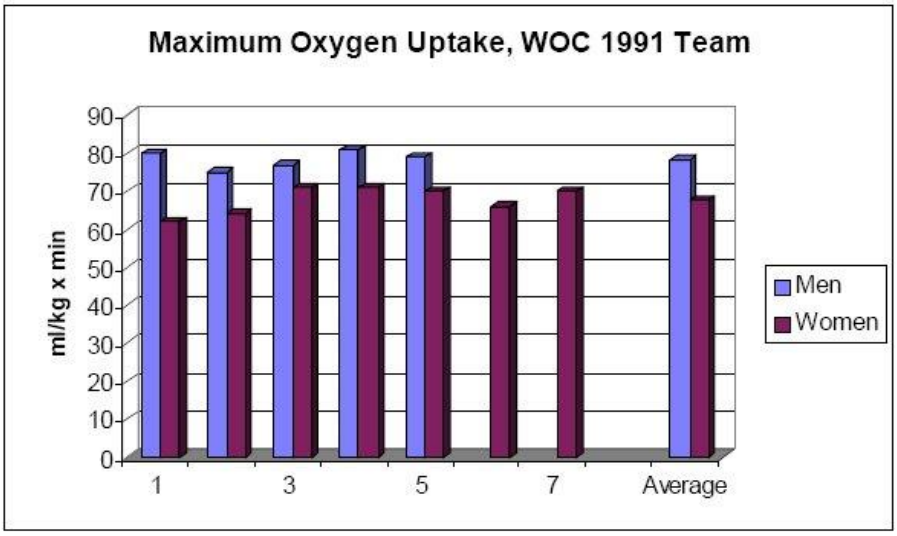
Aerobic Characteristics

The endurance aspect of the sport is well understood and much of the scientific research from the 1980's and 90's focussed on this aspect in a detailed analysis of traditional, long distance orienteering. The growth of other forms of orienteering in recent times, such as sprint, urban and park racing, superficially indicates that the sport is moving away from its 'aerobic' foundation, but this is not, in reality, the case. Most races, irrespective of type, are still at least a minimum of 10-15 minutes in duration and thus would have energy demands similar to a 3-5000m race on the track, ie. predominantly aerobic in nature (see figure 1).



(From Andersson, 2010)

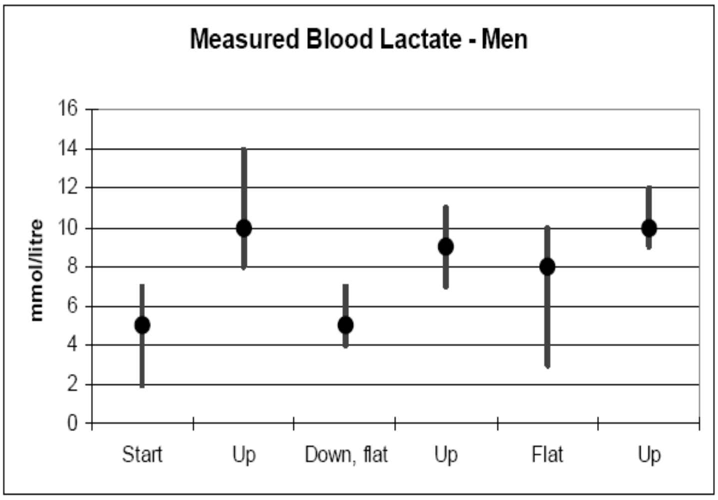
We can therefore begin to estimate that, regardless of specialist focus, most orienteers will need to develop a good cardiovascular base to their fitness work and, indeed, research within the sport indicates that in order to be an elite athlete, a high aerobic capacity (or $\dot{V}O_2max$) is a basic prerequisite (see figure 2). Typically, international level female orienteers have $\dot{V}O_2max$ values in the region of 60-70ml/kg/min, with international males reported to be in the 70-80ml/kg/min range (Gjerset et al., 1997; Jensen et al., 1999). Recent research (Smekal et al., 2003) showed on a simulated course that orienteers ran at around 80-86% of their maximum oxygen uptake levels throughout and supports the need for a high $\dot{V}O_2$.



(From Andersson, 2010)

Anaerobic Characteristics

If we refer back to the energy continuum in figure 1, we would estimate from this that orienteering races would see about 5% (classic distance) through to around 25% (sprint events) of our overall energy supply being created through anaerobic sources. Indeed, research from the 1990's has indicated that anaerobic demands of the sport are significant and that figure 1, based on more steady state running events, probably underestimates the anaerobic qualities of orienteering. This research has typically used blood lactate measurements as a general indicator of anaerobic energy production and Figure 3 shows an example of such data, taken from a simulated race (Johansson, 1990).



