Zone 2 Cardio

The Ultimate Guide to Zone 2 for Health, Longevity, & Performance

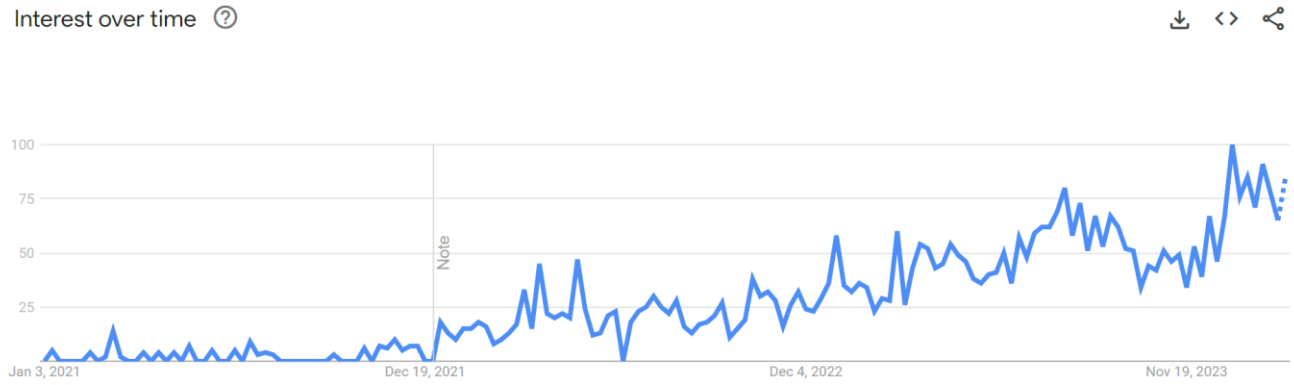
WEEKS OUT

Welcome to the workshop

Thanks for joining!

What we're going to cover:

1. Metabolic health & performance
2. The big picture of heart rate training
3. All about zone 2 cardio
4. Practical programming
5. Q&A



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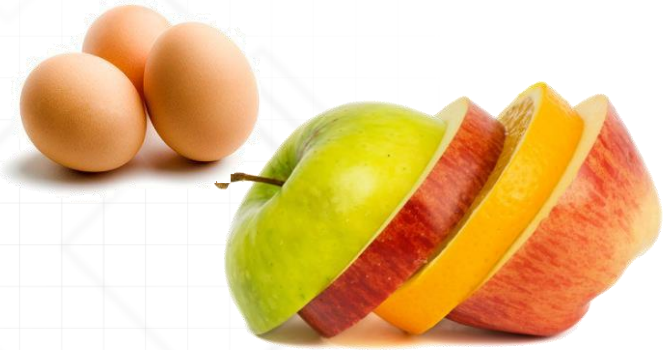
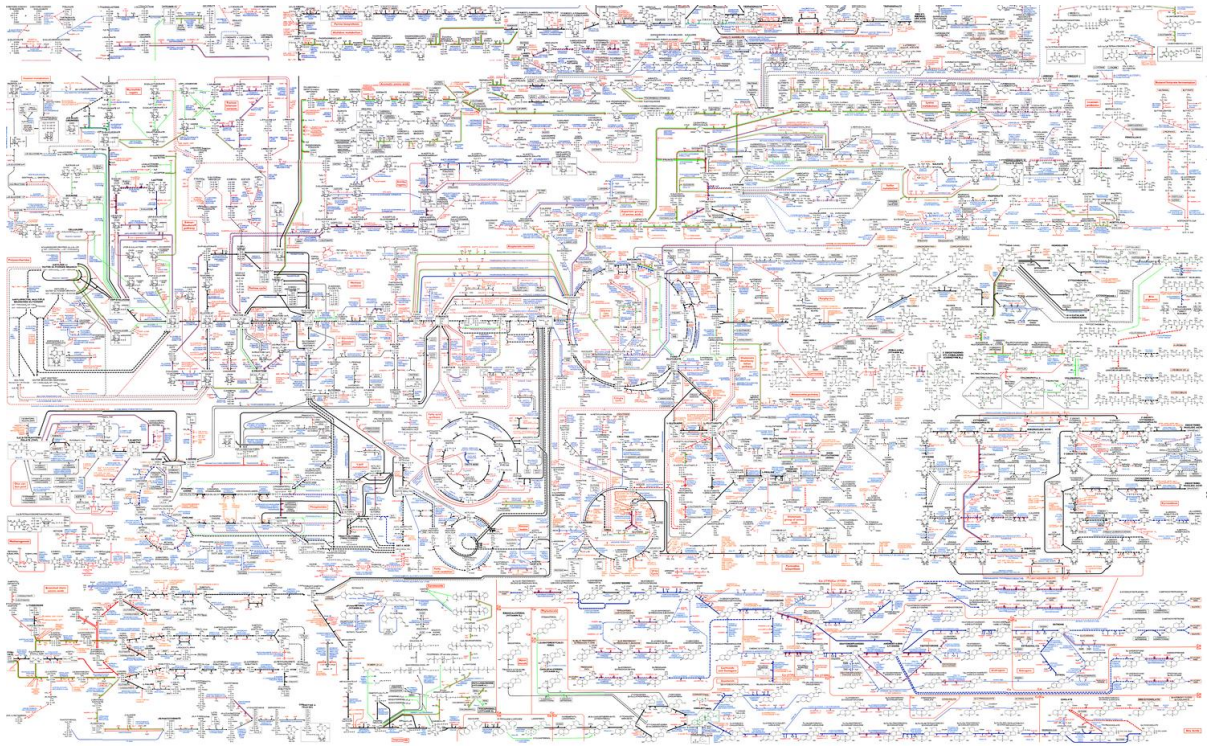
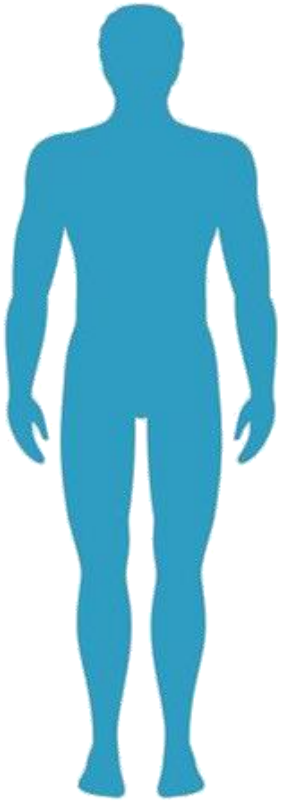
Understanding Metabolic Health and Performance

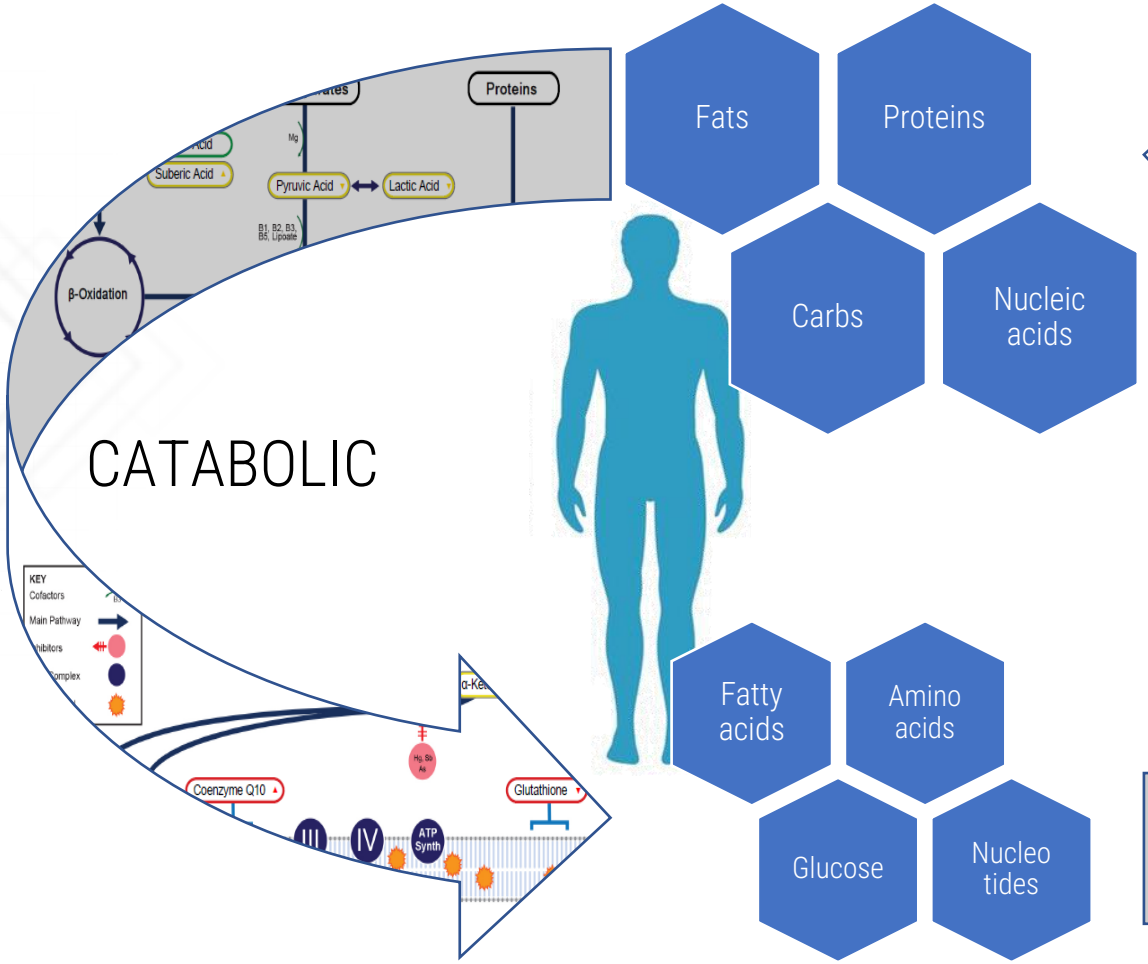
The story of metabolism







How does metabolism work?



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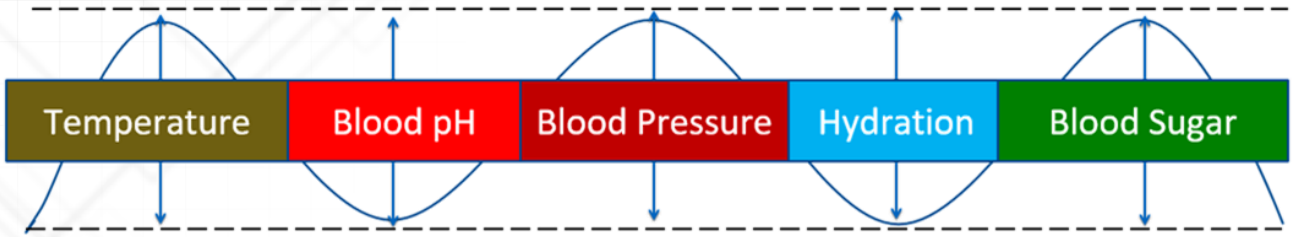
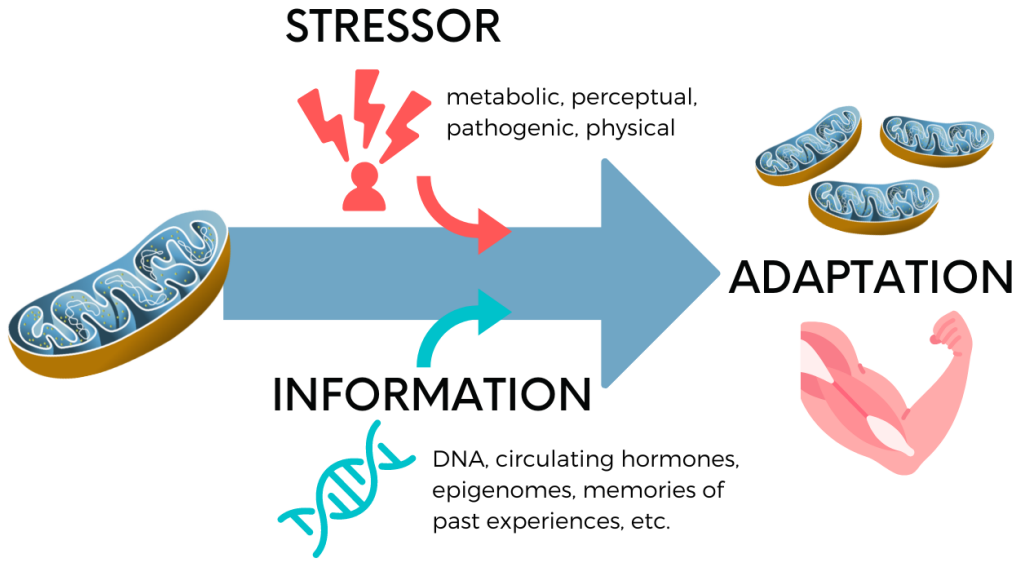
What is health?

"The capacity of your body's biological systems to regulate your internal environment (homeostasis) to sustain life and adapt to your environment"

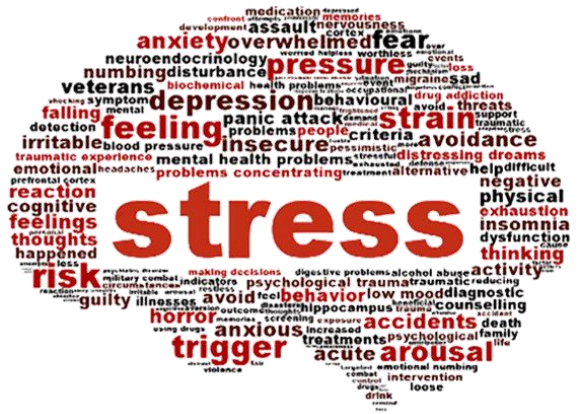


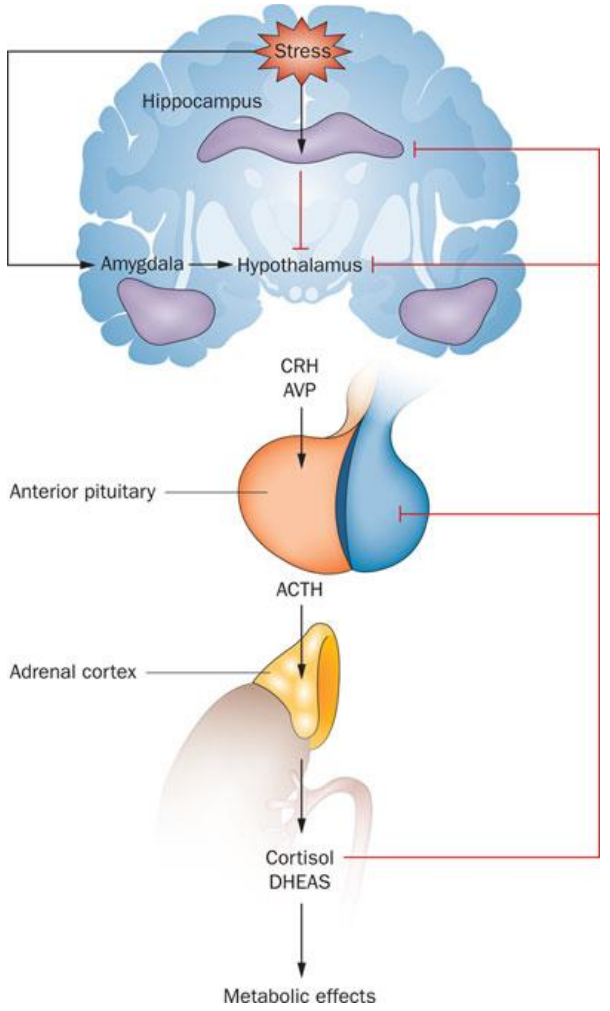


The stress of life

» Stress is the anything from the external environment that has a direct impact (response) on your internal physiology:

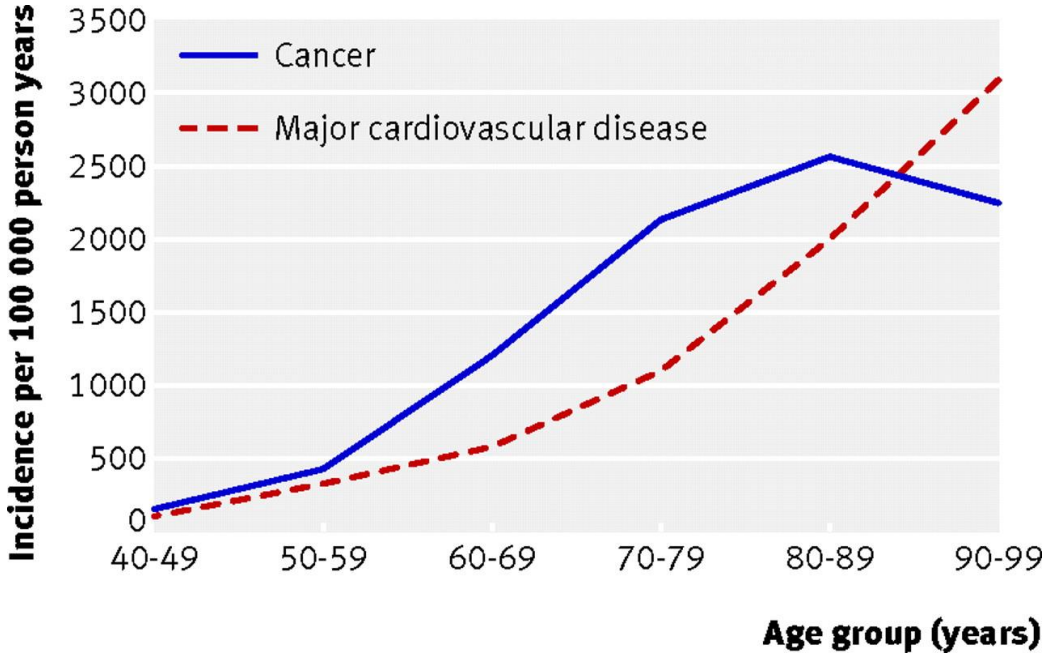
- **Environmental** – heat, cold, sun, pollution, noise, pathogens
- **Physical** – activity, training, working, etc.
- **Mental** – work, family, financial, social media
- **Nutritional** –food, alcohol, stimulants, hydration



