

CASE STUDY: THE EXERCISE PROFILE OF A POLISH REPRESENTATIVE IN MOUNTAIN RUNNING

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Abstract. This study is aimed at analysing the variability of oxygen parameters in subsequent annual training cycles at championship training level in mountain running. The study employed the following indirect methods: the Astrand Test, Conconi Running Test, and also a direct method (Bruce Test).

Research material is a young, talented 28-year-old athletic mountain runner. Research results were obtained within 4–5 years period, which were as follows: VO_2max 83–90 ml/kg/min – increased on average to 2–3 ml/kg/min per year, HR max 172–177 beats/min, PPA 158–169 beats/min. The case study was carried out within the framework of longitudinal research and was used to collect data for the formulation of a specific exercise profile in a new, dynamic sports discipline.

The research aims to serve as an example of a novel method of conducting training microcycles to the cyclic lifting aerobic capacity athletes.

Key words: long distance running, periods in sports training, VO_2max , individual training

Introduction

The aim of this study is to present an exercise profile of a Polish representative in mountain running, as well as the basic parameters of the athlete's aerobic capacity (VO_2max , HR max, PPA). The main research problem of this study was to determine the changes in the structure of aerobic work on the basis of longitudinal studies over the last 4–5 years period. Studies have shown some changes in the parameters on the basis of individualized aerobic training process of a runner. The paper presents one selected training microcycle of a mountain runner (1 of microcycles – General training period, and 1 of microcycles – Starting Period).

Mountain running: characteristics of the discipline

The history of mountain running goes back to the second half of the nineteenth century, i.e. 1868, before the modern Olympic Games (1896).

This discipline has flourished since the beginning of the twentieth century (Puchacz 2010).

Despite its popularity, mountain running has never been included in the classical program of the International Association of Athletics Federation (IAAF) (Obmiński and Michalak 2003).

There are two types of mountain running: Alpine and Anglo-Saxon. The Alpine style involves running up to mountain summits. It is characterized by a continuous run-up to a specific destination. The largest Polish mountain running contests are to the summits of Kasprowy Wierch, Żar and Śnieżka. The Anglo-Saxon style includes run-ups and rundowns (up-down). It is mainly done in loops, or the trail goes along several summits. The Anglo-Saxon style is more spectacular. The best known contests of Anglo-Saxon style mountain running in Poland are: the Stołowe Mts. Marathon (Maraton Gór Stołowych), Butcher's run (Bieg Rzeźnika), the Karkonosze Mts. Marathon (Maraton Karkonoski) (www.biegigorskie.pl).

The table below shows categories and distances of championship contests.

Table 1. Running distances in championship contents (Iskra 2004)

Category	Running type	Distance (km)	Elevation difference (m)
Men	Up	12	1200
	Up and down	12	700
Women + juniors (male)	Up	7	550
	Up and down	7	400
Juniors (female)	Up	3.5	275
	Up and down	3.5	200

Mountain running is also classified depending on the running distance in contests. Runs which cover the distance of a half marathon are classified as long-distance mountain running. World championship are also held in this discipline.

Skyrunning (which has its own federation) is one of numerous disciplines of mountain running. This discipline is held at high altitude or – in the vertical version – at very high elevation differences (more than 1000 m along a 3.5 km trail).

The following championships are held in Poland: (www.biegigorskie.pl)

- anglo-saxon style (up-down),
- alpine style (up),
- short-distance (up to 6 kilometres),
- long-distance (from half marathon onwards) since 2010,
- skyrunning (high altitude difference, ca. 1800 m a.s.l.) since 2012 (www.mountainrunning.coolrunning.com.au/misc/training.shtml; www.biegigorskie.pl/poradnik-poczatkujacego-gorala; www.biegigorskie.pl/biegi-gorskie-wprowadzenie-do-tematu).

Marcin Świerc — a multiple champion of Poland in mountain running

Marcin Świerc (Figure 1) is an experienced 28 year old professional runner. He has been a long-distance runner for 11 years (a mountain runner for 7 years) and is one of Poland's leading mountain runners.



Figure 1. Marcin Świerc

He commenced his sports career as an amateur. At first he did not belong to any club, but regularly improved his achievements every season, breaking mountain trail records.

Since 2008, he has started a semi-professional career in the light athletic section of the University Sports Association at the Katowice Academy of Physical Education. The training process has been planned in the short- and long- term perspective, with appropriate physiological diagnostics which includes laboratory tests. Regular examinations allow for the constant monitoring of basic exercise capacity parameters, including forecasting the progress of achievements. Since 2010, thanks to his cooperation with SALOMON STEAM, he has developed an individual training program including fitness predispositions and mental coaching (Starosta 2000).



