Welcome To Today’s Webinar

Overtraining from a Functional Health Perspective

Presented by
Ian Craig

About today’s webinar

Today’s webinar is being produced jointly by the British Association of Sport and Exercise Sciences (BASES) and Human Kinetics.

It is scheduled to last for about an hour and will be recorded and made available for download and playback. You will receive an email containing a link to the recording when it is available.

All microphones and phone lines are muted so we ask that you submit questions by typing them into the question box located in the lower right corner of your screen and click “send.”

We’ll collect any questions sent throughout the presentation for Ian and he will answer as many as possible during the Q&A segment at the end.

Join the conversation through Twitter #OvertrainingWebinar

@ian_tNI @HumanKineticsEU @BASESUK

About today’s presenter

Ian Craig is an exercise physiologist, nutritional therapist, NLP practitioner and an endurance coach.

He was a competitive middle-distance runner for 20 years and is now a more leisurely runner and cyclist.

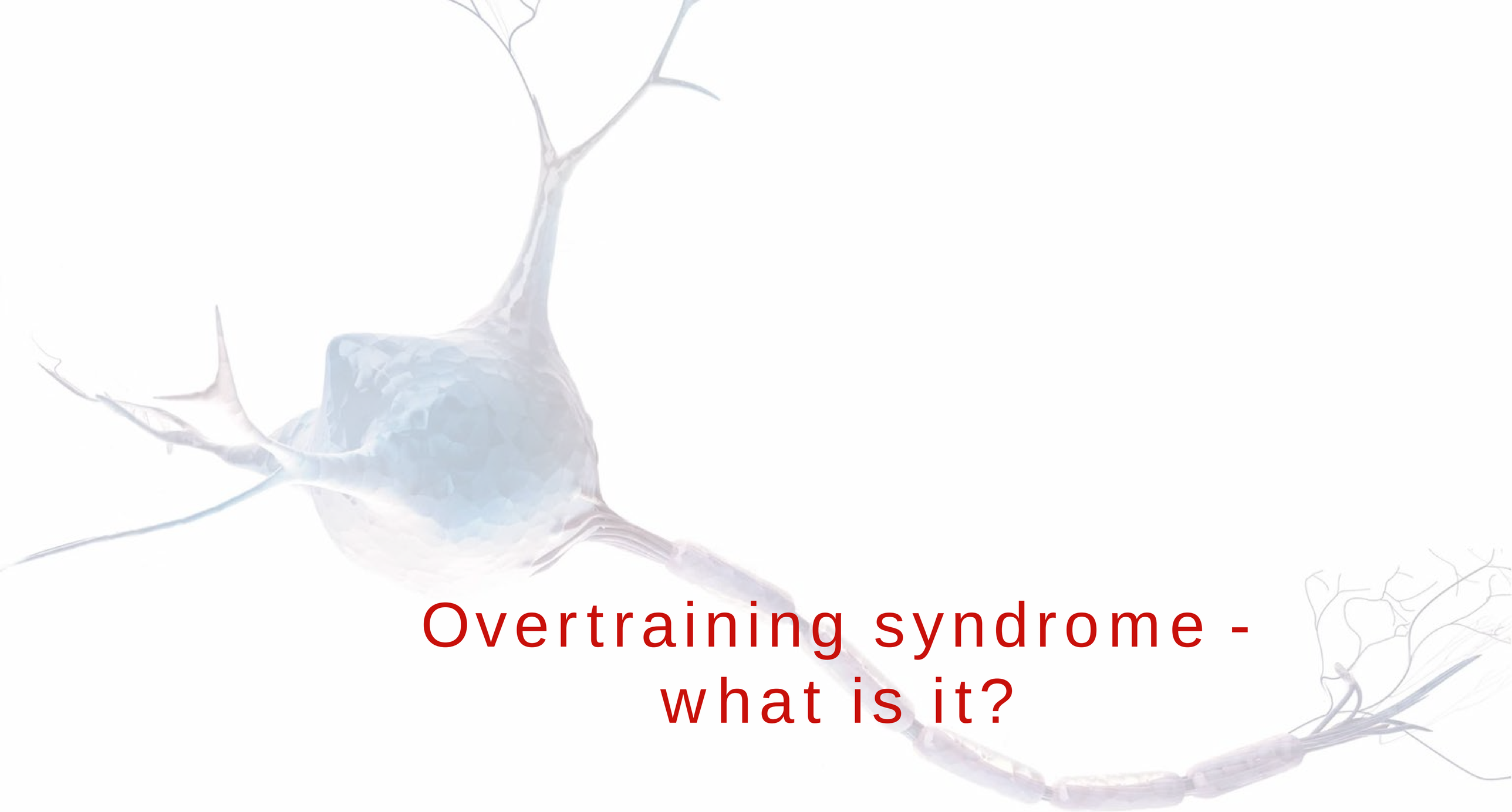
Ian specialises in Functional and Integrative Sports Nutrition, a fast-evolving discipline that considers both health and performance of an athlete from an integrative health perspective.

He is the editor of *Functional Sports Nutrition* magazine and is conference leader of Sports Nutrition Live. Additionally, Ian runs a private nutritional therapy practice in Johannesburg, South Africa.

Overtraining from a Functional Health Perspective

Ian Craig


10 LB
10 LB

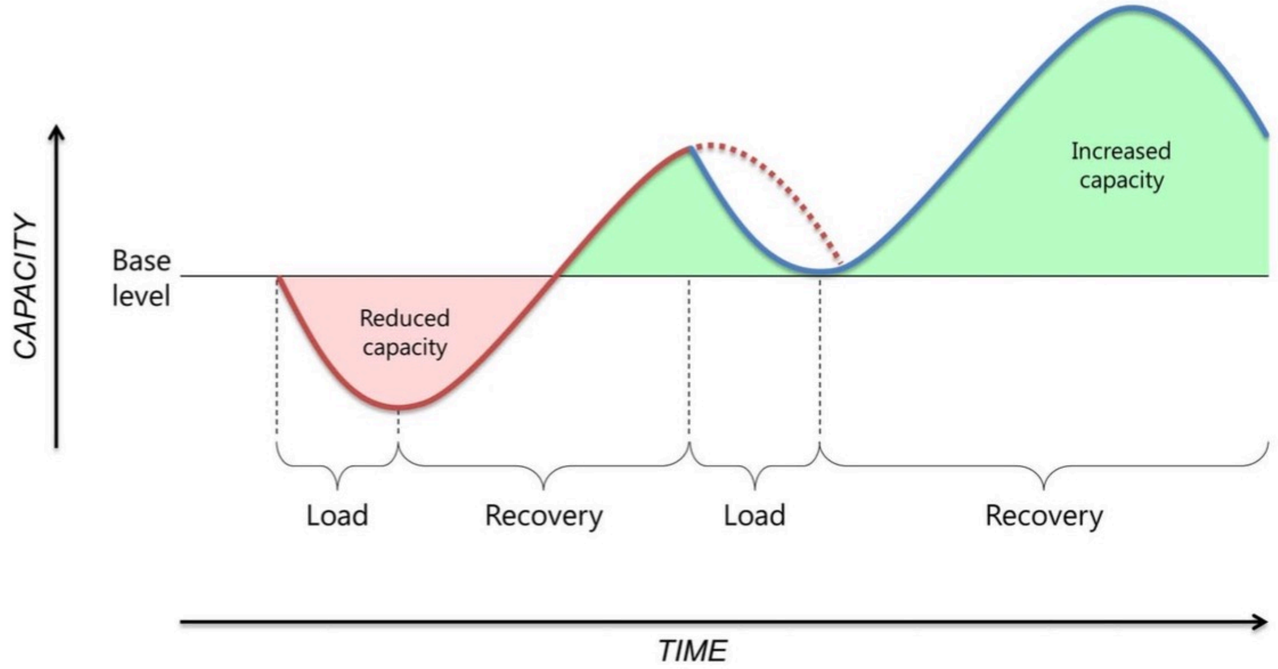


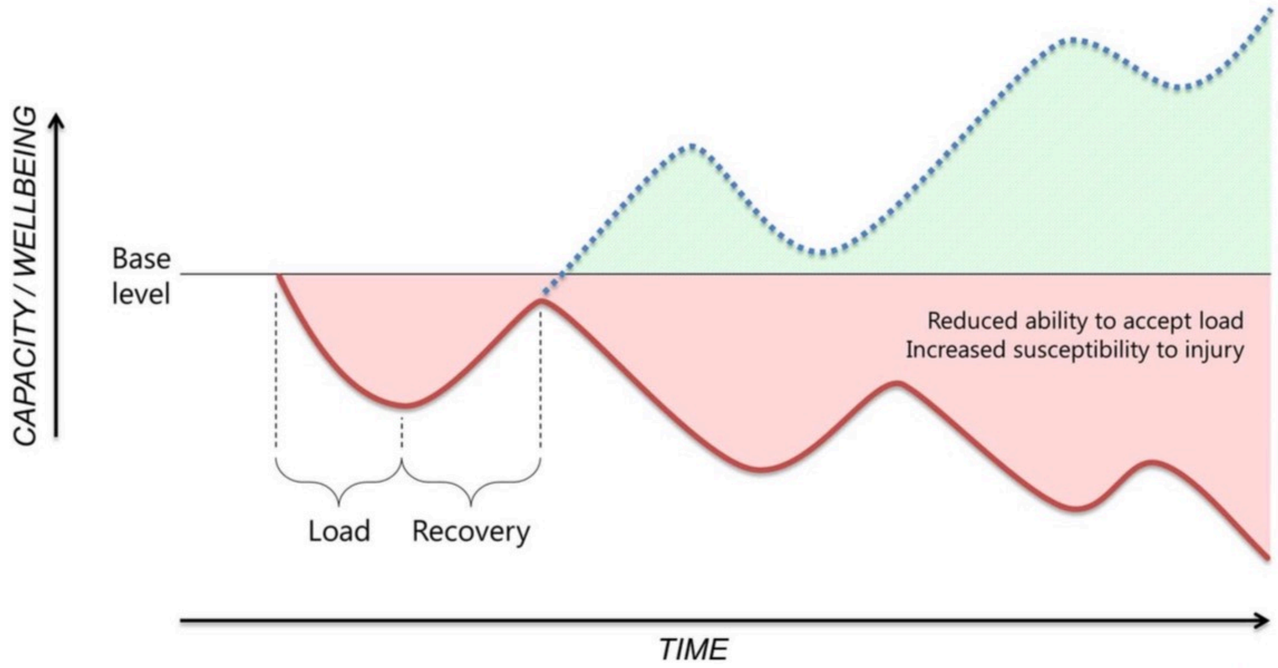
Overtraining syndrome - what is it?

What is Overtraining?

- If an athlete is overstressed, physically or psychologically for a long time, adaptation starts to fail, leading to the signs of overtraining, which may be a protective mechanism against continued stress
- It occurs in highly motivated athletes, especially those who are training and racing frequently **without adequate rest** – travel, heat extremes, altitude and unfamiliar surrounding can compound the situation, along with unrealistic goals and high expectations of the coach

O’Brien (1988); Kuipers (2000)





Soligard et al (2016) - adapted from Meeusen (2013)

Overreaching vs. Overtraining

Condition	Definition	Performance Decrement
Functional overreaching	Increased training leading to a temporary performance decrement	Days to weeks
Nonfunctional overreaching	Intense training leading to a longer performance decrement (weeks to months) but with full recovery after rest.	Weeks to months
Overtraining syndrome	Consistent with extreme nonfunctional OR but with >2 month performance decrements, more severe symptamology and maladapted physiology	Months

Kreher (2016); ACSM (2012)

My elite triathlete

- 1st 2 mins of training - hypoxic
- Sugar cravings
- Regular bloating, cramps, diarrhoea
- Regular flus
- Allergic to chlorine, foods and pets
- Chronic Candidiasis
- Post-nasal drip
- Bad brain fog and anxiety
- Debilitating periods w/o contraceptive pill
- Energy 3 out of 10 on many days
- On a shopping bag full of supplements….

Sympathetic or Parasympathetic?

Overtrained athletes can be sympathetically (Sym) or parasympathetically (Para) driven

- The Sym form is more often seen in team sports and sprint events (anaerobic), whereas the Para form is more seen in endurance athletes (aerobic)
- The Sym form may be associated with the early stages of overtraining, whereas in advanced overtraining, the Sym nervous system is inhibited

Kuipers (2000); Kreher J (2016)

Signs and Symptoms

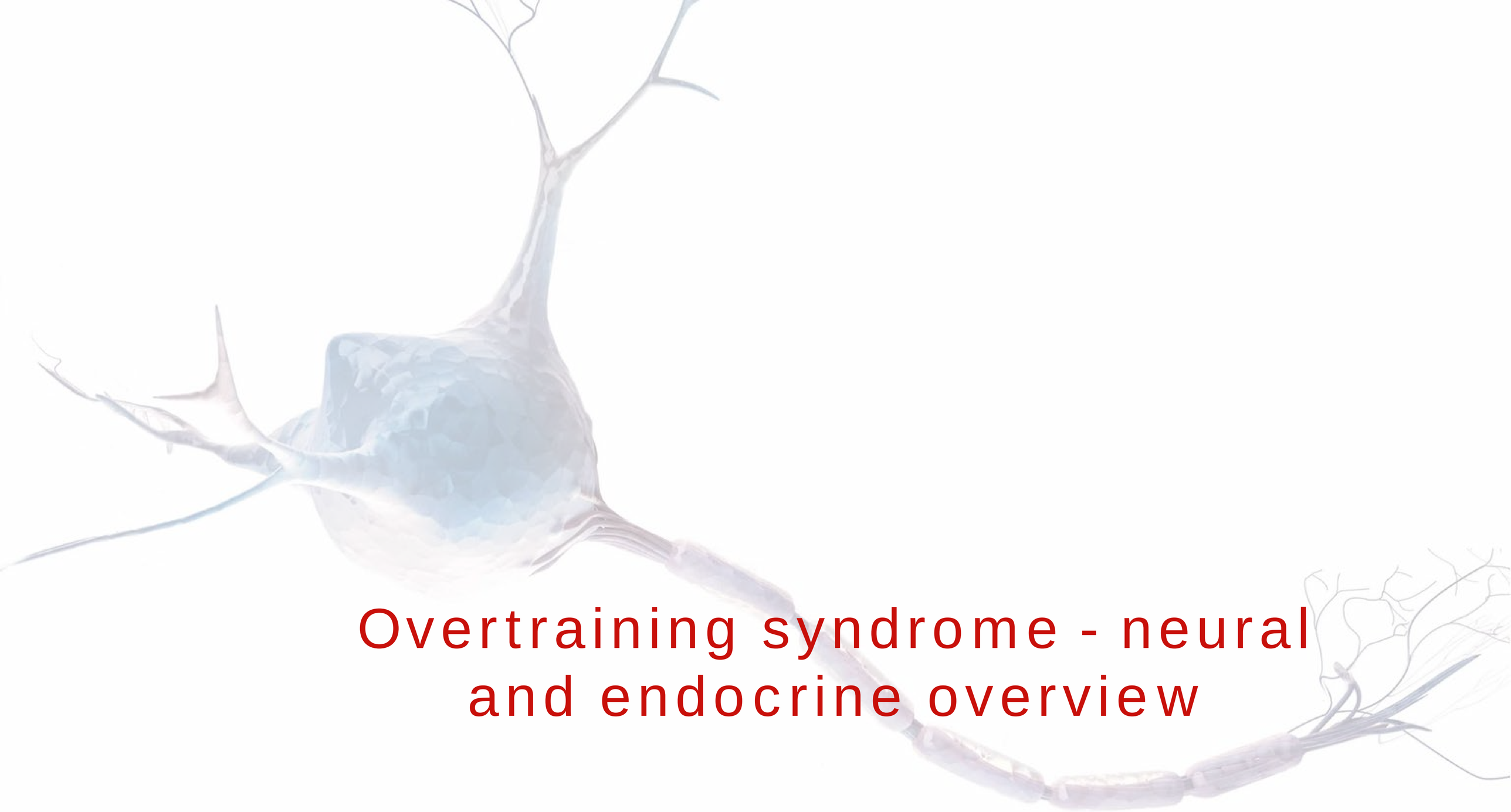
Sympathetic

- Increased resting & exercising HR & BP
- Slow HR recovery after exercise
- Irritability and mood swings
- Menstrual irregularities
- Sleep disruption