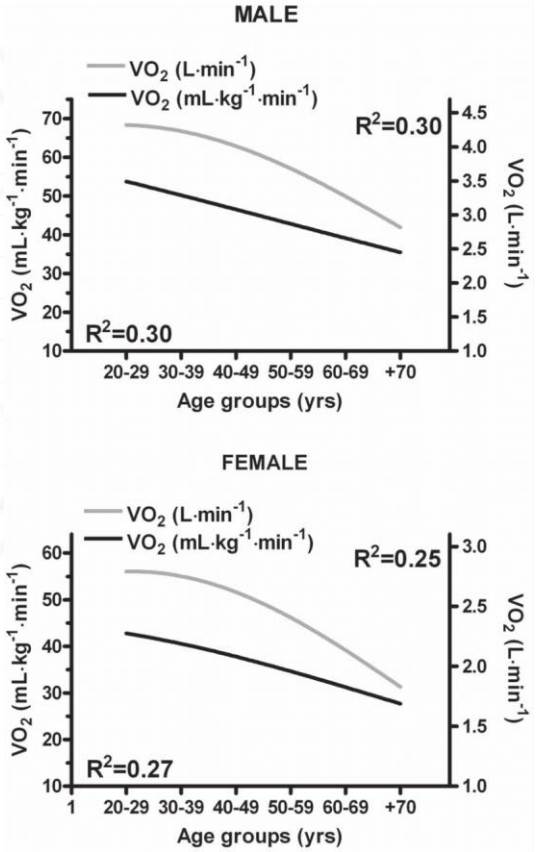


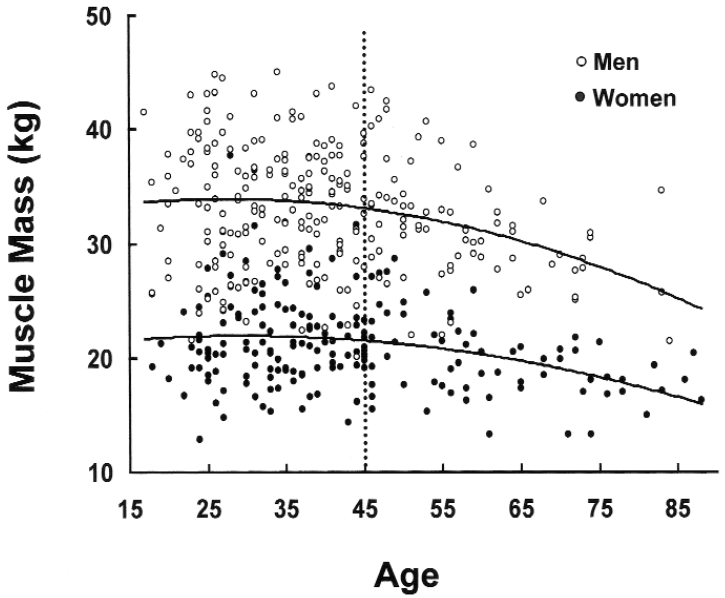
The cost of time

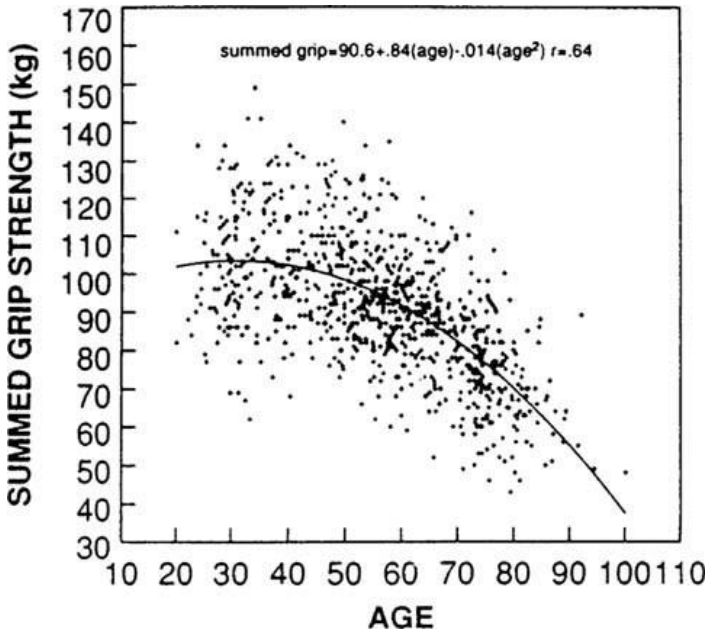
- Our risk of developing a major disease increases
- It takes longer to recover from everything:
  - Workouts
  - Illness
  - Injuries
  - Alcohol
  - Travel (Jetlag)
- We lose muscle mass, endurance, strength, while adding body fat more easily
- We get sick more often, and for longer



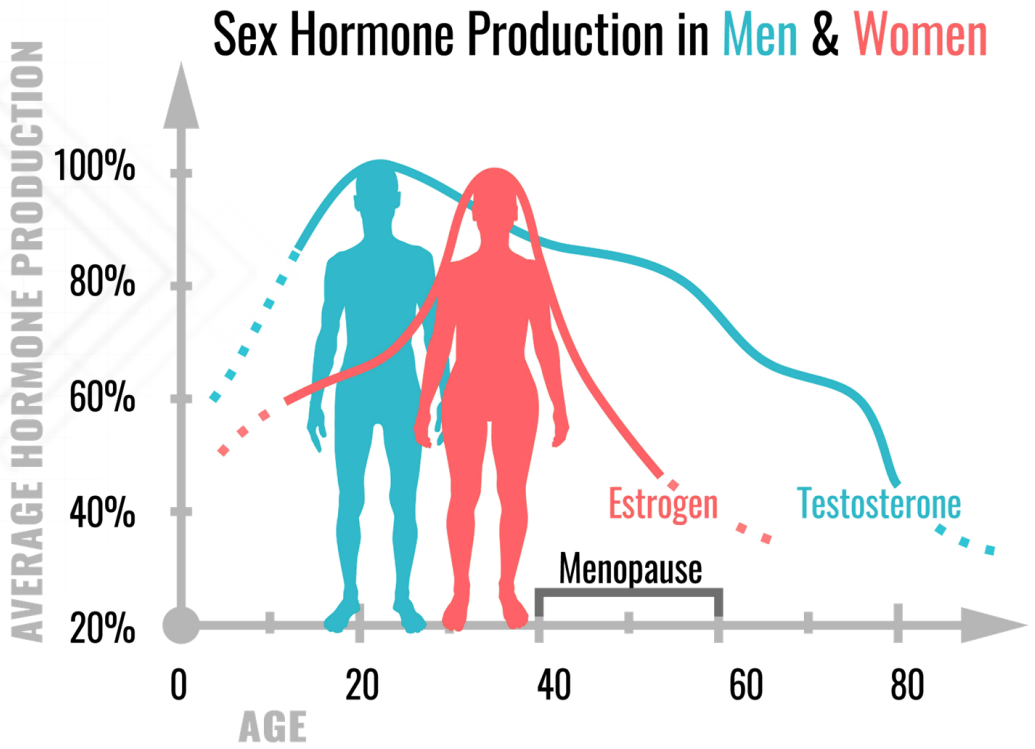
The cost of time

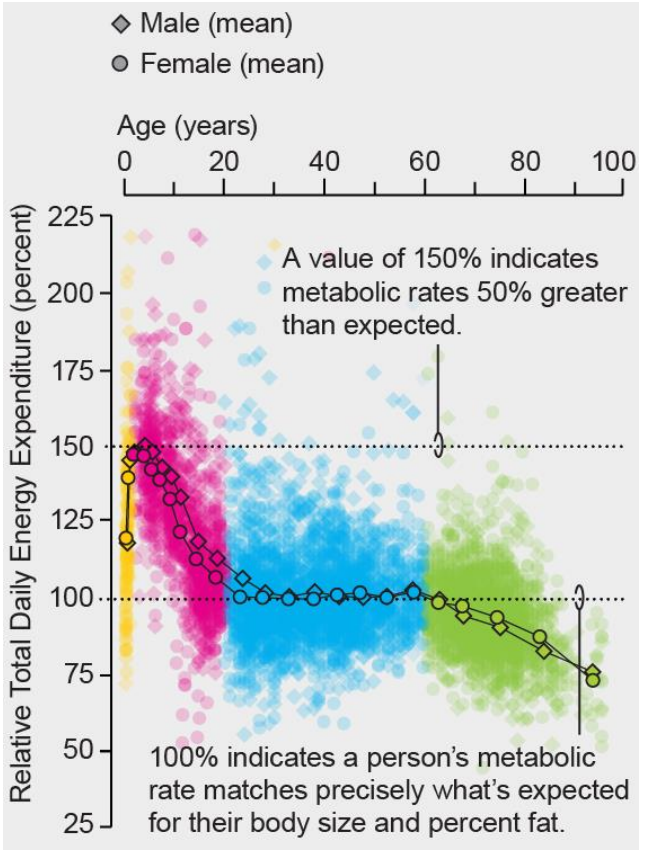




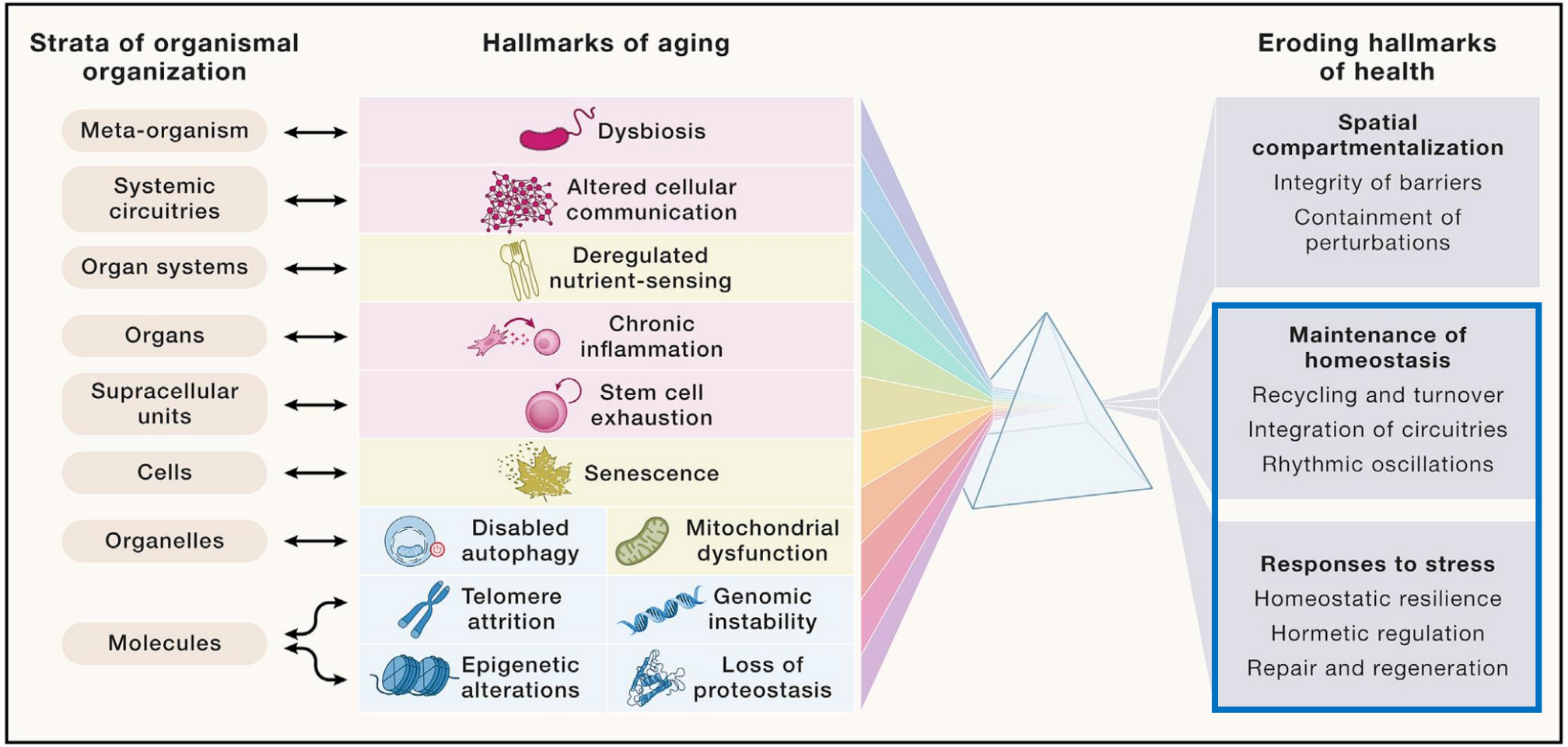


The cost of time

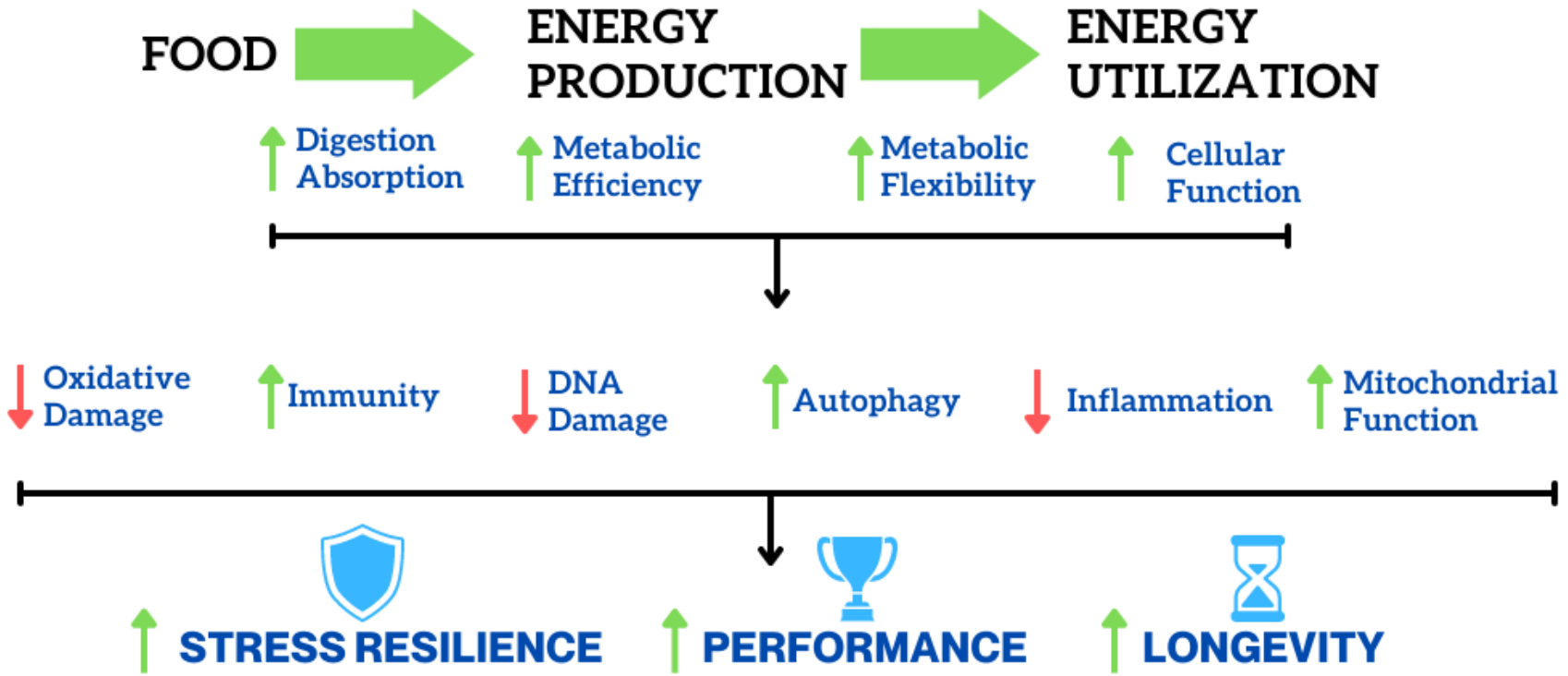




The hallmarks of aging



What is a"healthy metabolism"?