Figure 2. Mountain running in Anglo-saxon style, European Championship in Bulgaria 2010



Figure 3. Marcin Świerc, 2nd place in the Gorce Marathon 2011, southern Poland



Figure 4. Marcin Świerc, in AXA Mountain 2011



Figure 5. Butcher's run (2011), Marathon, Sweden 2011

Major achievements

A Ten-time Medallist at the Polish Championships

2012:

1st place in the Polish Skyrunning Championships (Franciszek Marduła High Mountain Run – Zakopane)
(he holds the record for this trail)

1st place in the Butcher's Run I (record for this trail) – Figure 5

1st place 24h Łysa Góra

6th place in UMTS Majorka – was considered the best in ultraruns in Poland

2011:

2nd place in AXA Mountain Marathon (Sweden) – Figure 4

2nd place in Gorce Mts. Marathon (southern Poland) – Figure 3

2010:

1st place in the first Polish long-distance mountain running championships held at Szklarska Poręba

5th place in Berglaufpur, European Championships ME Ex

(source: www.biegigorskie.pl/marcin-swierc).

Considerations for the individual training of mountain runners

Compliance with the basic principles of sports training is essential. Major rules include (Prus 2001): versatility, specificity, cyclical nature, progressive loading, combining theory and practice, immediate information and individuation.

Individuation in sports training is one of the major conditions to be met during planning and carrying out each training session as each sportsman has a different level of fitness (Prus 2001, Kielak 2009)!

“Application of the individuation principle is essential in the training of elite athletes [...]. They possess a very high level of abilities, which is their great strength. The trainer should [...] work on the development of the champion's features, shaping the individual technical and tactical style of the sportsman for each competition” (Kielak 2011). The application of individuation is strictly combined with the search for talented individuals and identifying them at the level of sports championships. The trainer's assistance is indispensable, especially in the forecasting and planning of the training process in the early stage of the training, including goals, tasks and applying measures (Kielak 2009, 2011; Żmuda and Witkowski 2010). Light athletics requires the adjustment of the training regime, with individual features taken into account, such as the fitness and regular development of sportsmen (Jelonek 2011).

Kielak reports that the importance of individuation in the training process depends above all on the: champion's model (how the sports competition proceeds), its somatic and mental features, skill level and exercise capacity, as well as the timing of the training session, i.e. the stage in which the sportsman is in (Kielak 2011). “The individuation principle can refer to the selection – searching for individuations with a specific profile, preparing the mental and physical personality for participation in a contest” (Czajkowski 1986; Kielak 2011).

Marcin Świerc, the aforementioned mountain runner, has been his own individual and optimal trainer since the very beginning of his sports career. The main principle he applies to himself is the cyclical pattern. As he states, “successful training” should be held regularly on the individuation basis.

The individuation principle is coupled with the self-education principle. The self-education principle states that the betterment of the ego requires self-cognition, i.e. the skilful forecasting of results, observing one's actions and their consequences, formulating conclusions on the basis of errors or failures made (Starosta 2000). Success is a series of failures and the ability to skilfully cope with them.

The more training sessions are adapted to the individual sportsman's needs and potential, the more efficient the training is. "Each training session is efficient only when it is based on general and special behavioural rules" (Prus 2001).

Material, tools and training control methods

A 28-year-old mountain runner at championship training level (BMI = 22.53, Rohrer index = 1.25). This study was aimed at analysing the annual training cycle of a mountain runner at a championship training level. Mezzo cycles for general training and the competition micro cycles were analysed. The basic oxygen capacity of the sportsman was analysed and evaluated.

Direct methods were applied in the research for this paper: Bruce Test (data from 2008 and 2009); indirect methods: Astrand Test (data from 2009), Conconi Test (data from 2011/2012); data from direct contests (mountain running competitions in Bielsko-Biala); and data from the runner's training in January 2012.

Training regimes in specific mezzo cycles of the mountain runner (world championships) were practised at a championship training level.

Test results and research analysis

Initial capacity tests were carried out in 2008 at the Katowice Academy of Physical Education and they confirmed the sportsman's skills and talent. The results showed that he possessed huge potential in long-distance runs, including mountain running. The tests were carried out using the Bruce Test, a direct method conducted on a mechanical running track. The results were based on actual and accurate results ($\text{VO}_2\text{max} = 83 \text{ ml/kg/min}$). He was examined twice a year in laboratory conditions, using specialized equipment.