(From Andersson, 2010)

The blood lactate levels of the subjects, measured at various points on the course, show the fluctuations that can be found from a traditional cross-country orienteering race. Steady state, aerobic-style running will usually elicit lactate values of around 2-4mmol/l and here we can see that a typical race would see values range between 3-10mmol/l when on the flat, indicating the existence of an additional anaerobic component. Unsurprisingly the uphill parts of the course saw blood lactate values soar to between 8-14mmol/l, reflecting the increasingly anaerobic nature of the incline running. Dresel (1985) and Smekal (2003) also demonstrated the existence of high anaerobic demand in orienteering, through recording blood lactate values of 3.7 to 6.7mmol/l for the athletes, with a peak of 8.8mmol/l following a severe ascent. Most of the data available on blood lactate markers is unfortunately from classic distance orienteering and more research is needed on how the profile differs when moving to middle and sprint racing.

Heart Rate Indicators

In addition to the reported values for oxygen uptake and blood lactate from studies over the past twenty years, heart rate data from races can also support the need for highly developed aerobic and anaerobic capabilities. Heart rate (HR) is a good indicator of exercise intensity and research (Bird et al., 1993; Creagh and Reilly, 1997; Creagh et al., 1998; Larsson et al., 2002) has shown that HR, just as with blood lactate levels, varies greatly during long distance orienteering. This variability can be attributed to a number of causes, including terrain type, course profile and technicality and is unsurprisingly greater than the variation shown in other forms of running.

Figure 4 shows a typical heart rate trace during a cross-country orienteering race of ‘middle distance’ duration, where values fluctuated from around 158-175bpm, with an overall race average of 169bpm. The three lines on the graph show heart rate values representative of levels established through laboratory testing. Maximum heart rate of the orienteer was recorded as 180bpm, with the lactate threshold (the first increase of lactate above resting levels - LT) and the lactate turn-point (the point at which lactate levels show a sudden and marked increase - LTP) at 142bpm and 159bpm respectively.

What does this data tell us about the nature of orienteering and its demands? The average HR of the orienteer over the course shows that they are working at around 90% of their maximum and is indicative of a very significant demand placed on both aerobic and anaerobic energy systems, with only brief periods where the intensity drops to around 80% of their maximum. The LTP is a benchmark level that has been shown to be reflective of an individual’s 10 mile to half-marathon running speed and it is not surprising that the orienteer is working at a level higher than this pace. The average HR is more representative of the intensity of 10k running, where the athlete is attempting to run around their anaerobic threshold level for as long as is feasible before fatigue takes hold and pace must begin to drop.

This ‘snapshot’ of a typical HR trace is representative of the research findings and endorses the dual demands of the sport. Johansson (2000) suggests that, as orienteers maintain a HR of around 90% of their maximum during competition, orienteering is not a purely aerobic sport. Smekal (2003) supports this further with data that shows orienteers running, on average, at 96-100% of their individual anaerobic threshold value on a simulated course. Finally, Gjerset et al. (1997), in the only research that so far attempts to draw comparisons between short and long distance orienteering, found that during a short distance race, HR was on average 4bpm (2.2%) over the laboratory established, anaerobic threshold level. Also, not surprisingly, they discovered that short distance racing resulted in higher average HR, with an increase of approximately 2% in women and 4% in men over the long distance HR results, giving credence to the logic that the shorter the race, the more anaerobic the demands become. Again, further research is needed to establish the differences between the various disciplines and to update these findings from research that is now beginning to be a little dated.

Other fitness demands

Much of the scientific research on orienteering has concentrated on the aerobic/anaerobic demands of the sport and unfortunately other fitness components, such as flexibility, strength and agility, have had scant regard paid to them. Early research (Garderud et al., 1985; Lusa & Lonka, 1988) showed some promising results from two limited studies into the use of weight training for the development of orienteering-related fitness. It was found that running times in terrain and lactate production were lowered, along with an improvement in the subjects' perception of their ability to run through terrain, after a period of strength training. This allows us to conclude, albeit cautiously, that strength is an important part of the orienteer's armoury and this is supported by later research on the use of core and strength work to offset injury in runners (Brummit, 2009) and improve their running economy and power (Paavolainen et al., 1999), but it requires research within orienteering to verify. Many practitioners have recently advocated the increased use of core work, in particular, to enhance orienteering fitness, through improved dynamic balance and muscular endurance, but research into its effectiveness for orienteering has yet to be conducted.

When examining the relevance of flexibility to the sport, no studies using orienteering have been carried out so far, but it has been suggested generally as being an important component for the avoidance of injury and improving overall sports' performance (Allison et al., 2008), however it remains a controversial area. The commonly accepted wisdom is to work on suppleness as part of a programme for orienteering, but the science behind how and why is sparse.

Conclusion

In summary, the nature of the sport is, not surprisingly, multi-dimensional. The available scientific research, allied to our own understanding of the demands of orienteering, suggests that we require a range of fitness characteristics in order to perform at our optimum level. The most succinct overview about the physical demands of orienteering I have come across is by Johansson (2000), who states that,

"…the elite orienteer should have an aerobic capacity of a world class skier, an anaerobic capacity of an elite middle distance runner" and the *"leg muscle strength and endurance of a professional cyclist…"*

Next issue will see us begin to build our orienteering fitness programme based on this knowledge.

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