Failure is Not an Option: Precision Nutrigenomic Interventions for Optimal Sports Performance & Recovery

Presented by:
Sarah Amidon, MS, RDN, LDN, IFNCP

Disclosure:

- No conflicts to disclose

Objectives:

- Understand the Role of Genomics in Athletic Performance
- Evaluate the Efficacy of Precision Nutrigenomic Interventions
- Analyze Case Studies of Elite Athletes
- Apply Sportomics Concepts to Injury Prevention and Management

- 2006 - Bachelor's Degree in Communication Studies, minor in Psychology from Indiana State University
  - Student-athlete - Volleyball
- 2006-2007 - Master's coursework in Communication at Western Illinois University
  - GA for the volleyball program
- 2007-2011 - Coached juniors volleyball in Dallas; blended loose leaf tea, tea education, sales, Director of Operations for Sterling Tea
- 2018-2022 - Pre-reqs, Master's in Dietetics from Eastern Michigan University
- 2022 - Private Practice: Root & Fruit Nutrition
- 2023 - Presented thesis research at ASN; Board-Certified in Integrative & Functional Nutrition; started using genomics for pro athletes
- 2024 - Research published: J. of Medicinal Food
- 2025 - DNA Dietitian for Indy Ignite

Nutrigenetics

- How body uses nutrients based on your unique genetic makeup
  - Genetic SNP's influence on nutrition status/health
- This is what can create an increased need for a type of nutrient, or even a form (more/less active forms)
  - Ex. Beta carotene vs. Vitamin A
- Symptoms of Vitamin A deficiency - night blindness, dry eyes, dry skin or keratosis pilaris, poor wound healing, frequent infections, infertility, acne

Nutrigenomics

- Relationship between our DNA/genome and nutrition ---
  - Influence that nutrients have on gene expression – such as prevention/treatment of disease
- If symptoms of deficiency show up: clue that diet is deficient, a disease state depleting or increasing need for vitamin A (liver, pancreas, CF) or there is an enzyme problem converting Beta carotene to Vitamin A like BCMO single nucleotide polymorphisms (SNPs)

Sport Nutrigenomics: Personalized Nutrition for Athletic Performance [1]

*Nanci S. Guest [1,2], Justine Horne [3], Shelley M. Vanderhout [1,2] and Ahmed El-Sohemy [1,2]**

[1] Department of Nutritional Sciences, University of Toronto, Toronto, ON, Canada, [2] Nutrigenomix Inc., Toronto, ON, Canada, [3] Department of Health and Rehabilitation Sciences, University of Western Ontario, London, ON, Canada

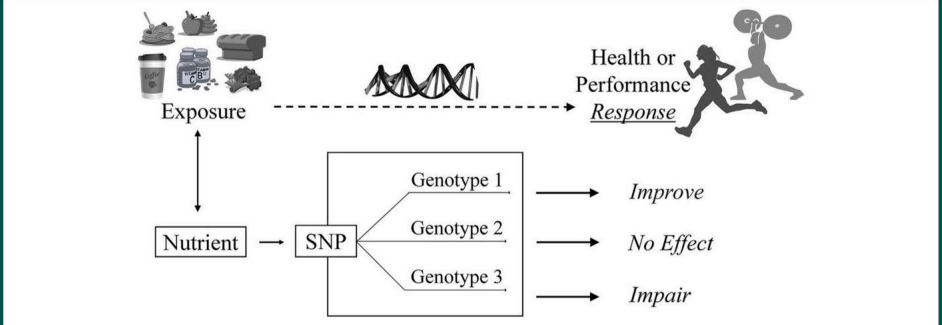

FIGURE 1 | The nutrigenomics approach to sport nutrition. An athlete is exposed to a food, beverage, nutrient or bioactive. A genetic variant such as a single nucleotide polymorphism (SNP) associated with that exposure modifiers the individual's requirement for or response to that exposure. Their unique response depends on their version of the gene or "genotype." For example, in the *CYP1A2* rs726551 SNP, individuals with the AA genotype (fast metabolizers) experience a positive or "improved" response (i.e., performance) to caffeine. Individuals with the *CYP1A2* AC or CC genotype experience no effect or impaired performance, respectively, from caffeine use (19).

Genomics-centric Nutrition Recommendations

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“But Sarah, I can’t even get my fitness clients/athletes to eat breakfast or to fuel properly!”