Parasympathetic

- Low or normal resting & exercising HR & BP
- Fast HR recovery after exercise
- Fatigue, depression
- Good appetite
- Hypoglycaemia during exercise
- Normal or deep sleep
- Loss of motivation

Kreher (2016); Carfagno & Hendrix (2014)



Overtraining syndrome - neural and endocrine overview

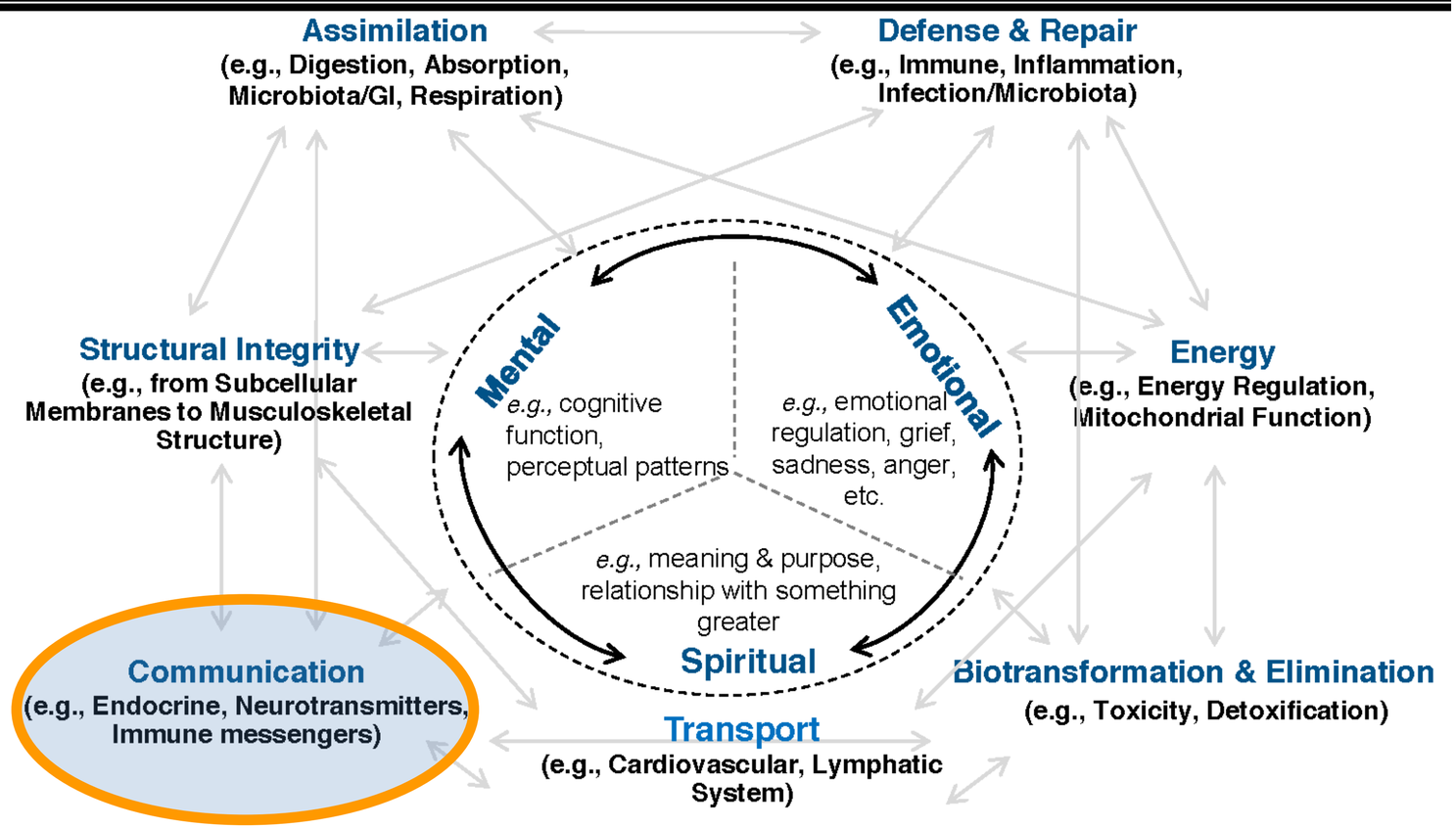
The Patient's Story Retold

Physiology and Function: Organizing the Patient's Clinical Imbalances

Antecedents
(Predisposing Factors-Genetic/Environmental)

Triggering Events
(Activators)

Mediators/Perpetuators
(Contributors)

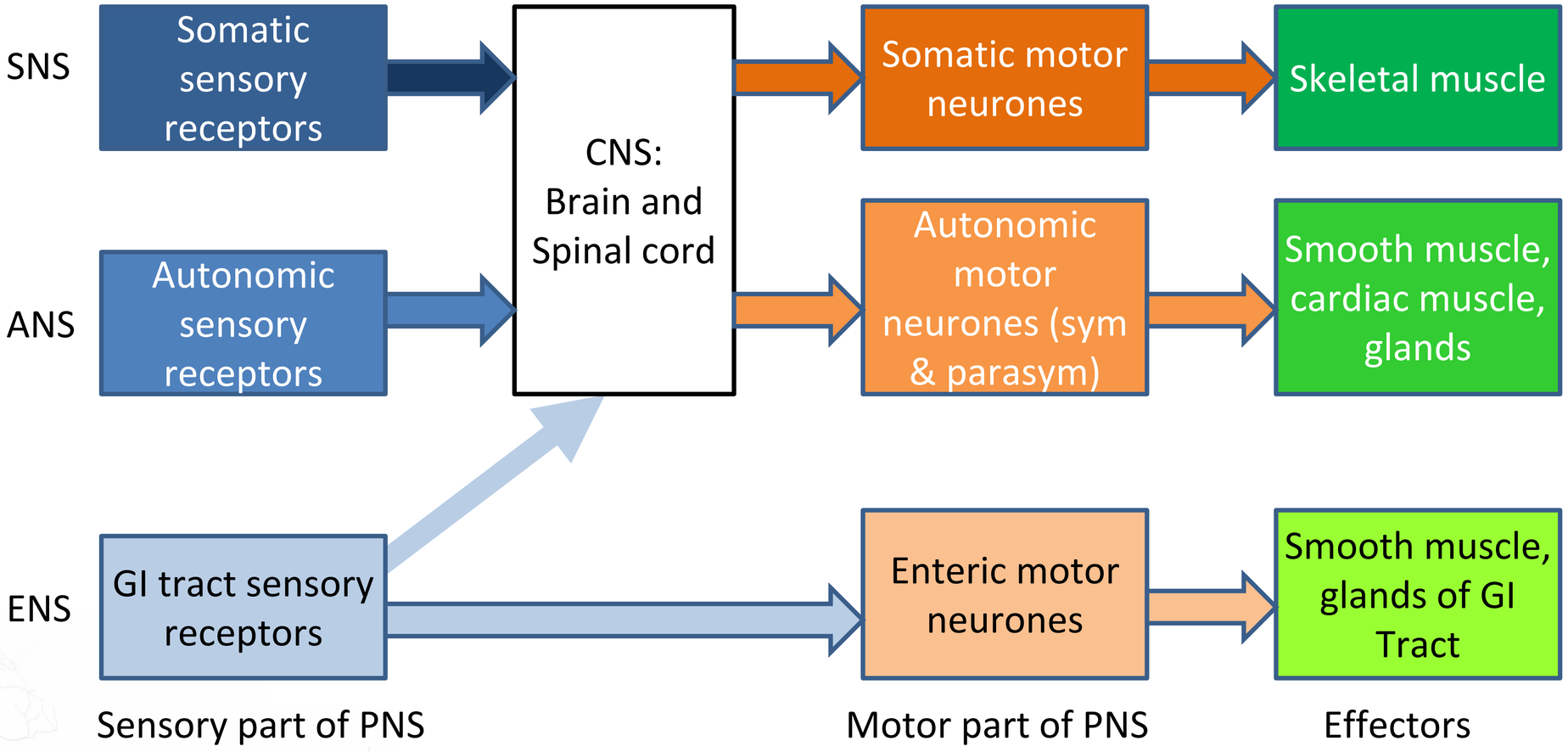


Fundamental Lifestyle Factors

Sleep & Relaxation	Exercise & Movement	Nutrition & Hydration	Stress & Resilience	Relationships & Networks

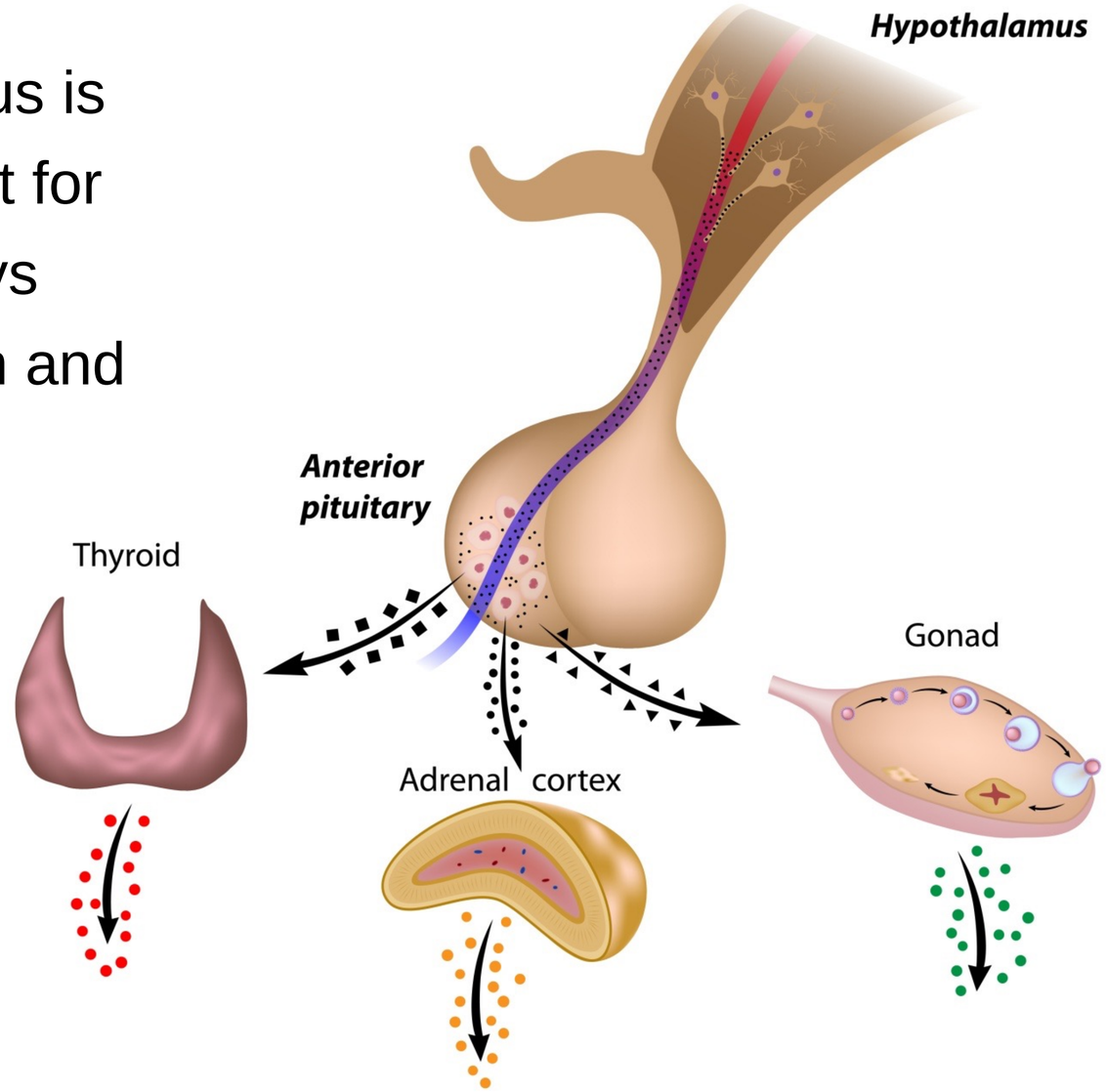
Name:_____ Date:_____ CC:_____

Organisation of the Nervous System



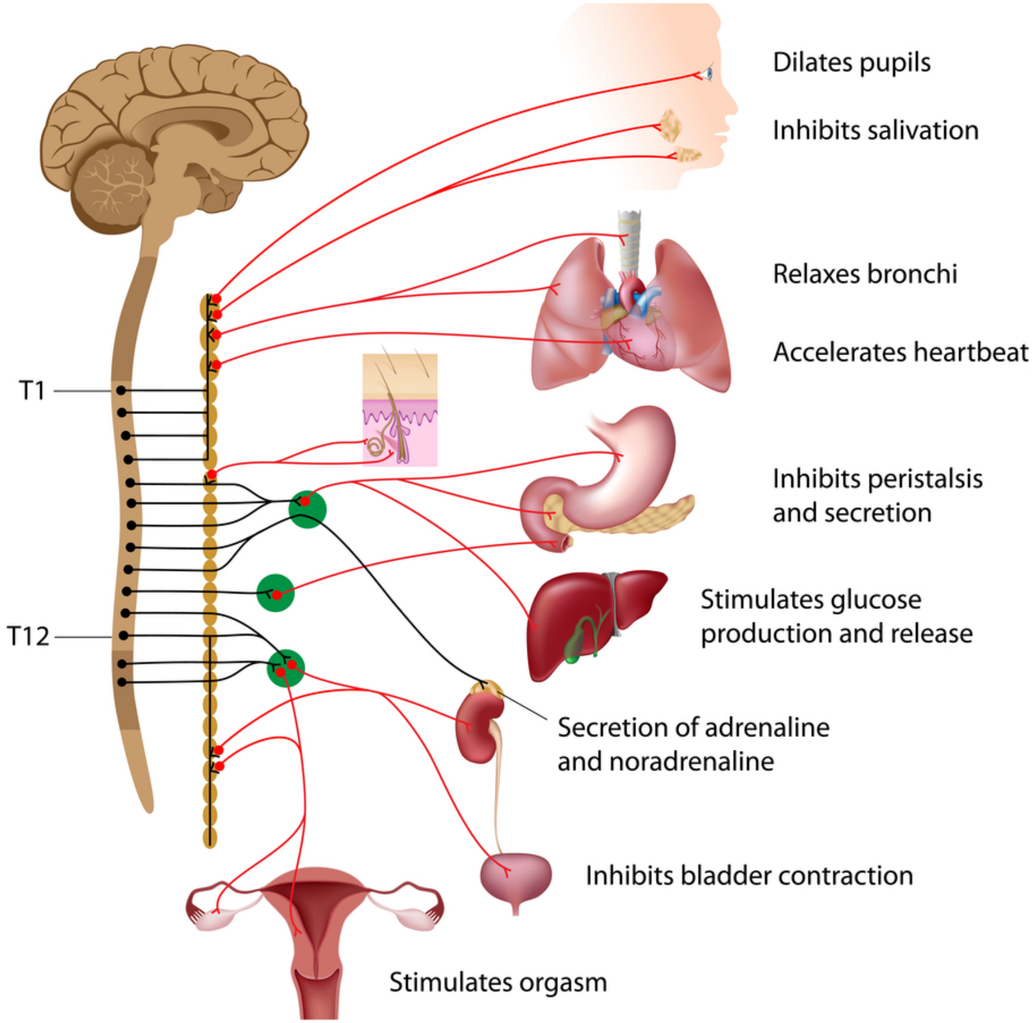
Anatomy of the Hypothalamus/Pituitary

The hypothalamus is the major conduit for nerve pathways between the brain and the body



