

# Masters Athlete Matters

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"If anyone sees me going anywhere near a boat again they have my permission to shoot me."

Sir Steve Redgrave immediately after winning an Olympic Gold medal in 1996

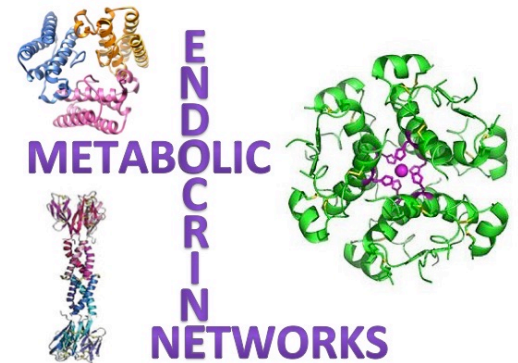


He returned to win another Olympic gold medal in 2000

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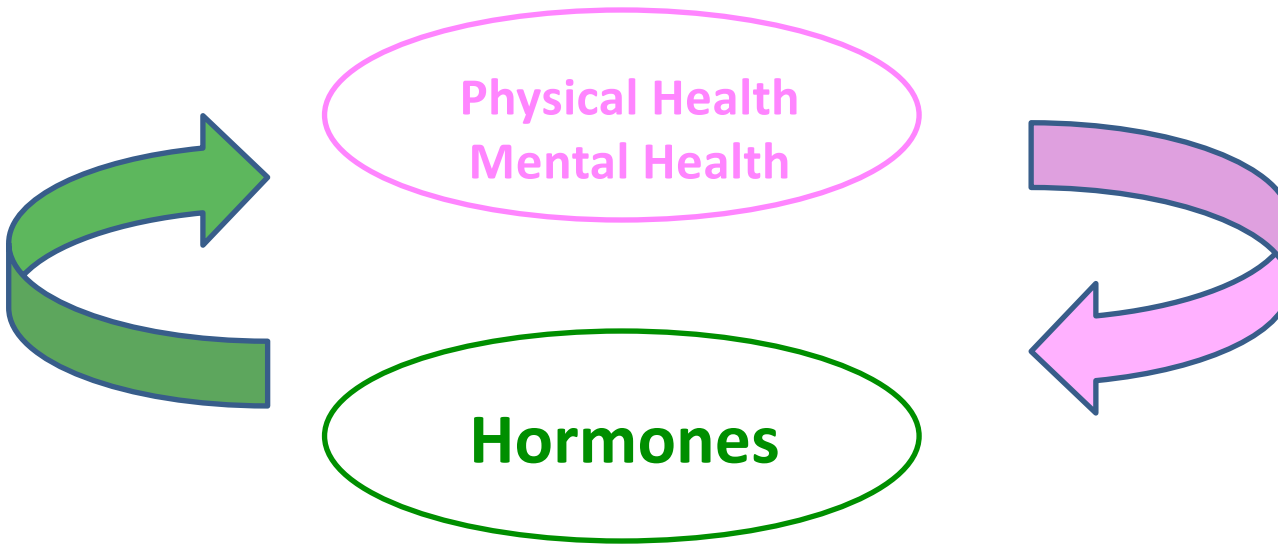
- Hormones “setting in motion”
- Harnessing hormones
- Hormone odyssey
- Adapting athlete behaviours with hormone changes
- Misunderstandings: REDs
- Peri and menopause. HRT
- Chronic conditions
- Positive conclusions



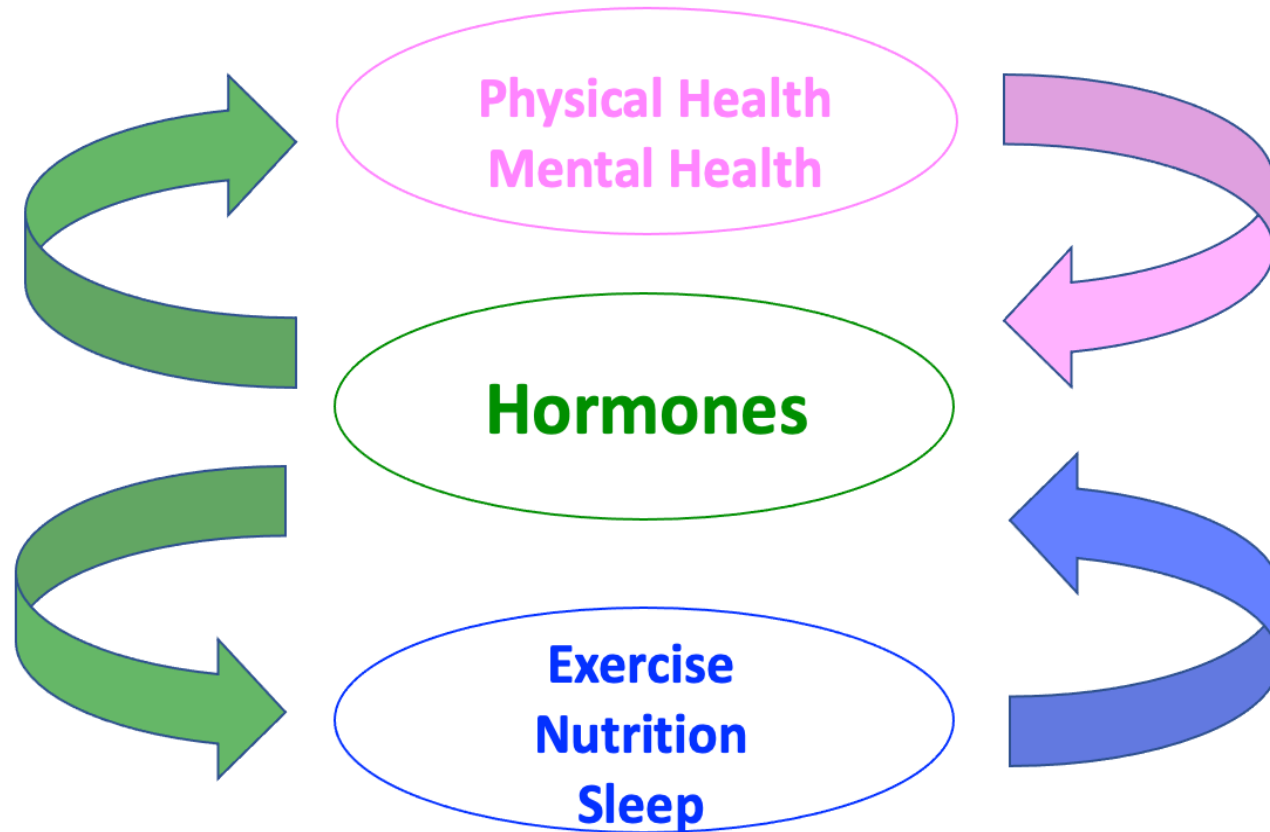
# Hormone

ὁρμῶν (hormon)

“Setting in motion”