Survival of the fittest

Research on centenarians suggests that the association between genetics and longevity is relatively modest until we surpass 90 years old

- 25% of living to 90
- 50% of living to 100
- 75% of living to 106

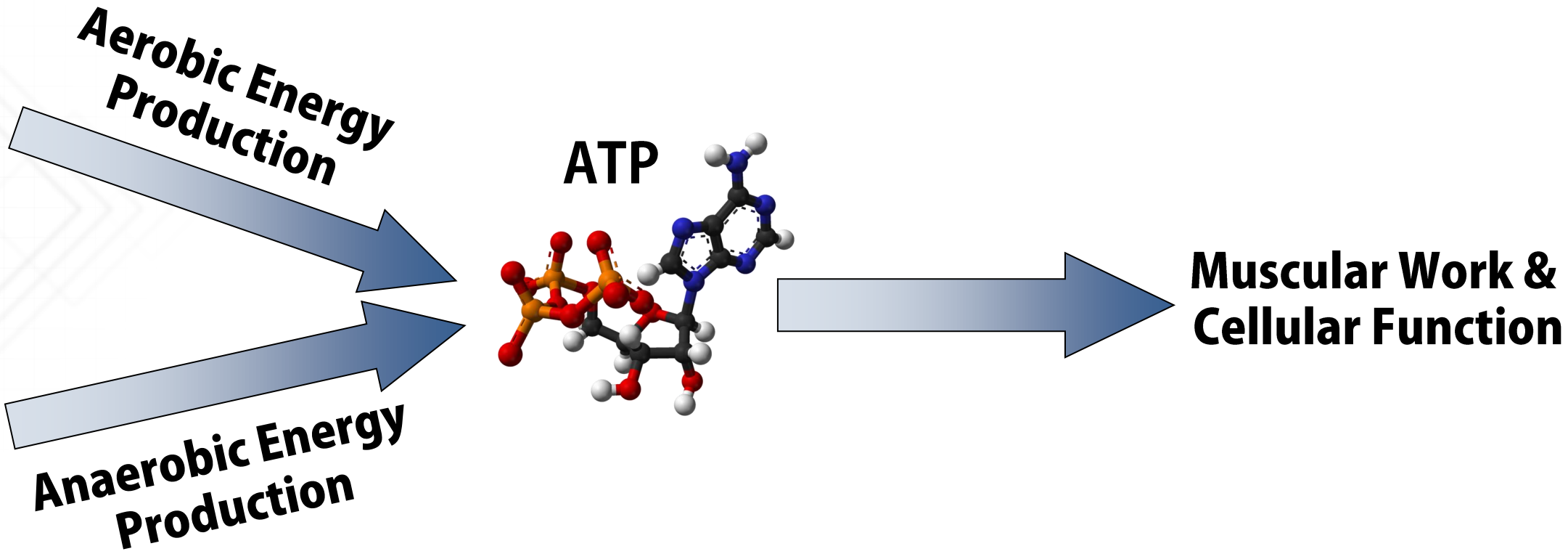
In the US, only 16% of men and 35% of women live to be 90 and the average life expectancy is 78

Summary

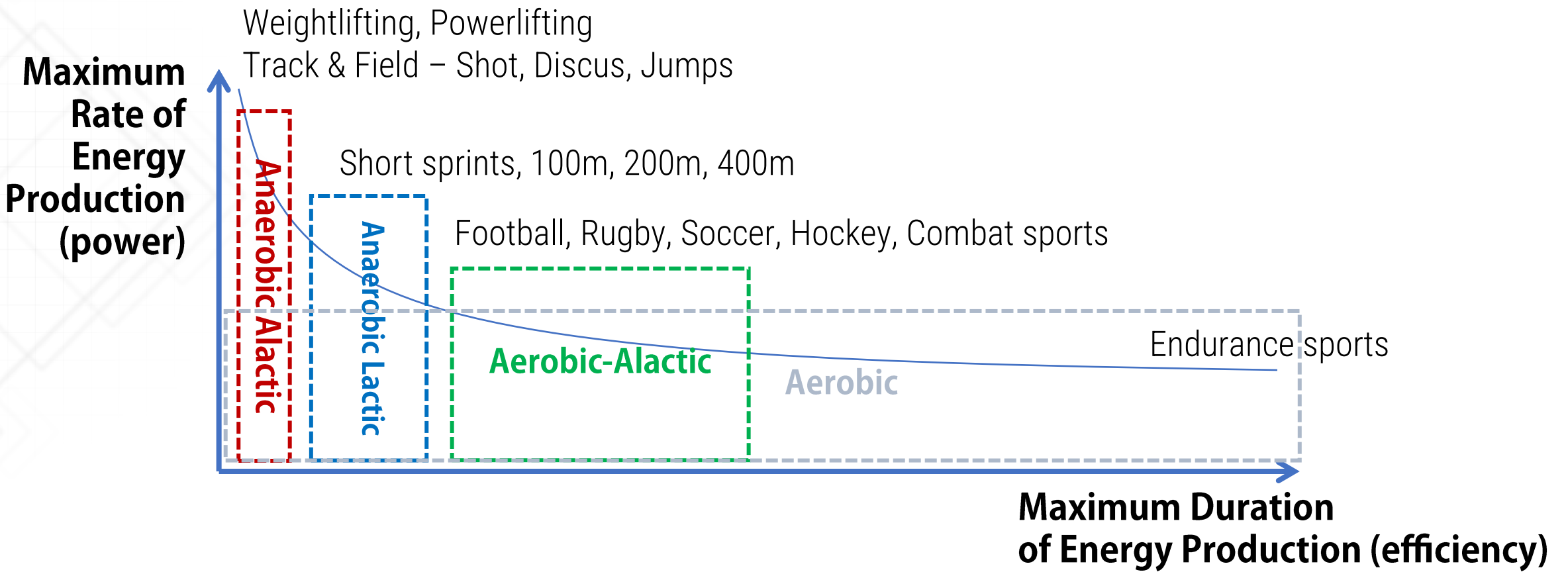
- Metabolism is about much more than just how many calories you burn in a day.
- Aging is marked by a decline in metabolic function and loss of adaptability, but you have a lot of control of how quickly that happens.
- One of the main reasons training and fitness improve health and longevity is because they build metabolic resilience and slow the aging process.

The big picture of heart rate training

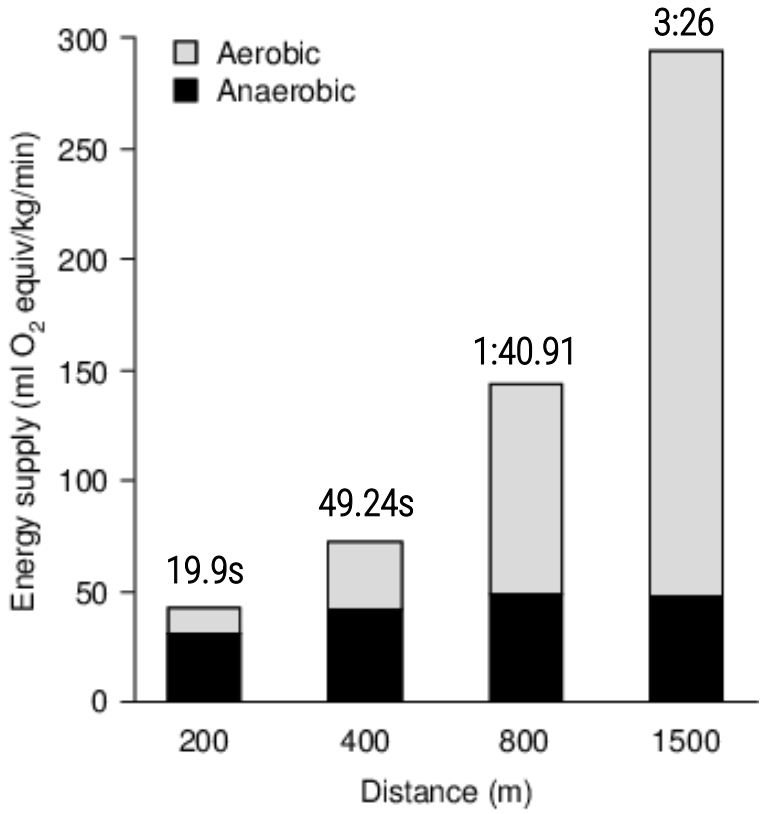
Everything starts with energy



The energy of performance



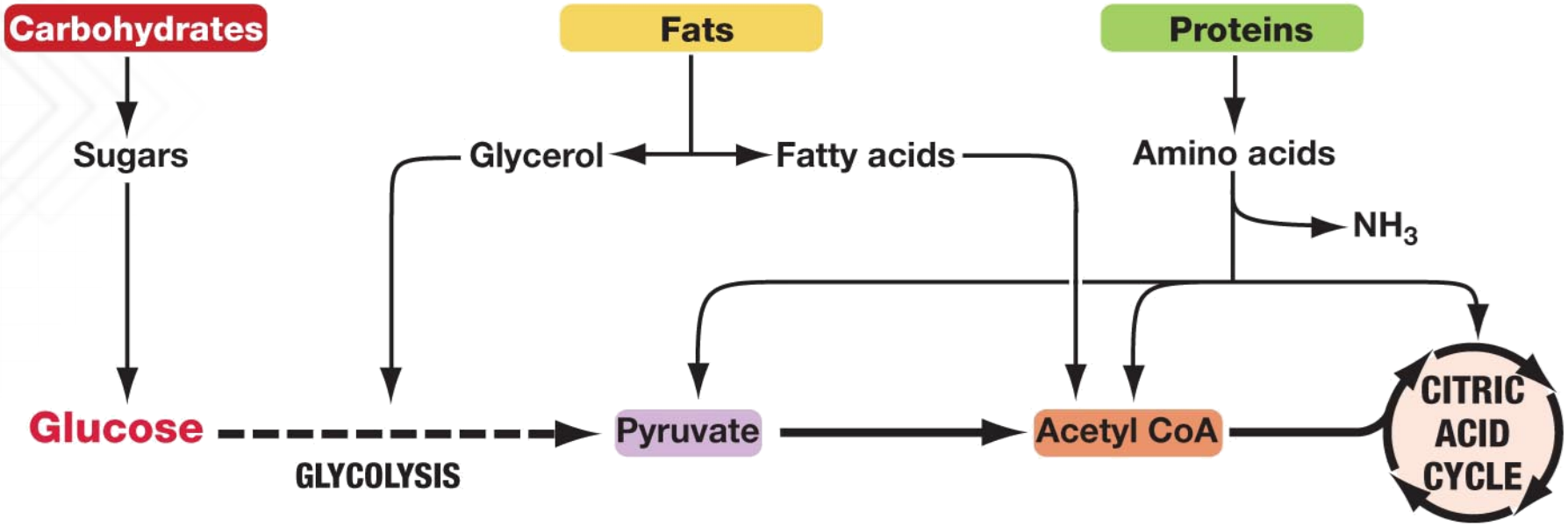
Fueling performance



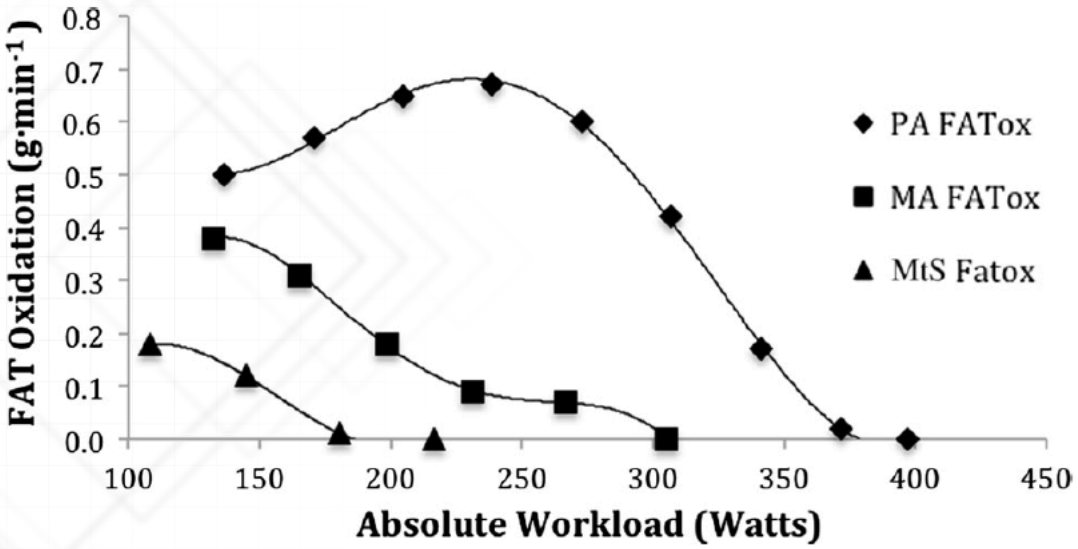
Energy System Interaction and Relative Contribution During Maximal Exercise

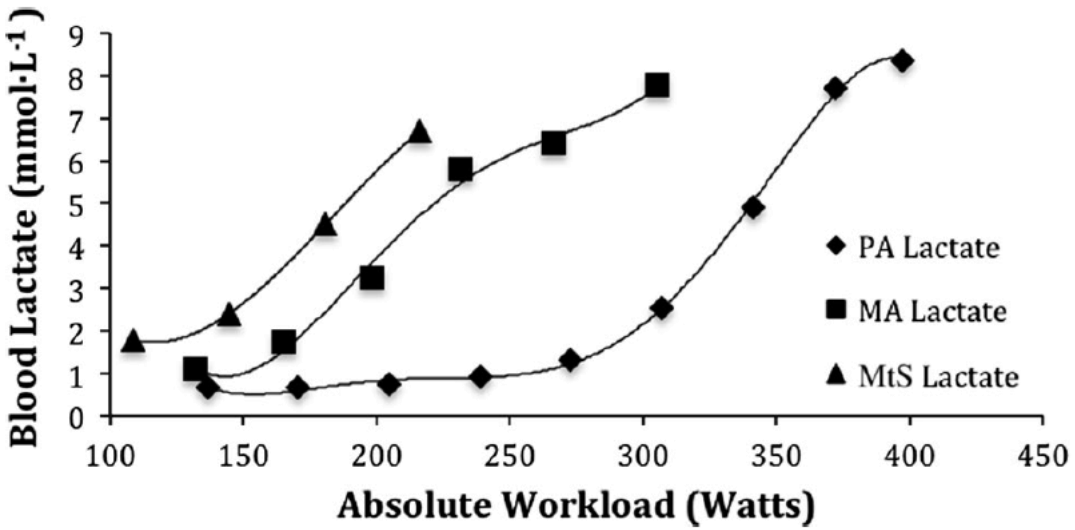
Fueling aerobic metabolism

» The aerobic system can produce ATP using different energy sources:



Intensity and energy

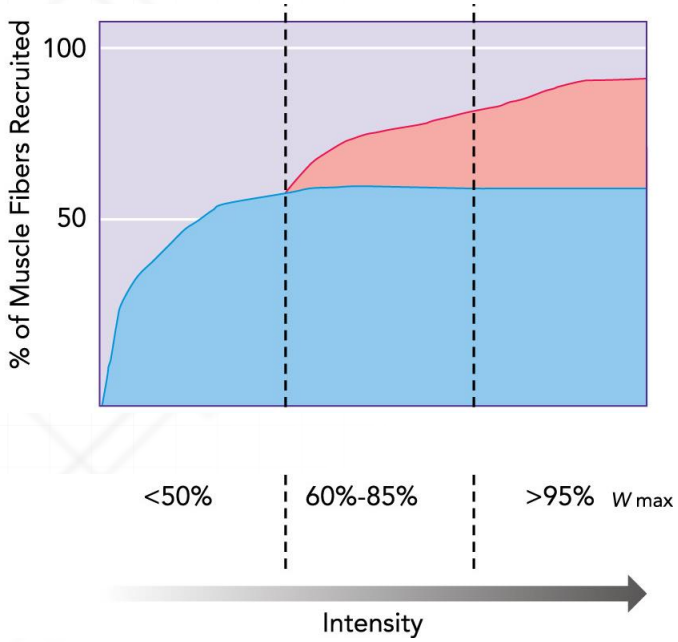


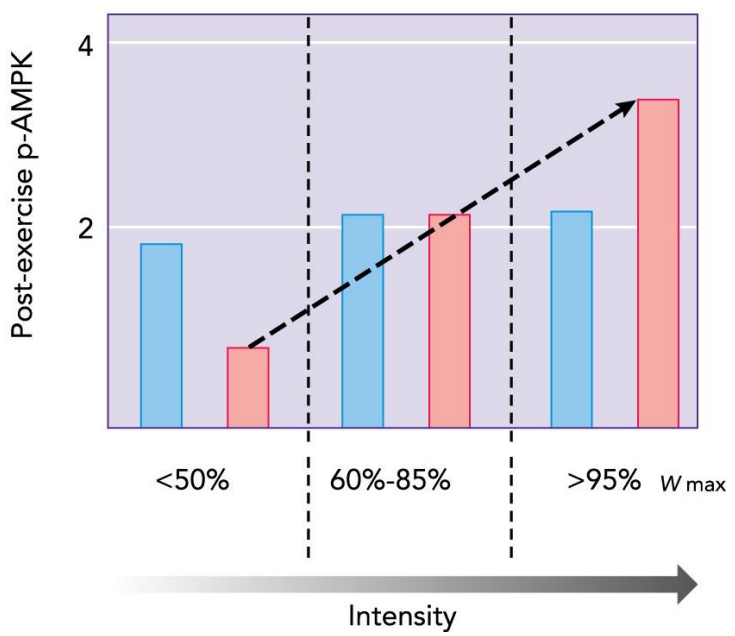


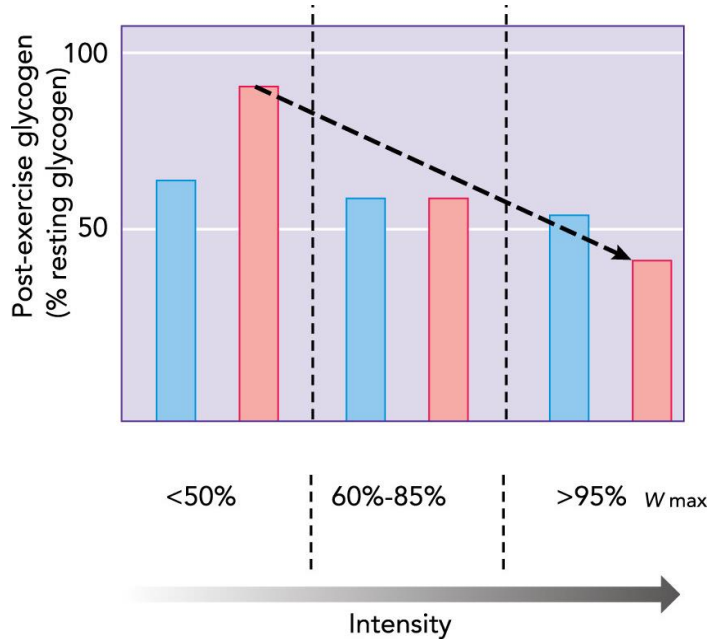
Assessment of Metabolic Flexibility by Means of Measuring Blood Lactate, Fat, and Carbohydrate Oxidation Responses to Exercise in Professional Endurance Athletes and Less-Fit Individuals