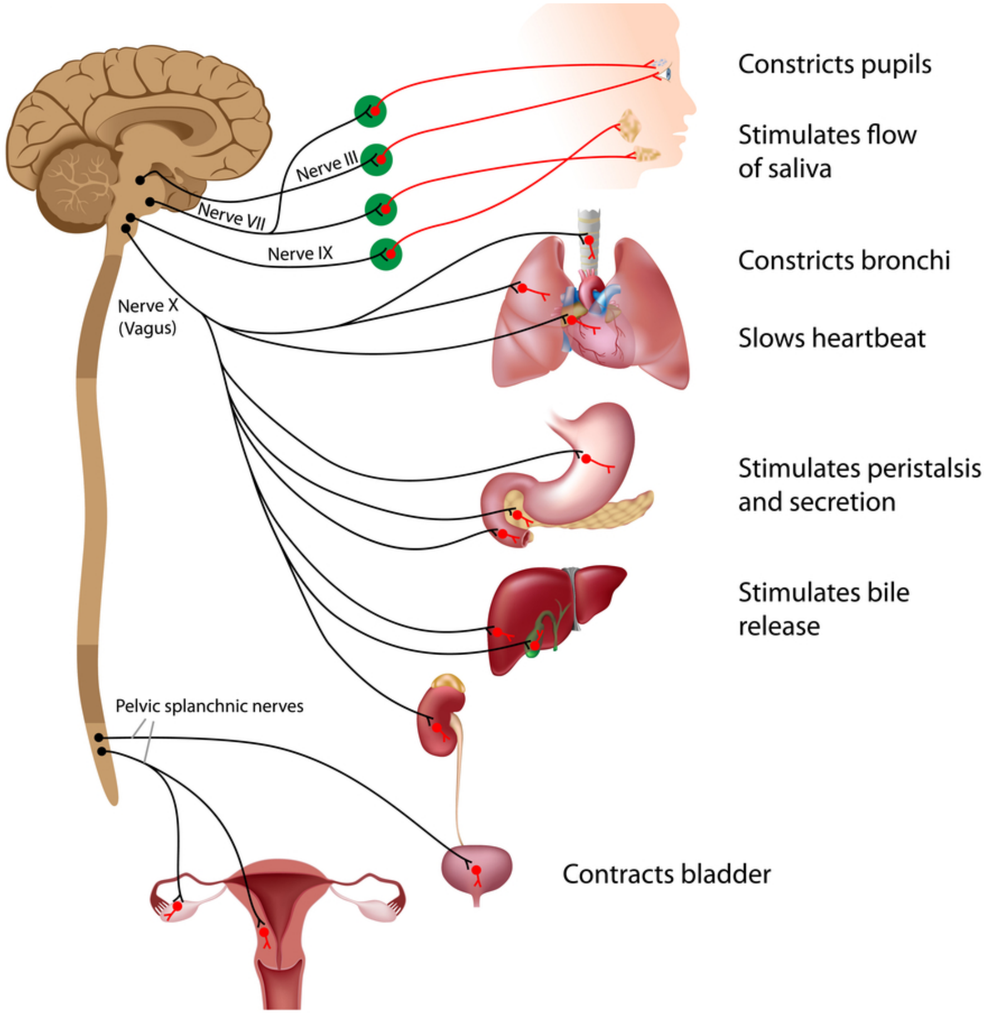
The proximity of hypothalamic nerves to the ANS means that hormone outputs of the hypothalamus coordinate closely with the activities of the sympathetic and parasympathetic nervous systems

Sympathetic Nervous System



“Fight or Flight”

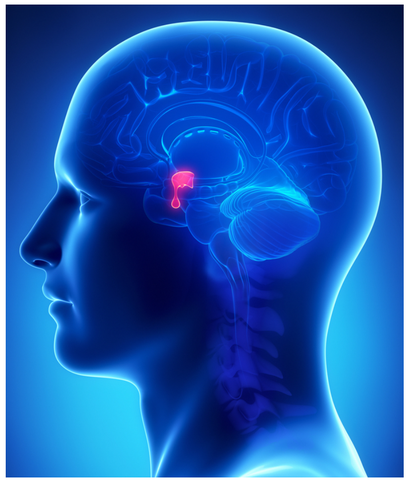
Parasympathetic Nervous System

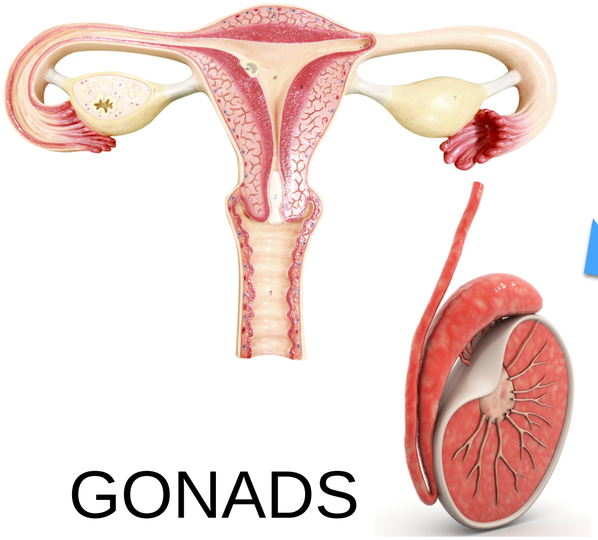


“Relax or Repair”

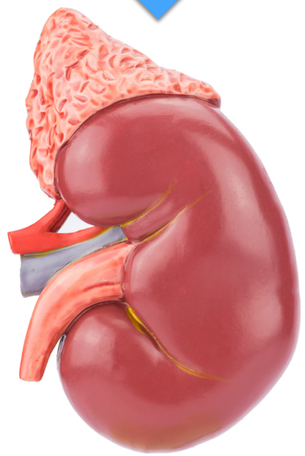
“Rest and Digest”

HYPOTHALAMUS & PITUITARY





GONADS

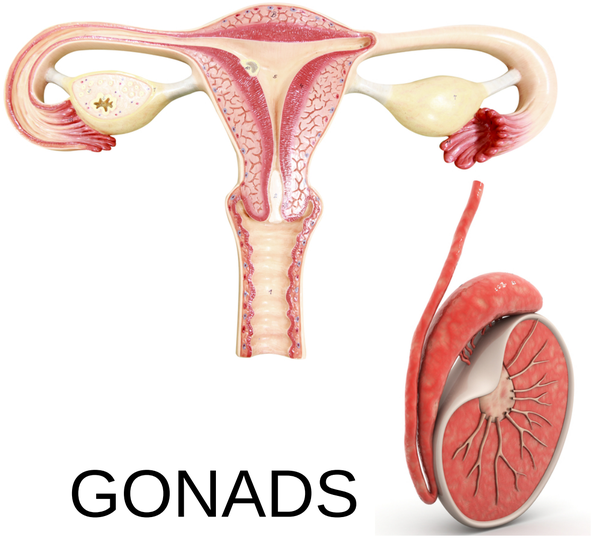


ADRENALS

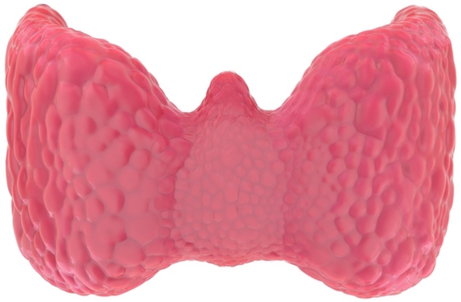
THYROID

HYPOTHALAMUS & PITUITARY

-ve feedback



GONADS



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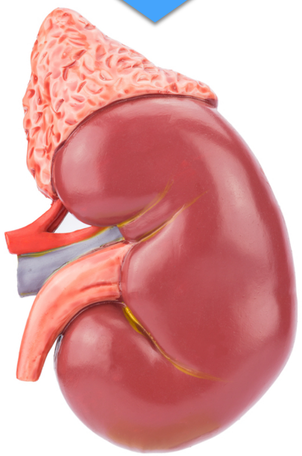

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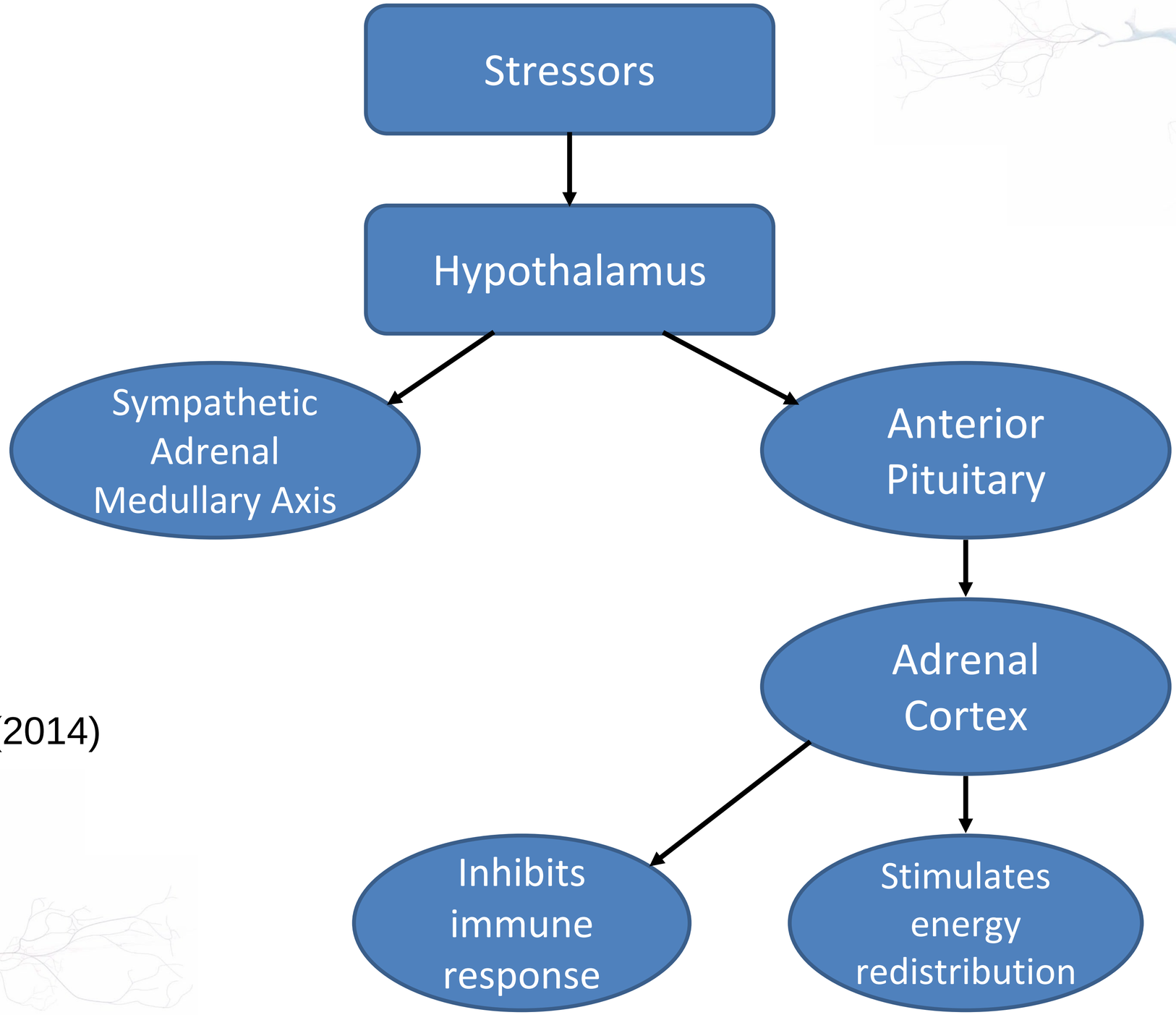
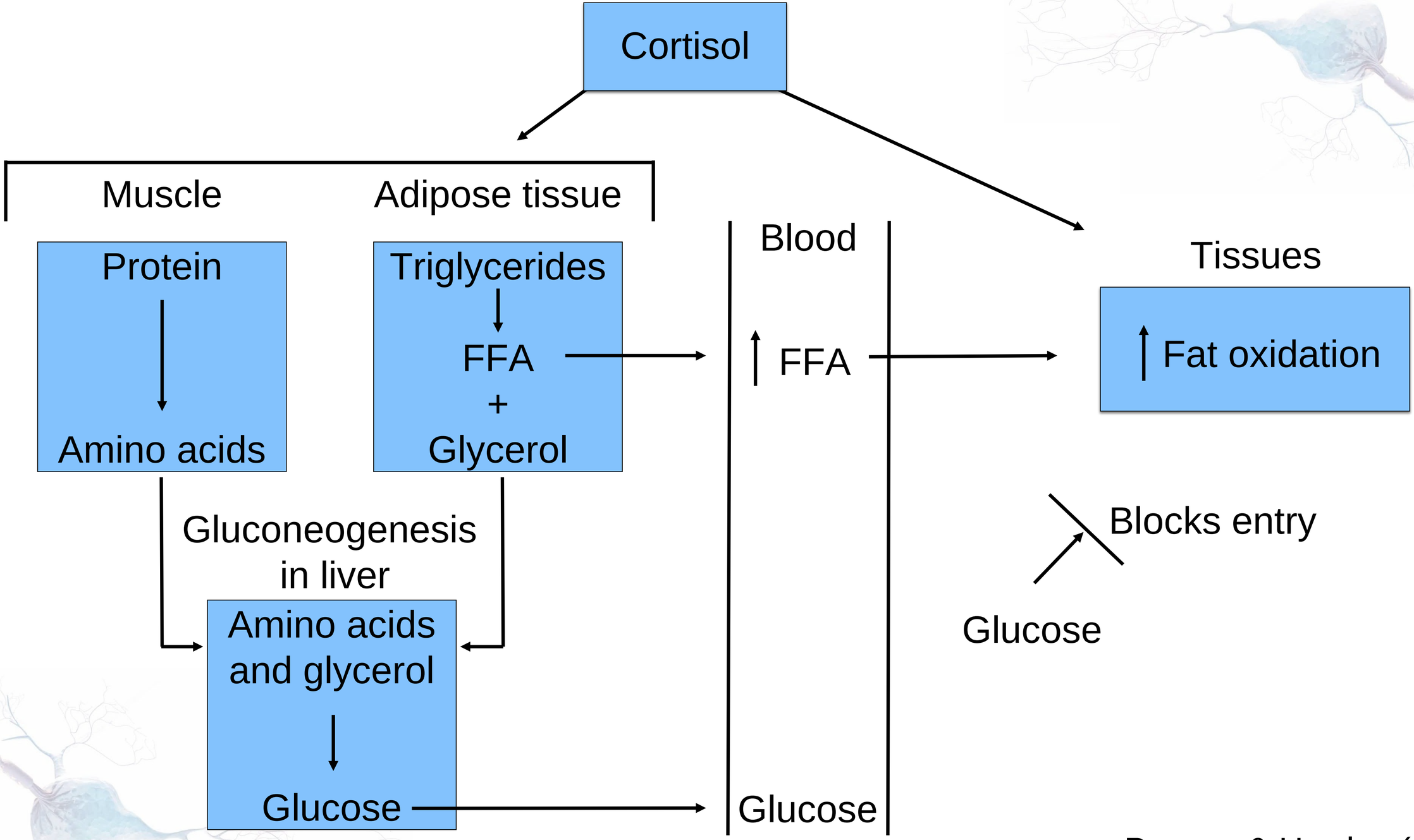