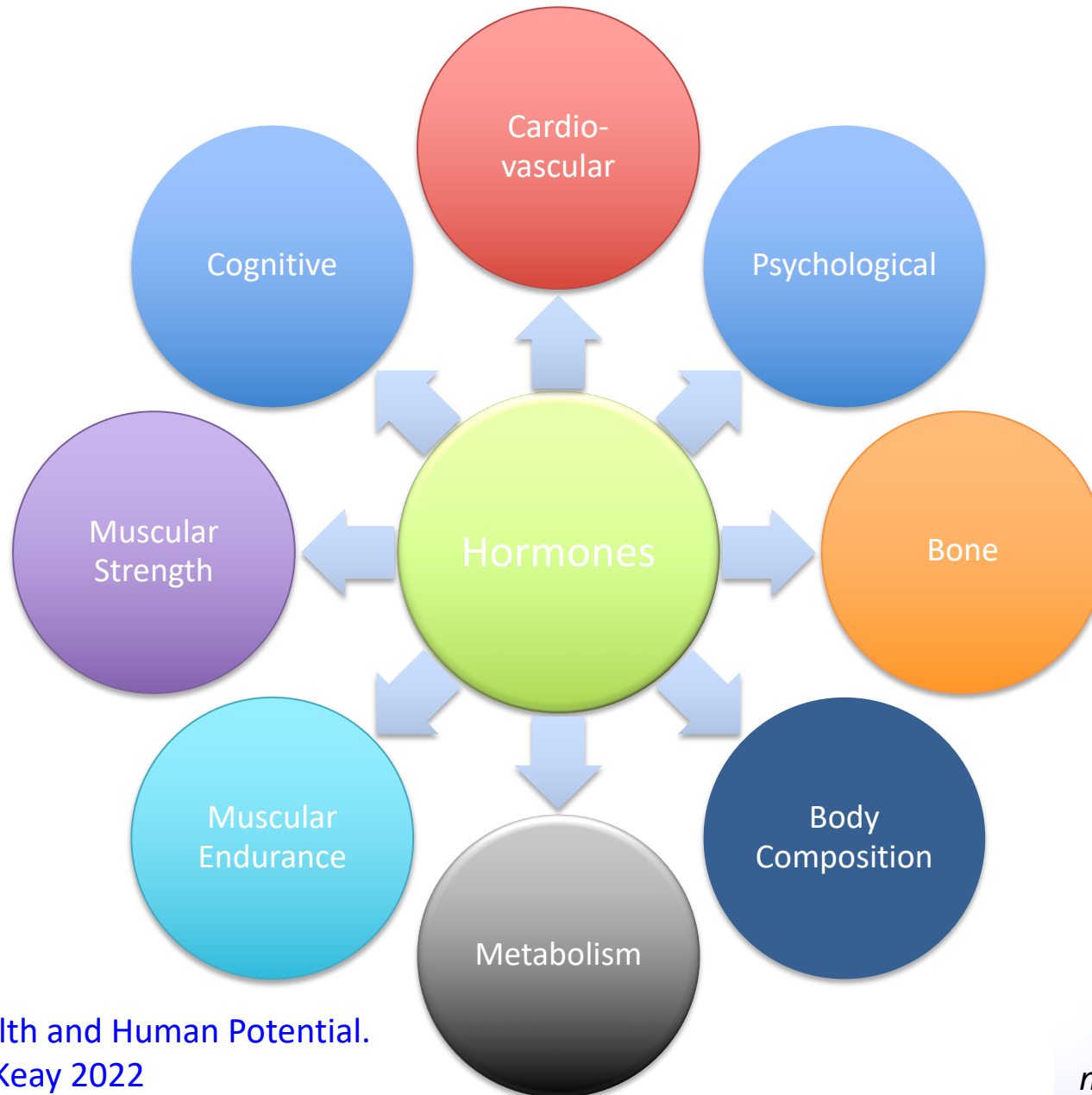


# Harnessing Hormones

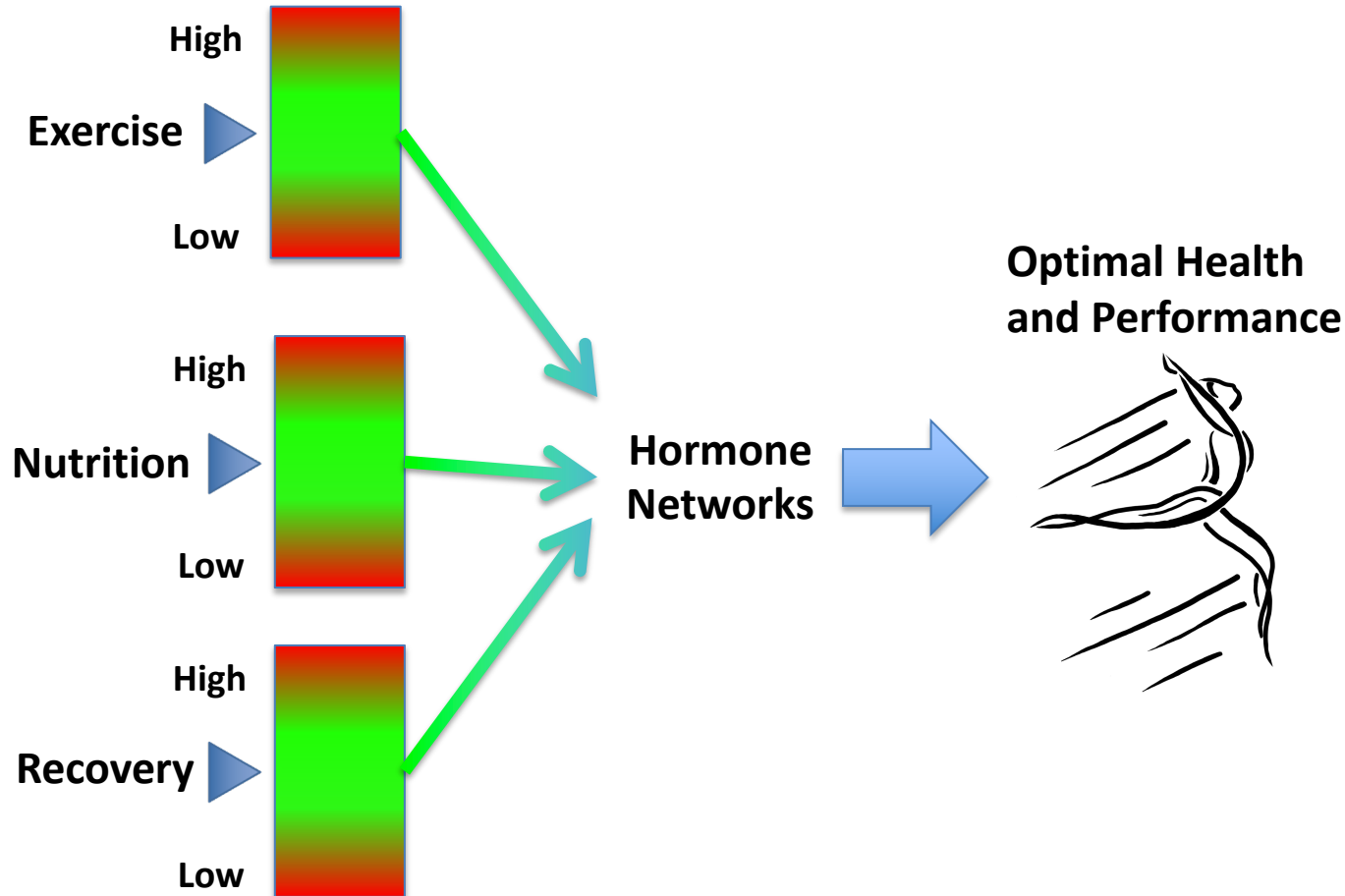


**Internal/external feedback loops**

# Endocrine Network Effects of Exercise

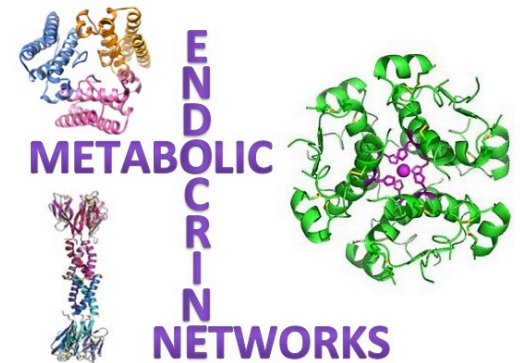


# Harnessing hormones to optimise health and performance over your lifespan



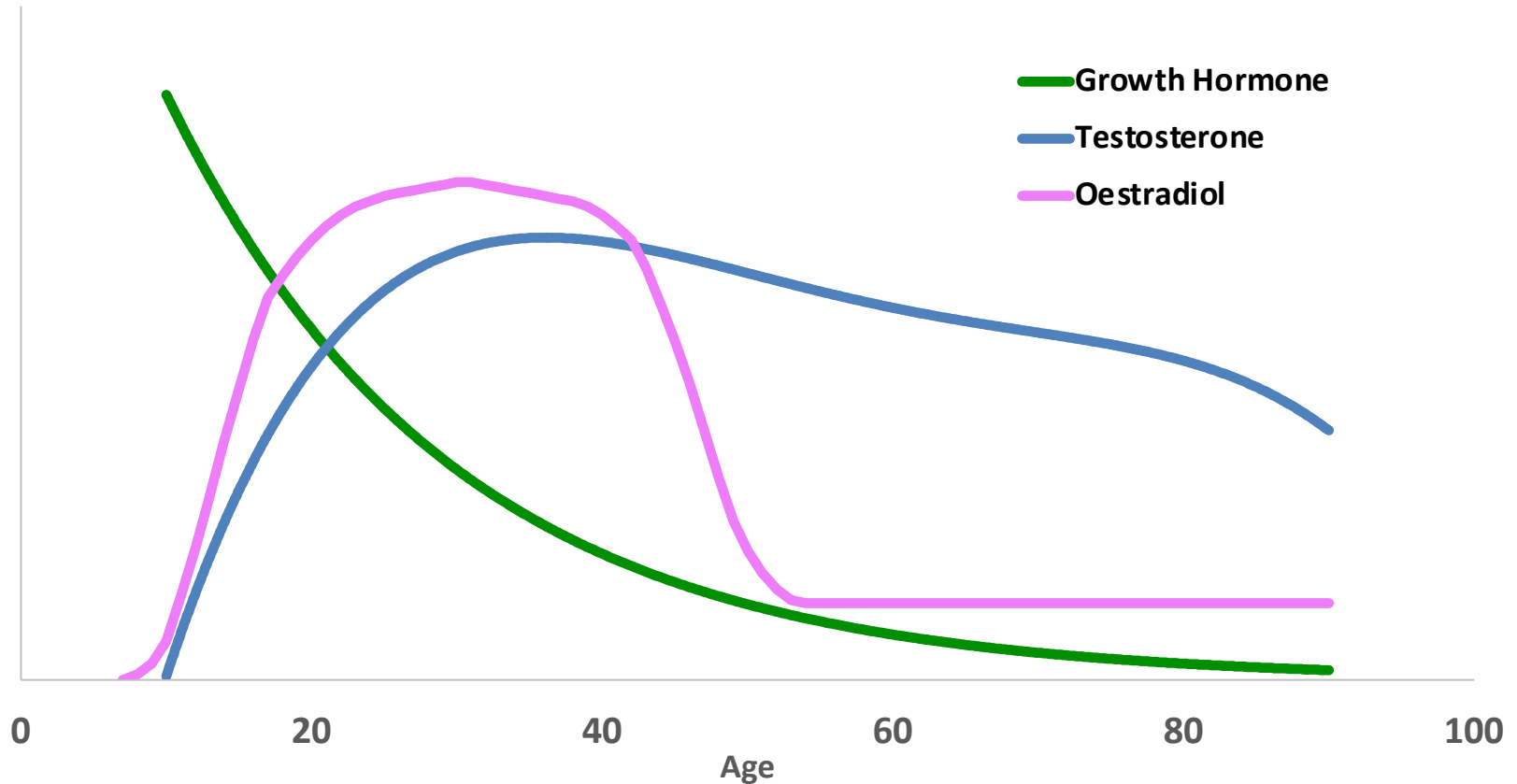
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# Decline of Anabolic Hormones with Age