He was examined a year later prior to and after a 2009 mountain run in Bielsko Biala (Figure 6). Blood samples were taken before the start and directly after the run. Examinations showed the maximum heart rate (HRmax) of the examined sportsman was 177 beats/min., while the average heart rate, which was steady for a longer time, was 167 beats/min. PPA was not recorded, but the chart below can lead to the conclusion that it is in the range of 165–170 rates/min.

However, in the same year (2009), another Bruce Test showed that the sportsman's HRmax was 173 beats/min, VO_2max 85 ml /kg/min of the bodyweight, thus there was a very high level of oxygen capacity as early as in 2009.

In 2009, results obtained from subsequent examinations using the indirect method (the Astrand Test) showed that the VO_2max increased to a 87 ml/kg/min of bodyweight.

Examinations conducted at the turn of 2011/12, also via an indirect method (Figure 7, the Conconi test), showed spectacular results.

General training period

December– January		
Weekday	Training I	Training II
Monday	GRC 1 – 12 km + rhythms 10 × 100 m + free run – 2 km	Gymnasium – muscle training srms, legs, abdomen, spine
Tuesday	GRC 1 – 12 km, RS – 2–3 km (accents) + free weigh training 2 km (free run – 2 km)	GRC 1 – 8 km or spinning – 40 min.
Wednesday	Initial run – 15 km + rhythms 10 × 100 m	Gymnasium – training mm arms, legs, abdomen, spine
Thursday	Initial run 26–28 km	–
Friday	GRC 1 – 12 km, RS – 2–3 km (accents) + free weight training 2 km (free run – 2 km)	–
Saturday	Warm-up – 4 km, BRR – ca 6–8 km	–
Sunday	28–32 km	–

March		
Day of the week	Training I	Training II
Monday	GRC 1 – 12 km, Rhythms 10 × 100 m (free run – 2 km)	GRC 1 – 8–10 km
Tuesday	GRC 1 – 12 km, RS – 2–3 km (accents) + free weight training 2 km (free run – 2 km)	GRC 1 – 8 km or spinning – 40 min.
Wednesday	Free run – 4 km + accent in the II range (12–16 km) + rhythms 1 km (3 × 1' p. 3')	Initial running – 8 km + free training
Thursday	Initial run 26–28 km	–
Friday	Free run – 12 km, RS – 2–3 km (accents + free weight training 2 km (free run – 2 km)	–
Saturday	Warm-up – 4 km + accents in II–III ranges (5–8 km), BRR – ca 6–8 km	–
Sunday	28–32 km	–

Starting Period

May	
Day of the week	Training
Monday	GRC 1 – 8 km, Rhythms 10 × 100 m. Free run – 2 km, free training
Tuesday	GRC 1 – 18 km (free run)
Wednesday	Free run – 4 km + accent 10 × 200 m/ p. 200 m (2–5 km)
Thursday	Initial run 18–20 km
Friday	Warm-up before the start
Saturday	Start or test
Sunday	Warm-up after the start