Carfagno & Hendrix (2014)

Cortisol during exercise

Action	Exercise Effect
Stimulates FFA mobilsation from adipose tissue; mobilises tissue protein to yield AA's for gluconeogenesis; decreases use of glucose by cells	↑ Heavy exercise ↓ Light exercise
Subjects who ran at 7.5mph for 10 or 30mins only showed an increase in urinary cortisol excretion after the 30min bout	The cortisol effect of exercise increases with time

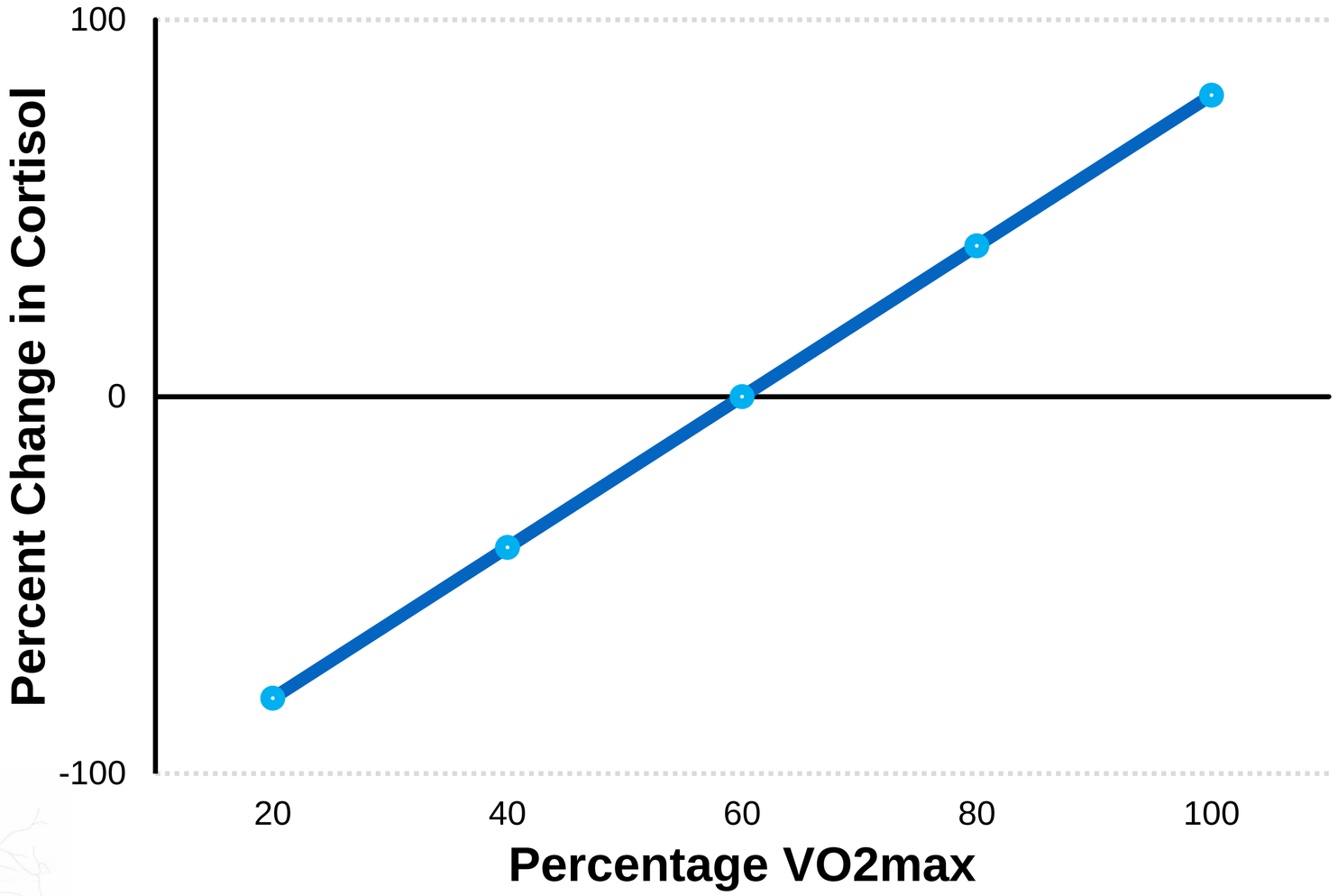
Bonen (1976); Guyton (1986); Powers & Howley (1990)



Powers & Howley (1990)

%age change in cortisol levels with increasing exercise intensity

Exercise for 1 hour at 40, 60 or 80% VO_2max showed a decrease in cortisol at low intensities and an increase at high intensities



Davies & Few (1973)

Cortisol - in summary

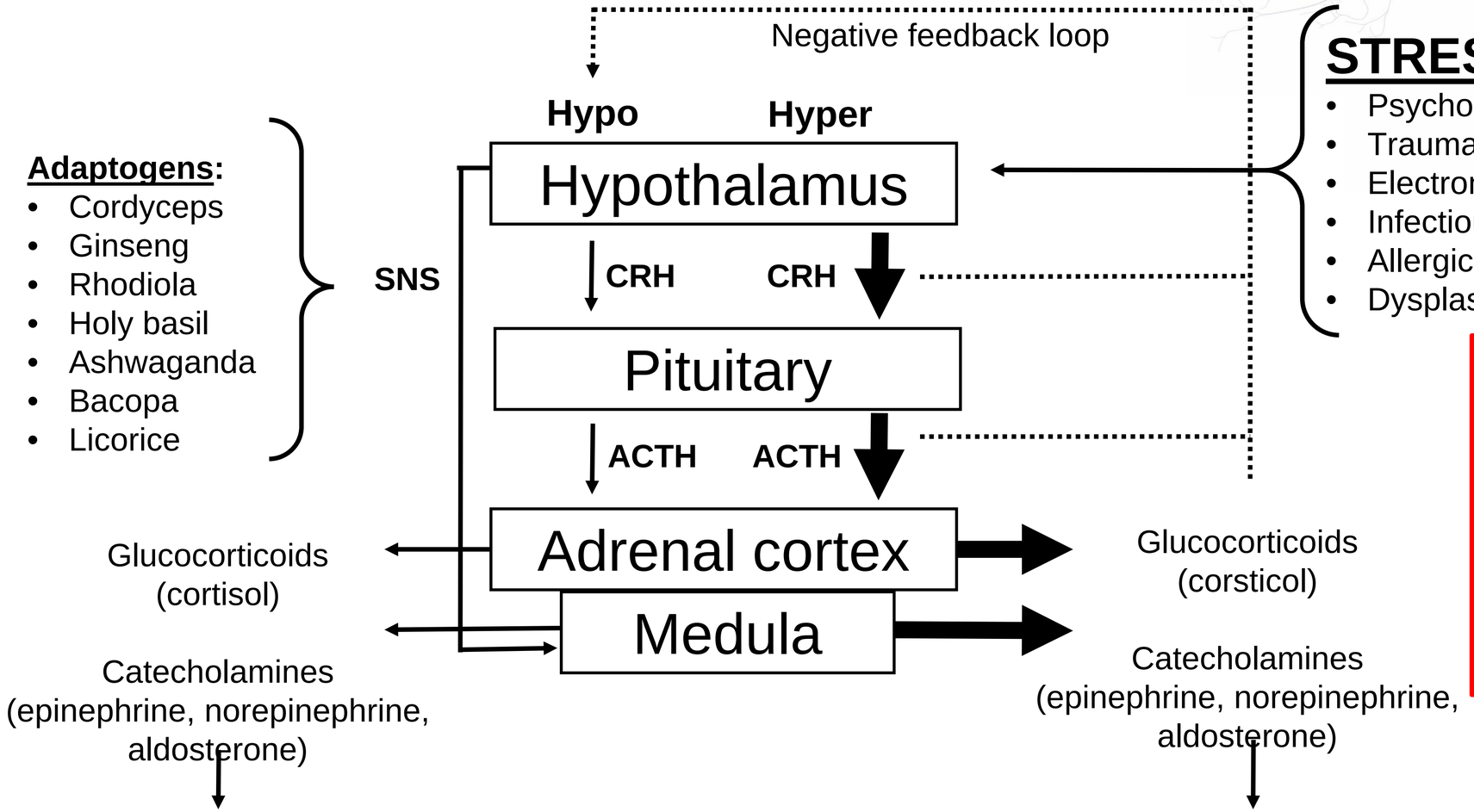
- In its normal function, cortisol helps us adapt to challenges by converting proteins and fats into energy, releasing glycogen and counteracting inflammation
- But ….. sustained high cortisol levels slowly break-down healthy muscle and bone, slow healing, impair digestion, interfere with endocrine function, weaken immune system and disrupts emotional wellbeing

HPA Axis

- Gradually increasing training loads have been shown to increase the stability of the pituitary adrenocortical system: a 7 wk training programme of 30-50 min/day (cycling or running) resulted in a decreased catecholamine response to exercise and a lowered resting heart rate
- But, excessive stress can lead to imbalances in the neuroendocrine axis and contribute to symptoms of overtraining: in overtrained individuals, the hypothalamus was less sensitive to insulin-induced hypoglycaemia – ACTH, cortisol, GH and prolactin responses were lower than normal

Gilmore (2004); Winder et al (1978); Barron et al. (1985)

HPA axis



Adaptogens:

- Cordyceps
- Ginseng
- Rhodiola
- Holy basil
- Ashwaganda
- Bacopa
- Licorice

STRESS

- Psychological
- Traumatic
- Electromagnetic
- Infectious
- Allergic
- Dysplastic

When an individual is operating outside (or at the limits of) optimal physiological range, things go wrong!

Symptoms and conditions associated with *hypoactivation*:

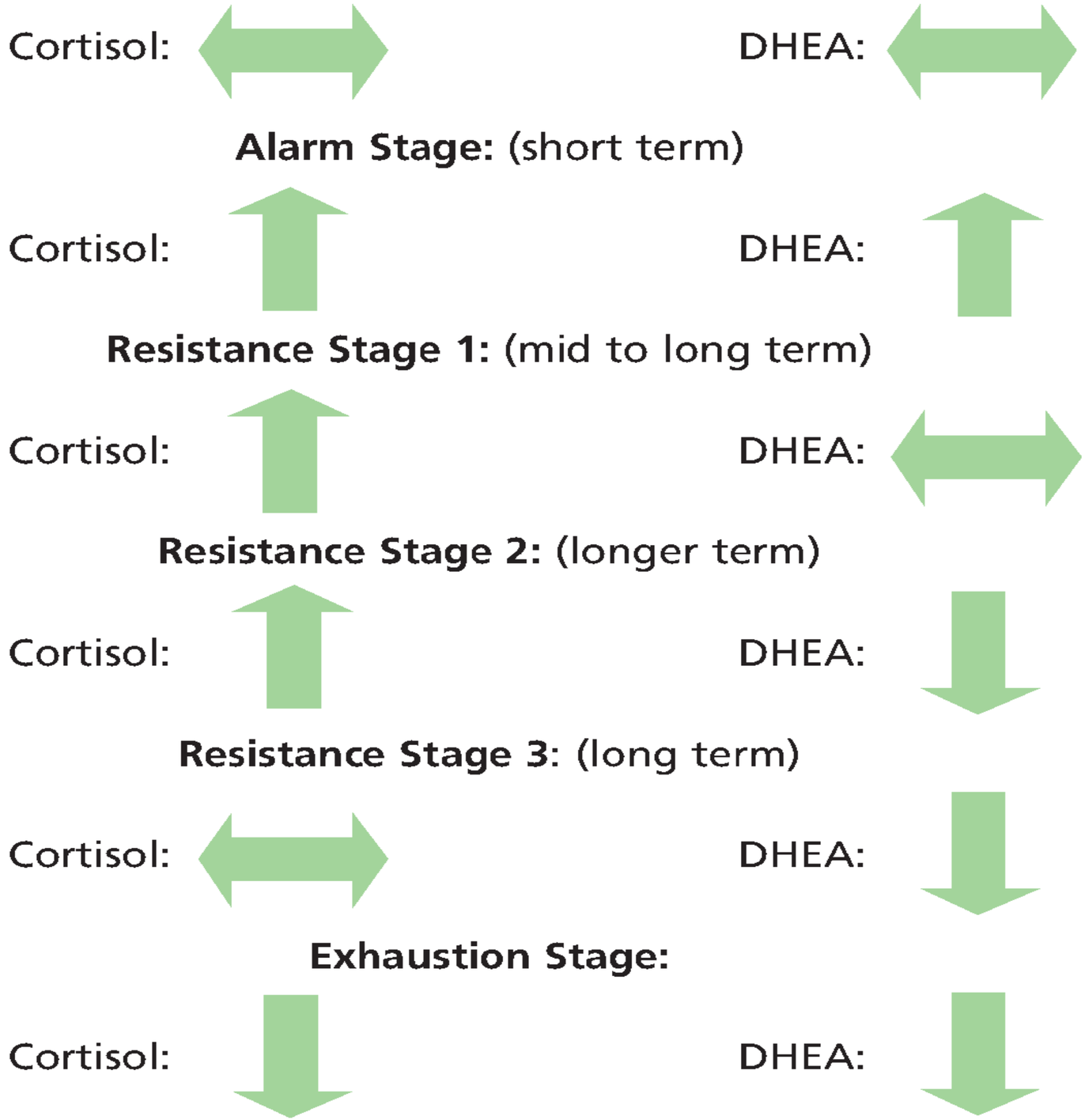
- Fatigue/malaise
- Risk of inflammatory conditions
- Risk of autoimmune disease
- Myocardial infarction
- Unable to perform routine tasks
- Allergies
- Apathy
- Weight loss/Anorexia
- Restless sleep
- Chronic pain
- Reduced libido

Symptoms and conditions associated with *hyperactivation*:

- Anxiety
- Agitation/Irritability
- Increased cholesterol and triglycerides
- Increased blood pressure
- Reduced libido
- Neurological disorders
- Depression
- Fatigue
- Impaired memory
- Gastrointestinal disorders
- Central obesity
- Loss of muscle tone

DHEA

- DHEA, produced by the adrenals, is a precursor to oestrogen and testosterone
- During stress, adrenaline and cortisol production takes priority – chronic stress may mean a drop in DHEA
- Insufficient DHEA contributes to **fatigue, bone loss, loss of muscle mass, depression, aching joints, decreased sex drive, and impaired immune function**