Iñigo San-Millán[1,2] · George A. Brooks[3]

Intensity is about muscle fibers







Type IA Type IIA

High-Intensity Exercise and Mitochondrial Biogenesis: Current Controversies and Future Research Directions

David J. Bishop,[1,2] Javier Botella,[1] Amanda J. Genders,[1] Matthew J-C. Lee,[1] Nicholas J. Saner,[1] Jujiao Kuang,[1] Xu Yan,[1] and Cesare Granata[3]

Heart rate training confusion

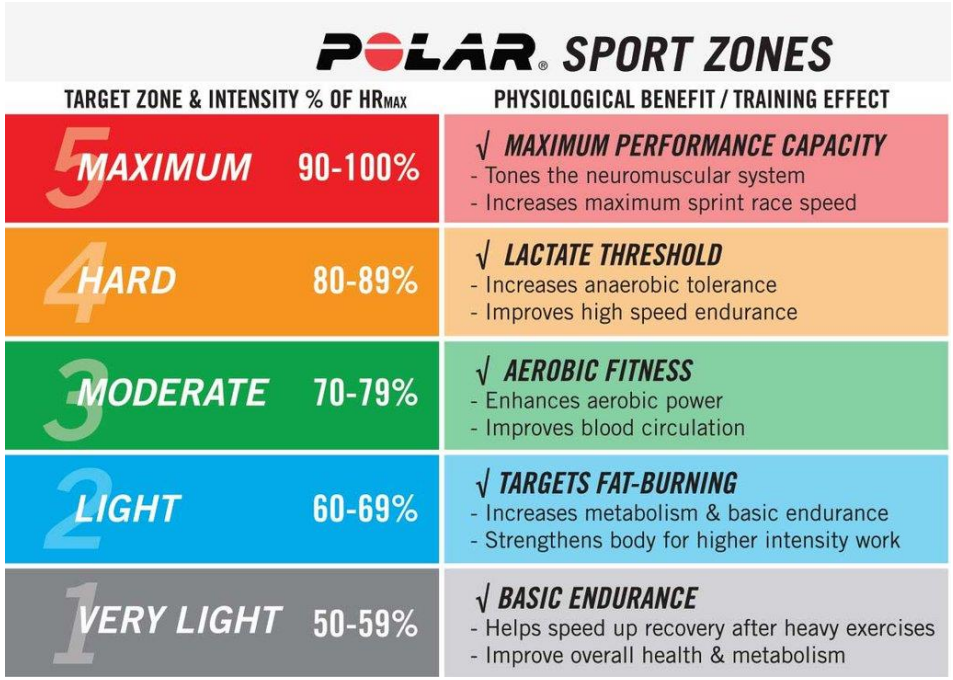
Table 1
Training Intensity Zones for the General Population

Intensity Zone	%HRmax	%HRR
Very Light	<57	<30
Light	57–63	30–39
Moderate	64–76	40–59
Vigorous	77–95	60–89
Near-maximal to Maximal	96–100	90–100

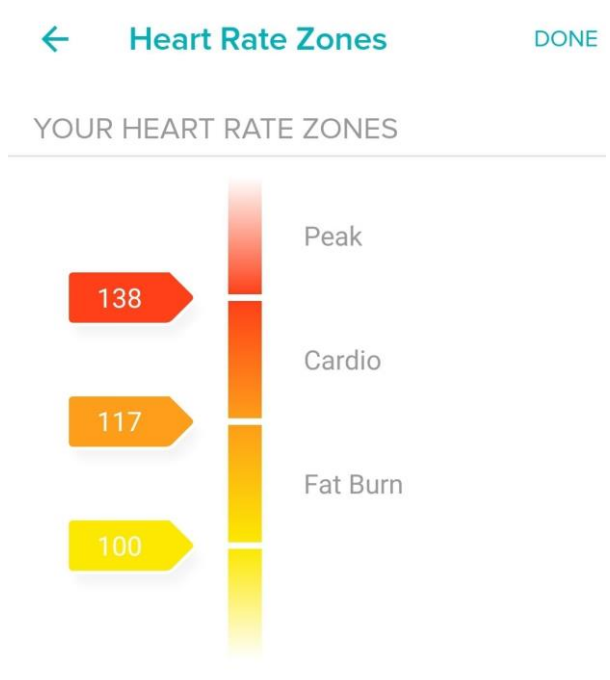
Note: %HRmax = Percentage of maximal heart rate; %HRR = Percentage of heart-rate reserve

Source: American College of Sports Medicine (2018). *ACSM's Guidelines for Exercise Testing and Prescription* (10th ed.). Philadelphia: Wolters Kluwer.

ACSM



Polar



Fitbit

Heart rate training confusion

Zone	Reference	% FTP	% Max HR	% Threshold HR	RPE*
1	Active recovery	<60%	50-60%	<68%	<3
2	Extensive aerobic	55-75%	60-70%	68-85%	3-4
3	Intensive aerobic	75-90%	70-80%	85-95%	5-6
4	Lactate threshold	90-105%	80-90%	95-105%	7
5	VO2max (aerobic capacity)	105-120%	90-100%	>105%	8
6	VLamax (anaerobic capacity)	120-130%	N/A	N/A	9
7	Neuromuscular power	>130%	N/A	N/A	10

Cycling

ZONE 1 Warm Up	**Up to 65% of MHR** — Easy effort, like a warm up, recovery or cool down
ZONE 2 Endurance	**65-75% of MHR** — Average effort; a comfortable, sustainable challenge
ZONE 3 Power	**75-85% of MHR** — Above average effort, feels challenging, heavy breathing
ZONE 4 Threshold	**85-95% of MHR** — Hard effort, very challenging, multi-minute sprints
ZONE 5 Max Capacity	**95%+ of MHR** — As hard as you can go, very short bursts to the finish line

Pelaton

WEEKS OUT

Approaches to heart rate training

Static %'s of max HR

- **Pros:**
  - Easy to understand
  - Common across many devices
  - Minimal testing required
- **Cons:**
  - Intensity is not linear
  - Not individualized/inaccurate
  - Does not change with fitness

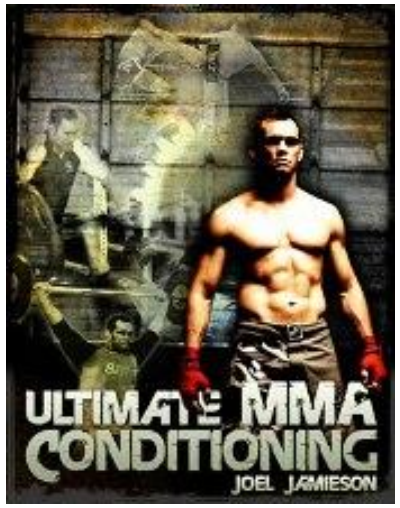
Metabolic testing

- **Pros:**
  - Derived from physiological data
  - Individualized
  - Measurable improvements
- **Cons:**
  - Time, expense, and effort to test
  - Varied accuracy depending on lab
  - Testing is only a snapshot

All about Zone 2 cardio

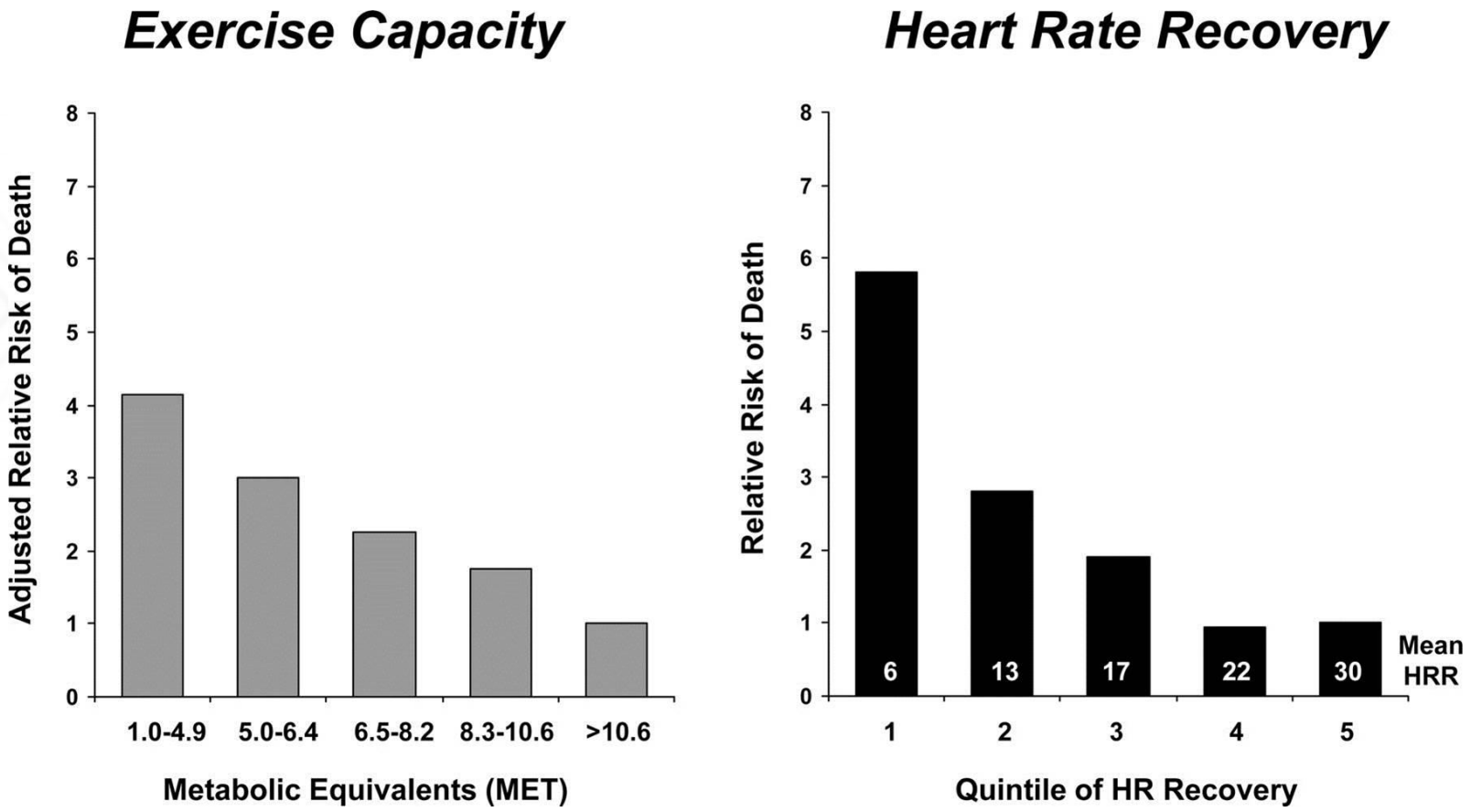
My Zone 2

"The level of intensity at which power output is mainly generated by slow-twitch muscle fibers using fat as their primary fuel source. This intensity can be sustained for long durations without significant fatigue."



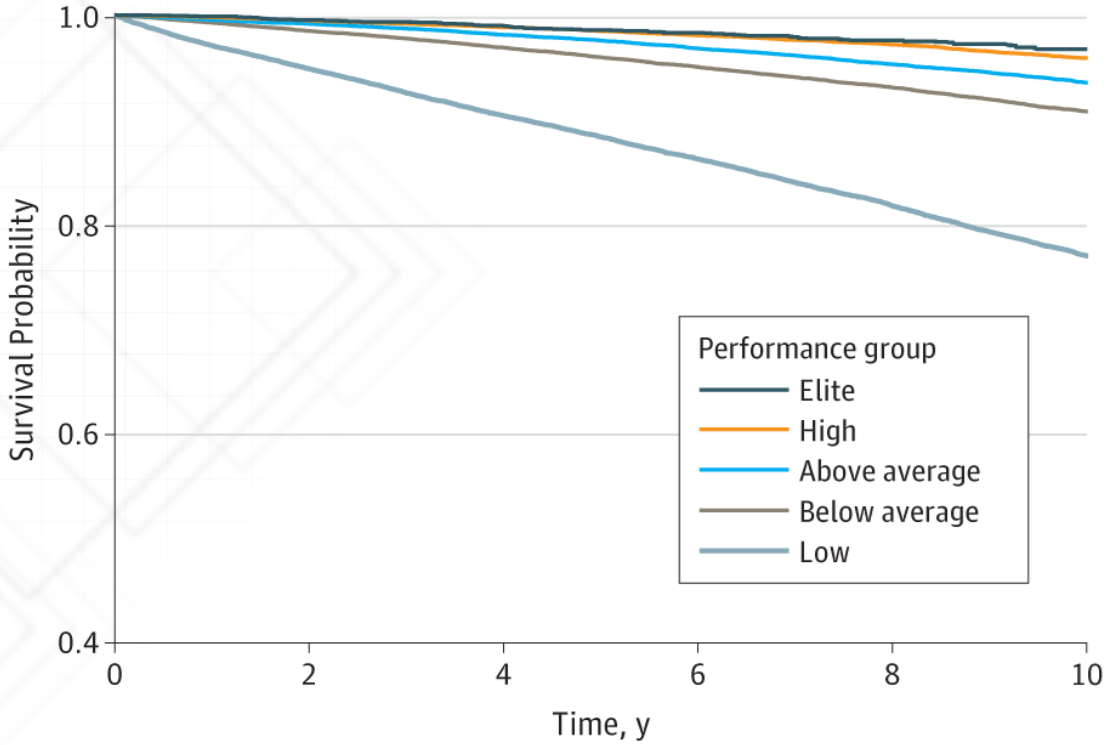
Cardiac Output Method	
Why is it important? Helps improve oxygen supply by increasing how effectively the heart can deliver oxygen and develops the peripheral vascular network.	**How does it work?** Stimulates eccentric cardiac hypertrophy through volume overload of cardiac fibers thus causing them to stretch. This leads to an increase in left ventricular cavity volume.
Exercises: Any low intensity, low pressure exercise such as jogging, biking, swimming, jumping rope, pad and bag work, etc. will work fine as long as heart rate is in correct range.	**Guidelines:** • Heart rate should be 130-150. • Each session should last 30-90 minutes • Increase volume over time. • Can be used 1-3 times per week in total.

What is zone 2 important?