Genomics-centric Nutrition Recommendations

“But Sarah, I can’t even get my fitness clients/athletes to eat breakfast or to fuel properly!”

I will validate you here that you are not alone and I hope that this presentation is an encouragement that this information is actually going to HELP you and increase compliance for your athletes and fitness clients to eat breakfast and to fuel properly.

Genomics-centric Nutrition Recommendations

“But Sarah, I can’t even get my fitness clients/athletes to eat breakfast or to fuel properly!”

Suggesting that having the genetic information does not change the specific dietary advice provided would be untrue. Ex. Caffeine metabolism for athletes.[2]

Have You Ever Seen a Sports RD before?

Perceptions/quotes from Elite Athletes at Initial Consult:

- **“It’s nothing I didn’t already know.”**
- **“They talked about hydration.”**
- **“They showed me MyPlate.”**
- **“We did body composition testing and I was never given the results.”**
- **“He/She did a presentation for our team.”**
- **“Yes, but it didn’t feel personalized.”**
- **“They helped me with my underfueling.”**

Challenges in Sports Nutrition

- Just because they say its nothing they didn't already know doesn't mean they are applying it or taking it seriously, so we do need to bridge the education gap and remind them of the sports nutrition foundations.
- Many athletes seem underwhelmed by their experience. Some even expressed sentiments that college coaches leveraged body composition testing with a dietitian as a way to shame her for her size (even leading to ED for some), and in volleyball, we come in all shapes and sizes and still compete at a high level.
- Many athletic programs do not properly utilize sports RDs - is that because there is a misunderstanding of the role of a sports RD by coaching staff seeing him/her as food service and not a clinical role? Are we advocating for ourselves and our profession and expertise as critical for optimal performance?

Dietitians are in a prime position as experts in nutrition science to practice nutrigenetics and nutrigenomics by utilizing biochemistry principles and pathways.

Athletes are hungry for specific, personalized recommendations to optimize performance or to get the edge over their competition and reach their goals/dreams.

Personalized Nutrition Recommendations[2]

"Knowing an individual's genotype enables practitioners to provide targeted, personalized recommendations that are more specific, and stringent, than general advice, and can better help the individual meet his or her health and performance goals."

"Randomized controlled trials consistently show that DNA-based, personalized nutrition advice is more effective than general advice at modifying behavior, and it is also more effective than personalized advice that does not incorporate genetic information."

When it comes to behavior modification and successful, sustained dietary behavior change:
General advice < personalized advice < DNA-based personalized advice

Why should this be any different for athletes? One-size-fits-all approaches are not always honored even with highly motivated athletes.

Inappropriate Uses of Sports Genomics

The context of the client or athlete must ALWAYS be considered with our recommendations!

Real Life Example:

Inappropriate Uses of Sports Genomics

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Endurance athlete goes to a sports performance center that utilizes genomics with their services. Athlete's results come in and it shows she is sensitive to carbohydrates and she should reduce her CHO intake 😳😳😳

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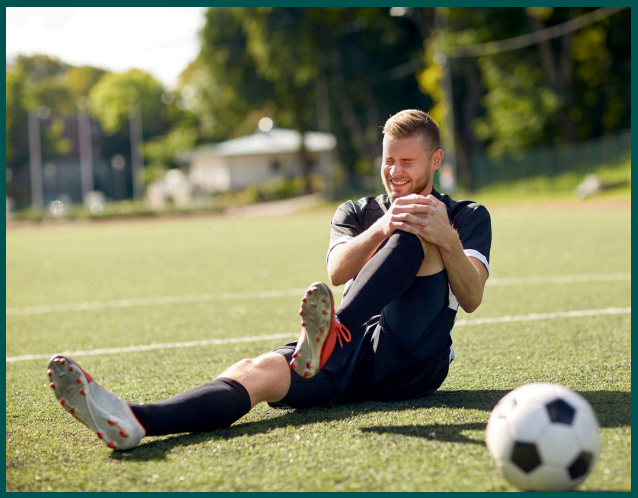
Inappropriate Uses of Sports Genomics

Sports Injury: The Statistics[3]