Cortisol:
DHEA:
Alarm Stage: (short term)
Cortisol:
DHEA:
Resistance Stage 1: (mid to long term)
Cortisol:
DHEA:
Resistance Stage 2: (longer term)
Cortisol:
DHEA:
Resistance Stage 3: (long term)
Cortisol:
DHEA:
Exhaustion Stage:
Cortisol:
DHEA:

Selye (1978)

Anabolic vs Catabolic

Anabolic

- Increased skeletal muscle blood flow
- Increased anabolic hormone release: GH, testosterone, IGF-1
- Increased insulin concentrations

Catabolic

- Glycogen depletion
- Decreased net protein balance
- Increased cortisol concentrations
- Decreased insulin concentrations
- Increased metabolic rate
- Dehydration

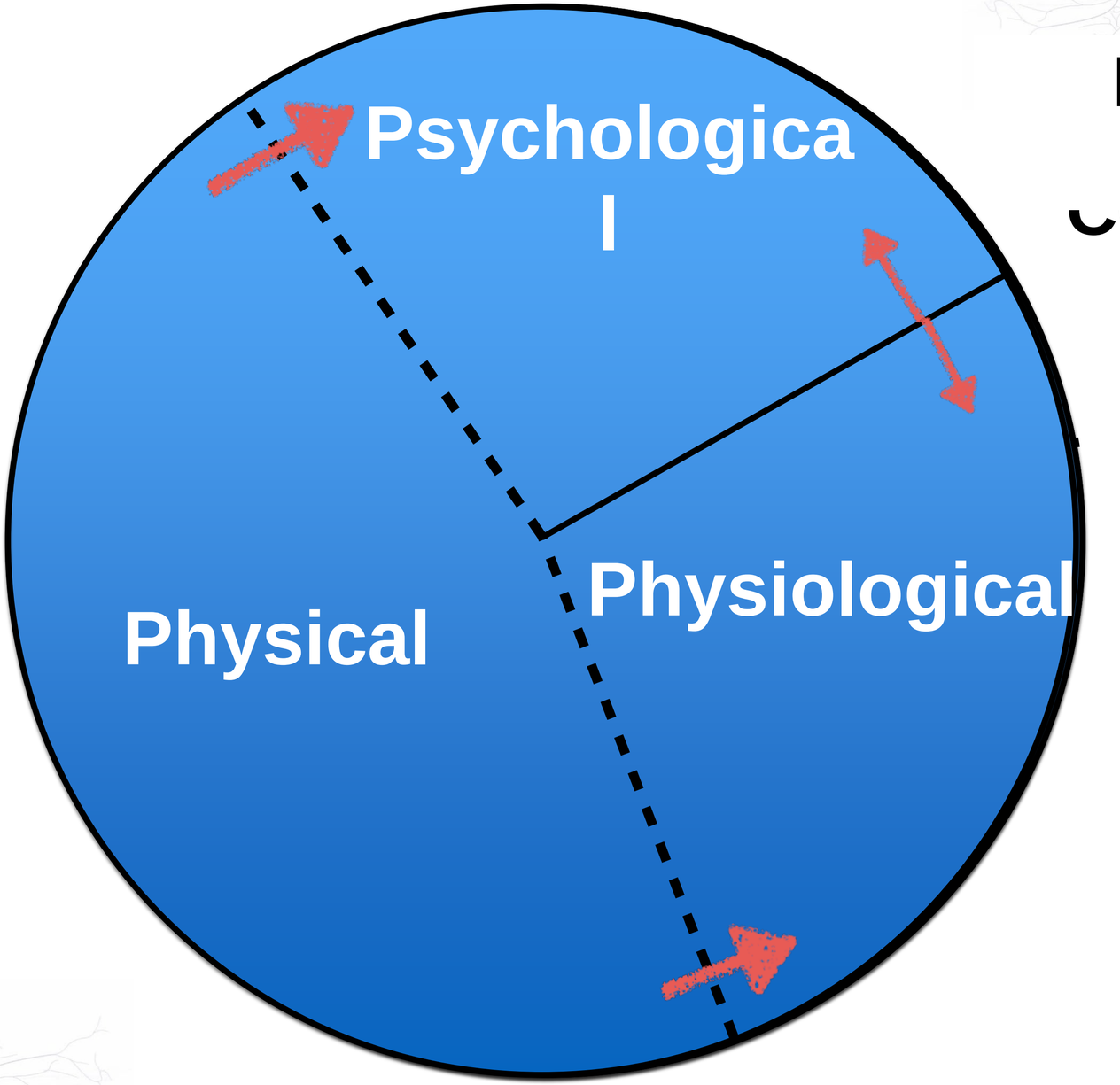
Carlson (2006)

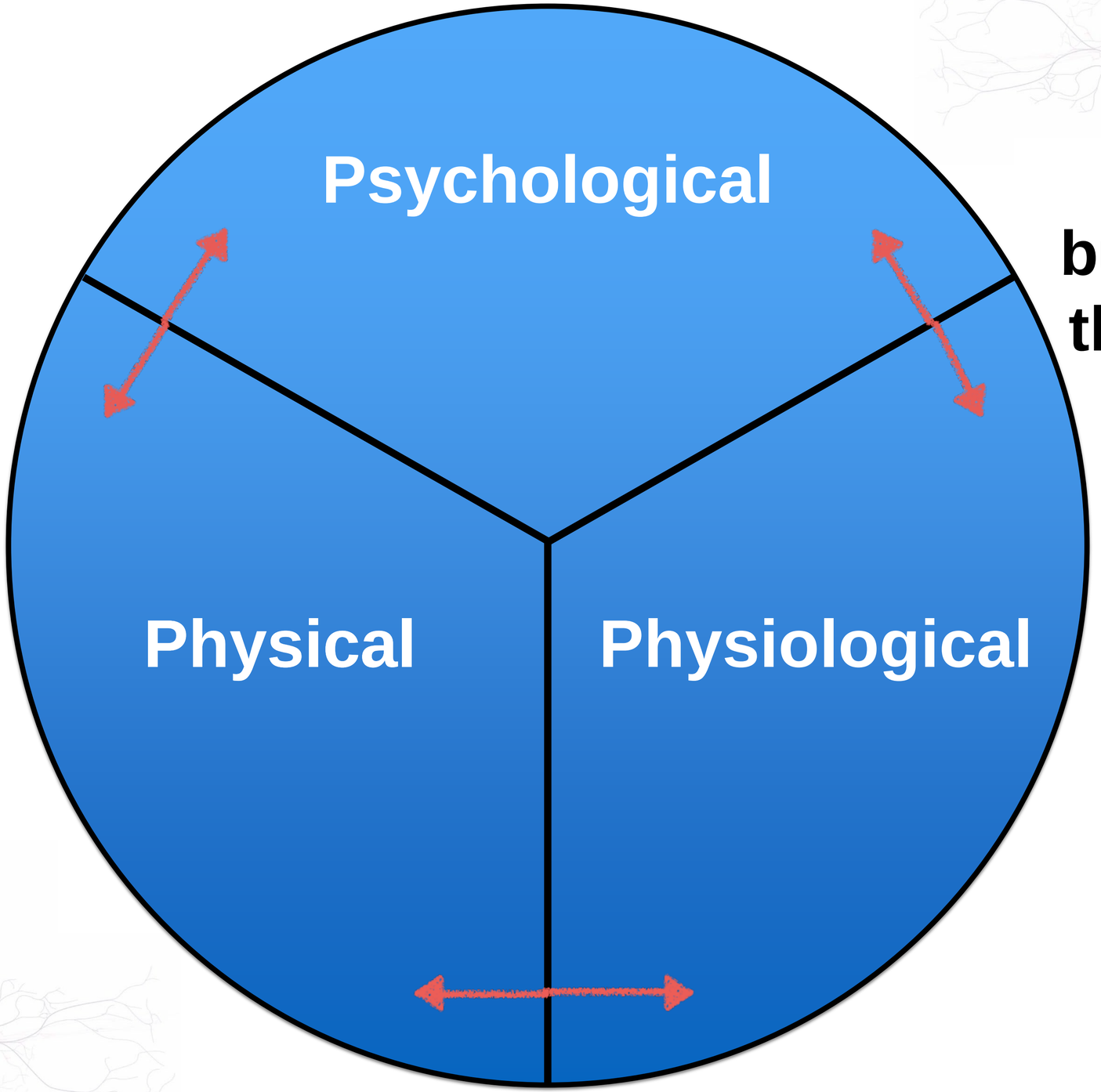
The total load concept

TOTAL

Physical Burden

CONCEPT





Life’s bursting at the seams

Overtraining syndrome - monitoring and testing

Monitoring for Overtraining

- Resting morning HR
- Regular field or lab testing
- Monitor dietary intake (sufficient macro and micronutrient needs for training loads)
- Use of a training log – record resting HR, body weight and symptoms
- Profile of Mood States (POMS) – measure mood, tension, depression, anger, vigour, fatigue and confusion

Gimore (2004); Kuipers (2000); O’Brien (1988)

IOC - OT monitoring tools

Load type	Examples of measurements
External load	Training or competition time (seconds, minutes, hours or days)[36]
	Training or competition frequency (eg, sessions or competitions per day, week, month)[37]
	Type of training or competition[38]
	Time-motion analysis (eg, global positioning system analysis)[39]
	Power output, speed, acceleration[40]
	Neuromuscular function (eg, jump test, isokinetic dynamometry and plyometric push-up)[41]
	Movement repetition counts (eg, pitches, throws, bowls, serves and jumps)[42 43]
	Distance (eg, kilometres run, cycled or swam)[44]
	Acute:chronic load ratio[45]
Internal load	Perception of effort (eg, rating of perceived exertion and RPE)[46]
	Session rating of perceived effort (eg, session duration (min)×RPE)[28]
	Psychological inventories (eg, profile of mood states (POMS),[47] recovery-stress questionnaire for athletes (REST-Q-Sport),[48] daily analysis of life demands for athletes (DALDA),[49] total recovery scale (TQR),[17] life events survey for collegiate athletes (LESCA),[50] multicomponent training distress scale (MTDS),[51] the hassle and uplift scale,[52] brief COPE,[53] the Swedish universities scales of personality (SSP),[54] state trait anxiety inventory (STAI),[55] sport anxiety scale (SAS),[56] athletic coping skills inventory-28 (ACSI-28),[57] body consciousness scale,[58] perceived motivational climate in sport questionnaire (PMCSQ)[59] and commitment to exercise scale (CtES))[60]
	Sleep (eg, sleep quality and sleep duration)[61]
	Biochemical/hormonal/immunological assessments[18 26]
	Psychomotor speed[62]
	HR[63]
	HR to RPE ratio[64]
	HR recovery (HRR)[65]
	HR variability (HRV)[66]
	Training impulse (TRIMP)[67]
	Blood lactate concentrations[68]
	Blood lactate to RPE ratio[69]

HR, heart rate; RPE, ratings of perceived exertion.

Soligard et al (2016)

Lab Testing

- **Adlercreutz et al (1986)** - decrease in the plasma-free testosterone to cortisone ratio of >30% combined with a high SHBG
- **ACSM (2012)** - the resting plasma testosterone/cortisol ratio was considered as an indicator of the overtrained state, but this ratio indicates only the actual physiological strain of training
- **Hecksteden et al (2016)** - changes in urea and IGF-1 for endurance athletes and CK for HIIT and strength training

Adlercreutz et al (1986), cited in O’Brien (1988); ACSM 2012, Hecksteden et al (2016)

OTS Diagnosis

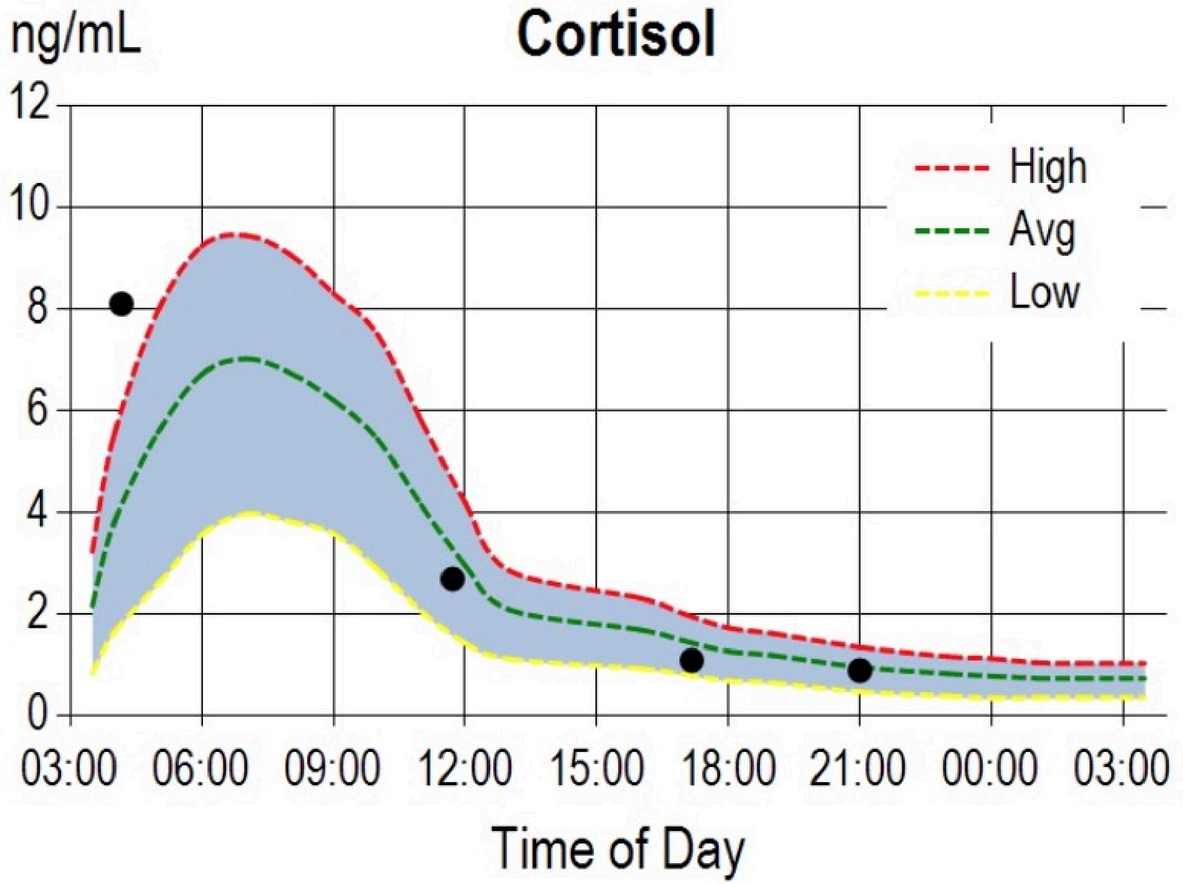
“As we have seen, the diagnosis of OTS is a complicated clinical endeavour. Therefore, much of the prevention of OTS is simply education of risk factors and ways to prevent excessive stress.”

“Because the manifestation of OTS can vary greatly in individuals, treatment must be appropriate for the specific cluster of symptoms in each person.”

“The interindividual variability of measured values and fatigue induced changes is considerable, pointing to the potential value of an individualised interpretation.”