Aerobic fitness and longevity

From: **Association of Cardiorespiratory Fitness With Long-term Mortality Among Adults Undergoing Exercise Treadmill Testing**



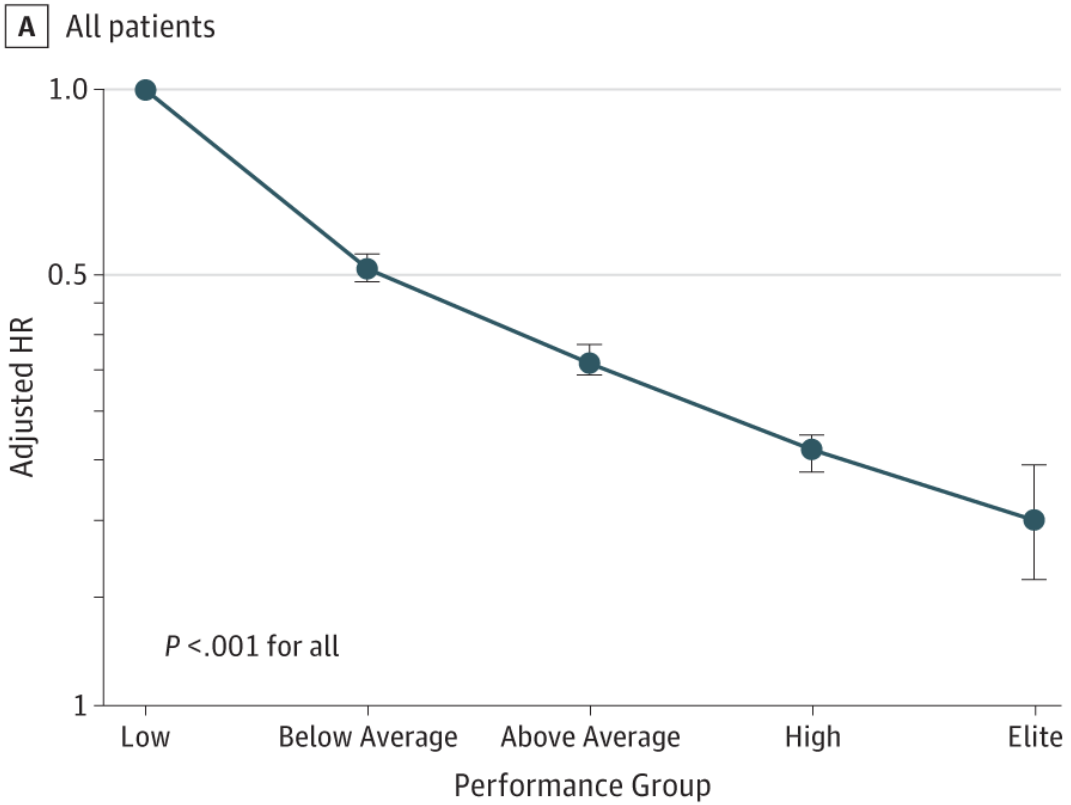
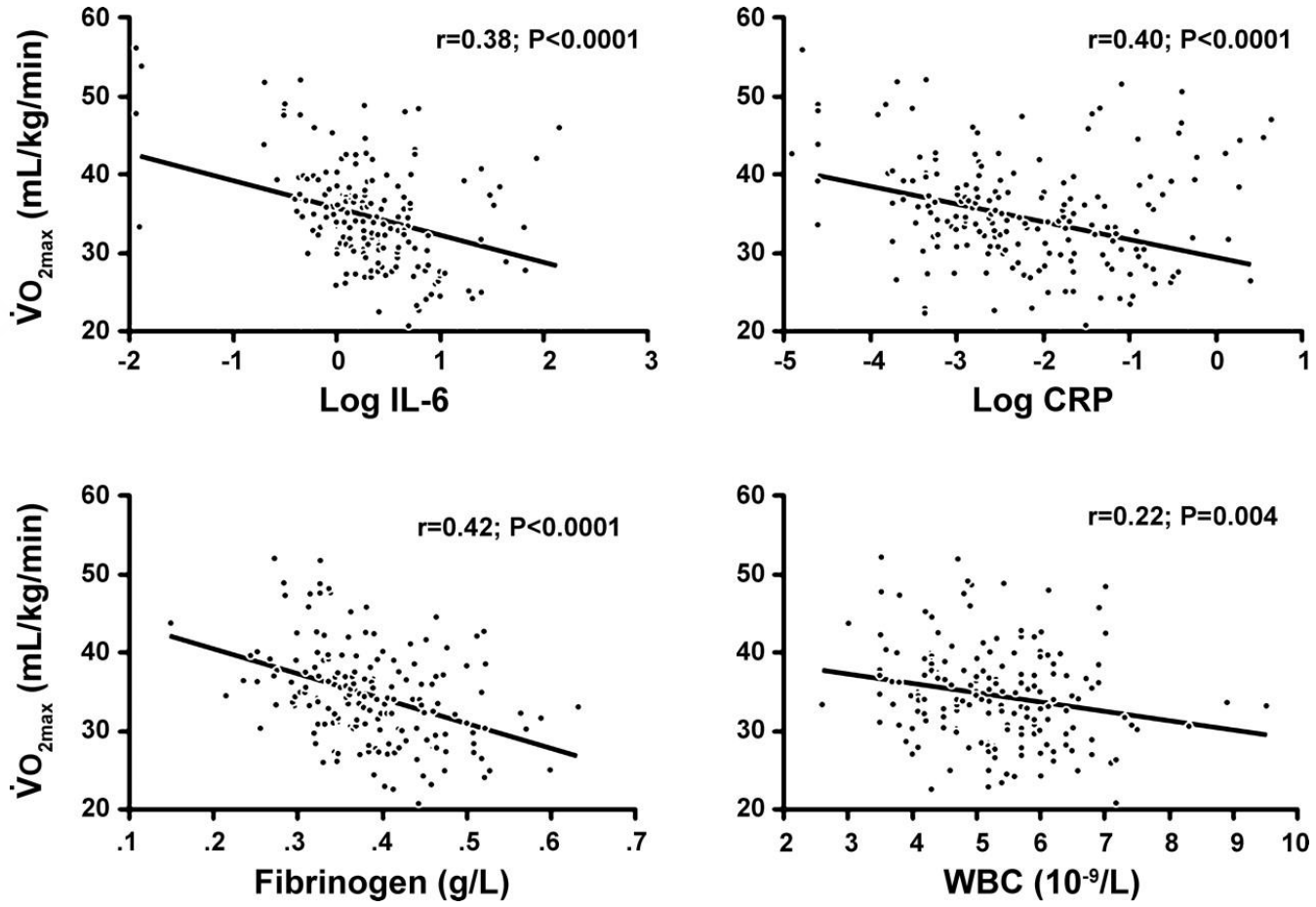


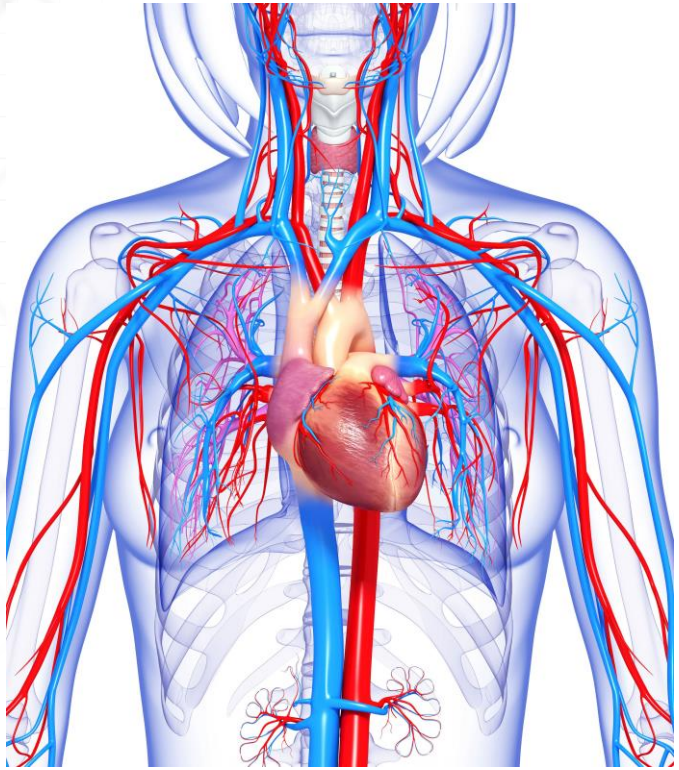
Figure Legend:

Patient Survival by Performance GroupLog-rank P < .001 for all groups, except elite vs high performers (log-rank P = .002). Performance group classifications by cardiorespiratory fitness are defined in Table 2.

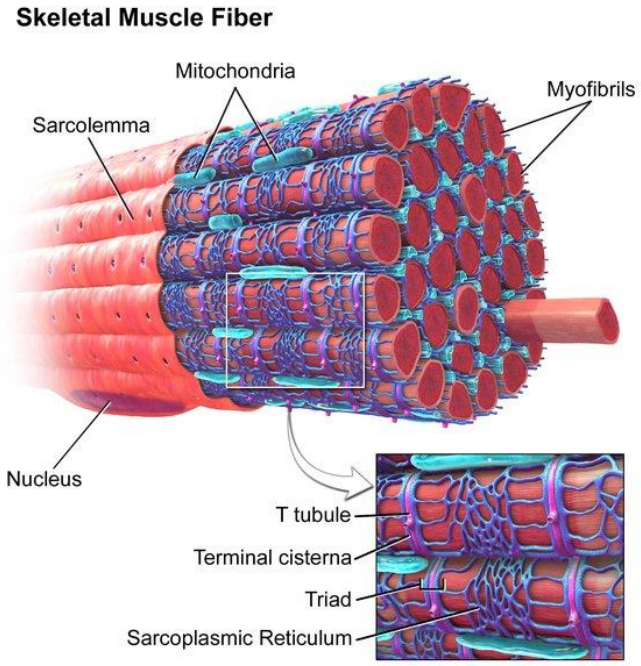
VO2 and inflammation



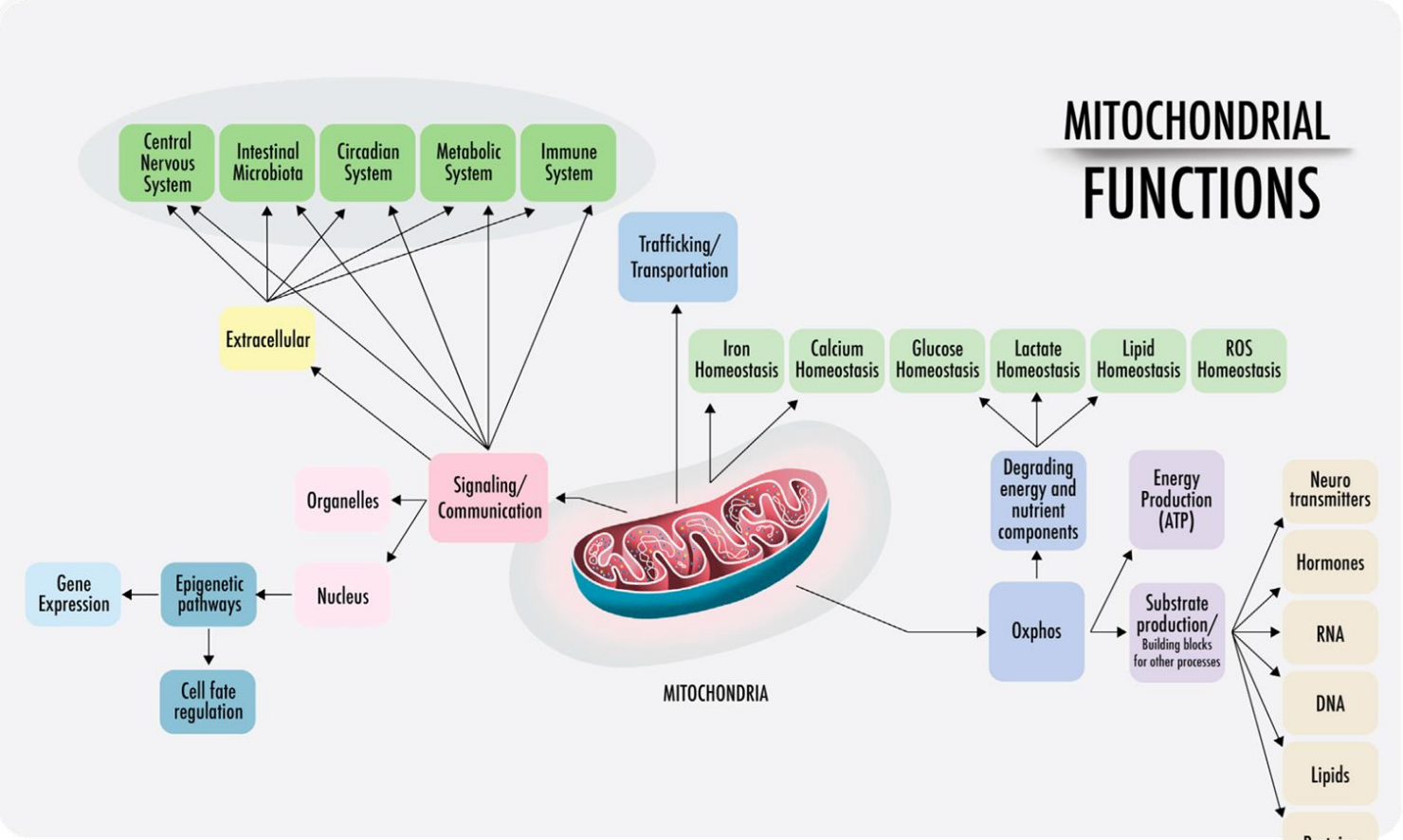
Components of the aerobic system



- **Oxygen Supply**
  - Cardiac Output
  - Peripheral Vascular Network
  - Respiratory System
- **Oxygen Utilization**
  - Number and size of slow twitch fibers
  - Oxidative abilities of fast twitch fibers
  - Aerobic enzymes



Mitochondria and metabolism



Mitochondria: It is all about energy

Amaloha Casanova[1,2,3,4], Anne Wevers[1,2,3,4], Santiago Navarro-Ledesma[1,2,3,4]* and Leo Pruimboom[3,4]

[1]Department of Physiotherapy, University of Granada, Granada, Spain, [2]Faculty of Health Sciences, Melilla, Spain, [3]PNI Europe, The Hague, Netherlands, [4]Chair of Clinical Psychoneuroimmunology, University of Granada and PNI Europe, Granada, Spain

Mitochondria and health

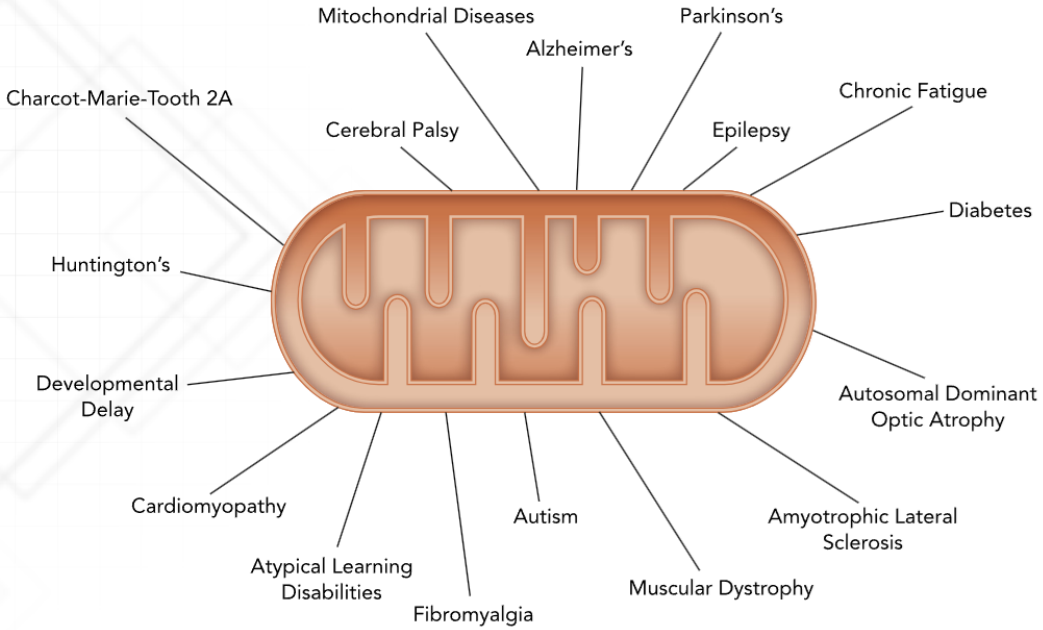
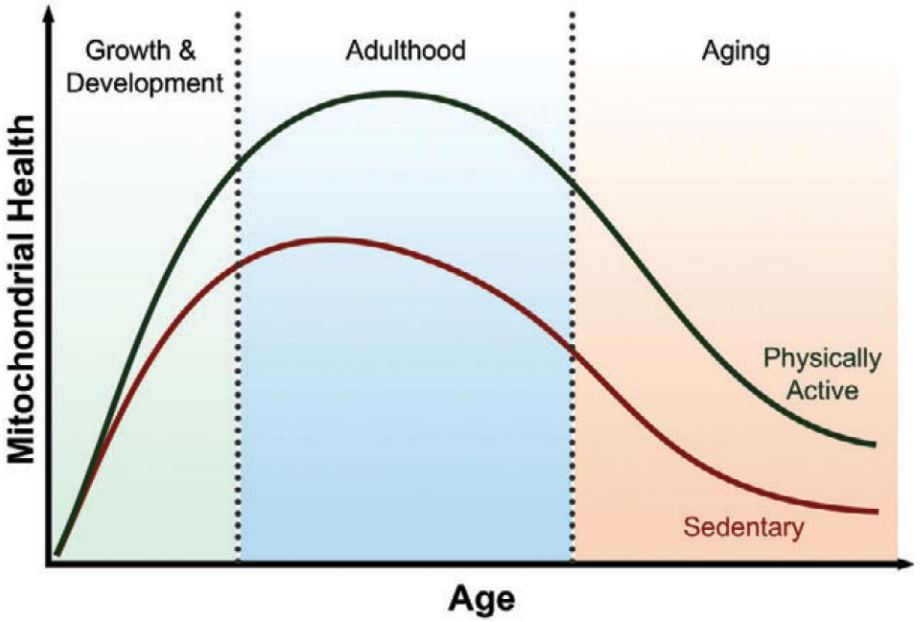


