Vliv intenzity fyzické zátěže v prevenci a léčby nejen obezity

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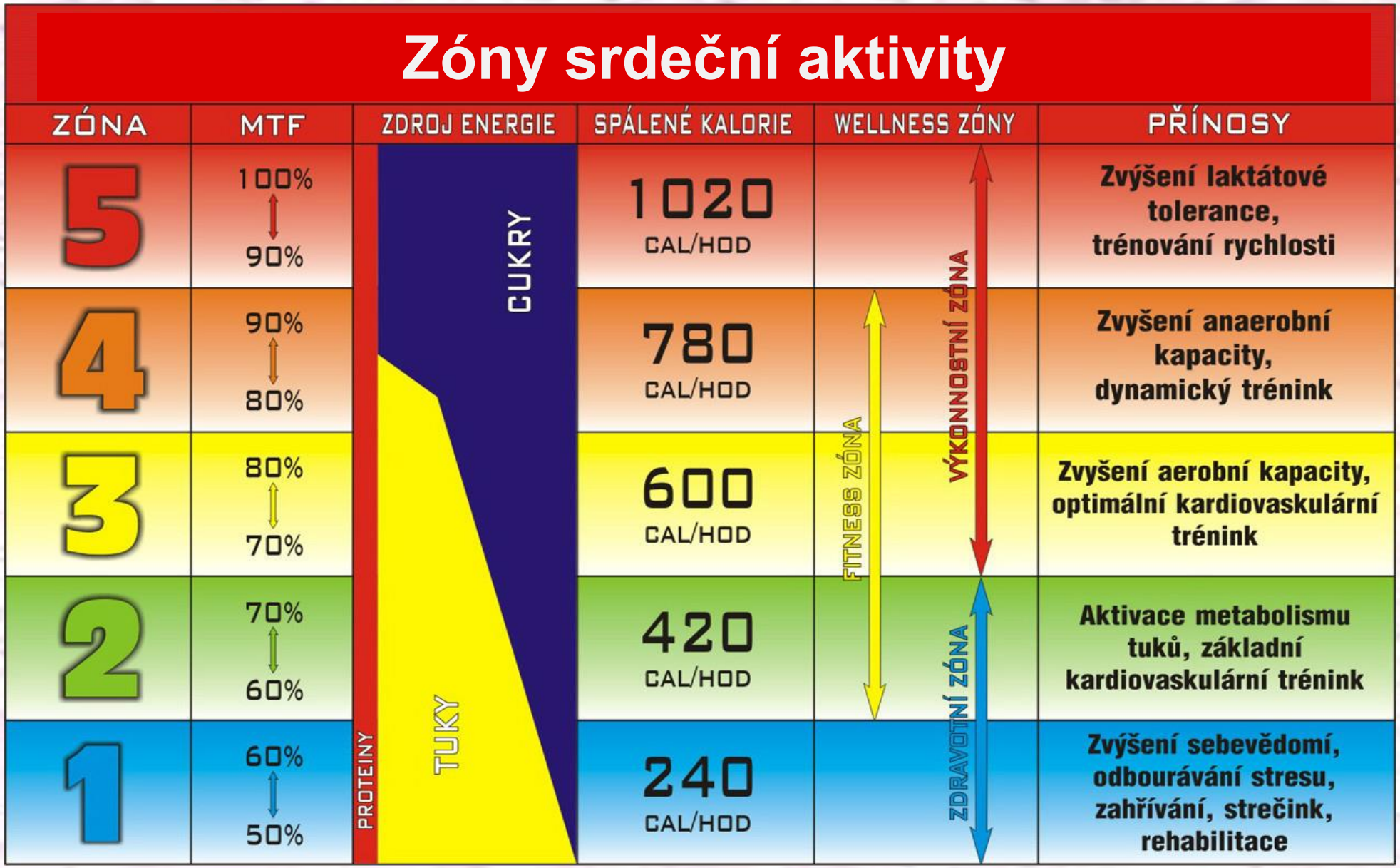
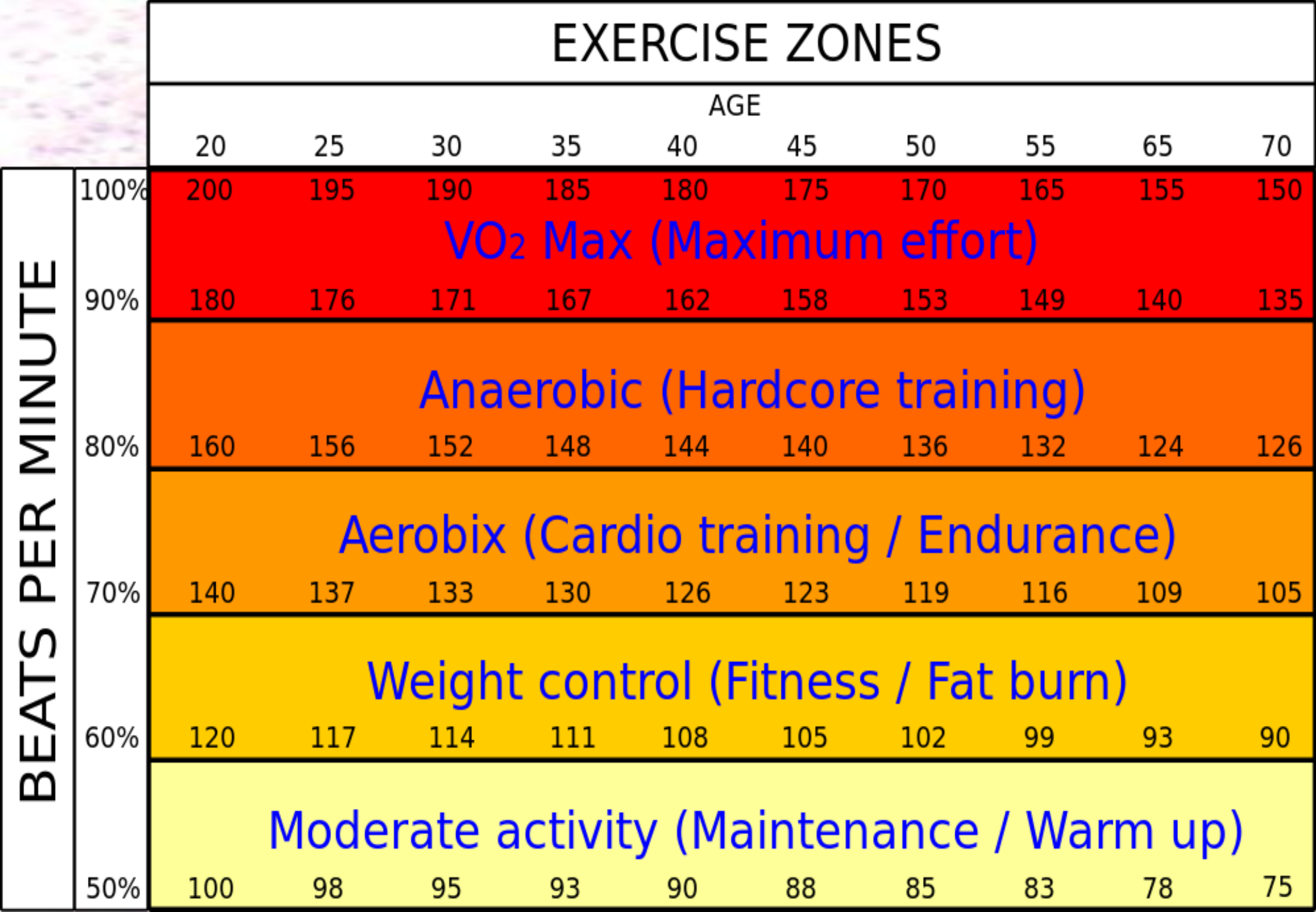
Aerobní vs. anaerobní aktivity?




