



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

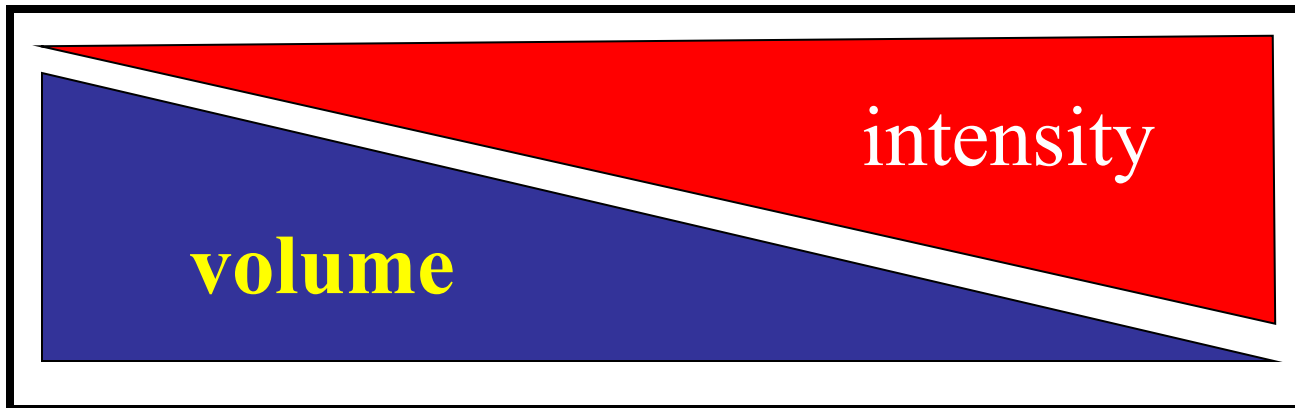
# ENDURANCE TRAINING

David Zahradník, PhD.

Projekt: Zvyšování jazykových kompetencí pracovníků FSpS MU a inovace výuky v oblasti kinantropologie, reg.č.: CZ.1.07/2.2.00/15.0199

ENDURANCE is the ability to resist fatigue in specific physical activities, which are described size of the load (i.e. volume, intensity etc.)

Relationship **volume** - **intensity**



**inversely proportional**

**INTENSITY** physical activity has a direct relationship to the way energy coverage

## Biological energy systems

(ATP-CP)

PHOSPHAGENS

(LA)

FAST GLYCOLYSIS

(LA-O<sub>2</sub>)

FAST GLYCOLYSIS

SLOW GLYCOLYSIS

(O<sub>2</sub>)

OXIDATIVE SYSTEM

volume

intensity



## Capacity of energy sources

Source	Supply	Energy (kcal)	Kilometres*
<b>ATP and PCr</b>	Small amount in muscles	4 – 5 kcal	<b>0,072</b>
<b>CARBOHYDRATE</b>			
<b>Muscle glycogen</b>	20 g/kg of muscle	1 600 kcal	<b>25,6</b>
<b>Liver glycogen</b>	80 g	320 kcal	<b>5,12</b>
<b>Blood glucose</b>	4 g	16 kcal	<b>0,256</b>
<b>FAT</b>			
<b>Muscle</b>	Limited; varies with training	1 500	<b>24</b>
<b>Adipose tissue</b>	<b>Variable**</b>	<b>30 000 – 70 000 kcal</b>	<b>480- 1100</b>

\* předpokládá 62,5 kcal/km a veškerou energii v pracujícím svalu

\*\* závisí na tělesné váze a procentu tělesných tuků

<b>ENDURANCE</b>	Intensity	Time	Repletion ATP
<b>LONG-TIME</b>	moderated	10 min and above	SG, OXI GL, GLU, LA, Lip
<b>MIDDLE-TIME</b>	middle	8-10 min	SG GL, GLU, LA
<b>SHORT-TIME</b>	submax.	2-3 min	FG, SG GL, GLU, LA
<b>SPEED ENDURANCE</b>	max.	20-30 s	GLS, FG, SG ATP, GL, GLU, LA,

SG- slow glycolysis, GL-glycogen, GLU-glucose, LA-lactate, FG-fast glycolysis, CP-creatin phosphate, Lip-fats, ATP-adenosine triphosphate, OXI-oxidative system, GLS-phosphagens systém (ATP-CP)

# Adaptation to Aerobic Load

Thanks to systematic aerobic load, the athlete is able to work at **higher intensity of load**, **prolongs the duration of exercise** and **works more efficiently**.