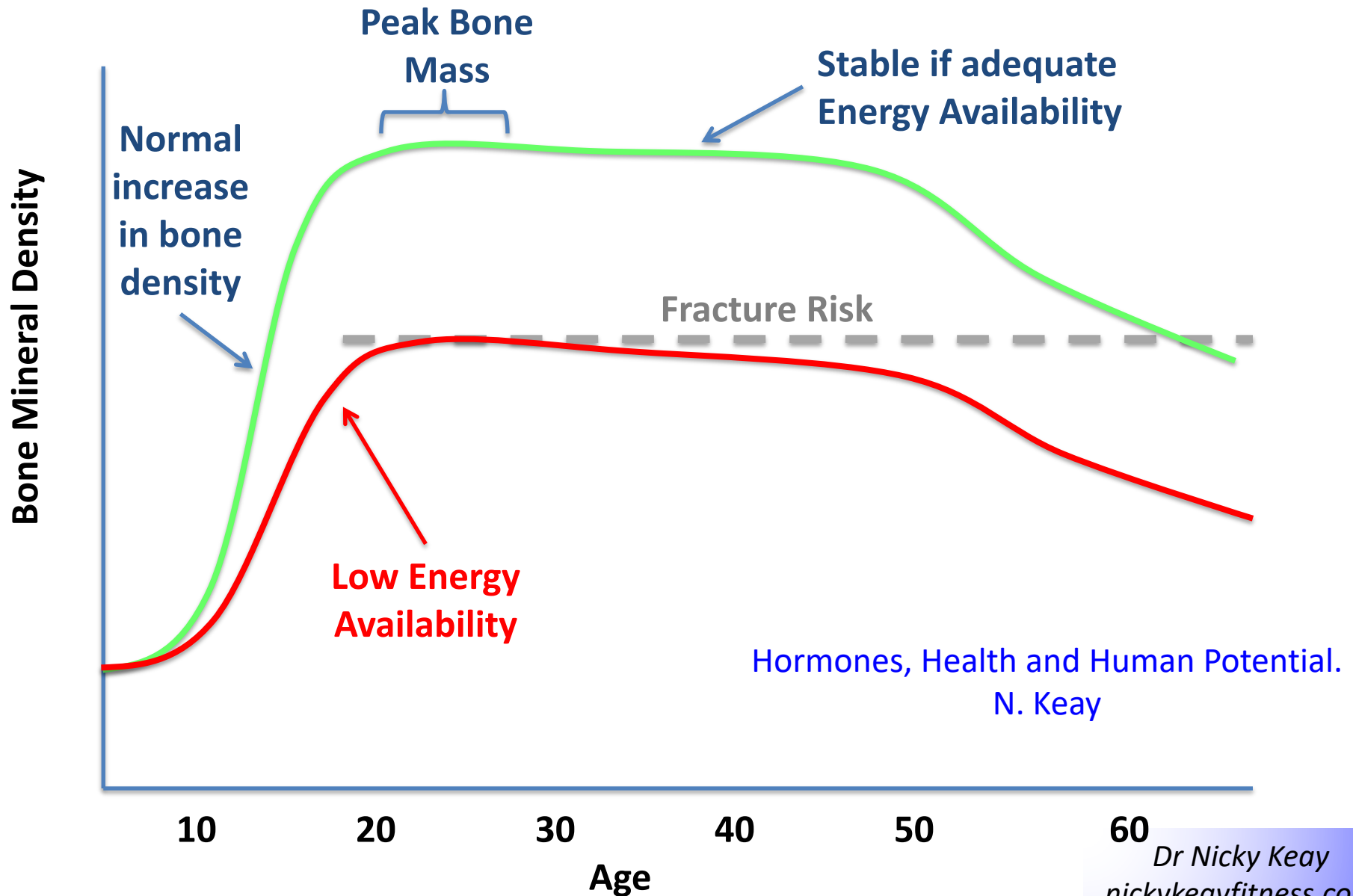
# Challenges of decline in anabolic hormones

- **Response to training decreased**
  - CVS
  - Energy systems reduced anaerobic capacity
- **Body Composition**
  - Lean body mass metabolically active (bone, muscle, organs)
  - Fat (subcutaneous and visceral)
- **Quality of tissues musculoskeletal system**
  - Muscle, tendon, ligaments
  - Bone

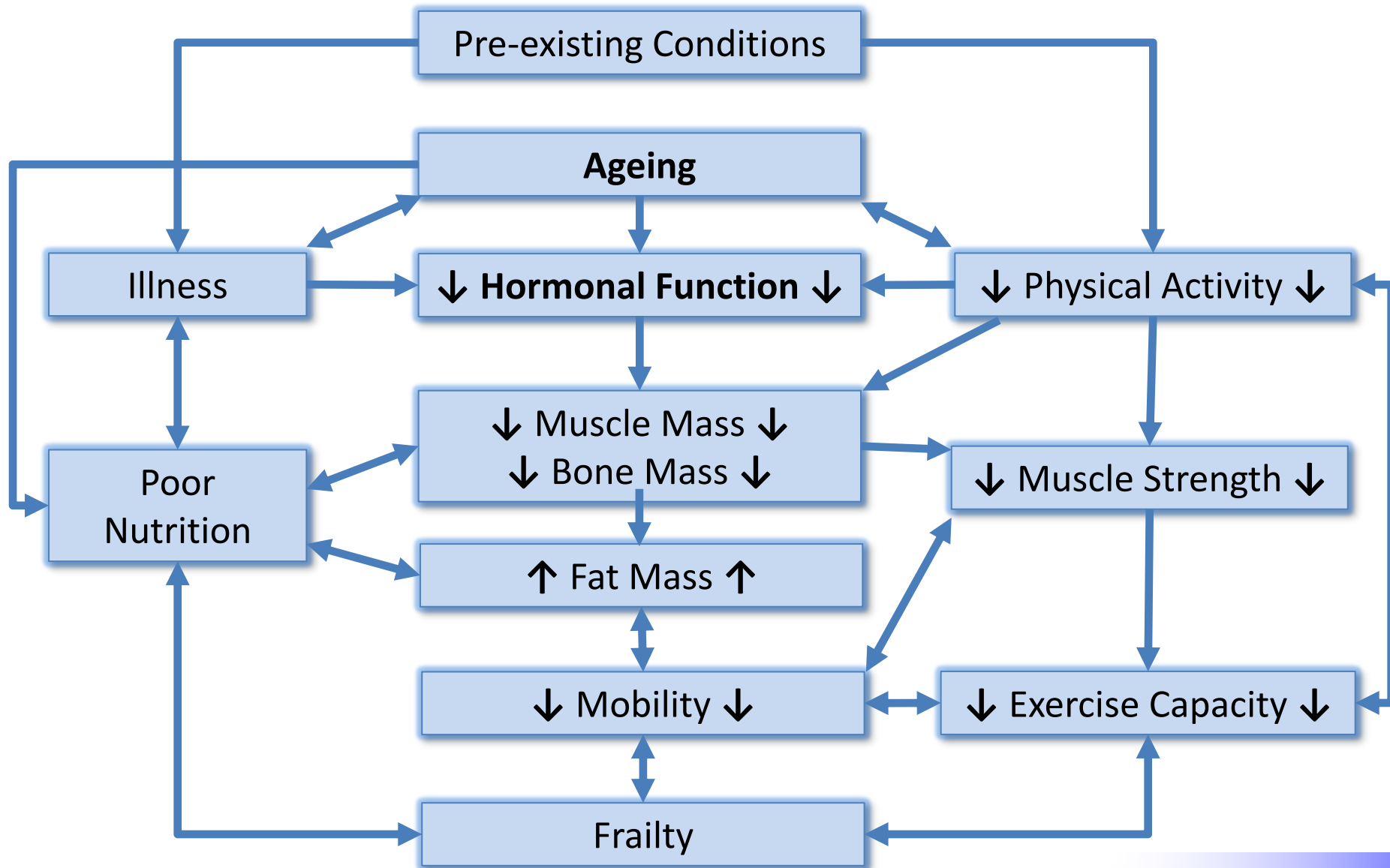
***Potential increased risk injury in master athletes***



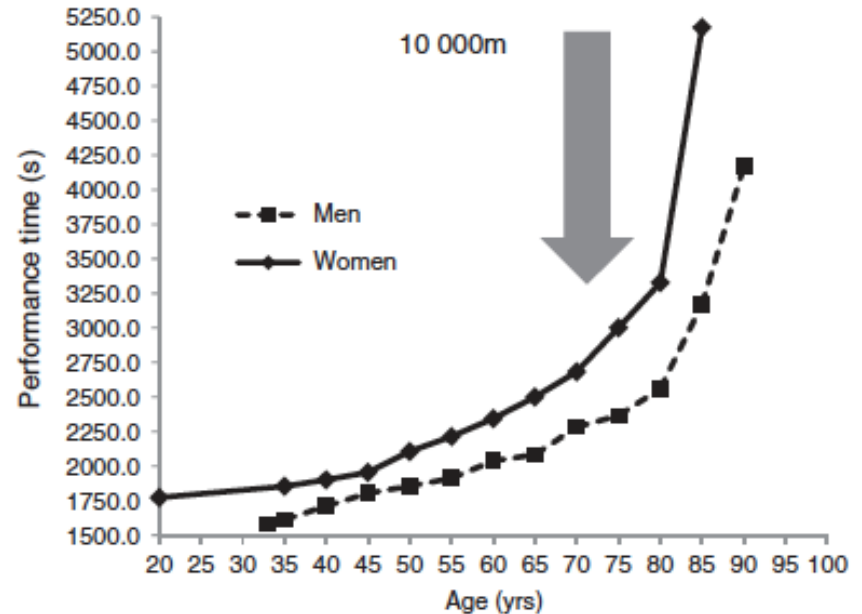
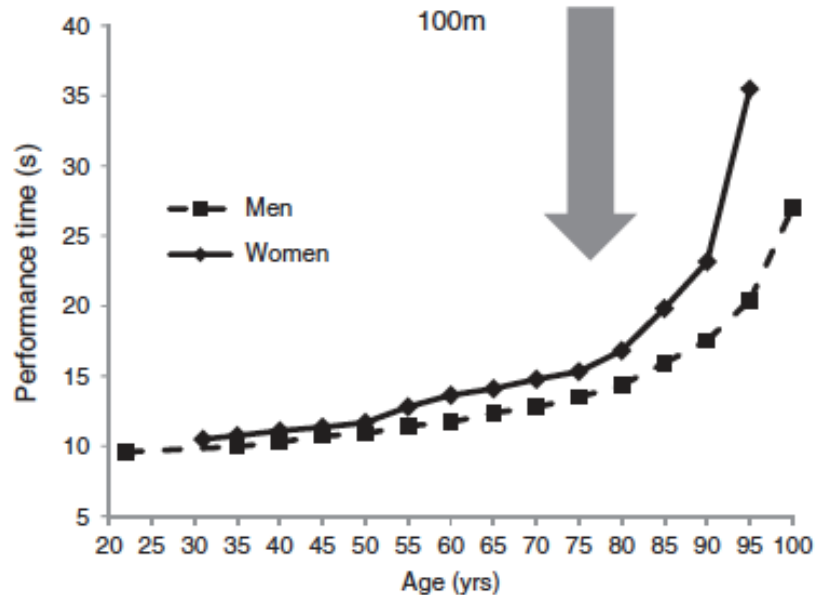
# Bone Mineral Density with Age