- An estimated **3 to 5 million sports injuries occur worldwide each year**
- 80% of injures affect musculoskeletal tissue (tendons, ligaments, hamstring muscle, ankle sprains, etc.)
- 72.2% of those injuries occurring during competitions, 21.8% during training
- 6.2x higher injury rate in soccer players who played two games a week compared to those who only played one, with the majority of injuries (76%) caused by overuse

Sports Injury: The Statistics[3]

- **<u>An estimated 0.5-0.6% of muscle mass is lost per day during immobilization</u>**
- **0.99% in VO2 max and 1.6% in cardiac output is lost daily after only 2 weeks of bedrest**
- The longitudinal Dallas Bedrest and Training study showed that VO2 max decreased more after 3 weeks of bedrest than during 30 years of aging
- Physical inactivity and loss of muscle mass, periods of disuse **induces an alteration of the metabolic state, favoring an increase in insulin resistance**

Sports Injury Highlights the Necessity for Genomics

- "Injury prevention is a priority for athletes, coaches and practitioners of sports medicine for whom the diagnosis, treatment and prevention of injuries constitute a large part of daily practice."[4]
- **"An individual's genetic profile is a recognized intrinsic factor predisposing individuals to a higher risk of suffering a musculoskeletal injury and/or necessitating longer recovery after intense exercise"[4]**
- Greater lean mass in athletes is associated with improved performance in strength and power sports, as well as some endurance events, and a decreased risk for injury[1]
- **Nutritional strategies can help protect or repair tissue and regulate inflammation and reactive oxygen species (ROS) production.**

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- **"An individual's gene… or predisposing individuals to a high… njury and/or necessitating longer…**
- Greater lean mass in … rformance in strength and power sports, as … ecreased risk for injury[1]
- **Nutritional strategie… l regulate inflammation and re… on.**

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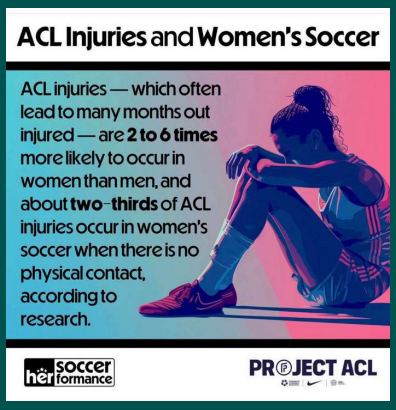
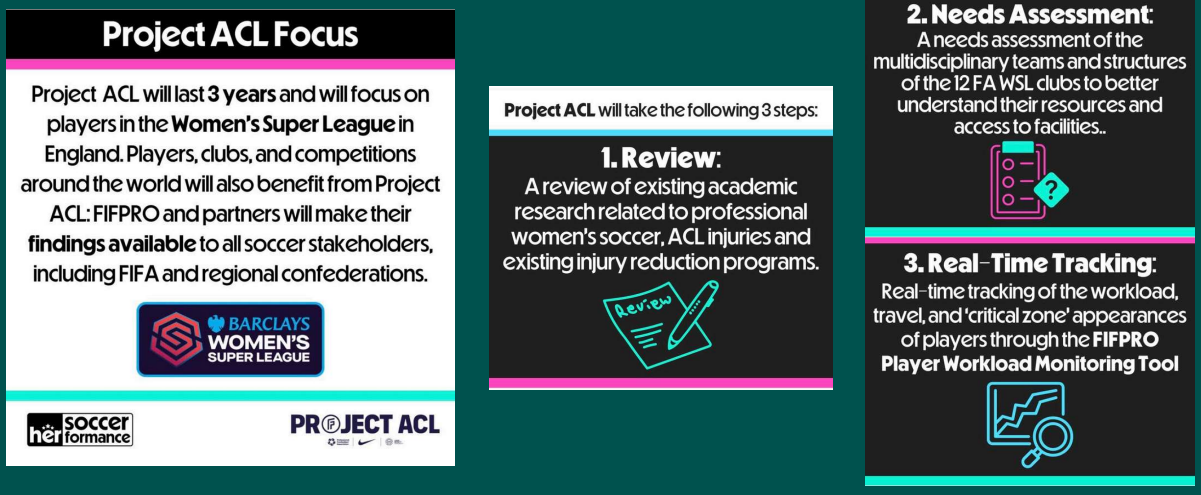


Instagram Post - May 9, 2024 - @Soccerherformance[6]