FIGURE 2. **Summary of diseases or conditions that have been linked to sub-optimal mitochondrial characteristics**



SYMPOSIUM REVIEW

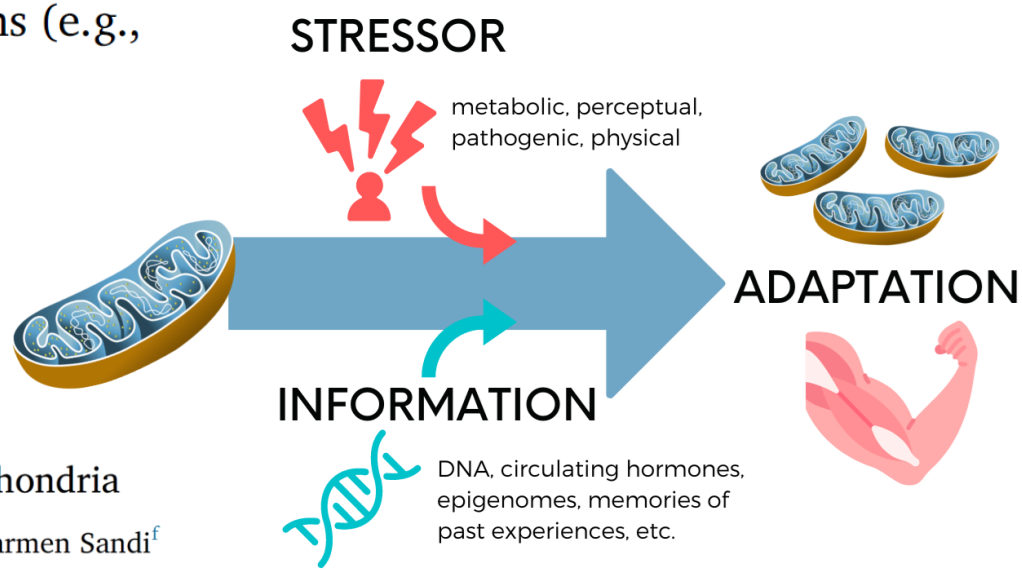
Exercise and mitochondrial health

Jonathan M. Memme[1,2], Avigail T. Erlich[1,2], Geetika Phukan[1,2] and David A. Hood[1,2]

[1]*Muscle Health Research Centre, York University, Toronto, Ontario, Canada, M3J 1P3*
[2]*School of Kinesiology and Health Science, York University, Toronto, Ontario, Canada, M3J 1P3*

Mitochondria and adaptation

Mitochondria, which have so far been described as the major source of cellular energy, are also the site of synthesis for all steroid hormones (Bose et al., 2002). This includes progestogens (e.g., progesterone), mineralocorticoids (e.g., aldosterone), glucocorticoids (e.g., cortisol and corticosterone), androgens (e.g., testosterone), and estrogens (e.g., estriol) (reviewed in (Midzak and Papadopoulos, 2016).



Review article

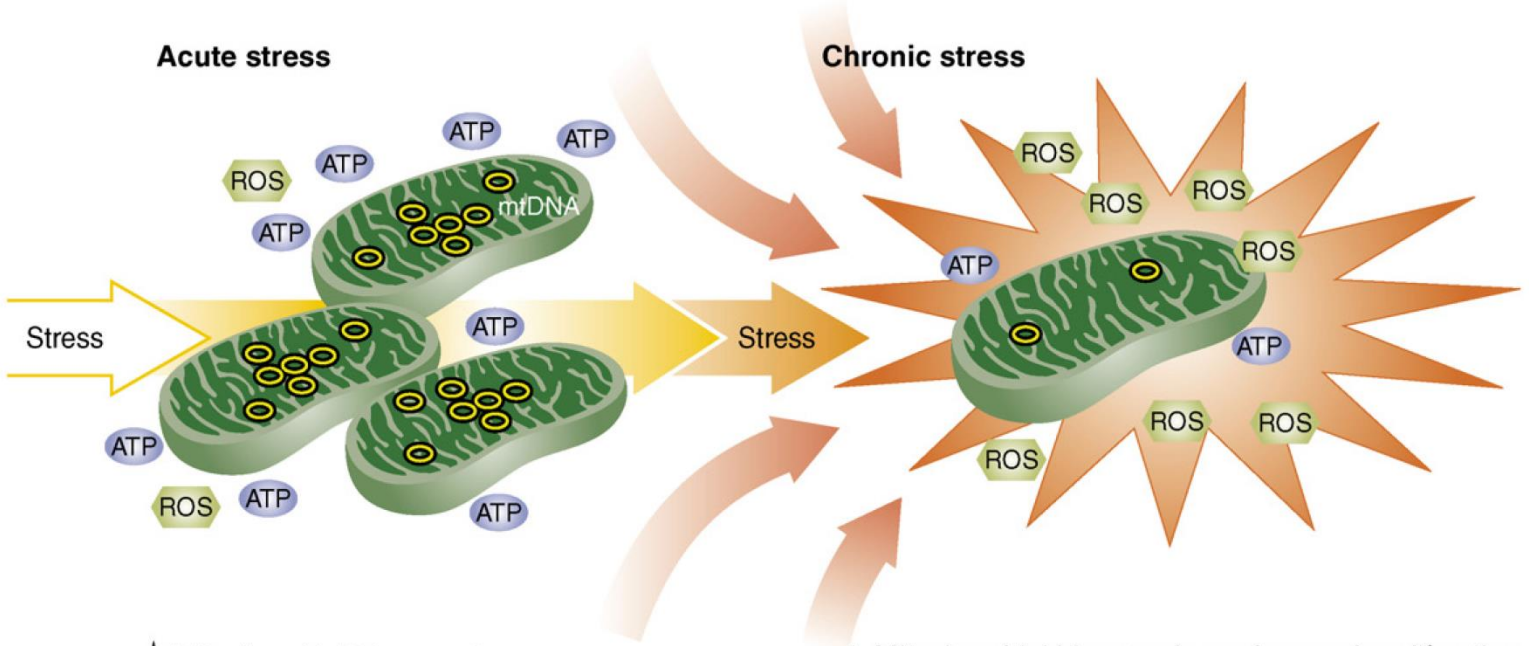
An energetic view of stress: Focus on mitochondria

Martin Picard[a,b,c,*], Bruce S McEwen[d], Elissa S Epel[e], Carmen Sandi[f]

Acute vs. chronic stress

Mitochondria as key components of the stress response

Irini Manoli[1,2], Salvatore Alesci[3], Marc R. Blackman[4], Yan A. Su[5], Owen M. Rennert[6] and George P. Chrousos[2,7]

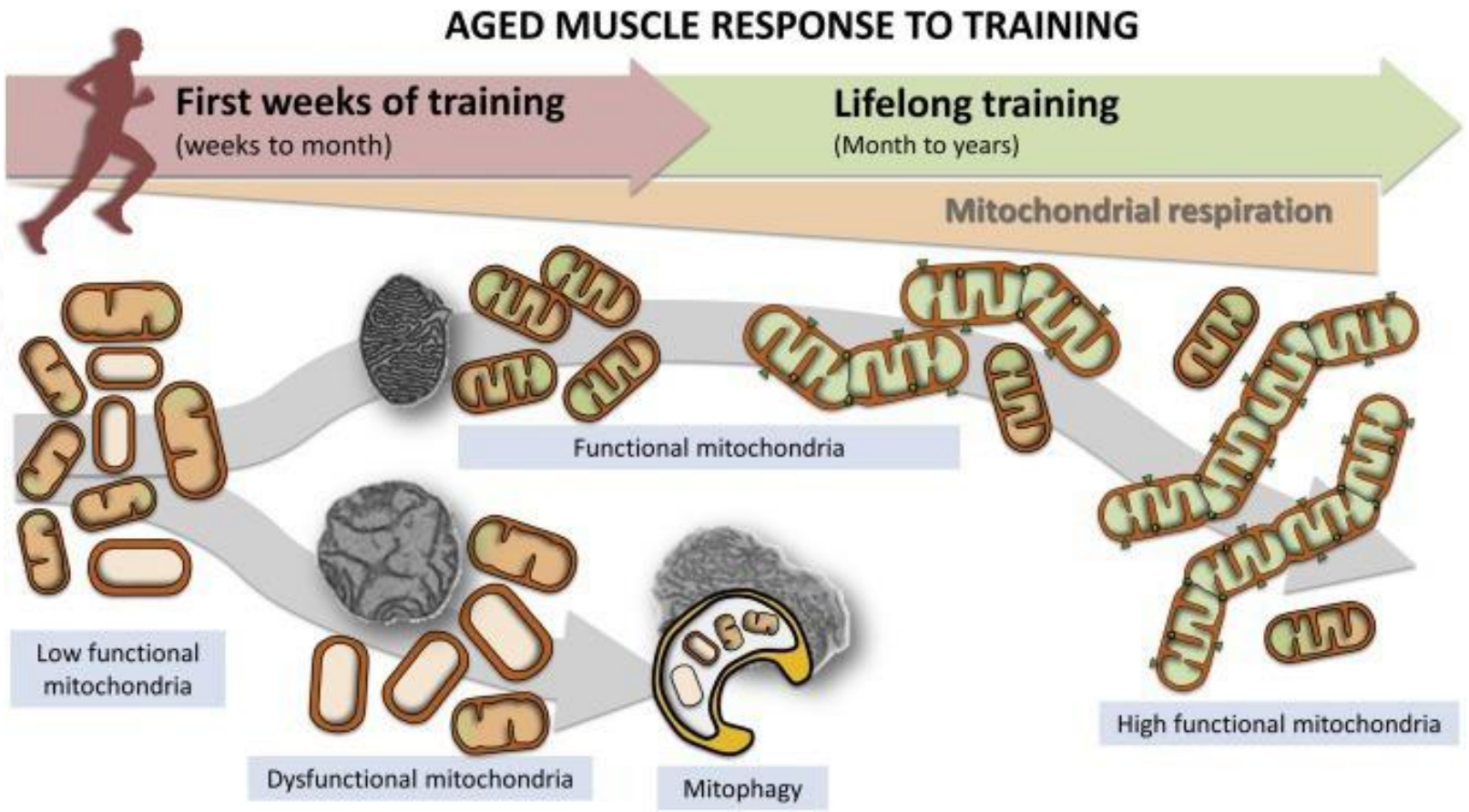


↑ Mitochondrial biogenesis
↑ mtDNA replication, transcription
↑ ATP production
Controlled ROS production
↑ Thermogenesis

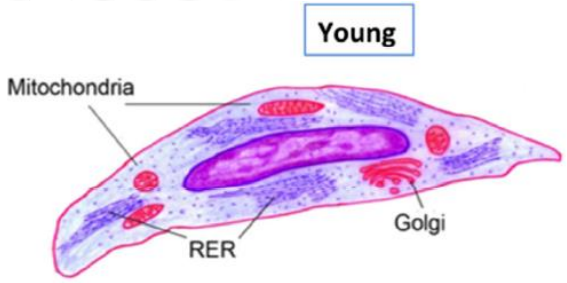
↓ Mitochondrial biogenesis or abnormal proliferation
↓ mtDNA replication, transcription
↓ ATP production
↑ ROS production
Mutagenesis, lipid peroxidation
Apoptosis or cell death

TRENDS in Endocrinology & Metabolism

Why exercise is the best medicine

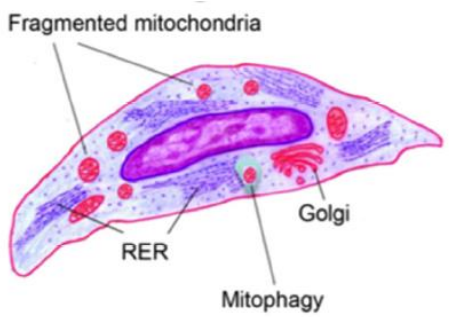


Why exercise is the best medicine

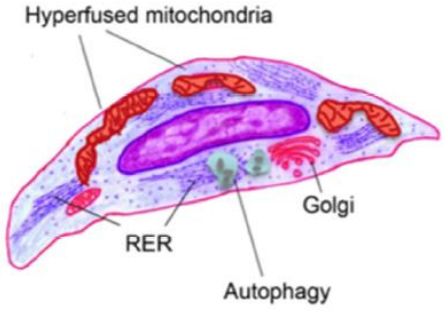


Increased mitochondrial fragmentation
Increased DRP1 expression levels
Increased mitophagy

Mild Increase in H_2O_2 production
Increased basal autophagy
Autophagic proneness
Block of mitochondrial fragmentation
Decreased mitophagy



Old



Increased mitochondrial mass
Maintenance of bioenergetic competence

Long living
(Centenarian)

www.impactaging.com AGING, April 2014, Vol. 6, No 4

Research Paper

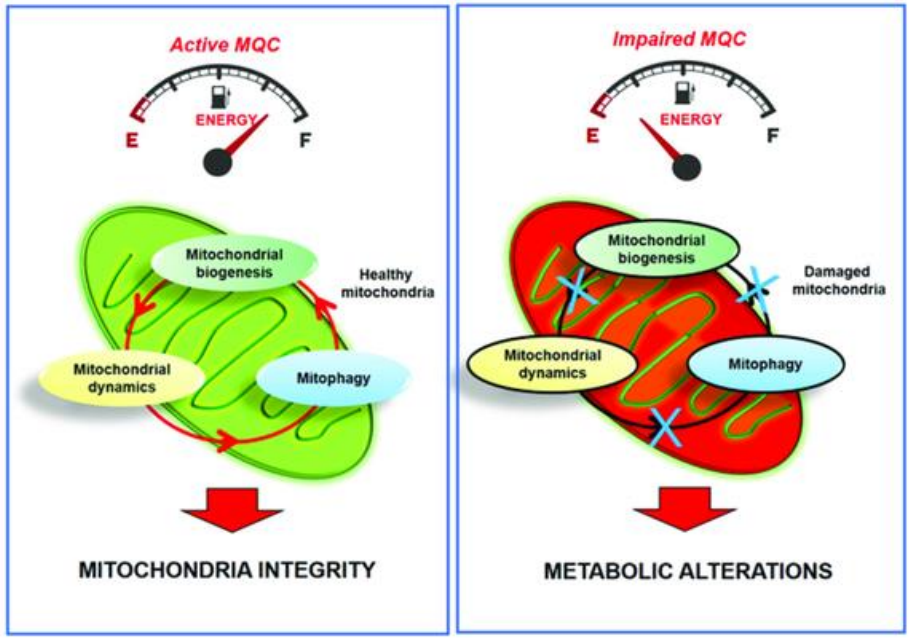
Mitochondria hyperfusion and elevated autophagic activity are key mechanisms for cellular bioenergetic preservation in centenarians

How training increases adaptability

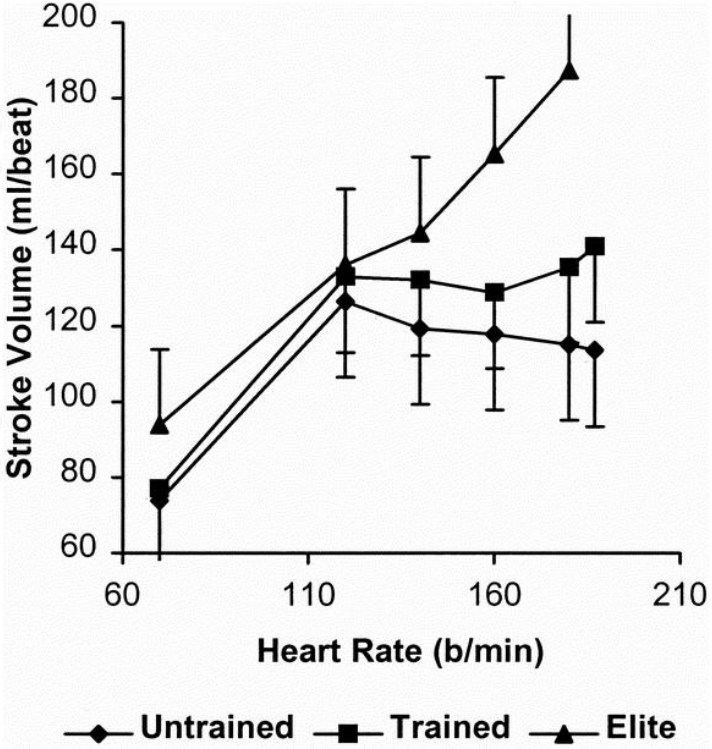
» Mitochondria are linked to almost every area of aging due to their central role as a mediator of the stress response

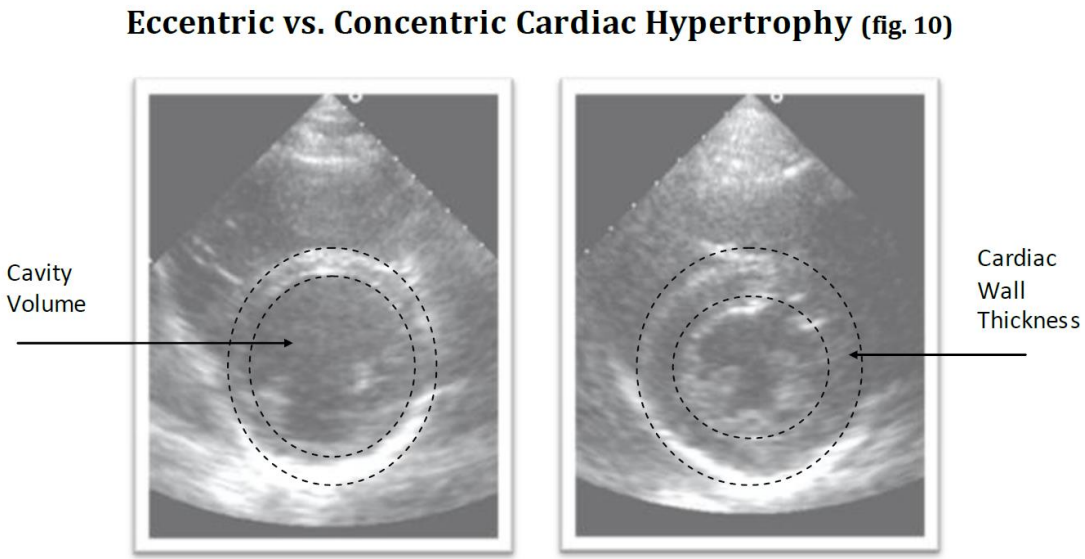
» Aerobic training improves both the number of mitochondria, as well as their function – upregulated MQQ and autophagy

» Aerobic training also leads to increases expression of "longevity genes" through NAMPT and other related proteins



Central adaptations





Zhou, Ben & Conlee, Robert & Jensen, Robert & Fellingham, Gilbert & George, James & Fisher, A.. (2001). Stroke volume does not plateau during graded exercise in elite male distance runners. Medicine and science in sports and exercise.