EXERCISE ZONES
AGE
20 25 30 35 40 45 50 55 65 70
BEATS PER MINUTE
100% 200 195 190 185 180 175 170 165 155 150
VO2 Max (Maximum effort)
90% 180 176 171 167 162 158 153 149 140 135
Anaerobic (Hardcore training)
80% 160 156 152 148 144 140 136 132 124 126
Aerobix (Cardio training / Endurance)
70% 140 137 133 130 126 123 119 116 109 105
Weight control (Fitness / Fat burn)
60% 120 117 114 111 108 105 102 99 93 90
Moderate activity (Maintenance / Warm up)
50% 100 98 95 93 90 88 85 83 78 75

A(na)erobní metabolismus a spalování sacharidů/tuků

Sacharidy

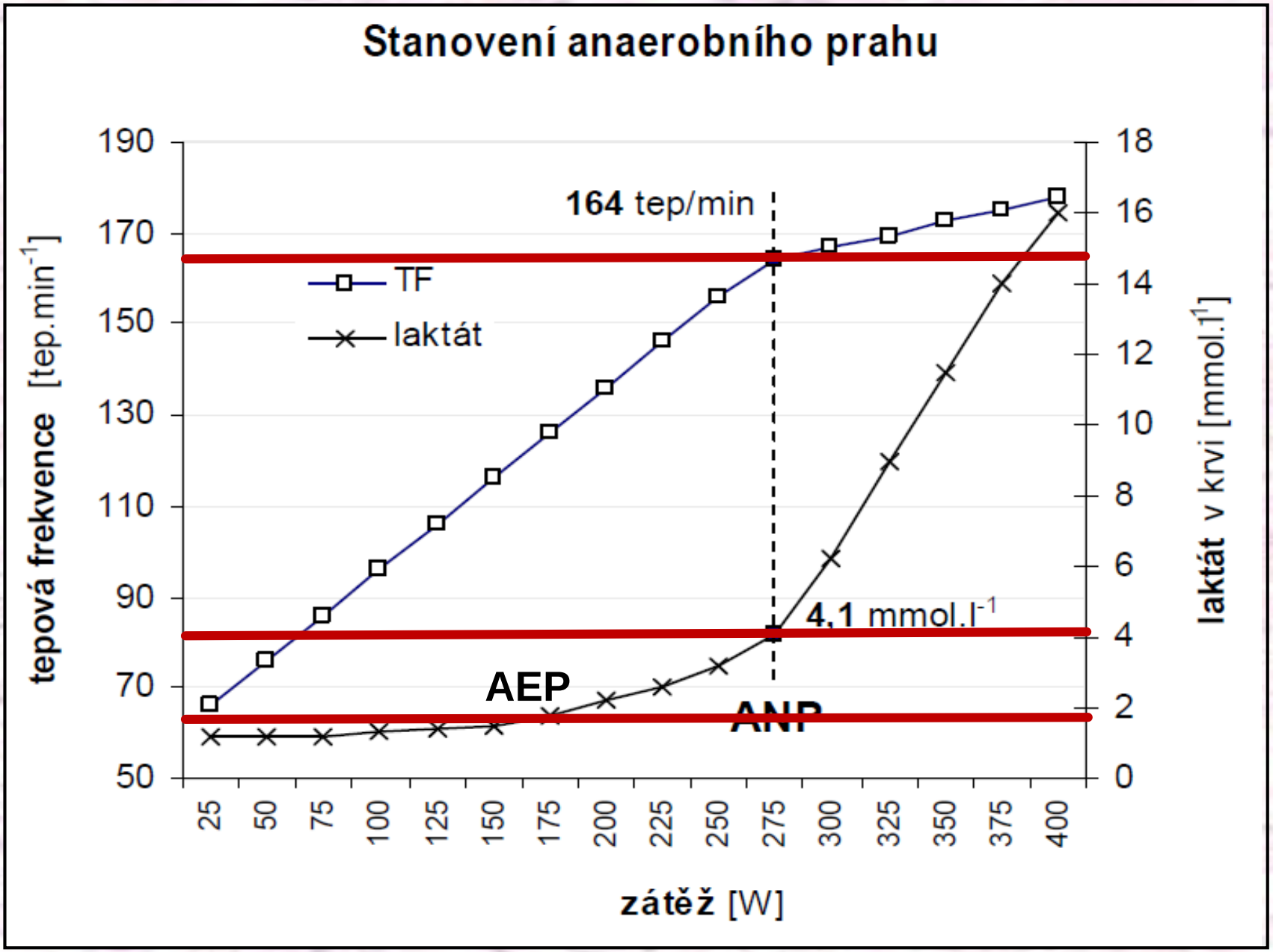
- $6\ O_2 + C_6H_{12}O_6 = 6\ CO_2 + 6\ H_2O + 38\ ATP$
- RER = $6\ CO_2/6\ O_2 = 1.0$