Sports Injury Highlights the Necessity for Genomics



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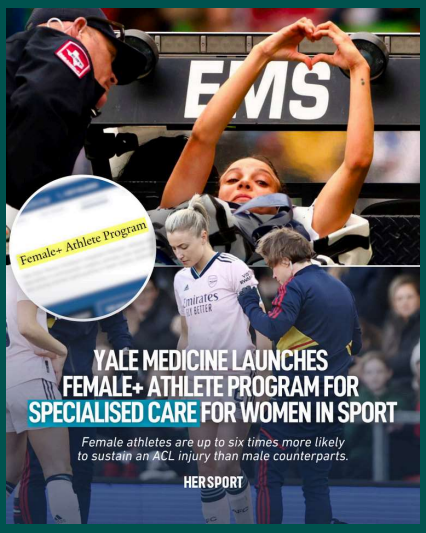
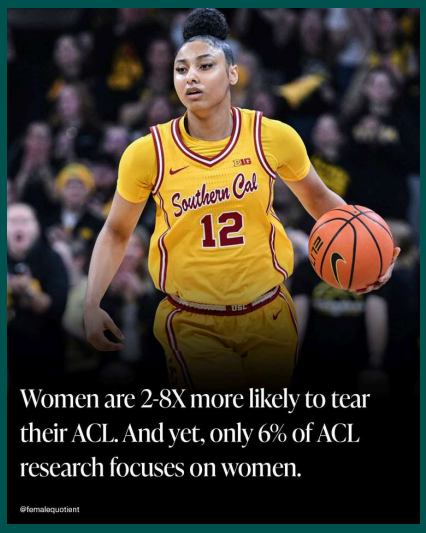




Instagram Post - February 26, 2025 - @hersport.ie[7]
Instagram Post - March 27, 2025 - @femalequotient[8]

Sports Cost Highlights the Necessity for Genomics

August 2023 article[9]- Parity Now

Sports Cost Highlights the Necessity for Genomics

Instagram Post - September 6, 2023[9] [10] - @Soccerherformance

Performance-Relevant SNPs

Via 3X4 Genetics DNA Blueprint

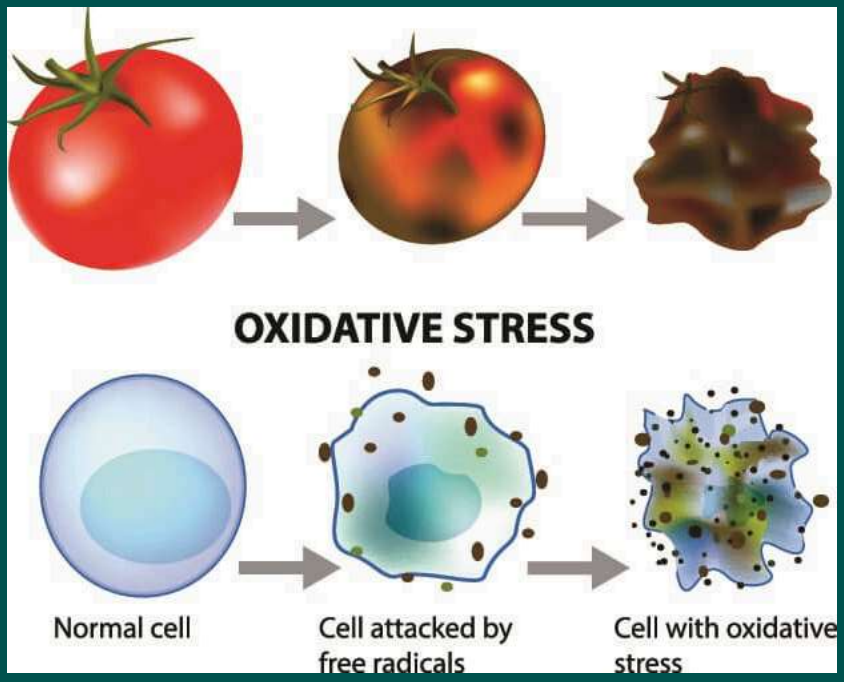
BONE HEALTH	4
CYP2R1 A>G	GG
GDF5 5'UTR C>T	TT
DIO2 Thr92Ala T>C	TC
VDR Bsm1 G>A	GA
TIMP4 –55 T>C	CT
COL1A1 1546 G>T	GG
VDR Fok1 T>C	CC
VDR Taq1 T>C	TC