# Model of Ageing, Hormones and Physical Function



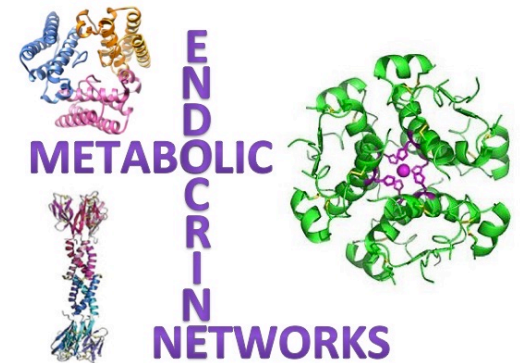
# Performance of Masters Athletes



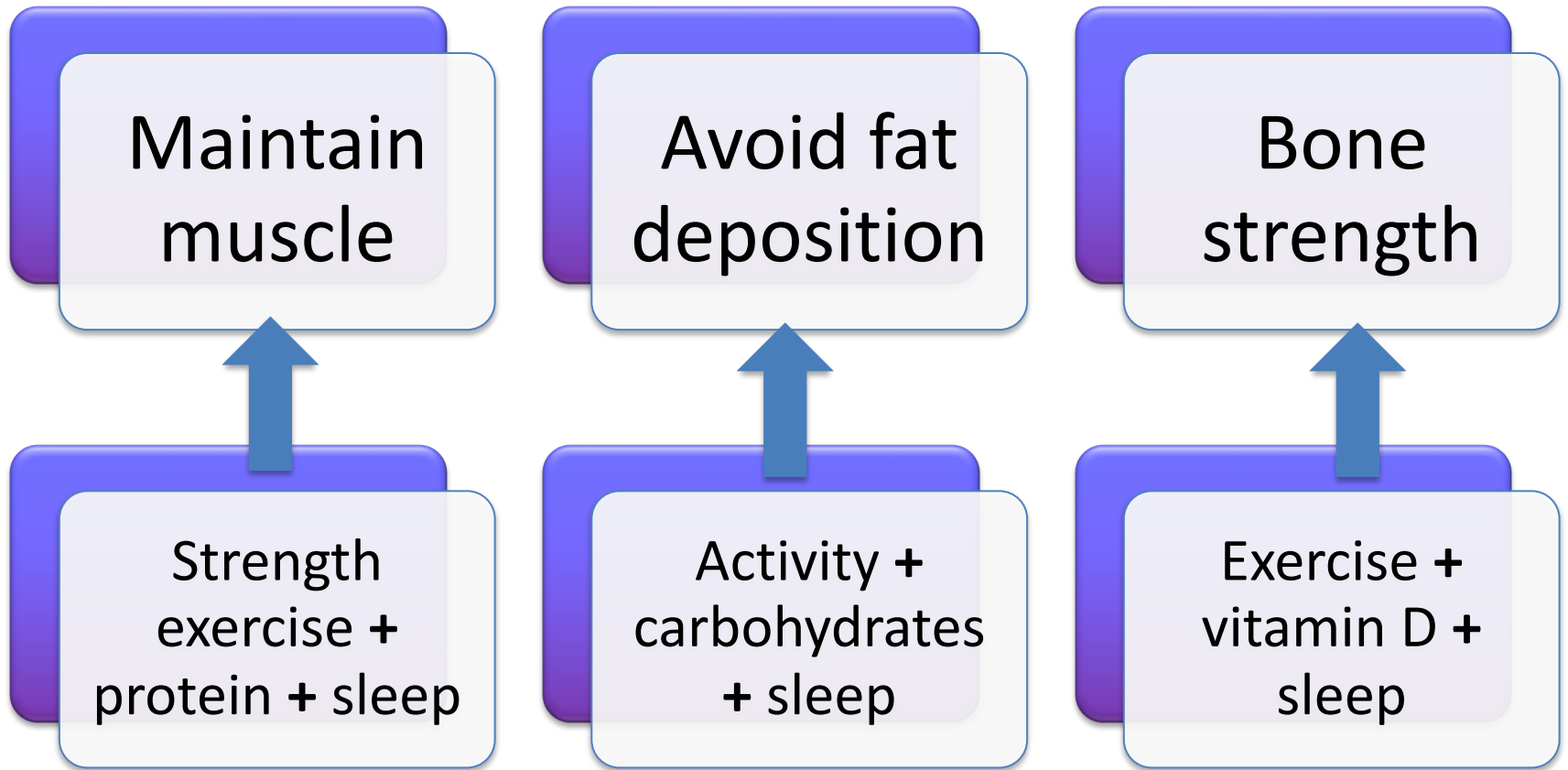
- Linear decline performance with age, until 80yrs
- Reflects effects **ageing** without confounding aspects of inactivity
- **Threshold of exercise** level to age optimally & extend healthspan

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# Adapting to declining Anabolic Hormones



# Sleep



## ***“Chief nourisher in life’s great feast”***

- You get fitter when you are asleep!
- Pulsatile release of hormones eg GH
- “Sleep hygiene” includes bedtime milk drink:
  - casein protein for muscle repair
  - precursor tryptophan for synthesis sleep hormone melatonin
- Mental refresh
- Avoid circadian misalignment and risk metabolic syndrome



# Training Schedule



- **Longer dynamic warm up**
- **Type of training** for max **anabolic stimulus** for hormone production (GH & testosterone)
  - Intensity intervals and polarisation
  - Strength work for favourable body composition (lean, fat, bone) (BJSM 2017)
- **Type of training** for prevention decline **muscle fibre type II** “fast twitch” with age & denervation due disuse
- **Recovery** for training response

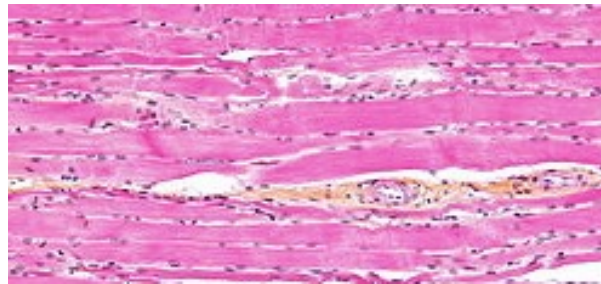
Royal Society of Medicine conference 2017 “Ageing Athlete”

Pedal Power conference 2018 “Strategies to Protect and Strengthen Ageing Skeletal Muscle” Gordon Wright

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# Training type for skeletal muscle

- 16 men average age 72 years v 14 men average age 26
- 12 week supervised resistance sessions with 4 sets of 8 reps at 80% of 1RM (1 rep. max) of leg press and extension.
- Significance differences at baseline between age groups in terms muscle fibre size and capillary density. No difference between age groups after resistance training!



- Increase in type II muscle fibre size (sprint)
- Increase capillary bed density in type II and in type I (slow twitch) (endurance)

Verdijk L et al. Resistance training increases skeletal muscle capillarization in healthy older men. Med and Sci in Sports and Exercise, 2016

# Nutrition



Muscle protein breakdown > muscle protein synthesis =  
sarcopenia

**Protein intake + anabolic training stimulus = mitigate  
sarcopenia**

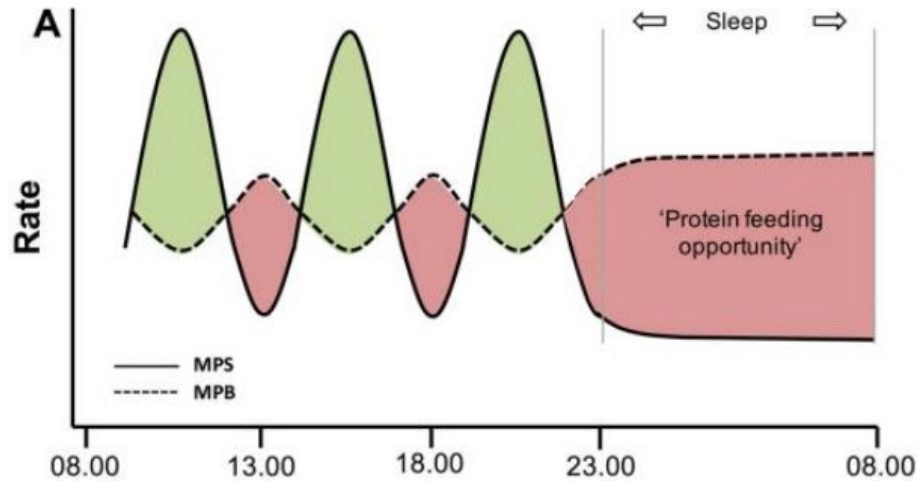
## Protein intake

- 1.2 – 1.5 g / kg / day. 70kg athlete = 84 – 105 g of protein per day
- Timing crucial. Daily intake split into 20-25 g portions of protein every 3-4 hours, ideally after an anabolic signal to avoid prolonged periods of MPB (muscle protein breakdown)

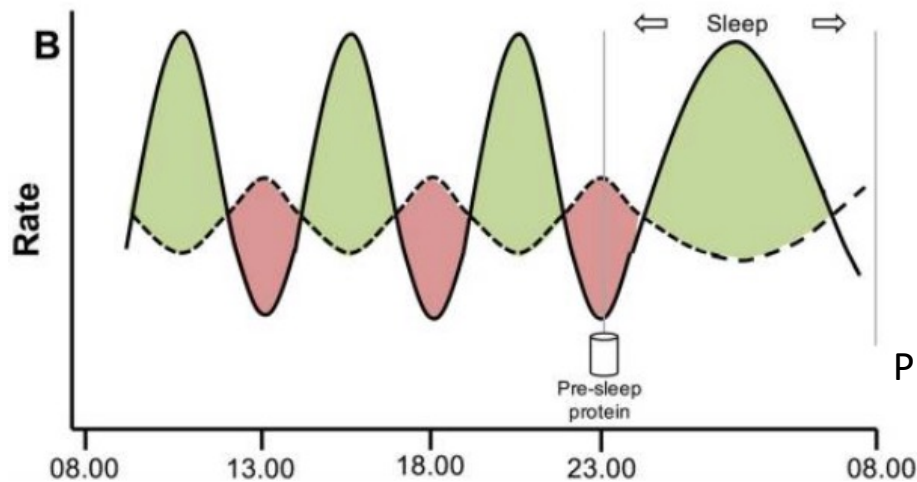
Traylor A et al. Perspective: Protein requirements and optimal intakes in aging: Are we ready to recommend more than the recommended daily allowance? *Advances in Nutrition*, 2018.