Kreher (2016); Carfagno & Hendrix (2014)

Adrenal Stress Index



"DHEAS is very low (lower than all observed age ranges), suggesting adrenal fatigue"

Nordic Laboratories

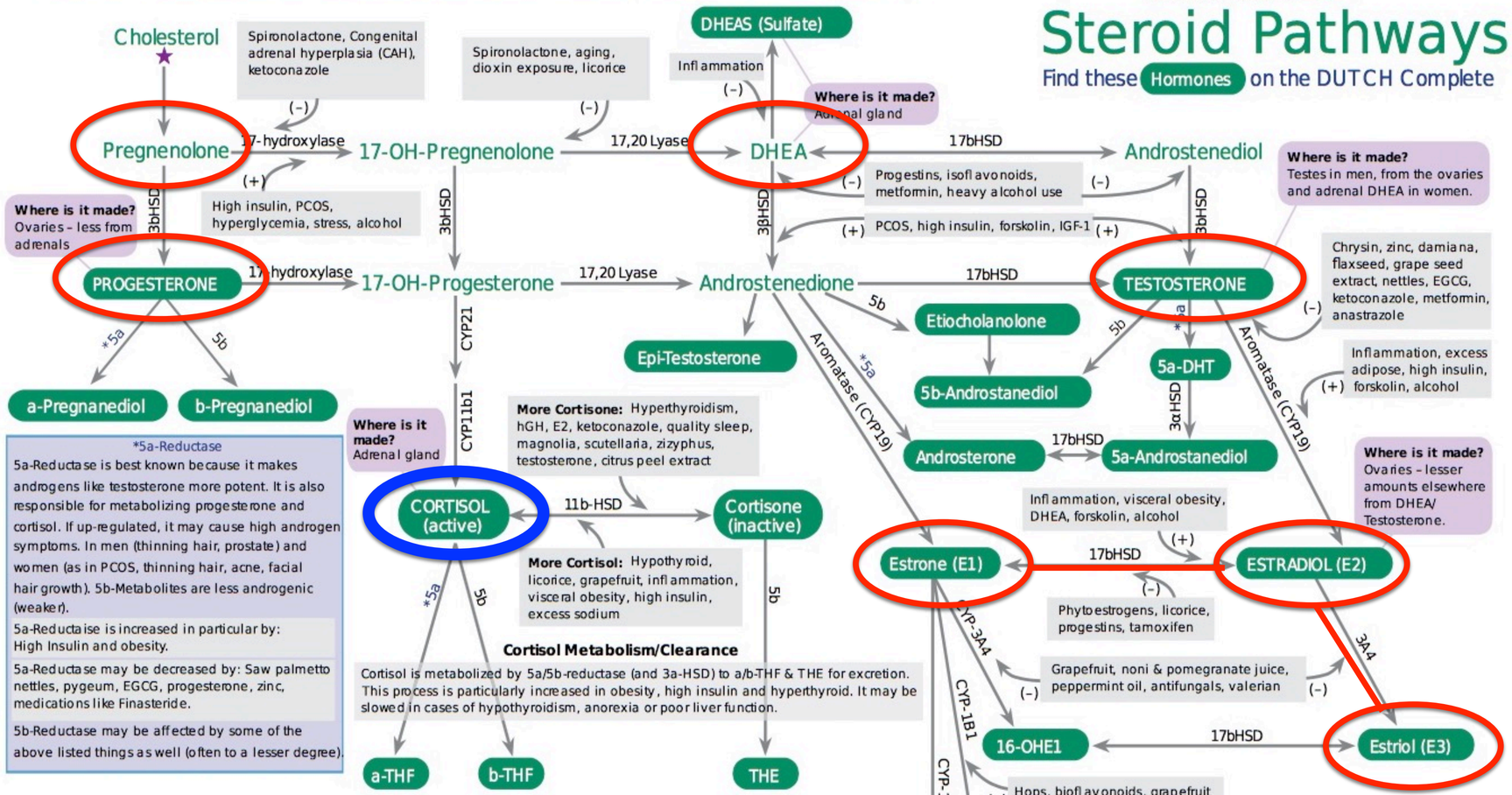
Test Name	Result		Units	Range
DHEAS (Saliva)	1.9	L	ng/mL	2-23 (Age Dependent)
Cortisol (Saliva)	8.1		ng/mL	3.7-9.5 (morning)
Cortisol (Saliva)	2.7		ng/mL	1.2-3.0 (noon)
Cortisol (Saliva)	1.1		ng/mL	0.6-1.9 (evening)
Cortisol (Saliva)	0.9		ng/mL	0.4-1.0 (night)

Primary hormones (in CAPS) are made by organs by taking up cholesterol ★ and converting it locally to, for example, progesterone. Much less is made from circulating precursors like pregnenolone. For example, taking DHEA can create testosterone and estrogen, but far less than is made by the testes or ovaries, respectively.

dutch
Dried Urine Test for Comprehensive Hormones

Steroid Pathways

Find these Hormones on the DUTCH Complete



***5a-Reductase**

5a-Reductase is best known because it makes androgens like testosterone more potent. It is also responsible for metabolizing progesterone and cortisol. If up-regulated, it may cause high androgen symptoms. In men (thinning hair, prostate) and women (as in PCOS, thinning hair, acne, facial hair growth). 5b-Metabolites are less androgenic (weaker).

5a-Reductaise is increased in particular by: High Insulin and obesity.

5a-Reductase may be decreased by: Saw palmetto nettles, pygeum, EGCG, progesterone, zinc, medications like Finasteride.

5b-Reductase may be affected by some of the above listed things as well (often to a lesser degree).

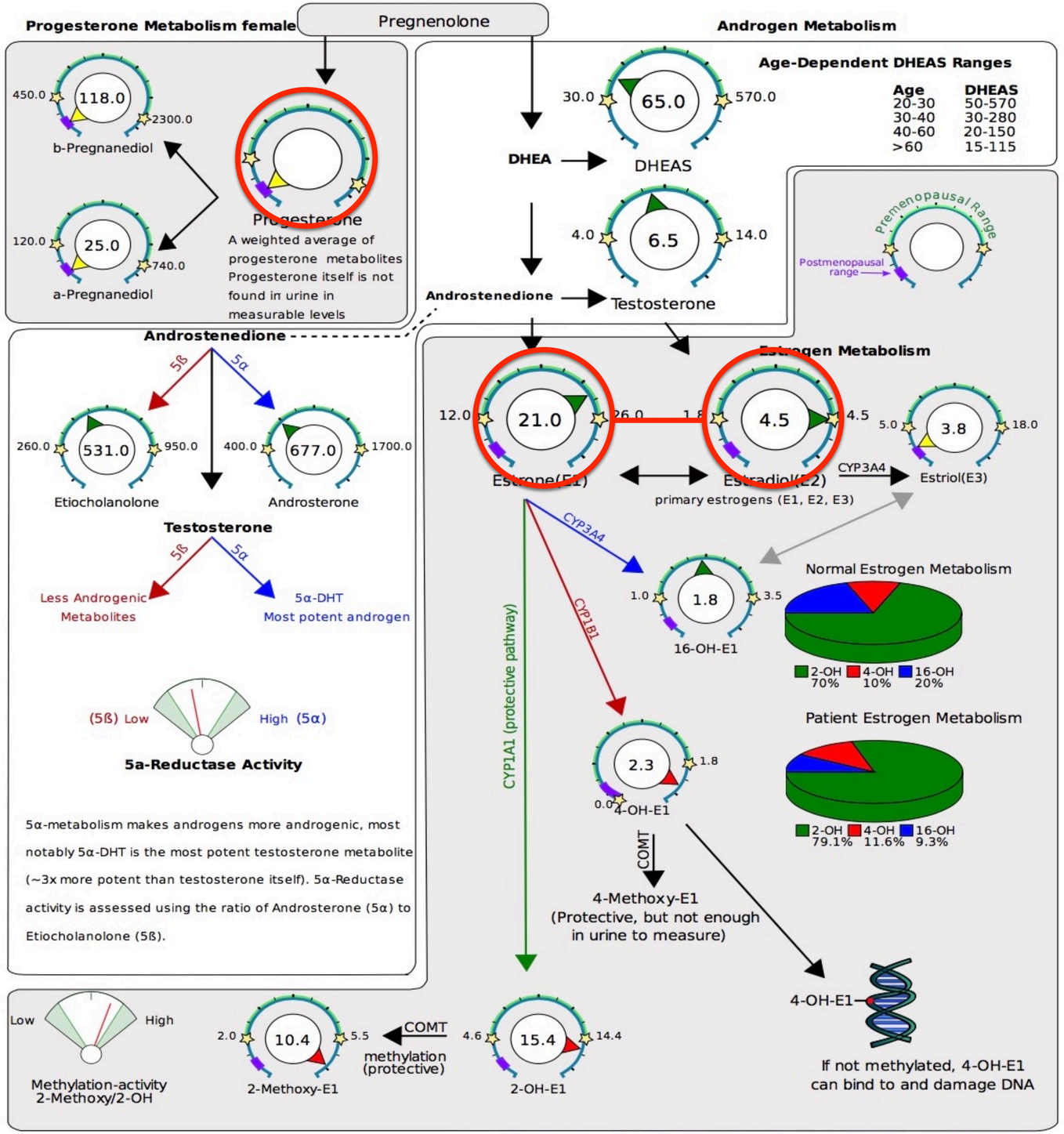
Cortisol Metabolism/Clearance

Cortisol is metabolized by 5a/5b-reductase (and 3a-HSD) to a/b-THF & THE for excretion. This process is particularly increased in obesity, high insulin and hyperthyroid. It may be slowed in cases of hypothyroidism, anorexia or poor liver function.

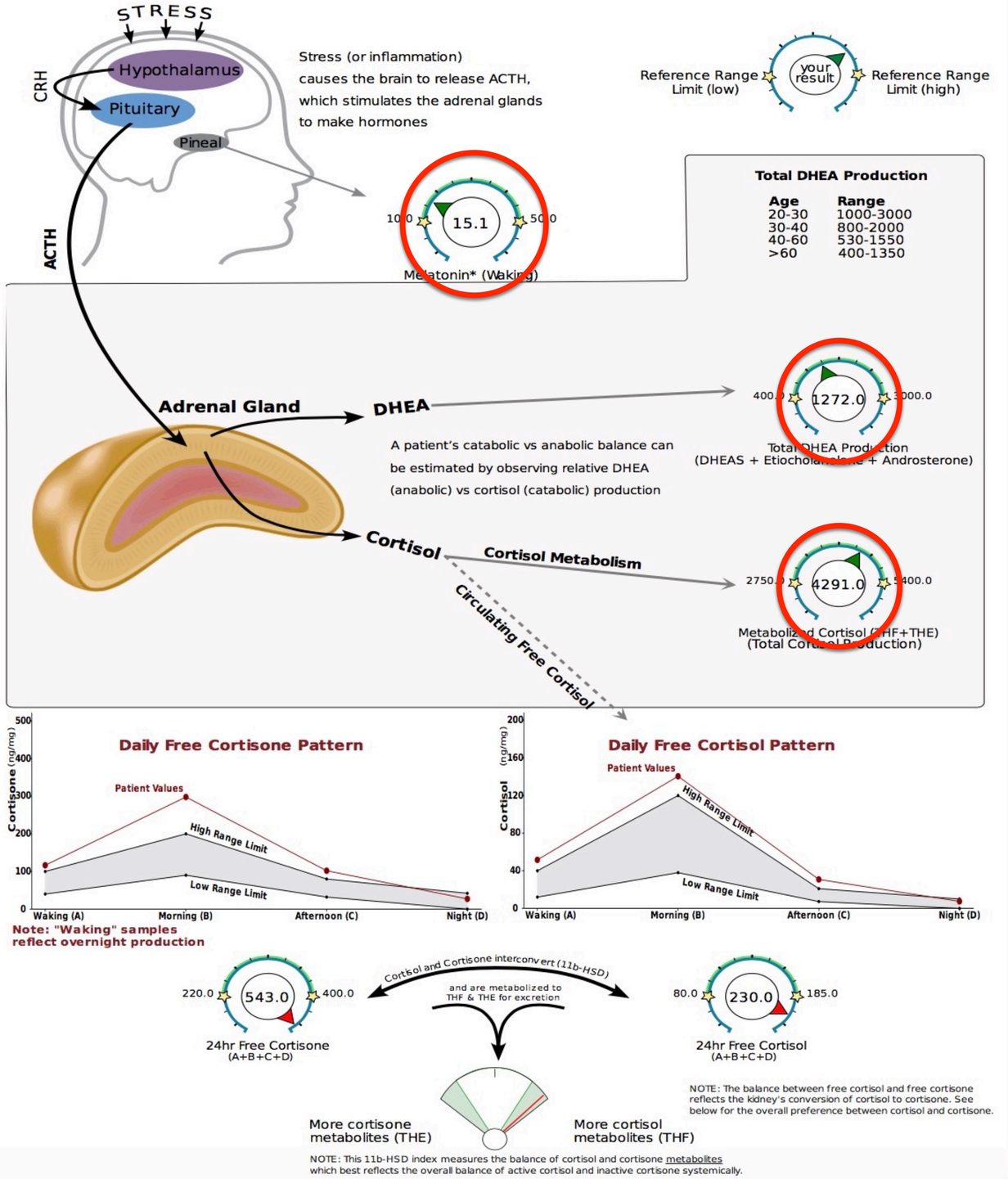
Other factors affecting the production of primary reproductive and adrenal hormones:

Increased Cortisol: stress, inflammation, Cushing's Disease, obesity
Decreased Cortisol: glucocorticoid use, opioid use, Addison's Disease, Accutane, chronic marijuana use
Increased DHEA: PCOS, acute stress, Bupropion (Wellbutrin), Alprazolam (Xanax), ADD meds
Decreased DHEA: aging, rapid weight loss, Venlafaxine/Mirtazapine, opioids, glucocorticoids, hormonal birth control, antipsychotic meds, estrogens, diabetes meds
Increased Testosterone: PCOS, HCG, HGH, L-Dopa, Climiphene Citrate (Clomid)
Decreased Testosterone: obesity, opioids, hormonal birth control, acute illness, aging, high insulin, steroid use
Increased Estrogens: PCOS, inflammation, pregnancy, DHEA/testosterone supplementation
Decreased Estrogens: hormonal birth control, ovarian failure (menopause), opioids, anorexia, underweight
Increased Progesterone: pregnancy, pregnenolone supplementation (increases urine progesterone metabolites, not actual circulating progesterone), Vitex (chaste tree berry)
Decreased Progesterone: hormonal birth control, stress, high insulin, opioids, NSAID use >10 days, anovulation, luteal phase defect, high prolactin, underweight, hypothyroid, hormonal IUD (Mirena)

Nordic Laboratories



Low Progesterone: menstrual irregularities, polycystic ovarian syndrome, menstrual cramping, infertility, acne, brittle nails, dry cracked skin, depression, anxiety, mood swings, low libido, fatigue, foggy thinking, slow metabolism, central weight gain, sugar cravings, migraines, headaches, joint pain and allergy symptoms