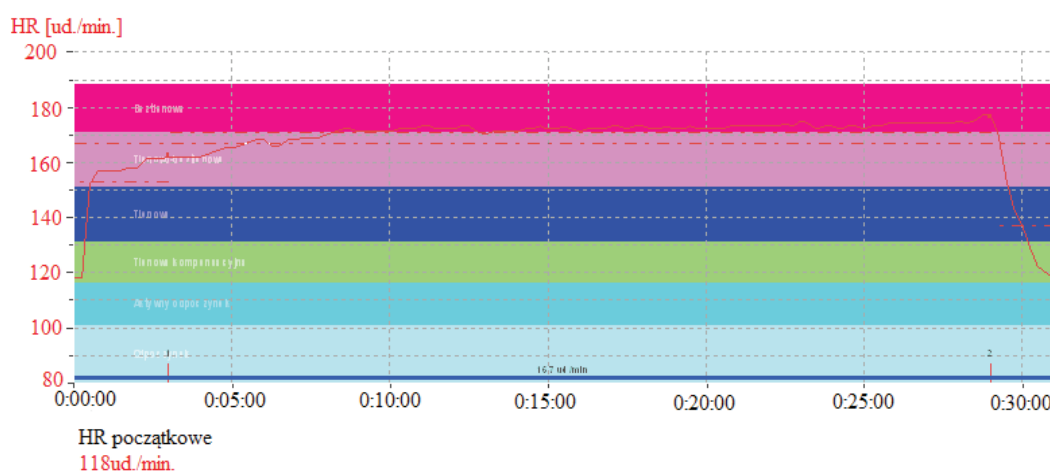


Figure 6. Mountain run results of Marcin Świerc in Bielsko-Biała

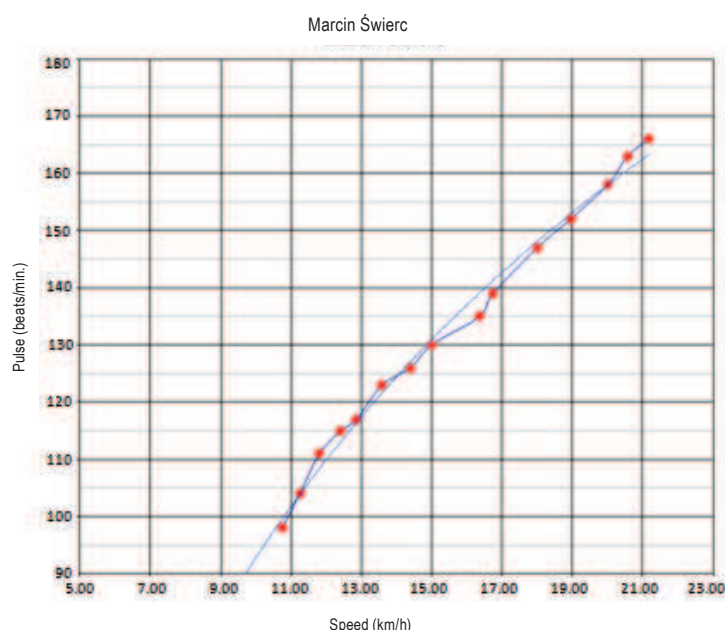


Figure 7. Results of a Conconi test carried out at the turn of 2011/2012

HRmax was above 172 beats/min and there was a very low PPA (158 beats/min) in relation to oxygen capacity, when the oxygen ceiling ($\text{VO}_{2\text{max}}$) was 92.2 ml/kg/min. of bodyweight. This result could be marginally over-assessed due to weather conditions during the tests (the result could fluctuate in the range of 90 ml/kg/min.). Undoubtedly, if the PPA is so low, the $\text{VO}_{2\text{max}}$ limit of ca 90 ml/kg/min is obtained. The capacity index also had an excellent value ($\text{WW} = 154.2$) which indicates very good fitness, which in turn leads to an excellent physical capability confirmed by $\text{VO}_{2\text{max}}$ level. The restitution index by Klonowicz was on an average level ($\text{WSR} = 61.62\%$). However, in this case the rate of returning to rest conditions is not so significant as the oxygen parameters referred to above. As a result of performed work, the sportsmen achieve considerably higher oxygen capacity thanks to so-called hypoxia, i.e. increased functional levels of the entire physiological system, especially the circulatory and respiratory systems in the first stage of adaptation to altitude above sea level (Prus 2001).

Figure 8 below shows the course of a typical training session of the runner when PPA is exceeded (February 2012). The chart presents a considerable rise in the heart rate after the warm-up (after running) in the 23rd minute, which is caused by disturbance of the sport tester (information provided by the examined person) because the next level shows a dynamic decrease in the heart rate.

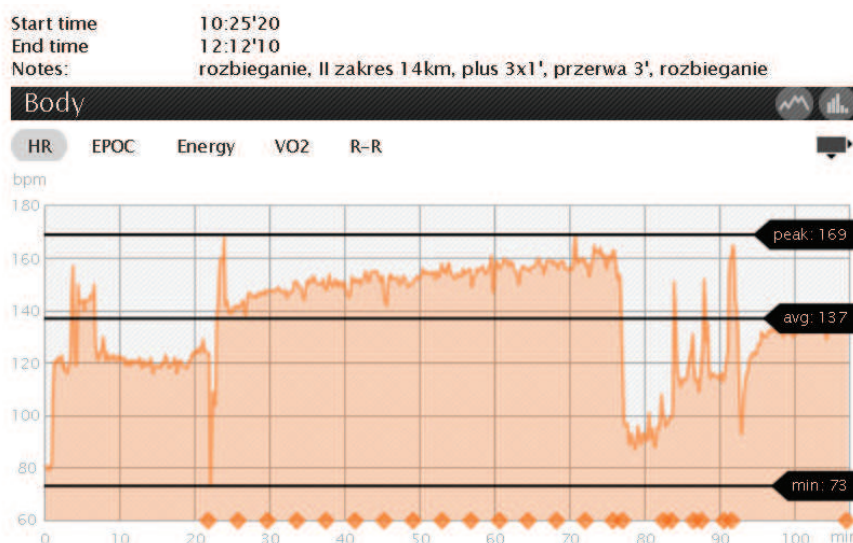


Figure 8. Marcin Świerc's training session when PPA is exceeded (21st February, 2012)