## Acute adaptation:

### Several days till weeks

- optimization of ATP resynthesis
- Adaptation to training stimuli of the same load:
- Lower heart rate
- Lower blood pressure
- Lower respiratory rate
- Better coordination of working muscles

## Long-term adaptation:

### Several months till years



#### Structural changes:

- Bigger size of mitochondria
- Bigger capillar density
- Heart muscle adaptation



#### Functional changes:

- Increased activity of mitochondrial enzymes
- Bigger aerobic volume and performance

# Trénink vytrvalostních schopností

The **main aims** of endurance aerobic training are **the improvement of**

- **personal limiting factors** :


 Personal physiological profile


 Motor abilities


- The most of top endurance athletes are aged over 25.

- Individual shift in the level of endurance is in four phases:

 First 10 days improvement of movement coordination

 Next 10 days energy store increases, the performance of energy system improves and changes in the muscle structure begins

 Next 10 days renew neural control of motor ability on a higher level

 Next 25 days many systems get coordinated on a higher level

- After 6 weeks is needed to repeat the process at a higher quality level

# Methods of Endurance Training

## Uninterrupted Methods

- Continuous
- Method of alternating intensity (fartlek)

## Intermittent Methods

- Intervals (insufficient recovery)
- Repetition (relative longer recovery)



# Uninterrupted Method - continuous

- **Continuous method** means load with **constant level of intensity or speed**
- Longer than 30 minutes
- Intensity below 85% HR max
- Suitable to develop energy resources
- It is used for training in the MLSS

# Uninterrupted method of alternating intensity

- During uninterrupted load of alternating intensity, **the athlete alternates, regularly or irregularly, different intensity and length of sections.**
- A similar effect as the continuous method

# Intermittent Methods-interval

- Interval training contains **several load units of high intensity** (from submaximal to maximal).
- Short interval 45-60s, medium 1-3min, long 3-5min
- Next work cycle should begin to HR 120-130 bpm
- Means for increasing values aerobic performance and capacity)

# Intermittent Methods-repetition

- **The intensity** of a repeated leg is **most often at the competition pace level**
- **The aim of training is improving or maintaining race pace**
- Resting period lasts from 5 to 15 (or 20) minutes

# Zones of Training Intensity



# Intensity Zone1

- Load intensity is **under MLSS**
- In sports, especially those in which oxygen consumption represents a limiting factor of performance.
- develops basic functional efficiency of the cardiorespiratory system and the economy of metabolic system and increases the capacity to resist stress during effort which lasts for a longer time.
- typical range of intensity is between 50-70 %  $VO_{2max}$  nebo 70-75 %  $HR_{max}$

# Intensity Zone 2

- It is training with **intensity in the area of MLSS**
- The main aim of the training is to improve the athlete's ability to utilize higher LA production during long-term load, **keep high intensity of load without accumulation of LA** (for a period longer than 5 minutes)
- The range of load intensity is between 75-85 %  $VO_{2max}$  nebo 80-93 % HRmax

# Intensity Zone 3

- The training of this intensity **stimulates the increase of maximal oxygen consumption**
- The rate of LA diffusion into the blood starts to exceed the rate of utilization
- the **main physiological aim of training intensity zone 3 is to increase resistance to LA accumulation**
- Load intensity within this zone should be between 85 –VO<sub>max</sub> a 90 (93) - 100% of HR<sub>max</sub>.

# Intensity Zone 4

- Training of this intensity can **improve and maintain short-time speed-time endurance**
- primarily for developing **movement economy, technical and tactic skills** which make use of ATP-CP system as the source of energy
- very short intervals (not exceeding 20 seconds) of short and explosive exercises of intensity over 100 % effort with resting period long enough to fully recover the source of energy
- Sufficient resting period



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

Thank you for your attention