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# Pre-Sleep Protein



MPS= muscle protein synthesis  
MPB= muscle protein breakdown



Pre sleep protein 40mg caesin

Trommelen J, van Loon L. Pre-sleep protein ingestion to improve the skeletal muscle adaptive response to exercise training. *Nutrients*, 2016

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# Bone



Bone turnover: formation and resorption

Resorption > formation = bone loss

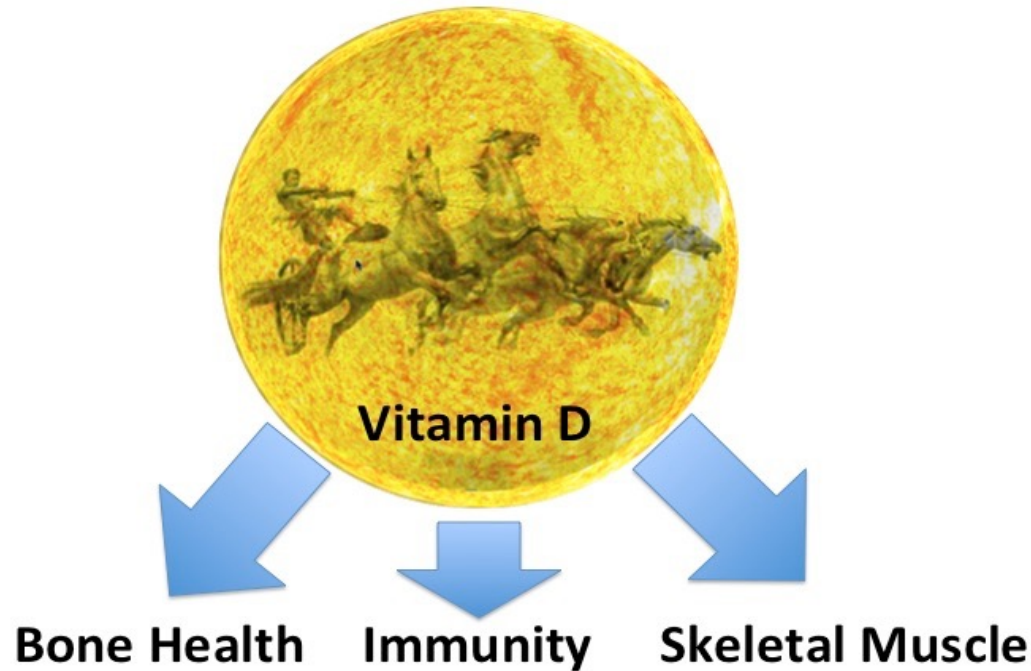
**Nutrition and multidirectional loading skeleton = mitigate bone loss**

- Nutrition:
  - Energy availability
  - Timing around training pre and post
- Multidirectional loading



# Vitamin D

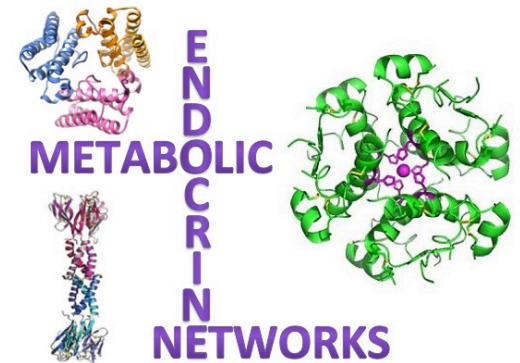
## Steroid Hormone



Hormones, Health and Human Potential. Keay 2022

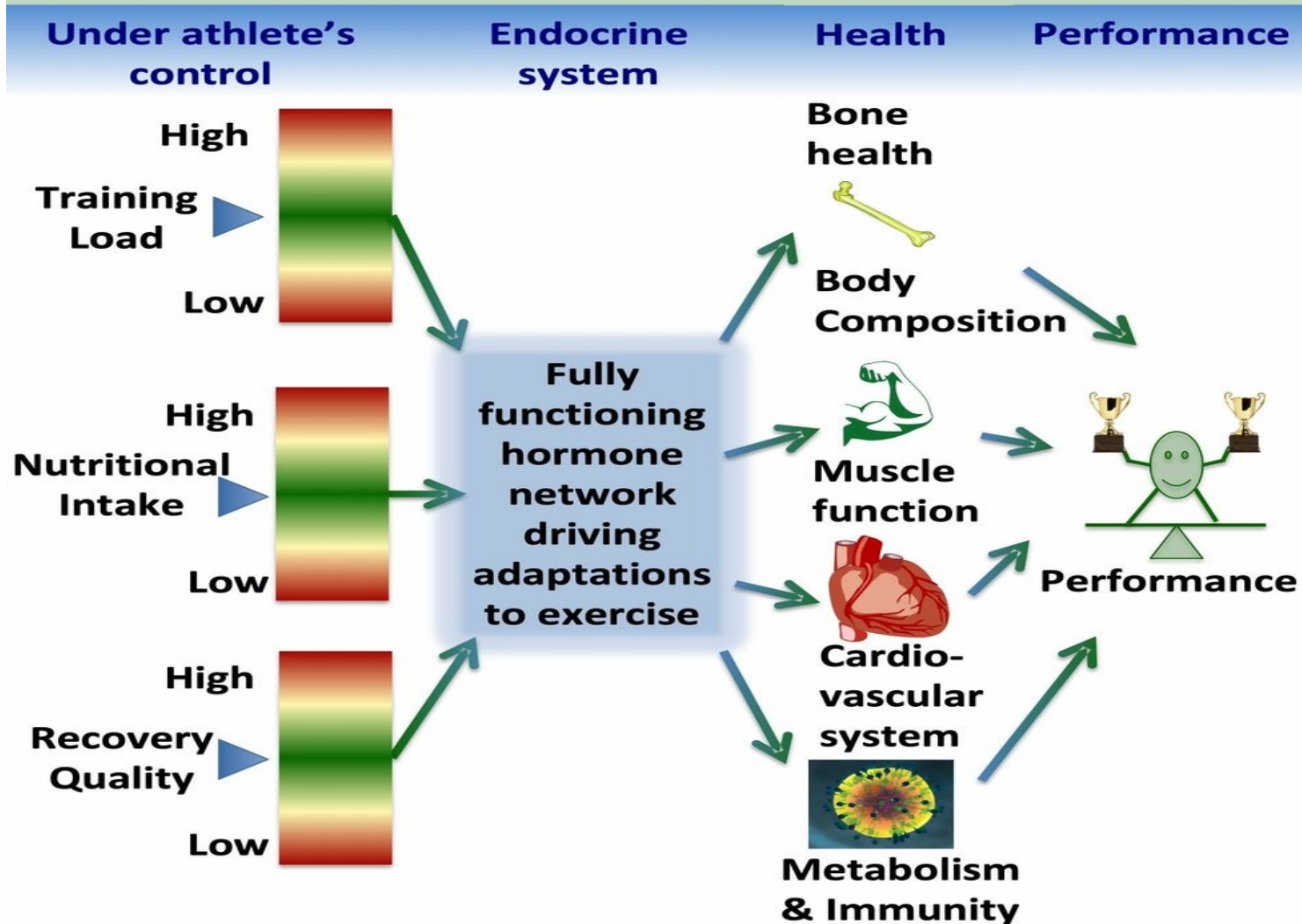
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# Energy Availability Consequences Health and Performance



**Adequate Energy Availability maintains a fully functional hormone network to drive positive adaptations to training, leading to positive health and performance outcomes**

Dr Nicky Keay: [nickykeayfitness.com](http://nickykeayfitness.com)

Nicola Keay, and Gavin Francis Br J Sports Med doi:10.1136/bjsports-2019-100611

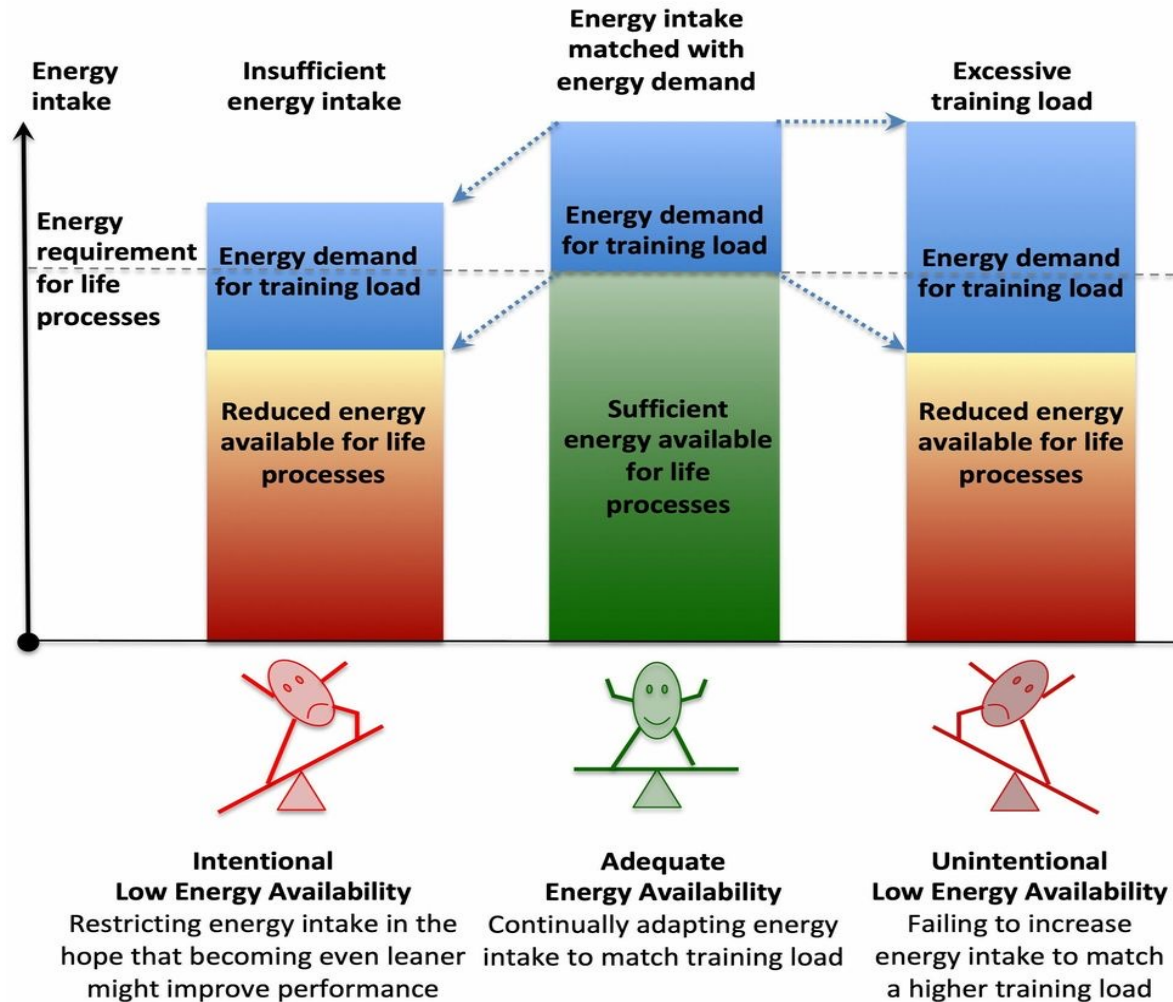
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# Energy Availability Concept