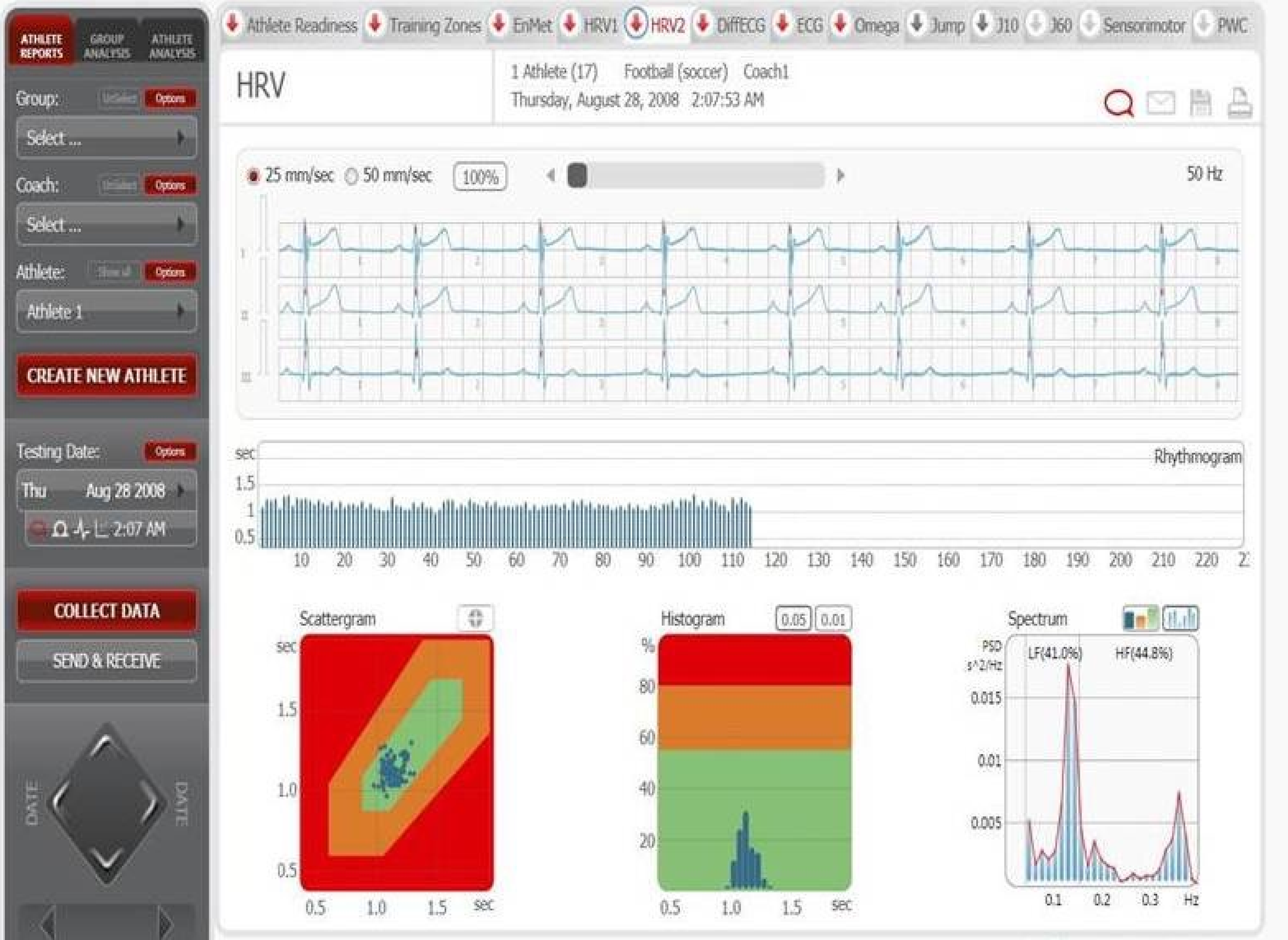
Think:

Catabolic

Heart rate variability (HRV)

Heart Rate Variability is strongly related to parasympathetic nervous activation (Goldberger 2001)

Iellamo et al demonstrated a decrease in HRV and increase in RHR during peak training in Junior national rowers


ATHLETE REPORTS
GROUP ANALYSIS
ATHLETE ANALYSIS
Group:
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Select ...
Coach:
Options
Select ...
Athlete:
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Athlete 1
CREATE NEW ATHLETE
Testing Date:
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HRV2
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Omega
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J10
J60
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1 Athlete (17) Football (soccer) Coach1
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50 mm/sec
100%
50 Hz
Rhythmogram
sec
Scattergram
Histogram
0.05
0.01
Spectrum
PSD
s^2/Hz
LF(41.0%)
HF(44.8%)
Hz

SNS +ve PNS +ve

- where we want to be on a regular basis

SNS -ve PNS +ve

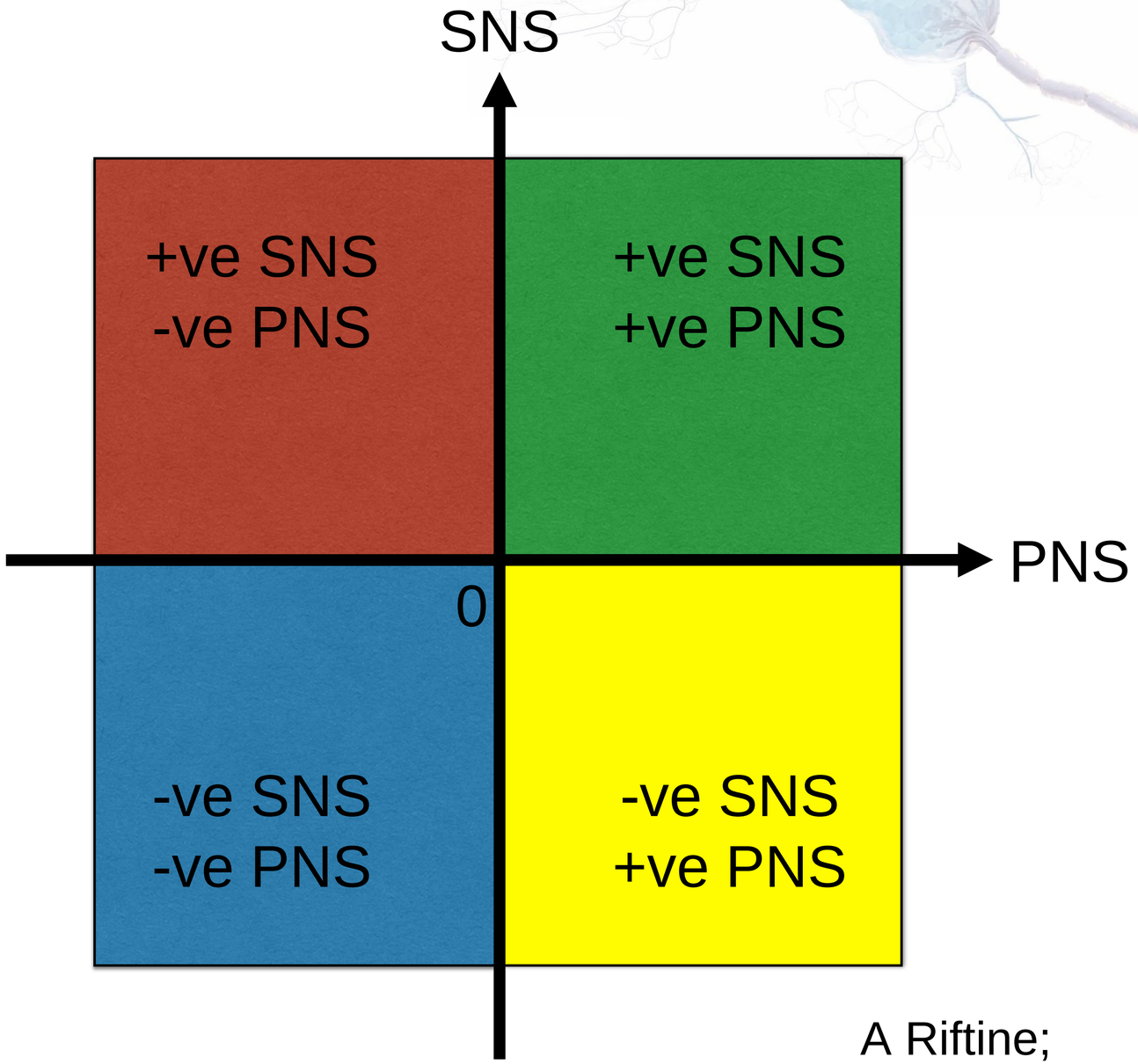
- active healing

SNS +ve PNS -ve

- the stress of western societies and diseases that go with that

SNS -ve PNS -ve

- the lack of the will to live, chronic stable illness



A Riftine;
www.nerveexpress.com

Chronic fatigue

overtraining syndrome

overreaching

overtraining

adrenal fatigue

fibromyalgia

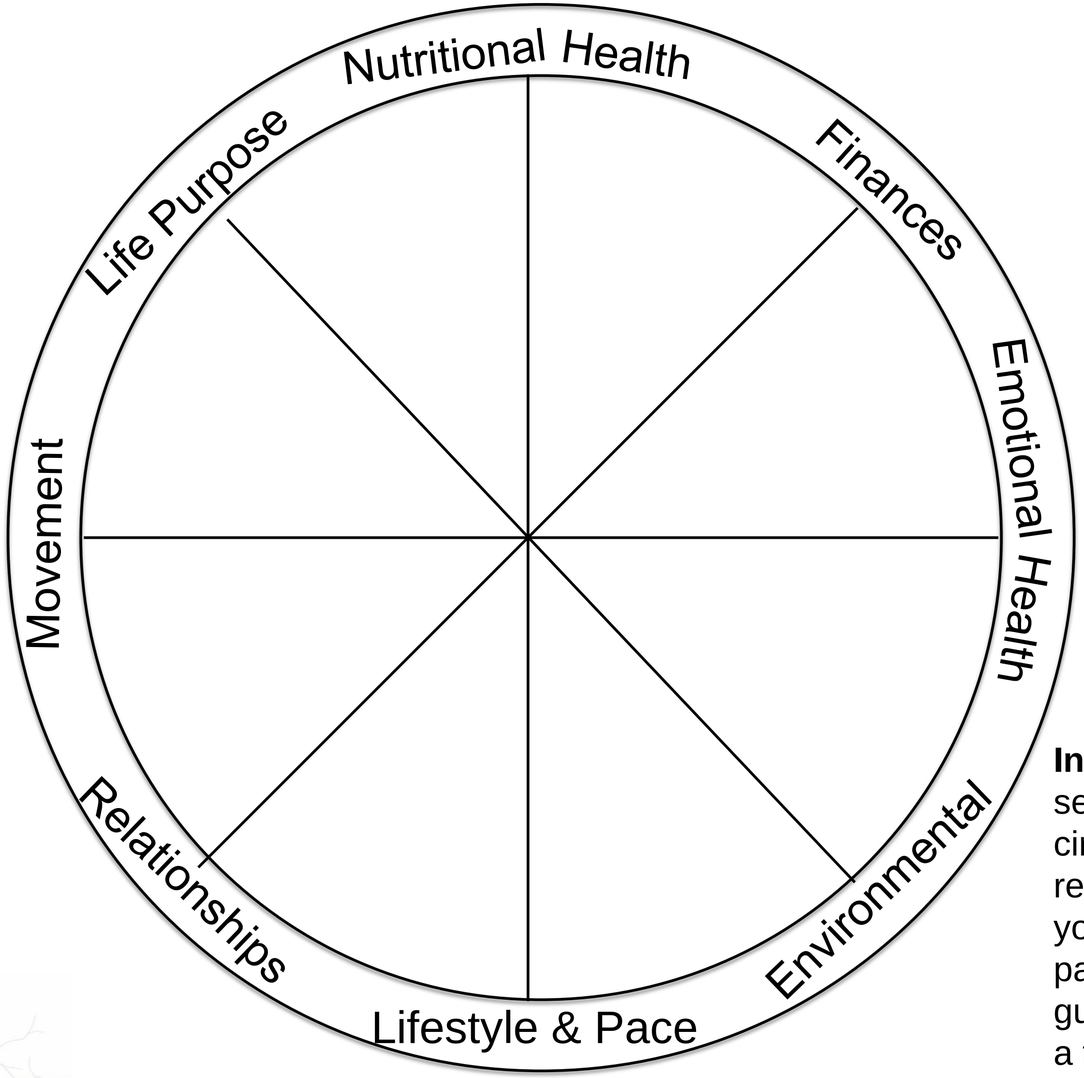
chronic fatigue

etc….

Where does one stop and the other begin?

8-elements wheel

A tool for chronic fatigue syndrome, fibromyalgia and related disorders



Instructions: for each segment, the middle of the circle is 0 and the outer ring represents 10. Score yourself for how well this part of your life is going. Use gut instinct to come up with a figure from 0 to 10. Continue until you've scored all segments of the circle.

Training Wellbeing Quiz

Anderson (2007)

- Question #1
  I slept really well last night.
- Question #2
  I am looking forward to today's workout.
- Question #3
  I am optimistic about my future performance(s).
- Question #4
  I feel vigorous and energetic.
- Question #5
  My appetite is great.
- Question #6
  I have very little muscle soreness.

Each question is scored:

- Strongly Disagree - 1
- Disagree - 2
- Neutral - 3
- Agree - 4
- Strongly Agree - 5

Subjective measures respond to training-induced changes in athlete well-being, except during acute increases in training load and with a chronic training load (Saw et al 2015).

FRIDAY March 3, 2017 12:00 am

Metrics

Weight: lbs

Sleep Hours: hrs

Water Percent: %

Steps:

Sleep Quality: Bad

Overall Feeling: Best

Muscle Mass: lbs

Note:

Training Peaks

Delete Cancel OK

ACSM exclusion list

Is the athlete experiencing the following:
- Unexplainable underperformance
- Persistent fatigue
- Increased sense of effort in training
- Sleep disorders
- …

Exclusion criteria

Are there confounding diseases?
- Anemia
- Epstein–Barr virus
- Other infectious diseases
- Muscle damage (high CK)
- Lyme disease
- Endocrinological diseases (diabetes, thyroid, adrenal gland, …)
- Major disorders of eating behavior
- Biological abnormalities (increased erythrocyte sedimentation rate, C-reactive protein, creatinine, or liver enzymes, decreased ferritin, …)
- Injury (musculoskeletal system)
- Cardiological symptoms
- Adult-onset asthma
- Allergies
- …