Tuky

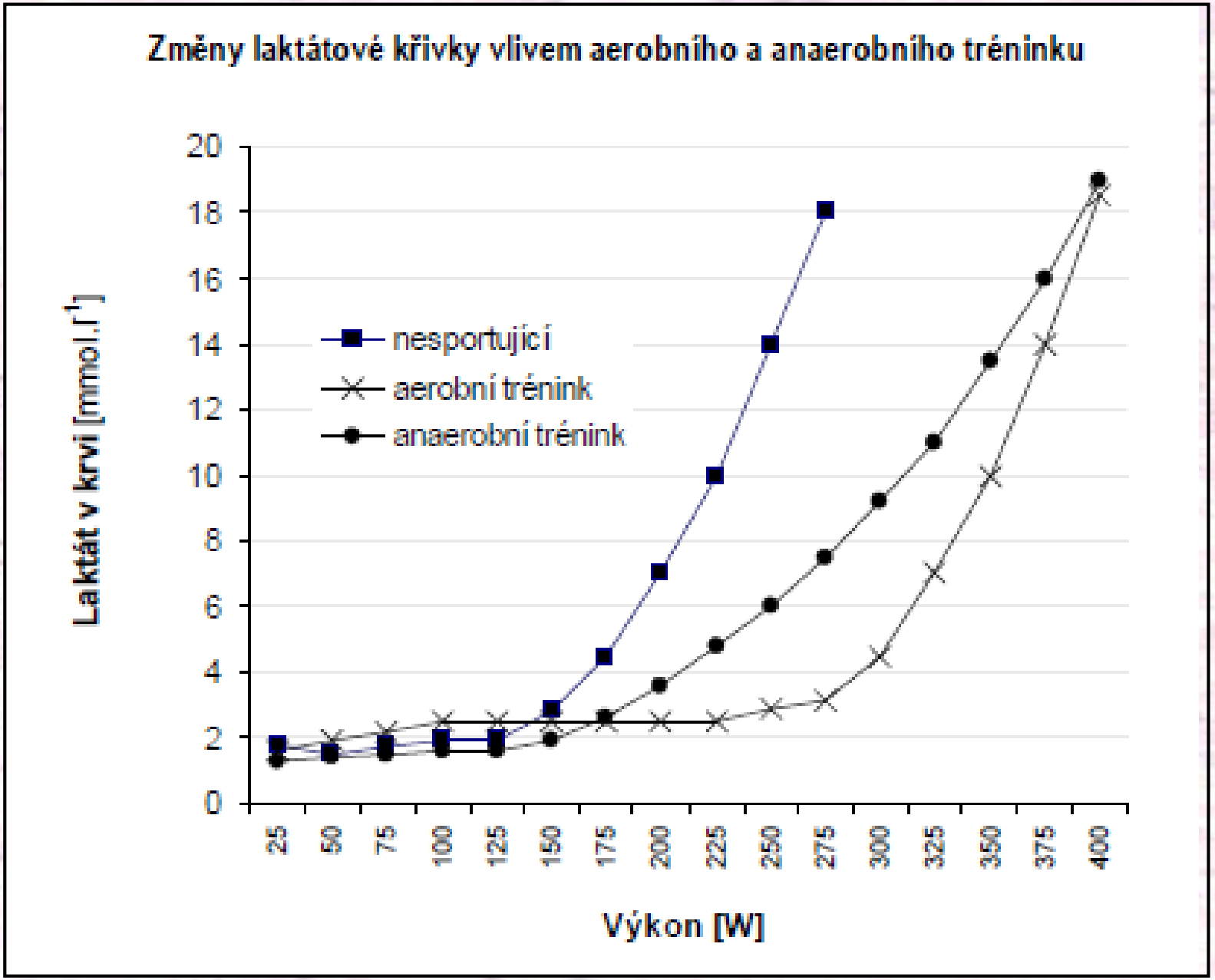
- $23\ O_2 + C_{16}H_{32}O_2 = 16\ CO_2 + 16\ H_2O + 129\ ATP$
- RER = $16\ CO_2/23\ O_2 = 0.7$

Zdroje energie v těle

Zdroj	Množství (g)	Energie (kJ)
Glykémie	20	360
Jaterní glykogen	100	1 800
Svalový glykogen	350	6 300
Plasma FFA	0,4	16
Plasma Tgl	4,0	156
i.m. Tgl	300	11 700
Tuková tkáň	12 000	468 000



Vilikus Z. Funkční diagnostika. Praha 2012



Vilikus Z. Funkční diagnostika. Praha 2012

Proč nespalujeme tuky při anaerobním cvičení?