## Matching Energy Intake with Energy Demand



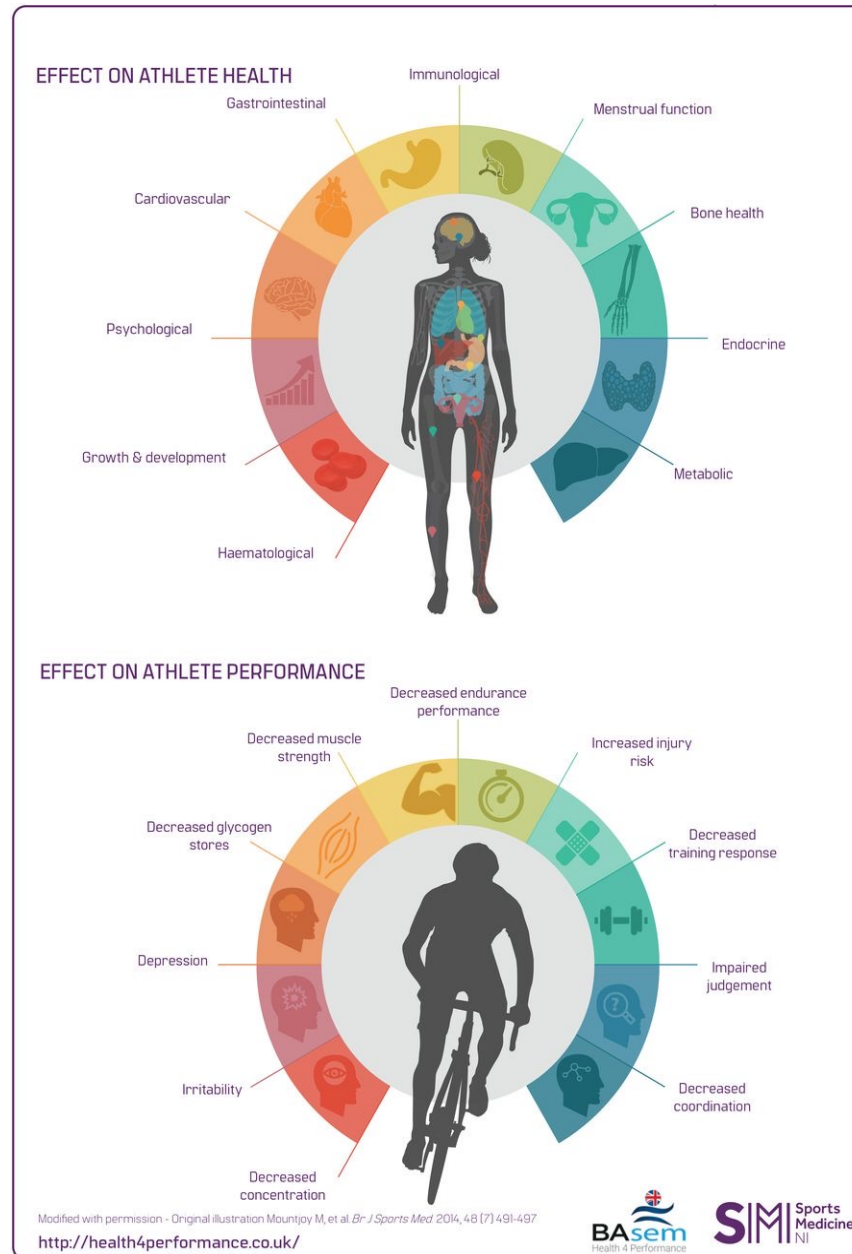
**Low Energy Availability forces the body to trigger hormonal responses that adversely affect normal life processes, leading to negative health and performance consequences**

Dr Nicky Keay: [nickykeayfitness.com](http://nickykeayfitness.com)

Nicola Keay, and Gavin Francis Br J Sports Med doi:10.1136/bjsports-2019-100611

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# Significance of relative energy deficiency in sport (RED-S)





# Weight and Body Composition

- **Myths**

- Restricting carbohydrates
- Skipping breakfast
- Intermittent fasting
- Fasted training

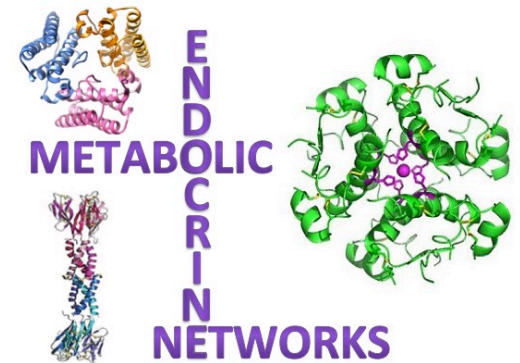
- **Consequences**

- Increased cortisol (catabolic)
  - Increased fat deposition
  - Additional down-regulation of anabolic hormones
  - Disturbed sleep
- Disruption of appetite hormones
- Disturbance of thyroid function
  - Weight regulation problems



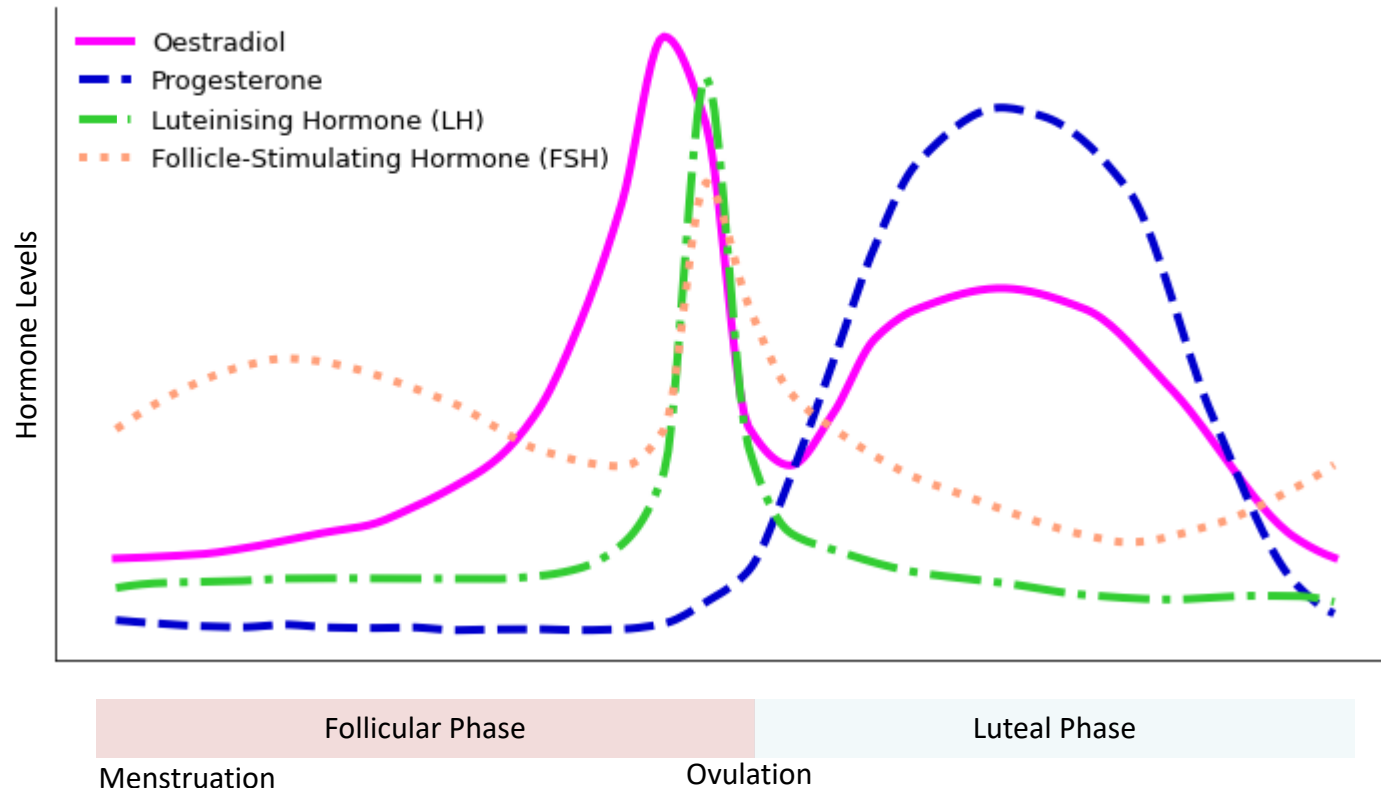
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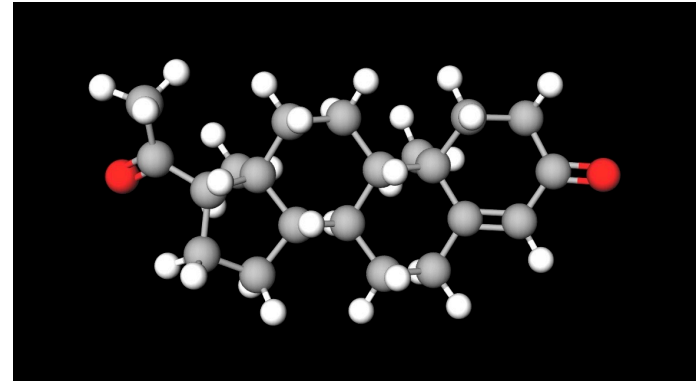
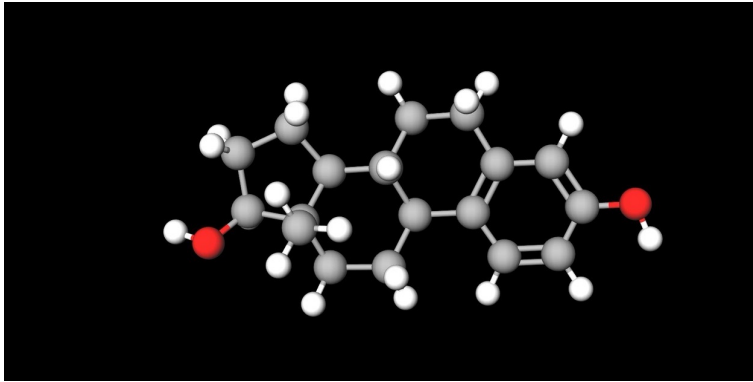