The actual interruption of the linear dependence and simultaneous reaching of PPA occurred on the level of 169 beats/min in the 72nd minute. Data from the training session (Figure 8) also leads to the conclusion that the runner covered 14 kilometres in the II range, which means that the work performed by the runner was greater than his standard training endurance session. In order to start up oxygen adaptation mechanisms, long-distance runners should plan and perform a training session aimed at increasing lactate levels. Such a training session is more intensive than the previous ones and the limit of 4 mmol/l of blood is met.

It can be concluded that the specific nature of such a sports discipline as mountain running and the cyclic rise in oxygen capacity (ca 2.5 ml/kg/min. per year) indicate the start-up of adaptive mechanisms which increase VO_2max . The comparison of exercise profiles in marathon runners (their VO_2max is within the range of between 70 and 80 ml/kg/min.) with profiles of the mountain runner studied (ca 90 ml/kg/min.) leads to the conclusion that the specific nature of mountain running requires commencing additional muscle mechanisms or energy expense. Undoubtedly, Marcin Świerc shows very rare and non-standard values of oxygen capacity. Thus, this provides grounds for the conclusion that Marcin Świerc uses his genetic profile and he is a model champion!

Conclusions

The analysis of obtained study results can lead to the following conclusions:

1. The increase in basic oxygen capacity was proved on the basis of multiannual cyclic examinations (from 2008) by the case study method. The level of oxygen capacity (VO_2max) increased on average by 2–3 ml/kg/min per year.

2. The specific nature of long-distance runners aimed at rising the exercise profile requires 2–3 training schemes per month and then the PPA has to be exceeded, especially during general preparation and before contents.

3. The specific nature of mountain running indicates that additional muscular mechanisms and the genetic profile are commenced, and the oxygen capacity (VO_2max) is increased.

4. The annual training plan at the championship training was elaborated on the basis of specialized training procedures, with taken into account individual features, skills and potential of the mountain runner.

Discussion

The analysis of the annual training cycle presented in this case study can be a pattern or model for other specific runners due to the modern and specific nature of this sport discipline. The presented description of the preparatory training and participation can be a model and an example of which modifications should be made and how to diversify the sportsman's training regime.

It can be concluded from studies conducted during the last 4–5 years that annual training regimes have translated into a permanent increase in oxygen capacity parameters (VO_2max , WW capacity index or PPA). Each training microcycle was developed in accordance with individual predispositions and the potential of the runner. It can be noted that each period in the annual training session is based on curious specialized training schemes (drills) which have an impact on the increase of the oxygen capacity of the sportsman.

A comparison of the oxygen capacity of the mountain runner was made on the basis of the results of longitudinal studies. In particular, the increase in VO_2max level was underlined. Thanks to conducted studies and their analyses, it can be concluded that the level of oxygen capacity increased cyclically by 2–3 ml/kg/min per year in the period from 2008 (on the basis of the Bruce Test) to 2012. The oxygen capacity determined by the Bruce Test amounted to 83 ml/kg/min in 2008; in 2009 it was 85–87 ml/kg/min; in 2011/ it was equal to 12–90 ml/kg/min. Data for 2010 is lacking but it can be supposed that VO_2max level fluctuated between 87 and 90 ml/kg/min. This is undoubtedly related to the nature of training regimes in high mountains. Thanks to this fact, the described runner has achieved increasingly better results as regards the physiological parameters and professional level!

Despite the need for effort, training mountain runners need to forecast and conduct a training regime exceeding the limit of 4 mmol/l 2–3 times per month. Above all, it results from the specific nature of effort in mountain areas. The cyclical increase of oxygen capacity is the main advantage.

Numerous sportsmen use ready training regimes or plans and they believe that these regimens or plans are sufficiently good and appropriate. They could be used by someone to achieve success, and therefore they have been published. However, the principle of an individual approach to the training process is very important in sports. Methods, measures, and training workload should be taken into account and adjusted to the sportsman's skills and potential.

Marcin Świerc lives in the Silesia region which is why he cannot do training in the mountains. Thanks to numerous trips to the Stołowe Mountains, he has had many opportunities to constantly maintain or even increase his level of fitness marginally. His life motto is: "One who does not aspire to achieve impossible things, never reaches them."

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