- Tuky mají nízký respirační kvocient
- Sacharidy jsou mnohem pohotovější zdroj energie
- Svaly mají mnohem vyšší aktivitu glykolytických vs. lipolytických enzymů
- Zvýšená glykolýza inhibuje oxidaci tuků
  - malonyl-CoA vs. CPT-1 – efekt nízkého pH ve svalech
  - acetylkarnitin vs. karnitin

Anaerobní cvičení/HIIT

- HIIT – High intensity interval/intermittent training
- Ve vrcholovém sportu od 70. let minulého století (Peter Coe/Sebastian Coe)
- Izumi Tabata – japonští rychlobruslaři (1996)
- Řada dalších komerčních programů/režimů (Gibala, Zuniga, Timmons…) inzerovaných i pro běžnou populaci

Jak by se tedy měly při anaerobním cvičení spalovat tuky?

- **EPOC - Excess post-exercise oxygen consumption**
- **Tento efekt trvá až 24 hodin**
- **Primárně využívána energie z tukové tkáně**
- **Je podstatně vyšší po anaerobním cvičení (15 vs. 7 %)**

Comparison of energy expenditure elevations after submaximal and supramaximal running

J Appl Physiol 1997

J. LAFORGIA, R. T. WITHERS, N. J. SHIPP, AND C. J. GORE
Exercise Physiology Laboratory, School of Education, The Flinders University of South Australia, Adelaide, South Australia 5001, Australia

- **??? 65 vs. 10 %, výjimečně i zcela opačně**

Anaerobní cvičení – předpokládané mechanismy účinku vedoucí k hubnutí?

- Regenerace ATP
- Resyntéza svalového glykogenu (i) z laktátu
- Reoxygenace kosterního svalstva
- Reparace poškozených tkání
- Tepelná homeostáza

Anaerobní cvičení – dochází skutečně ke spalování tuků?

- **Zvýšená lipolýza v důsledku EPOC?**

Abstract

Recovery from a bout of exercise is associated with an elevation in metabolism referred to as the excess post-exercise oxygen consumption (EPOC). A number of investigators in the first half of the last century reported prolonged EPOC durations and that the EPOC was a major component of the thermic effect of activity. It was therefore thought that the EPOC was a major contributor to total daily energy expenditure and hence the maintenance of body mass. Investigations conducted over the last two or three decades have improved the experimental protocols used in the pioneering studies and therefore have more accurately characterized the EPOC. Evidence has accumulated to suggest an exponential relationship between exercise intensity and the magnitude of the EPOC for specific exercise durations. Furthermore, work at exercise intensities ≥50–60% $\dot{V}O_{2max}$ stimulate a linear increase in EPOC as exercise duration increases. The existence of these relationships with resistance exercise at this stage remains unclear because of the limited number of studies and problems with quantification of work intensity for this type of exercise. Although the more recent studies do not support the extended EPOC durations reported by some of the pioneering investigators, it is now apparent that a prolonged EPOC (3–24 h) may result from an appropriate exercise stimulus (submaximal: ≥50 min at ≥70% $\dot{V}O_{2max}$; supramaximal: ≥6 min at ≥105% $\dot{V}O_{2max}$). However, even those studies incorporating exercise stimuli resulting in prolonged EPOC durations have identified that the

EPOC comprises only 6–15% of the net total oxygen cost of the exercise.

the earlier research optimism regarding an important role for the EPOC in weight loss is generally unfounded.

unfounded. This is further reinforced by acknowledging that the exercise stimuli required to promote a prolonged EPOC are unlikely to be tolerated by non-athletic individuals. The role of exercise in the maintenance of body mass is therefore predominantly mediated via the cumulative effect of the energy expenditure during the actual exercise.

Anaerobní cvičení

Wikipedia: https://en.wikipedia.org/wiki/High-intensity_interval_training

- **Compared with other regimens, HIIT may not be as effective for treating hyperlipidemia and obesity, or improving muscle and bone mass.**
- **HIIT requires "an extremely high level of subject motivation"**
- **There is a question whether the general population could safely or practically tolerate the extreme nature of the exercise regimen…**

ALE!!!

Conclusions: HIIT could be considered a more effective and time-efficient intervention for improving blood pressure and aerobic capacity levels in obese youth in comparison to other types of exercise. © 2016 World Obesity

Is high-intensity interval training more effective on improving cardiometabolic risk and aerobic capacity than other forms of exercise in overweight and obese youth? A meta-analysis

A. García-Hermoso,[1] A. J. Cerrillo-Urbina,[2] T. Herrera-Valenzuela,[1] C. Cristi-Montero,[3] J. M. Saavedra[4] and V. Martínez-Vizcaíno[2]

pared with CON. HIIT appears effective at improving metabolic health, particularly in those at risk of or with type 2 diabetes. Larger randomized controlled trials of longer duration than those included in this meta-analysis are required to confirm these results.