# Όρμή (Horme)

## Goddess of effort, energy, and action



# What's so good about female hormones?



**Oestrogen and progesterone** female sex steroids important for:

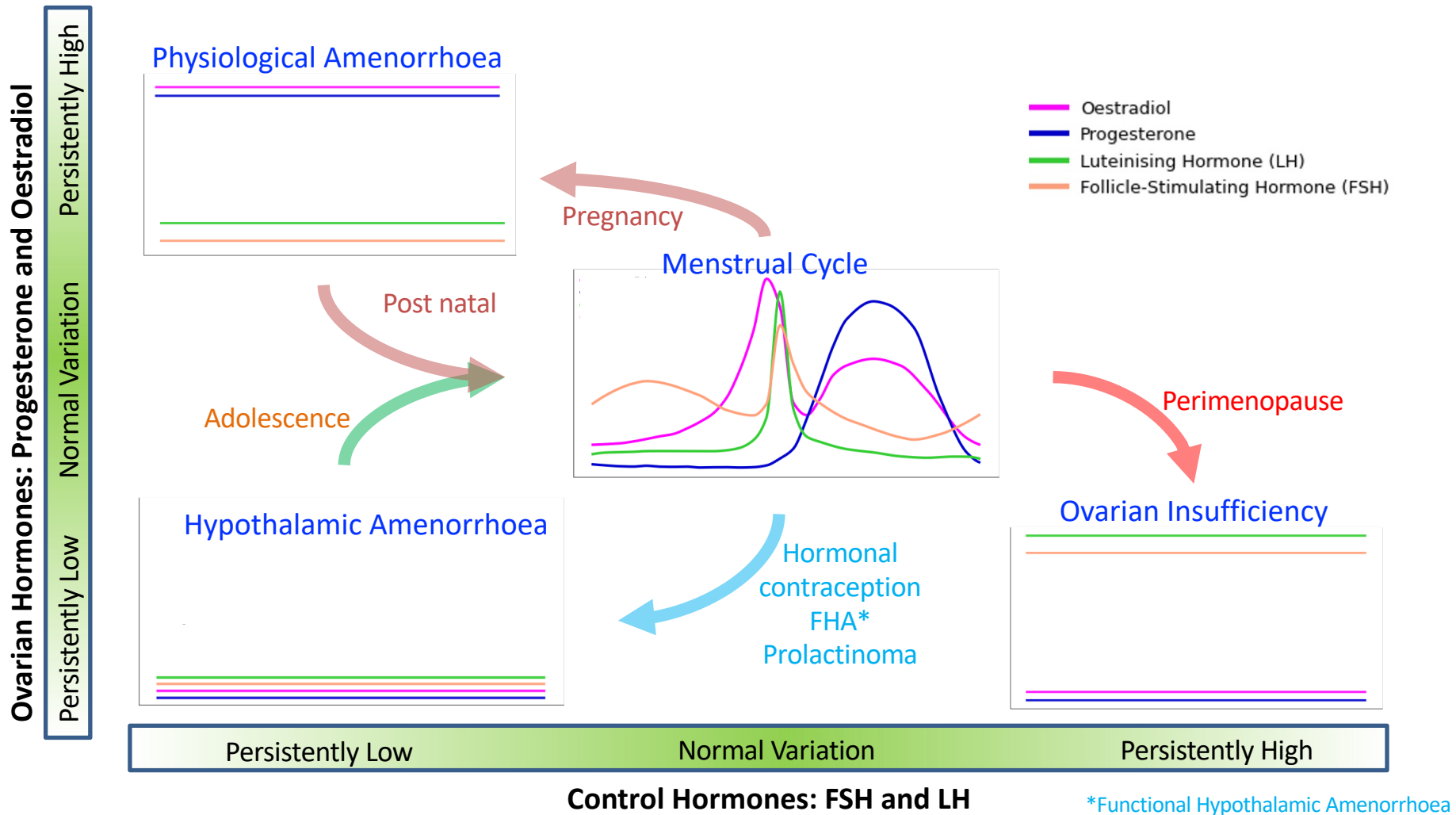
- Bone and soft tissue health: increased bone AND soft tissue injury risk (*Med & Sc in Sports & Exercise 2017*)
- Cardiovascular health: adverse lipid profile, endothelial dysfunction, autonomic dysfunction blood pressure and heart rate (*J Cl Invest 2014*)
- Neurological function: neurotransmitters and neuromuscular control and cognitive function (*Melin et al, Med Sc Spots & Exercise 2017*)
- Response to exercise: cardiovascular and musculoskeletal (*Proc Nutr Soc*)

Periods for health and performance. Keay BJSM 2019

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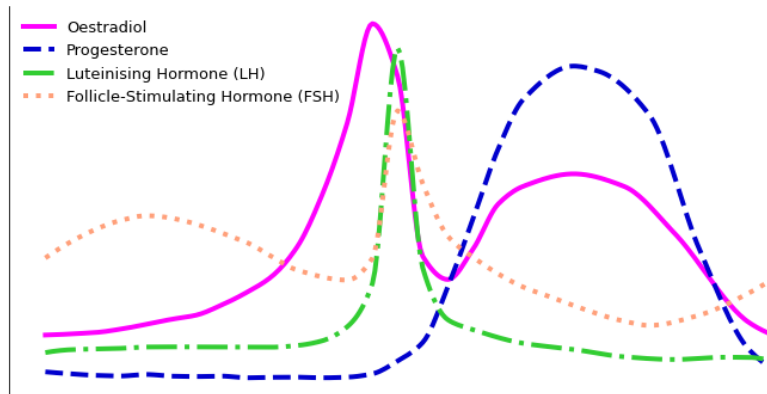


# Female Hormone Odyssey

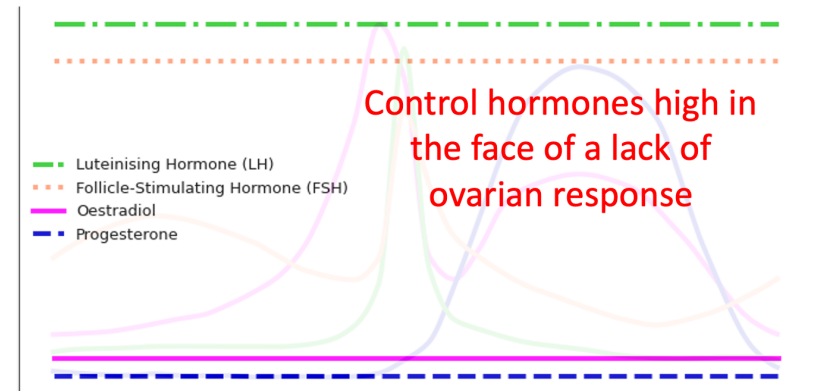




# Changes in Female Hormones



Reproductive years



Menopause

# Why is this an important population to consider?

- All women will experience menopause
- Increased life expectancy: up to third life in menopausal status
- Reduced ovarian hormones
  - Reduced quality of life
  - Increased risk cardiometabolic disease
  - Increased risk of osteoporosis
- Significant for individual and society and economy as a whole
- Increasing numbers of master athletes
- Lifestyle and medical approaches can help



Hamoda H, Moger S. Looking at HRT in perspective *BMJ Editorial* 2022

# Ovarian Responsiveness

- **Peri menopause** from age around 40 years ovaries become less responsive
  - Produce less female hormones in a more erratic manner
  - Anovulatory cycles
- **Menopause** when ovaries do not respond
  - Lack of any menstrual periods 12 months
  - Retrospective diagnosis
  - Average age 51 years (range 45-55 years)
  - Consequences: quality of life and health
- **Action!** Lifestyle priority
  - Exercise (for symptoms and long-term health)
  - Nutrition
  - Sleep

