

CHAPTER 1

BACKGROUND AND STUDY OBJECTIVES

1.1 INTRODUCTION

Many scientific investigations have consistently identified the physiological variables that are positively related to successful endurance performance (Hawley, 1995). The extent to which these and other factors are “trainable” as opposed to genetically determined is a topic of considerable debate (Bouchard et al., 1992). Maximal oxygen uptake is the most common parameter used in exercise laboratories to estimate physical fitness. Costill et al. (1973) noted that subjects with similar VO_2 max values often performed quite differently in endurance events. To evaluate physical fitness more precisely, another parameter, reflection endurance capacity, should be determined in addition to VO_2 max (Vago et al., 1987).

Endurance running performance has repeatedly been shown to be related more to submaximal effort measurements, such as the onset of blood lactate accumulation and the anaerobic threshold than to VO_2 max (Maffulli et al., 1994). Long-distance runners have somewhat lower maximal oxygen uptake values than middle-distance runners, but they run at exceptionally high percentages of VO_2 max before the onset of blood lactate accumulation occurs (Costill, 1972; Costill et al., 1973; Louanne et al., 1989;).

Judging by the frequency with which the topic is discussed amongst athletes and coaches, it would still appear that the vast majority of runners, cyclists and triathletes implicitly believe that the VO_2 max is the single best predictor of athletic potential in all endurance events (Noakes, 1988). Endurance running performance is strongly influenced by VO_2 max, running economy, fractional utilisation of VO_2 max, blood lactate accumulation during submaximal exercise, and ventilatory and lactate thresholds (Maffulli et al., 1994).

Although VO_2 max is a satisfactory predictor of endurance performance in a heterogeneous group of athletes (Costill et al., 1973; Farrel et al., 1979), individuals with similar VO_2 max

values can differ markedly in performance velocity (Costill et al., 1973; Daniels, 1985; Coyle et al., 1988; Noakes, 1988).

Recently, both sports physiologists (Hawley & Noakes, 1992) and coaches have recognised the importance of peak sustained power output as a predictor of endurance performance (Hawley, 1995). In runners, for example, the peak treadmill velocity that an athlete can achieve during a maximal test has been found to be as good a predictor of endurance performance as any physiological variable currently measured (Morgan et al., 1989; Noakes et al., 1990)

Distance runners who are the fastest over the shorter distances will also be the fastest over longer distances (Hawley, 1995). Time to exhaustion at the velocity associated with VO_2 max, together with the anaerobic threshold, should provide information about the anaerobic capacity of an individual (Hill & Rowell, 1996). The more economical a particular runner was, the faster his pace could have been before he accumulated blood lactate (Louanne et al, 1989). Fohrenbach et al. (1987) determined that high correlation's existed between marathon velocity and running velocity at lactate accumulation levels of 2,5, 3,0 and 4,0 mmol/L, with elite marathoners racing at a pace that elicited about 3,0 mmol/L (Louanne et al., 1989).

Lactate threshold merely reflects the highest exercise intensity that an athlete can sustain for an extended period without amounts of lactate accumulating that are limiting for performance (Hawley, 1995). The strong relationship between endurance performance and lactate kinetics led to the suggestion that blood lactate concentration could be used as a training tool (Keith et al., 1992).

There is a close relationship between lactate threshold and endurance performance (Coyle et al., 1988). Running endurance training increases the speed at the lactate turning point, and these changes correlate closely with the actual improvements in running performance (Hawley, 1995).

In theory, exercise at power outputs above individuals anaerobic threshold will result in a progressive metabolic acidosis (McLellan & Jacobs, 1989). Endurance training has been

shown to increase the rate of oxidation or clearance of blood lactate during exercise (McLellan & Jacobs, 1989).

The intensity and duration of exercise will determine the production and accumulation of lactate. By altering the intensity of exercise and the work:rest ratio, the contribution of anaerobic and aerobic metabolism to total energy needs may be manipulated (Burke et al., 1994). The question which is the most appropriate training intensity for exercise prescription has not been resolved. Some investigators suggest that lactate threshold is a critical training intensity; others support the use of fixed blood lactate concentrations of 2,0, 2,5 and 4,0 mmol/L (Hetzler et al., 1991).

Sjodin et al. (1982) reported that middle-distance and long-distance runners who were able to train closest to the running speed that elicited a lactate concentration of 4 mmol/L demonstrated a greater training response after 14 weeks of endurance training than those runners who had higher or lower lactate concentrations during training (Keith et al., 1992). These results suggest that there may be an optimal lactate concentration to stimulate aerobic training effects during steady-state training (Keith et al., 1992). In contrast, they were able to calculate an individual anaerobic threshold that was the intensity that could be maintained for a relatively long duration with stable lactate concentrations, rather than being a fixed concentration (Keith et al., 1992). This value varied significantly among subjects.