The effects of high-intensity interval training on glucose regulation and insulin resistance: a meta-analysis

C. Jelleyman[1,2], T. Yates[1,2], G. O'Donovan[1], L. J. Gray[3], J. A. King[2,4], K. Khunti[1,5] and M. J. Davies[1,2]

Heart, Lung and Circulation (2015) xx, 1–9
1443-9506/04/$36.00
http://dx.doi.org/10.1016/j.hlc.2015.06.828

ORIGINAL A

High Intensity Interval versus Moderate Intensity Continuous Training in Patients with Coronary Artery Disease: A Meta-analysis of Physiological and Clinical Parameters

Kevin Liou, MPH, FRACP [a,c*], Suyen Ho, FANZCA [b], Jennifer Fildes, RN, CNC [d], Sze-Yuan Ooi, MD, FRACP [a,c]

Conclusion HIIT improves the mean VO_{2peak} in patients with CAD more than MCT, although MCT was associated with a more pronounced numerical decline in patients' resting heart rate and body weight. The underlying mechanisms and clinical relevance of these results are uncertain, and remain a potential focus for future studies.

Sports Med
DOI 10.1007/s40279-015-0365-0

SYSTEMATIC REVIEW

Effectiveness of High-Intensity Interval Training (HIT) and Continuous Endurance Training for VO_{2max} Improvements: A Systematic Review and Meta-Analysis of Controlled Trials

Zoran Milanović[1] · Goran Sporiš[2] · Matthew Weston[3]

Key Points

When compared with no exercise, endurance training and high-intensity interval training elicit large improvements in maximal oxygen uptake.

Endurance training and high-intensity interval training elicit additional benefit for individuals with lower pre-training fitness.

In healthy, young to middle-aged adults, high-intensity interval training improves maximal oxygen uptake to a greater extent than traditional endurance training.

BJSM Online First, published on June 18, 2015 as 10.1136/bjsports-2014-094490

High-intensity interval training for improving health-related fitness in adolescents: a systematic review and meta-analysis

S A Costigan,[1] N Eather,[1] R C Plotnikoff,[1] D R Taaffe,[2,3,4] D R Lubans[1]

Conclusions HIIT is a feasible and time-efficient approach for improving cardiorespiratory fitness and body composition in adolescent populations.

Sports Med
DOI 10.1007/s40279-015-0321-z

Conclusion HIIT is more effective at improving brachial artery vascular function than MICT, perhaps due to its tendency to positively influence CRF, traditional CVD risk factors, oxidative stress, inflammation, and insulin sensitivity.

Joyce S. Ramos · Lance C. Dalleck · Arnt Erik Tjonna · Kassia S. Beetham · Jeff S. Coombes

Anaerobní cvičení - výhody

Medicine & Science in Sports & Exercise:
October 1996 - Volume 28 - Issue 10 - pp 1327-1330
Applied Sciences: Physical Fitness and Performance

Effects of moderate-intensity endurance and high-intensity intermittent training on anaerobic capacity and ˙VO2max

TABATA, IZUMI; NISHIMURA, KOUJI; KOUZAKI, MOTOKI; HIRAI, YUUSUKE; OGITA, FUTOSHI; MIYACHI, MOTOHIKO; YAMAMOTO, KAORU

Intervalový trénink po dobu 6 t (5 x t. a 1 hodina) vedl ke zvýšení VO_2 max z 53 na 58 ml O_2 . kg^{-1} . min^{-1}

Závěr

- Tak tedy aerobní nebo anaerobní cvičení?
- Počítá se jakýkoli pohyb…
- Anaerobní cvičení má nepochybný vliv na zvyšování výkonnosti a nezpochybnitelný význam ve vrcholovém i výkonnostním sportu
- I přes prokázané účinky na kardiovaskulární aparát a metabolické efekty vliv anaerobního cvičení pro běžnou populaci má pro špatnou compliance a nízkou toleranci význam spíše omezený
- u vysoce motivovaných jedinců však může velmi dobrým nástrojem pro zvyšování výkonnosti
- Optimální je nepochybně kombinace aerobních i anaerobních tréninků

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