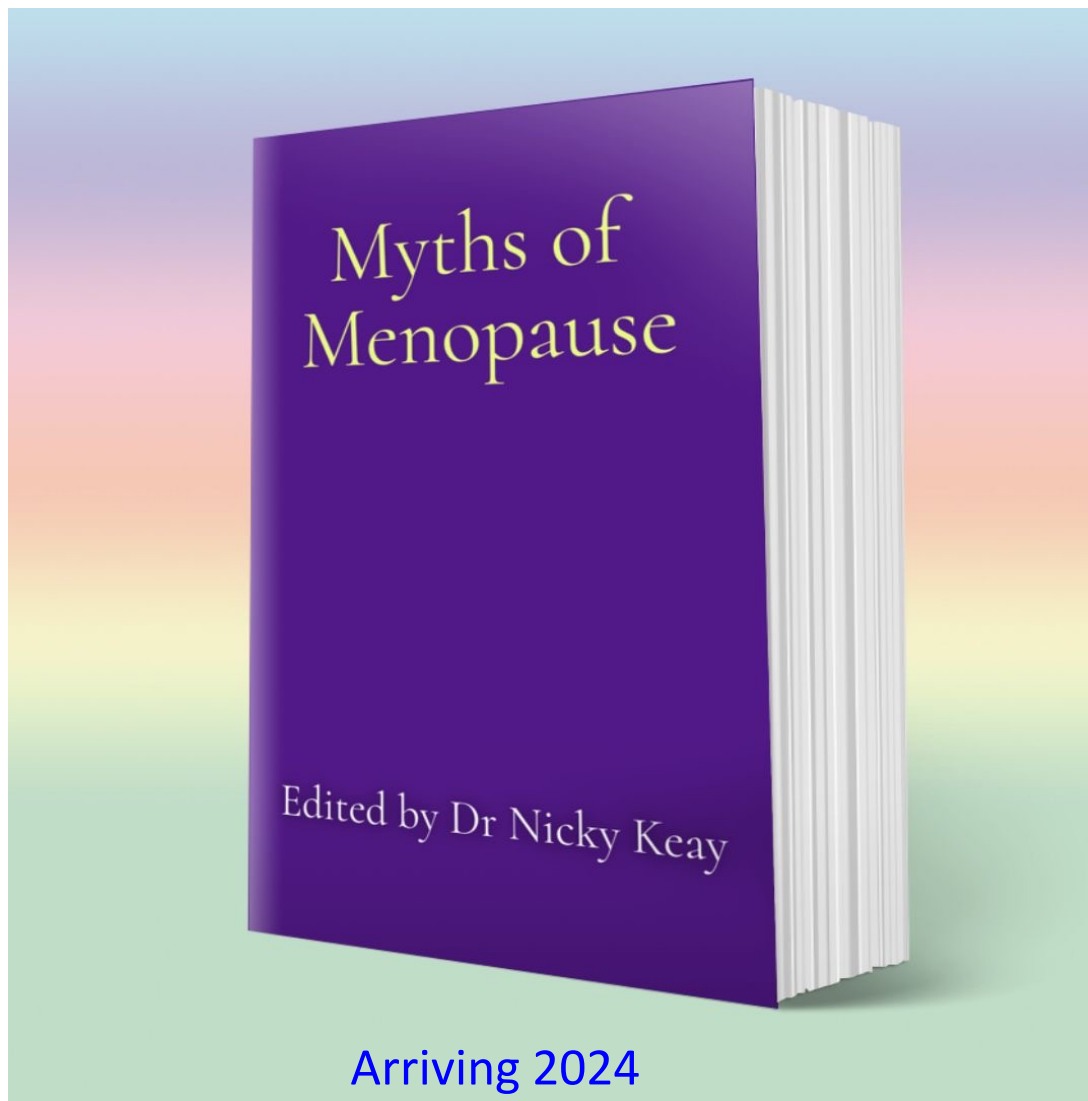


# Hormone Replacement Therapy (HRT)

**Priority: quality of life**

For those in whom not contra indicated. Risk: benefit ratio

- Decrease overall mortality
- Extra 4 cases breast cancer per 1,000 women 50-59 years with HRT. Same as taking COCP or drinking >2 units per day
- 24 extra cases breast cancer if adverse lifestyle factors
- 7 fewer cases if taking 2+ hours moderately intense exercise per week
- Most effective start HRT asap menopause
- Transdermal oestradiol best metabolic health and micronised progesterone lowest risk breast cancer
- Note testosterone not permissible under WADA regulations

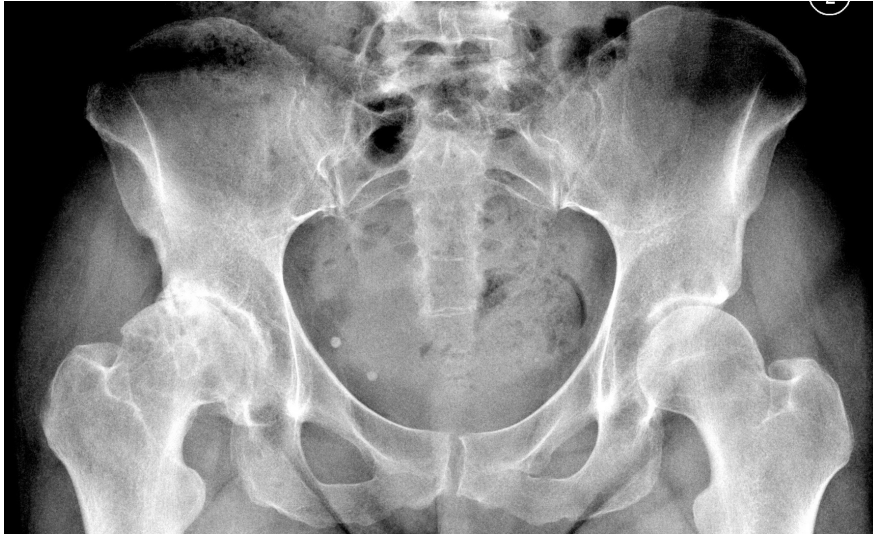


Arriving 2024

National Menopause education and support network programme UCL. Backed by  
British Menopause Society and Royal College Obstetrics and Gynaecology

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# Chronic Medical Conditions

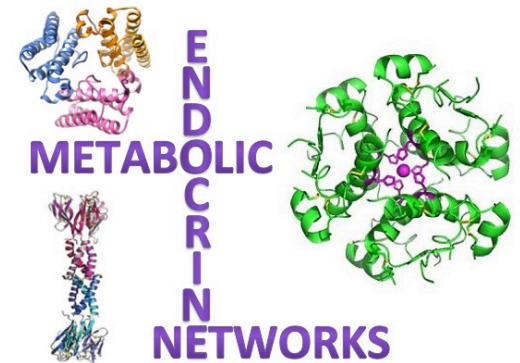


- Increase likelihood with age
- Medical/surgical interventions

Maintaining health and fitness

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# Competitive sprint finish 30 year age gap



At end of 2 hour off road duathlon father regrets handing over last gel to his son....



# References

- Keay N. Hormones, Health and Human Potential. *Sequoia books* 2022
- Impey S et al. Fuel for the work required: A theoretical framework for carbohydrate periodization and the glycogen threshold hypothesis. *Sports Medicine* 2018
- Keay N, Francis G. Infographic. Energy availability: concept, control and consequences in relative energy deficiency in sport (RED-S) *British Journal of Sports Medicine* 2019;53:1310-1311.
- Keay N, Rankin A. Infographic. Relative energy deficiency in sport: an infographic guide *British Journal of Sports Medicine* 2019;53:1307-1309.
- Traylor A et al. Perspective: Protein Requirements and Optimal Intakes in Aging: Are We Ready to Recommend More Than the Recommended Daily Allowance? *Advances in Nutrition*, 2018
- Trommelen J et al Pre-sleep protein ingestion to improve the skeletal muscle adaptive response to exercise training *Nutrients* 2016
- Mountjoy M et al 2023 International Olympic Committee's (IOC) consensus statement on Relative Energy Deficiency in Sport (REDs) 2023 *British Journal of Sports Medicine* 2023; 57:1073–1097.
- Keay N, Francis G, Entwistle I, et al Clinical evaluation of education relating to nutrition and skeletal loading in competitive male road cyclists at risk of relative energy deficiency in sports (RED-S): 6-month randomised controlled trial *BMJ Open Sport & Exercise Medicine* 2019;5:e000523. doi: 10.1136/bmjsem-2019-000523
- Keay N, Francis G, Hind K Low energy availability assessed by a sport-specific questionnaire and clinical interview indicative of bone health, endocrine profile and cycling performance in competitive male cyclists *BMJ Open Sport & Exercise Medicine* 2018;4:e000424. doi: 10.1136/bmjsem-2018-000424
- Hamoda H, Moger S. Looking at HRT in perspective *BMJ Editorial* 2022; 377 doi: <https://doi.org/10.1136/bmj.o1425>
- Menopause Practice Standards by the British Menopause Society. July 2022
- National Institute of Clinical Excellence. Menopause: Diagnosis and Management Update 2019
- Royal College Obstetrics and Gynaecology. Treatment for symptoms of the menopause 2018
- NHS initiative “think menopause”
- Bailey T, Cable T, Aziz N et al. Exercise training reduces the acute physiological severity of post-menopausal hot flushes. *Journal of Physiology*. 2016; 594 (3): 657–667. <https://doi.org/10.1113/JP271456>
- Mandrup C, Roland C, Egelund Jon et al. Effects of high-intensity exercise training on adipose tissue mass, glucose uptake and protein content in pre- and post-menopausal women. *Frontiers in Sports and Active Living*. 2020; (2): 60. <https://www.frontiersin.org/article/10.3389/fspor.2020.00060> DOI 10.3389/fspor.2020.00060
- Bermingham K, Linenberg I, Hall W et al. Menopause is associated with postprandial metabolism, metabolic health and lifestyle: the ZOE PREDICT study. Preprint *Lancet*. Available at SSRN: <https://ssrn.com/abstract/4051462>; <http://dx.doi.org/10.2139/ssrn4051462>
- Watson S, Weeks B, Weis L et al. High-intensity resistance and impact training improves bone mineral density and physical function in postmenopausal women with osteopenia and osteoporosis: the LIFTMOR randomized controlled trial. *JBM*. 2018; 33 (2): 211–220. <https://doi.org/10.1002/jbmr.3284>
- Effects of free weight and body mass-based resistance training on thigh muscle size, strength and intramuscular fat in healthy young and middle-aged individuals *Experimental Physiology* 2023;108(7): 975-985 <https://doi.org/10.1113/EP090655>
- Royal Osteoporosis Society. Strong, Straight, Steady. <https://theros.org.uk/media/0o5h1I53/ros-strong-steady-straight-quick-guide-february-2019.pdf>.
- Lucassen EA, de Mutsert R, le Cessie S et al. Poor sleep quality and later sleep timing are risk factors for osteopenia and sarcopenia in middle-aged men and women: The NEO study. *PLoS ONE*. 2017; 12 (5):e0176685. <https://doi.org/10.1371/journal.pone.0176685>
- British Menopause Society & Women's Health Concern 2020 recommendations on hormone replacement therapy in menopausal women. <https://thebms.org.uk/publications/consensus-statements/bms-whcs-2020-recommendations-on-hormone-replacement-therapy-in-menopausal-women/>
- Prior J et al. Oral micronized progesterone for perimenopausal night sweats and hot flushes a Phase III Canada-wide randomized placebo-controlled 4-month trial. *Sci Rep* 2023. <https://doi.org/10.1038/s41598-023-35826-w>

# Hormones Health and Human Potential

A guide to understanding your hormones  
to optimise your health and performance



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