Summary

- Zone 2 cardio is a tool to improve the aerobic system through increases in both mitochondrial number and function, as well as central cardiovascular changes

- Functional changes in aerobic fitness drive a healthier metabolism that supports greater adaptability, reduced likelihood of disability and disease, and greater mobility with age

- Instead of thinking about zone 2 purely as a static heart rate range, it's more accurate to define it by the desired underlying physiological state

Practical Zone 2 programming

Programming questions

- How do you know if you're in zone 2?
- How much should you do, and how often?
- Does it matter what exercise(s) you use?
- How do I know if you're improving?
- Where does it fit into your programming?

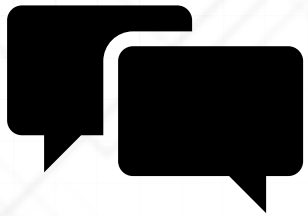
Zone 2 is a moving target

"The level of intensity at which power output is mainly generated by slow-twitch muscle fibers using fat as their primary fuel source. This intensity can be sustained for long durations without significant fatigue

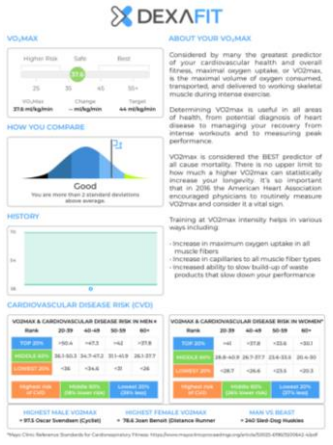
A wide range of variables acutely impact the metabolic cost of power output

- Fatigue/recovery/readiness
- Previous training
- Dietary composition
- Pre-workout nutrition / stimulants
- Temperature
- Mental stress
- Sleep

How to find your zone 2

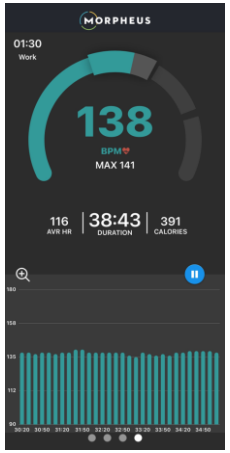


Talk test



VO2 max test

Lactate

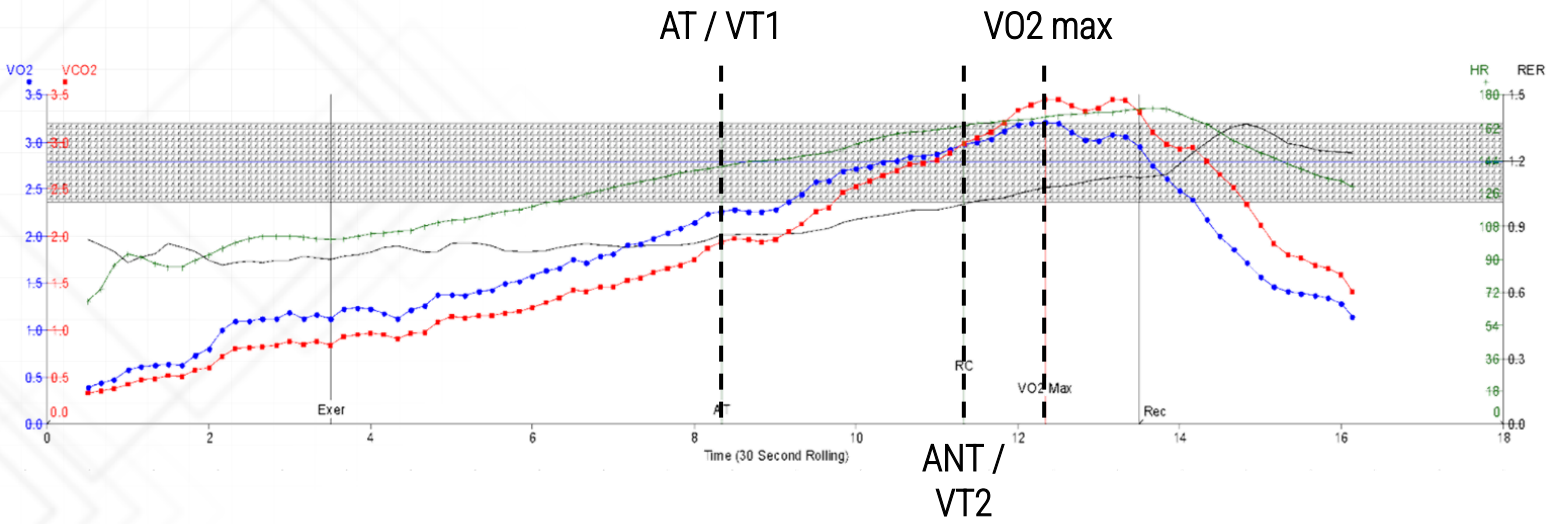


Morpheus

The talk test

- Maintain a pace where you would be able to carry on a conversation without having to constantly pause to catch your breath
  - Easiest method and generally corresponds well to zone 2 range
  - Can/should be used even if other testing methods are

Metabolic testing



DEXAFIT

HEART RATE ZONES

LOW **Benefits:** Improves overall health and helps recovery.	105-126 BEATS/MIN	495-594 KCALS/HOUR		In this zone your body is using completely aerobic energy systems. Your heart and lungs easily provide the needed oxygen for your activity.
VT 1	141 BEATS/MIN	47% FAT	53% CARBS	Ventilatory Threshold 1 (VT1) is when your breathing increases and lactate begins to accumulate in your blood.
MODERATE **Benefits:** Improves aerobic fitness.	126-146 BEATS/MIN	594-811 KCALS/HOUR		As intensity increases, your heart and lungs are challenged to meet oxygen demands. You can maintain this level for a long time before fatigue.
HIGH **Benefits:** Increases maximum performance.	146-151 BEATS/MIN	811-890 KCALS/HOUR		Your body is heavily relying on anaerobic energy. You'll rapidly build an oxygen debt and not be able to maintain this level of exertion for long periods of time.
VT 2	163 BEATS/MIN	0% FAT	100... CARBS	Ventilatory Threshold 2 (VT2) is when lactate quickly accumulates in your blood and you need to breathe heavily.
PEAK **Benefits:** Improves overall health and helps recovery.	151-176 BEATS/MIN	890-1038 KCALS/HOUR		This is your highest intensity level based on your peak heart rate measured during the test. Effort in this zone will be of very short duration. For example, a sprint.

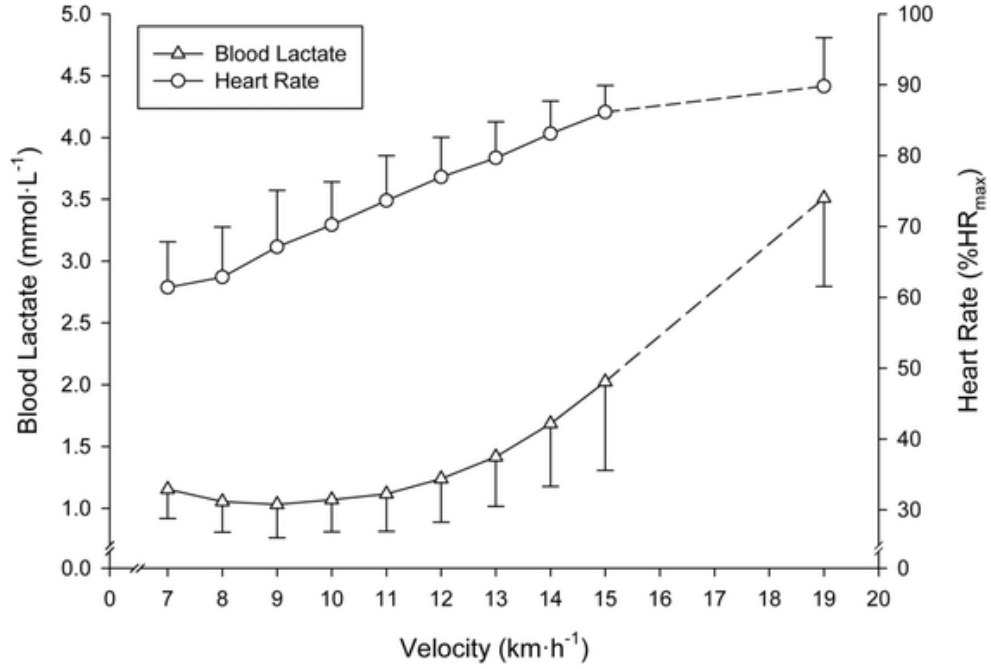
WEEKS OUT

Lactate testing

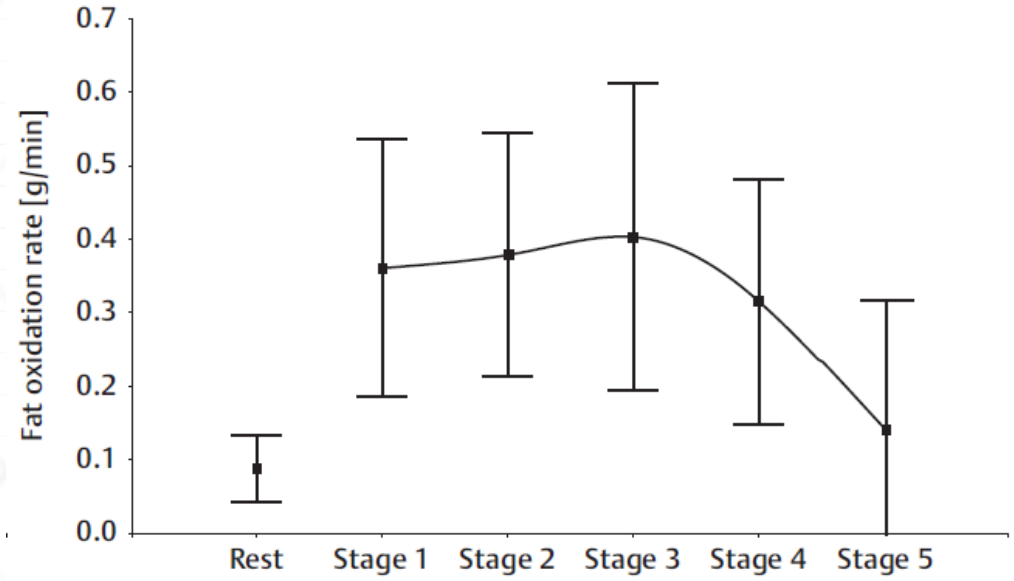
Incremental work stages while measuring blood lactate, typically through finger or ear

» Provides overview of increase in carbohydrate utilization as intensity increases

» Specific to exercise being tested



Testing vs. training

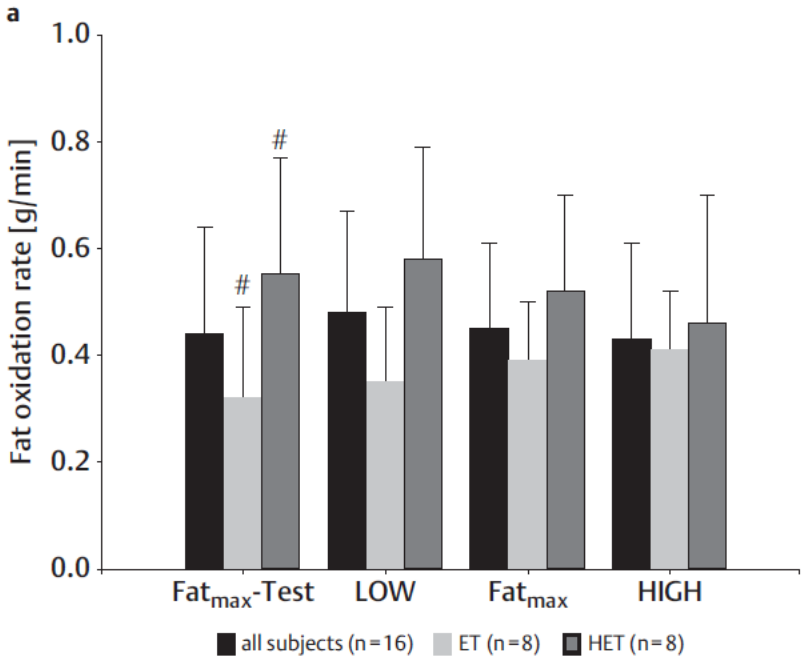


Limited benefit of Fatmax-test to derive training prescriptions

S Schwindling [1], F Scharhag-Rosenberger [2], W Kindermann [1], T Meyer [1]

Affiliations + expand

PMID: 24022578 DOI: 10.1055/s-0033-1349106



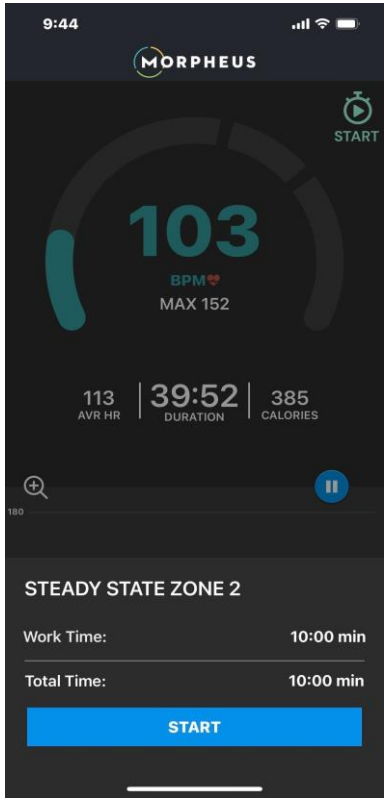
In conclusion, the fat oxidation rate of endurance trained cyclists shows no difference between 1-h constant load exercise bouts at about 50–70 % VO 2max

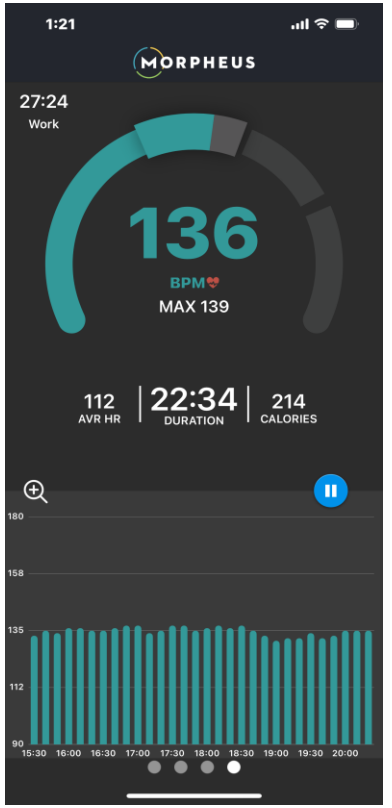
Morpheus

Three dynamic heart rate zones, low/mod/high, that shift daily based on HRV, recovery, previous training, fitness level, etc.