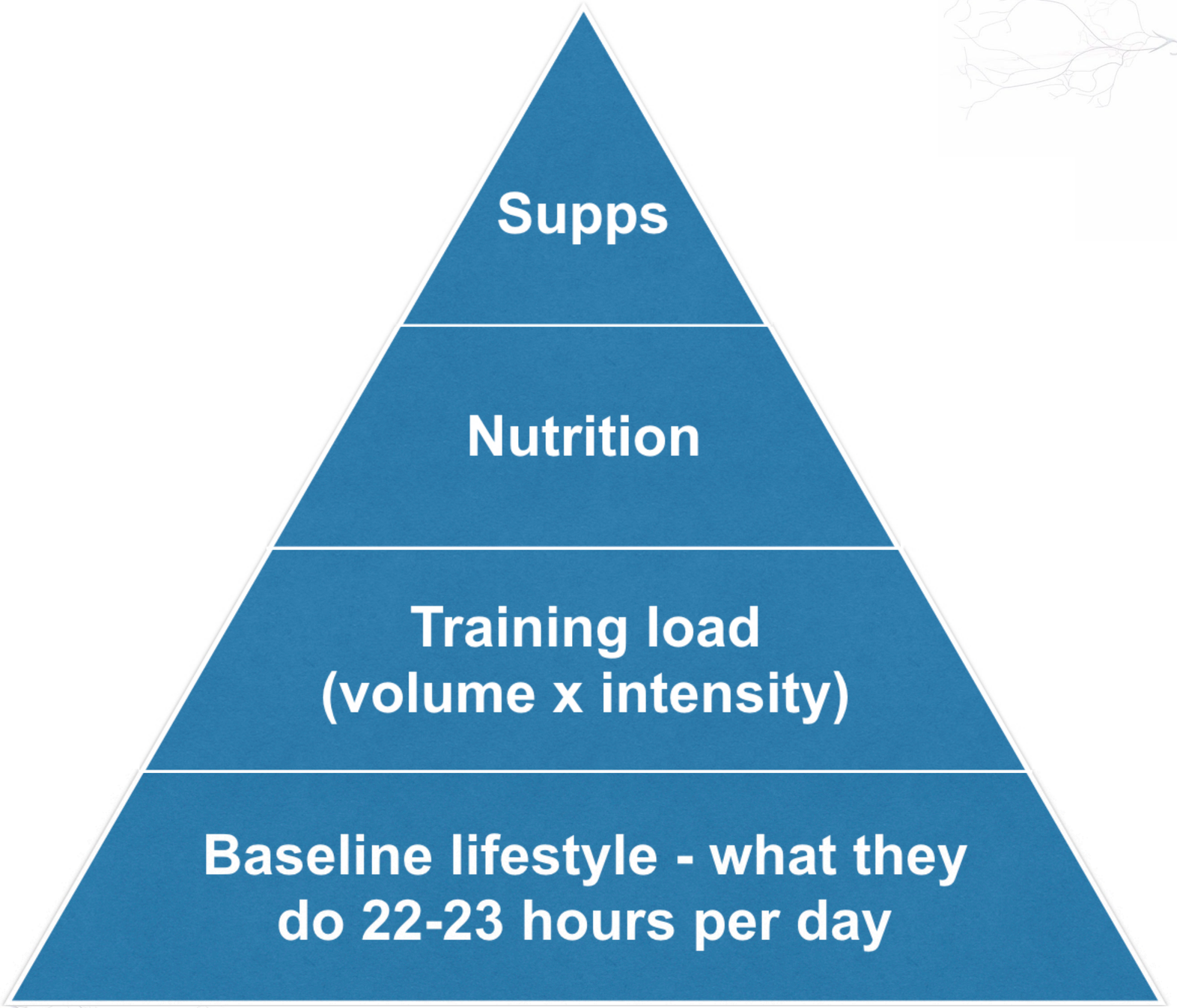
Are there training errors?
- Training volume increased (>5%) ($h \cdot wk^{-1}$, $km \cdot wk^{-1}$)
- Training intensity increased significantly
- Training monotony present
- High number of competitions
- In endurance athletes : decreased performance at "anaerobic" threshold
- Exposure to environmental stressors (altitude, heat, cold, …)
- …

Other confounding factors:
- Psychological signs and symptoms (disturbed POMS, RESTQ-Sport, RPE, …)
- Social factors (family, relationships, financial, work, coach, team, …)
- Recent or multiple time zone travel
- …

Exercise test
- Are there baseline values to compare with? (performance, heart rate, hormonal, lactate, …)
- Maximal exercise test performance
- Submaximal or sport-specific test performance
- Multiple performance tests

ACSM 2012

Recuperation strategies


Supps
Nutrition
Training load
(volume x intensity)
Baseline lifestyle - what they
do 22-23 hours per day

ACTIVE RESTORATION LIST

PHYSICAL

All types of Massage, Physiotherapy, Osteopathic, Acupuncture, TCM, physical contact, touch, flexibility, power napping, active recovery, hot/cold, breathing techniques, saunas

NUTRITIONAL

Macro, micro, herbal, ergogenic aids, fluids

PSYCHONEUROIMMUNOLOGY (PNI)

Personal time, positive self talk, self help improvement, meditation, visualisation, psychological life coaching, hypnotherapy, beliefs, positive values and goals, laughter, become an optimist, become aware of self talk, self-actualization, quiet mind

PSYCHO SOCIAL

Friends, socialising in like minded groups, children, laughter, music , religion, tears, social isolation, thoughts feelings, love

NATURAL WORLD/ PHYSICAL ENVIRONMENT

Being with nature, pets, outdoors, sunshine, minimising chemical toxic exposure, EMF, Radiation

Williams 2010

Sleep

Sleeping less than six hours per day for a period of four days, had the following effects on performance:

- Impaired cognitive function and mood
- Disturbed glucose metabolism
- Negative consequences for appetite regulation
- Impacted negatively on immune function

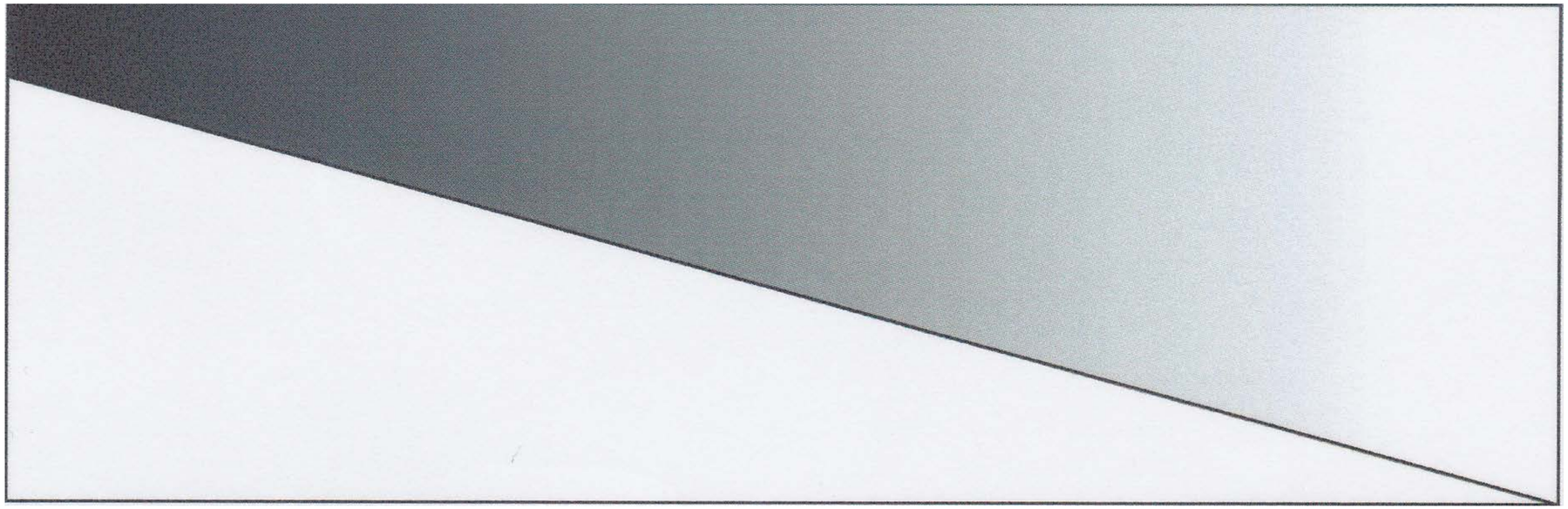
Halson (2014)

Training – Establish Balance

- Anabolic - Catabolic Balance
- Sympathetic – Parasympathetic Balance
- Ying – Yang Balance

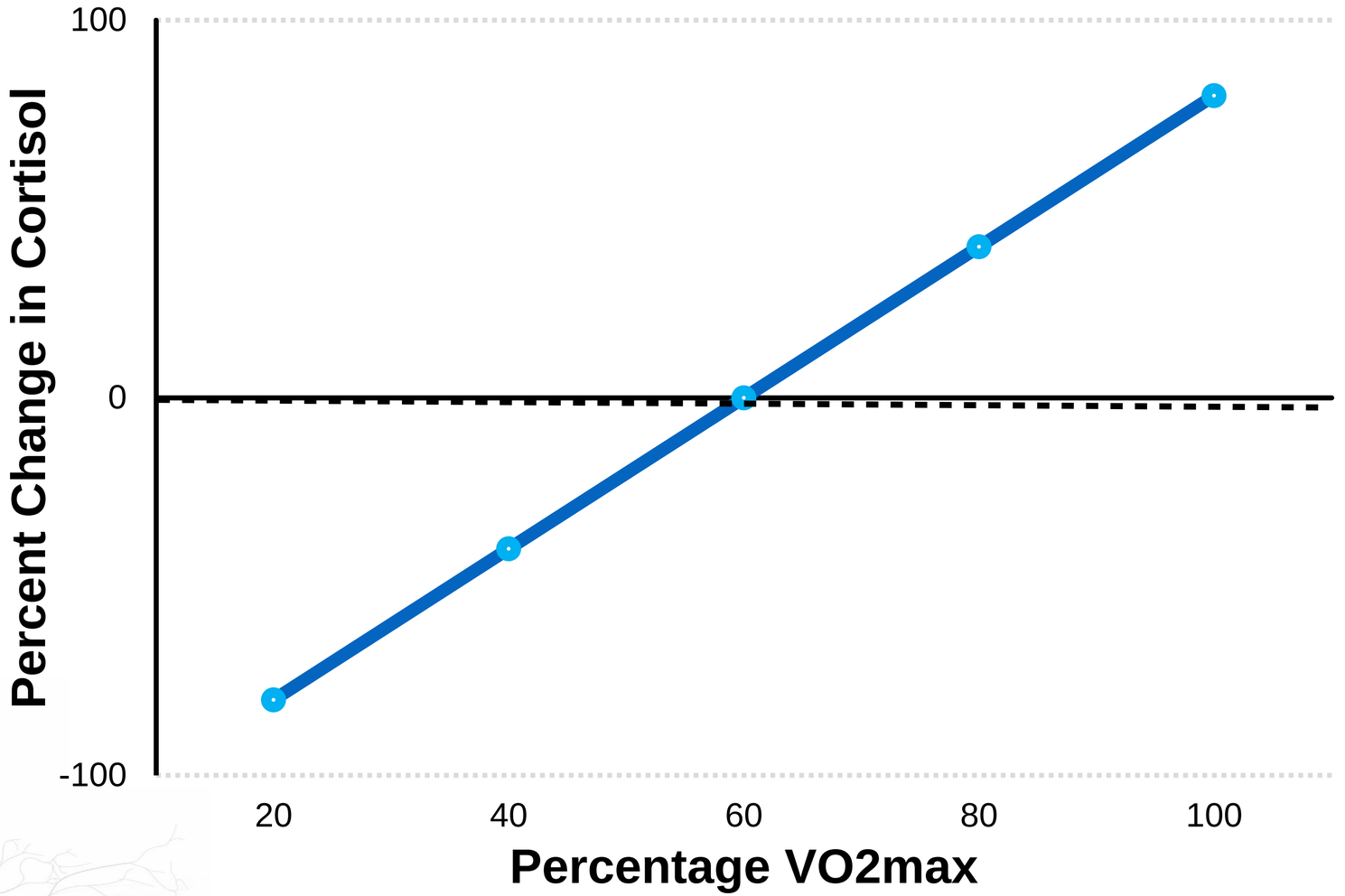
Yin/Parasympathetic Training

More Mind →



YANG ← More Body YIN

How do you train below the 0% line?



The American Journal of Chinese Medicine
An International Journal of Comparative Medicine East and West

Myeong Soo Lee et al, *Am. J. Chin. Med.* **30**, 463 (2002). DOI: 10.1142/S0192415X02000491

Effects of Qi-Training on Heart Rate Variability

Myeong Soo Lee
Department of Qi-Medicine, Institute of Biotechnology, School of Medicine, Wonkwang University, Iksan, 570-749, Korea

Hwa Jeong
Departme

Byung Gi
Departme

Hoon Ryu
Departme

Ho-Sub Le
Departme

Jong-Moor
Departme

Hun-Tae Chung
Correspondence to: Dr. Hun-Taeg Chung, Department of Microbiology and Immunology, School of Medicine, Wonkwang University, Iksan 570-749, Republic of Korea. Tel: (+82) 63-850-6762, Fax: (+82) 63-851-5066
Department of Qi-Medicine, Institute of Biotechnology, School of Medicine, Wonkwang University, Iksan, 570-749, Korea
Department of Microbiology and Immunology, School of Medicine, Wonkwang University, Iksan, 570-749, Korea

These results support the hypothesis that Qi-training increases cardiac parasympathetic tone. In addition, Qi-trainees were found to have higher parasympathetic heart modulation compared with their age-matched, sedentary counterparts.

This study investigates changes in autonomic nervous function through Qi-training. The power spectrum of heart rate variability (HRV) was examined in 20 sedentary healthy subjects and 20 Qi-trainees. It was found that Qi-training in healthy young subjects during controlled respiration increases the high frequency (HF) power and decreases the low frequency / high frequency (LF/HF) power ratio of HRV. These results support the hypothesis that Qi-training increases cardiac parasympathetic tone. In addition, Qi-trainees were found to have higher parasympathetic heart modulation compared with their age-matched, sedentary counterparts. This augmented HRV in Qi-trainees provides further support for long-term Qi-training as a possible non-pharmacological cardio-protective maneuver. In conclusion, Qi-training may stabilize the autonomic nervous system by modulating the parasympathetic nervous system.

Food and Supplements

Nervous System – top down

- Neuro-transmitter balancing

Endocrine – bottom up

- Adrenal
- Thyroid
- Gonadal

Mitochondria - energy

- Krebs Cycle & bioenergetic pathways
- Antioxidant and detoxification support

Base nutrition

Focus on

- **Proteins** – meat, poultry, fish, eggs, dairy, legumes, nuts, seeds, wholegrains
- **Carbs** – wholegrains, vegetables & fruit. Choose mostly low Glycaemic Index foods
- **Fats** – Monounsaturated (olive oil, avocado), Polyunsaturated (nuts, seeds, fish) and moderate Saturated (animal & dairy products)
- **Vegetables** – mixed colours & textures: raw or lightly cooked
- **Fruits** – in moderation
- **Salt** – Sea, Celtic or Himalayan in moderation

Avoid/limit

- Sugar
- Refined grains
- Chocolate
- Hydrogenated Oils
- Processed Oils
- Foods that you are allergic or sensitive to
- Alcohol
- Caffeine
- Soft Drinks
- Eating against your genotype

Nutrients & Supplements

- **Adrenal support** - adaptogens, Vits B5, B6, B12 & C, zinc, magnesium, l-tyrosine, phenylalanine, cordyceps mushroom, liquorice, selenium, glandulars….
- **Thyroid support** - adaptogens, iodine, zinc, selenium, rosemary, glandulars, desiccated thyroid….
- **Calming HPA axis** - phosphatidyl serine, l-threonine, l-taurine, magnesium, calcium, inositol, GABA, ginger….
- **Blood sugar balance** - adaptogens, B-vitamins, chromium, vanadium, cinnamon, alpha lipoid acid, fenugreek….
- **Mitochondria** - B-vitamins, alpha lipoid acid, magnesium, manganese, l-cysteine, CoQ10….

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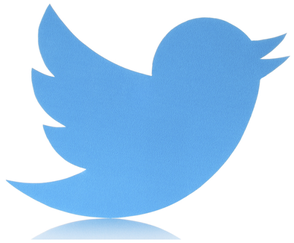

@ian_tNI

Any Questions?

We have already received quite a number of questions and we will now try and answer as many as possible in the time remaining.

Any that remain unanswered will be forwarded to Ian and he'll try and email you a reply in due course.

Join Us Next Time

This was the second webinar of a 4 part series by Ian Craig

Join us for the 3rd part on Wednesday 22nd March 2017 for the next webinar:

“DIY sports drinks and gels that nourish, not deplete”

You can find details on the Human Kinetics website at:

www.humankinetics.com/webinars

Thank you for joining us

Thank you to everyone for joining us today and thanks also to Ian for such an interesting presentation.

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Thank you again for your participation, enjoy the rest of your day.