The Comrades is a race steeped in history, controversy and tradition. The American edition of "Runners World" rated the Comrades as one of the top ten races in the world, along with events of such status as the New York, London, and Boston Marathons. South Africa is the only country in the world where ultra-running is a national sport.

Internationally, the only comparable situation is in Japan, where the popularity of ultras is also growing. Many people have discovered the challenge of the Comrades. Success in ultra-running lies in doing as much volume as one's physiology, biomechanics, immune system and mind can deal with. Although running is the world's largest participation sport, most runners have to train alone. Without the benefit of a coach, they have no one to make sure they're using the most effective training methods, no one to show them how to achieve their

maximum running potential. Sport Science can play a vital role in the success of ultra-marathons by helping the athletes to achieve their optimal fitness levels. Science has given us a unique insight into the anatomy of one of the most difficult races in the world.

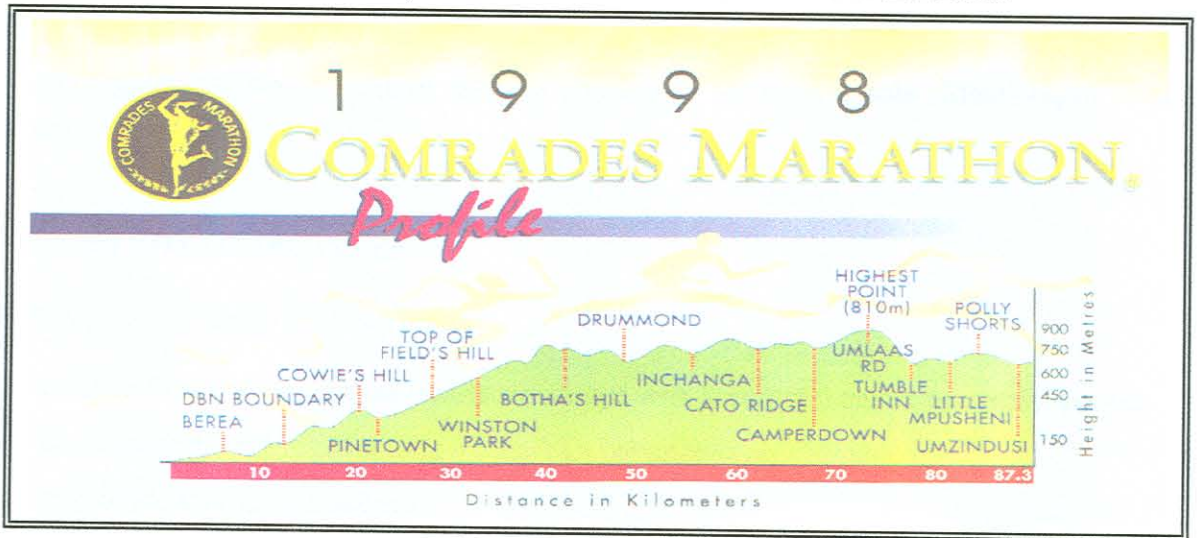


Figure 1: The profile of the 1998 Comrades race (up run)

1.2 FORMULATION OF THE PROBLEM

The purpose of the study was to assess experimentally the physiological status of a Comrades Marathon athlete and to examine the effect of training on the physiological parameters.

The testing programme indicates the athlete's strengths and weaknesses in relation to marathon running and provides baseline data for an individual training programme prescription. However, marathon running involves several physiological components. Although in the field setting it may be relatively easy to evaluate the sum results, it usually is difficult to assess the athlete on each of the components. In the laboratory, the biokineticist or sport scientist is often able to isolate a given component and to assess objectively the athlete's performance on that variable. The results of the assessment then become the basis for prescribing an optimal training programme that concentrates on identified areas of weakness. A testing programme provides feedback. Comparing the athlete's results on a given test item with those of his previous tests provides a basis for assessing the effectiveness of the intervening programme.

Laboratory testing does have severe limitations for identifying potential talent. The complete performance of any athlete is a composite of many different factors of which physiological function is only one. Therefore performance cannot be predict by a single physiological test or battery of physiological tests, especially in sports in which technical, tactical, and psychological components might relegate physiology to a lesser role (MacDougall et al., 1991).

1.3 STUDY OBJECTIVES

The major objectives of the study were:

- to identify the physiological factors associated with successful endurance performance;
- to measure the effect of training on the VO_2 parameters on a regular basis;
- to provide training guidelines;
- to use heartrate monitors to guide training and optimise race performance; and
- to measure heartrate response during the Comrades Marathon race, thus to determine race intensity.

A comprehensive exposition of a literature review appears in Chapter 2. The various procedures that have been used are shown in Chapter 3. Chapter 4 contains the results and discussion and a conclusion and recommendations follow in Chapter 5.