» Zones baselines based on estimated/predicted AT & ANT based on fitness level

» 12 built-in training methods, including Zone 2, that can be selected during workouts





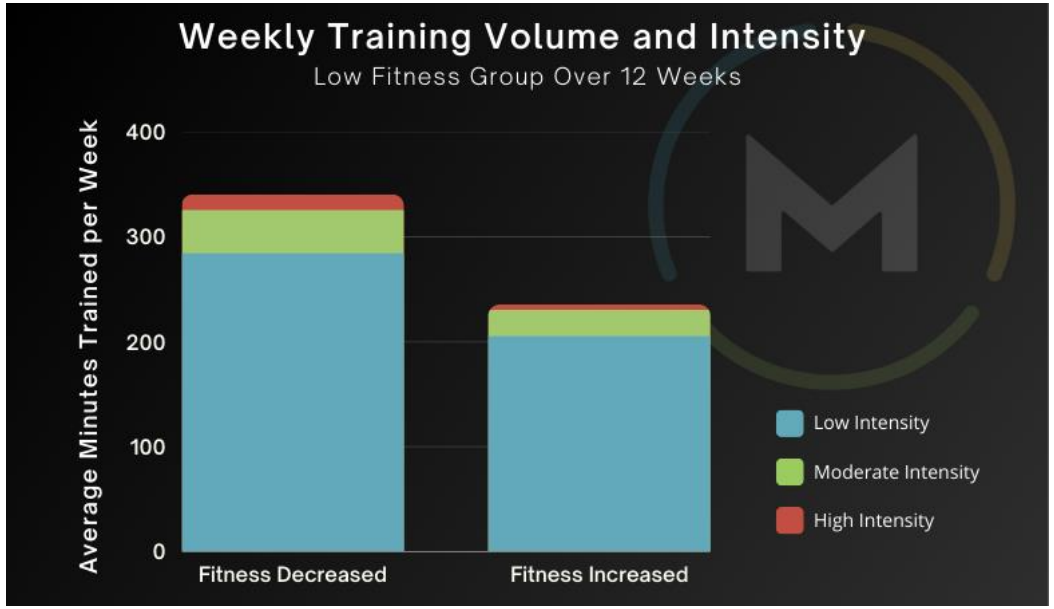
Zone 2 volume

» Weekly volume depends on fitness level, goal, practical limitations, etc.

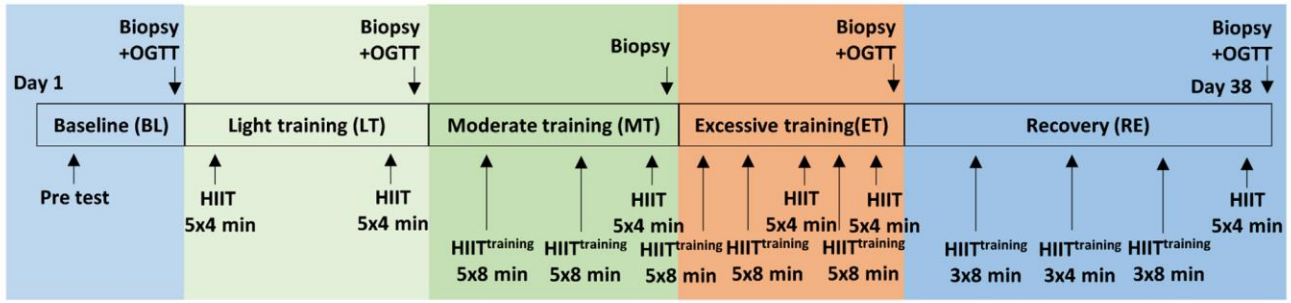
» Morpheus data showed people that improved aerobic fitness over 12 weeks averaged:

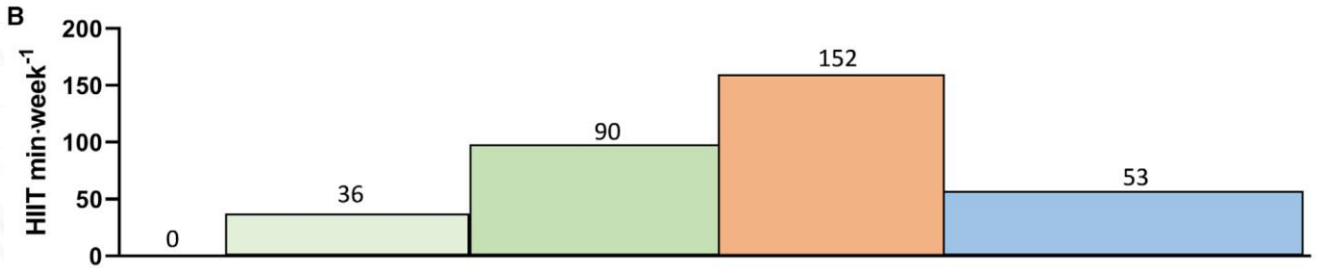
- Low 200-300 min
- Mod 40-50 min
- High 11-14 min

» More is NOT better if you can't recover from it

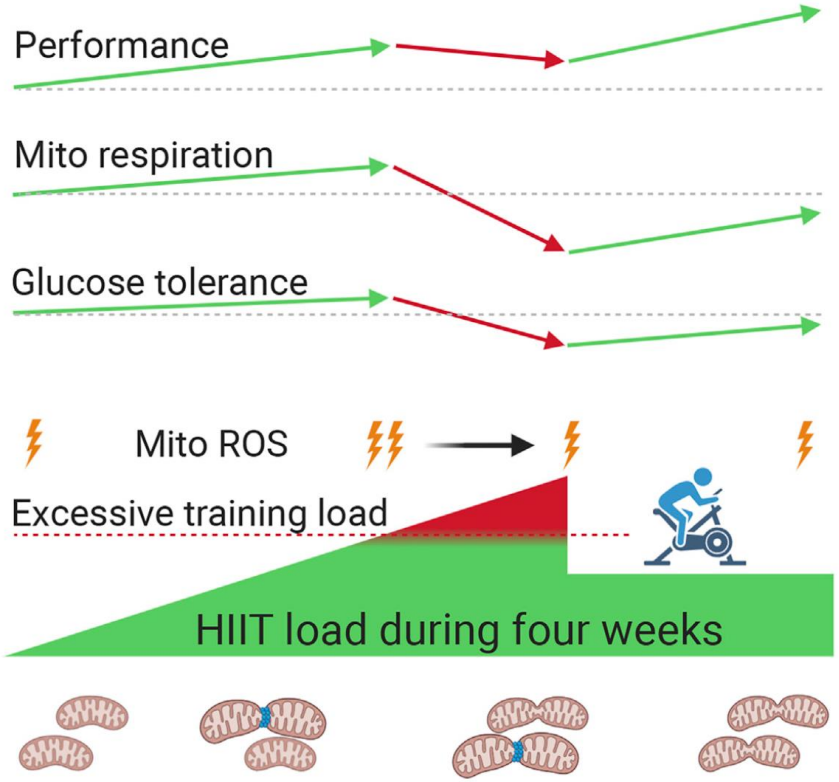


Why more is not better





Excessive exercise training causes mitochondrial functional impairment and decreases glucose tolerance in healthy volunteers



WEEKS OUT

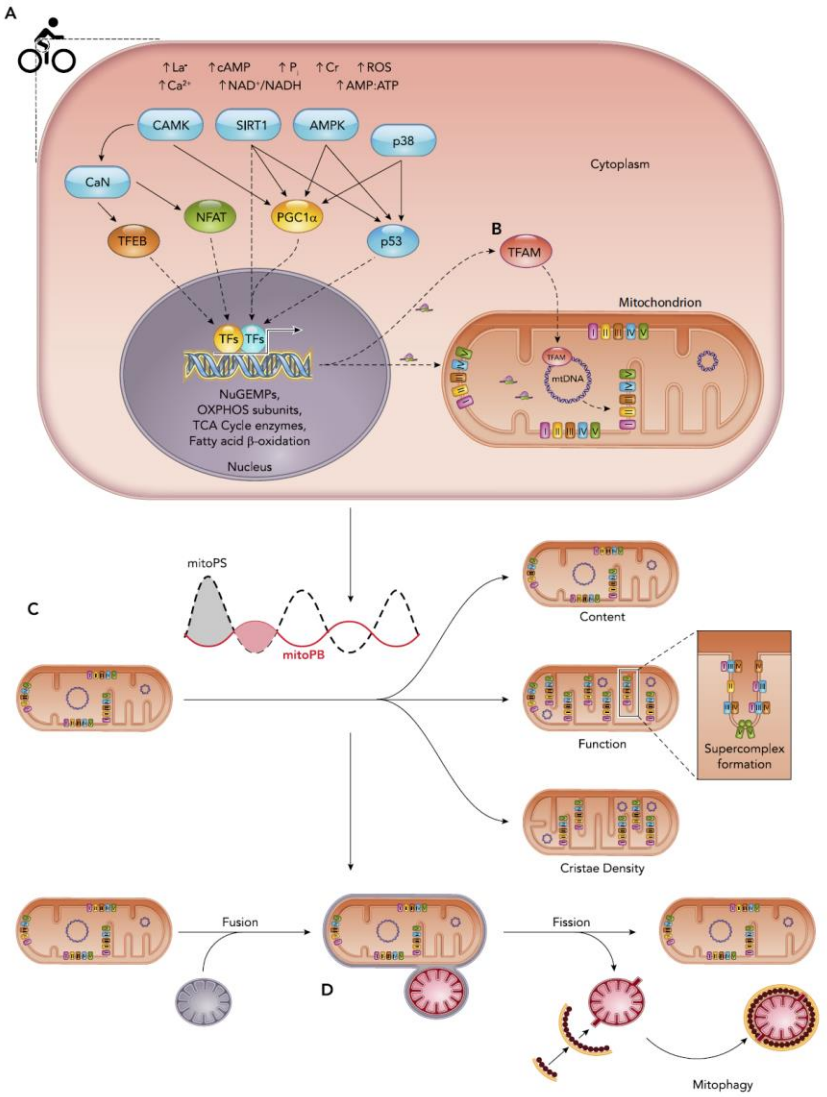
Duration and frequency

» Duration (how long each workout) and frequency (how many times per week), are both hugely important

» Greater duration provides stronger stimulus to improve metabolic *efficiency*

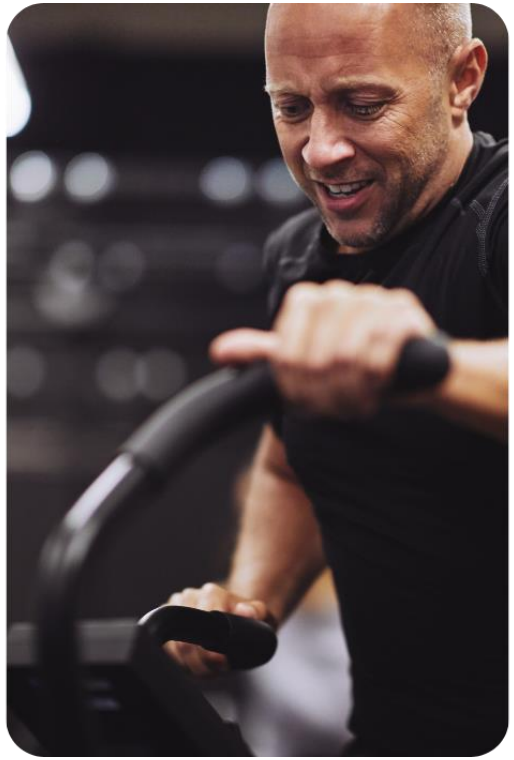
- 30 min – 90 min per workout
- Should be as continuous as possible

» Aerobic system generally requires *minimum* of 3x week to improve. 4-6 total weekly bouts of aerobic work is better



Zone 2 exercises

- Exercise selection dictates which muscle fibers and movement patterns get developed through training
- Cyclic exercises such as running, cycling, rowing, swimming, etc., are the easiest for controlling pace and power output
- Sport-specific exercises and movements can be used effectively – shadow boxing for boxing/combat sports
- For general health, variety of exercises is valuable, and circuits can be used



Zone 2 vs. strength training

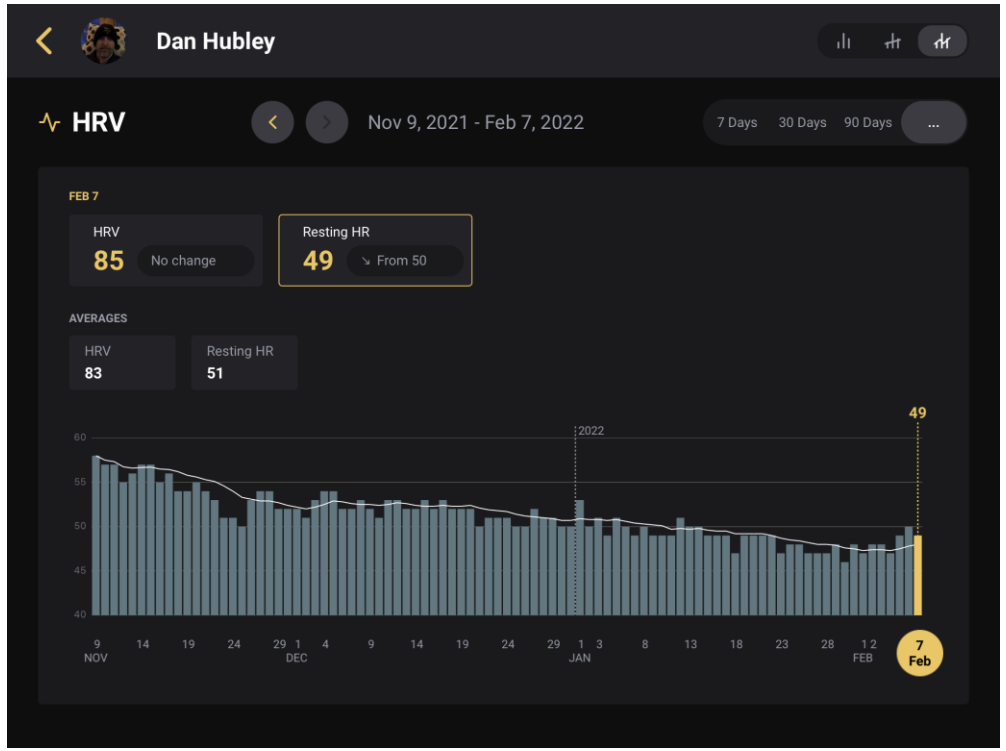
- Primarily slow twitch fibers
- Predominantly oxidative
- Majority of fuel from fat
- Low to moderate blood pressure
- Continuous moderate power output

- Fast and slow twitch fibers
- Predominantly glycolytic
- Fuel from glucose and stored ATP/PC
- High blood pressure
- Intermittent high level of power output

Zone 2 improvements

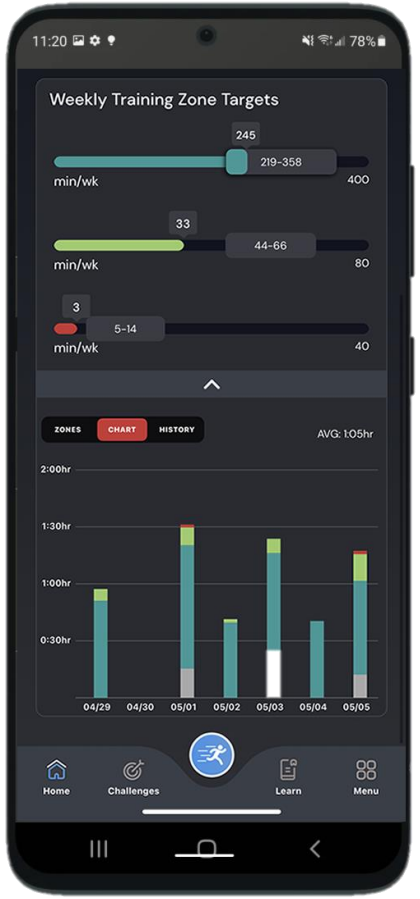
Increased aerobic fitness can be seen in a variety of testing and in-workout metrics:

- Lower average resting HR
- Higher average HRV
- Increased speed/power in zone 2
- Lower lactate levels at a given speed/power
- Higher VO2 max
- Faster heart rate recovery



Weekly programming principles

- The higher the volume of zone 2 you do, the more effective it becomes to do it as its own workout
- If mixed with strength training in a workout in moderate volumes, it can be done before or after
- Roughly 80% of your total aerobic training should be lower intensity methods, 20% moderate to high

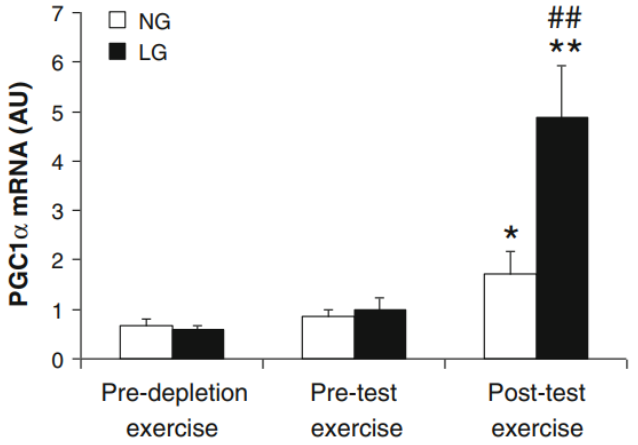


Tips and tricks

» Fasted and/or glycogen depleted zone 2 may have additional impact on stimulating mitochondrial function

» Deliberately varying power output/HR within zone 2 can help improve pacing and energy control

» Most effective supplements I've found to increase mitochondrial function: L-carnitine (injectable) & MOTS-C – requires healthcare practitioner



Exercise with low glycogen increases PGC-1α gene expression in human skeletal muscle

Niklas Psilander · Per Frank · Mikael Flockhart · Kent Sahlin

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