COLLAGEN & JOINTS	1
GDF5 5'UTR C>T	TT
COL12A1 AluI A>G	AA
VEGFA -2578 C>A	AA
COL1A1 1546 G>T	GG
COL3A1 Ala698Thr G>A	GA
MMP1 –1607 1G/2G	1G/1G
MMP3 A>G	AG

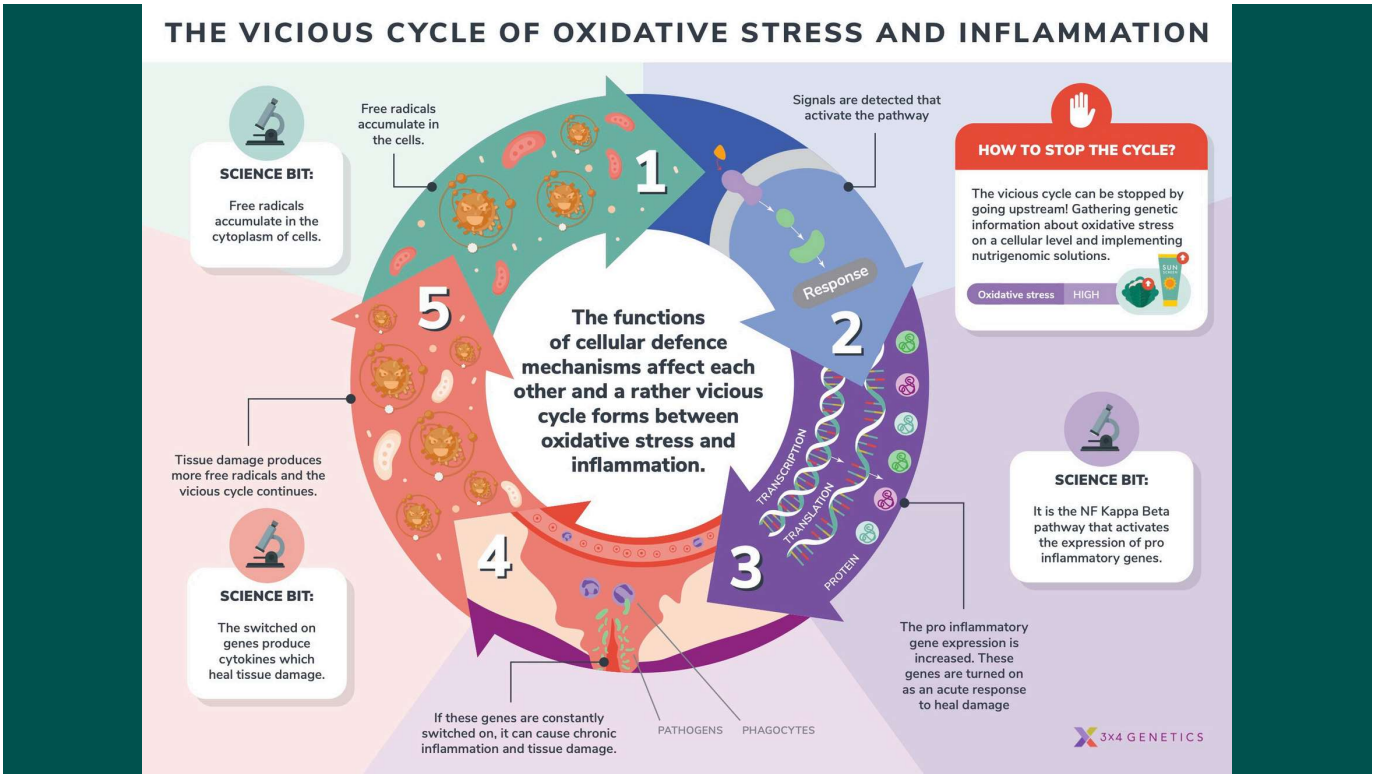
INJURY	1
COL12A1 AluI A>G	AA
GDF5 5'UTR C>T	TT
VEGFA -2578 C>A	AA
TNFA –308 G>A	GA
COL1A1 1546 G>T	GG
COL3A1 Ala698Thr G>A	GA
MMP3 A>G	AG

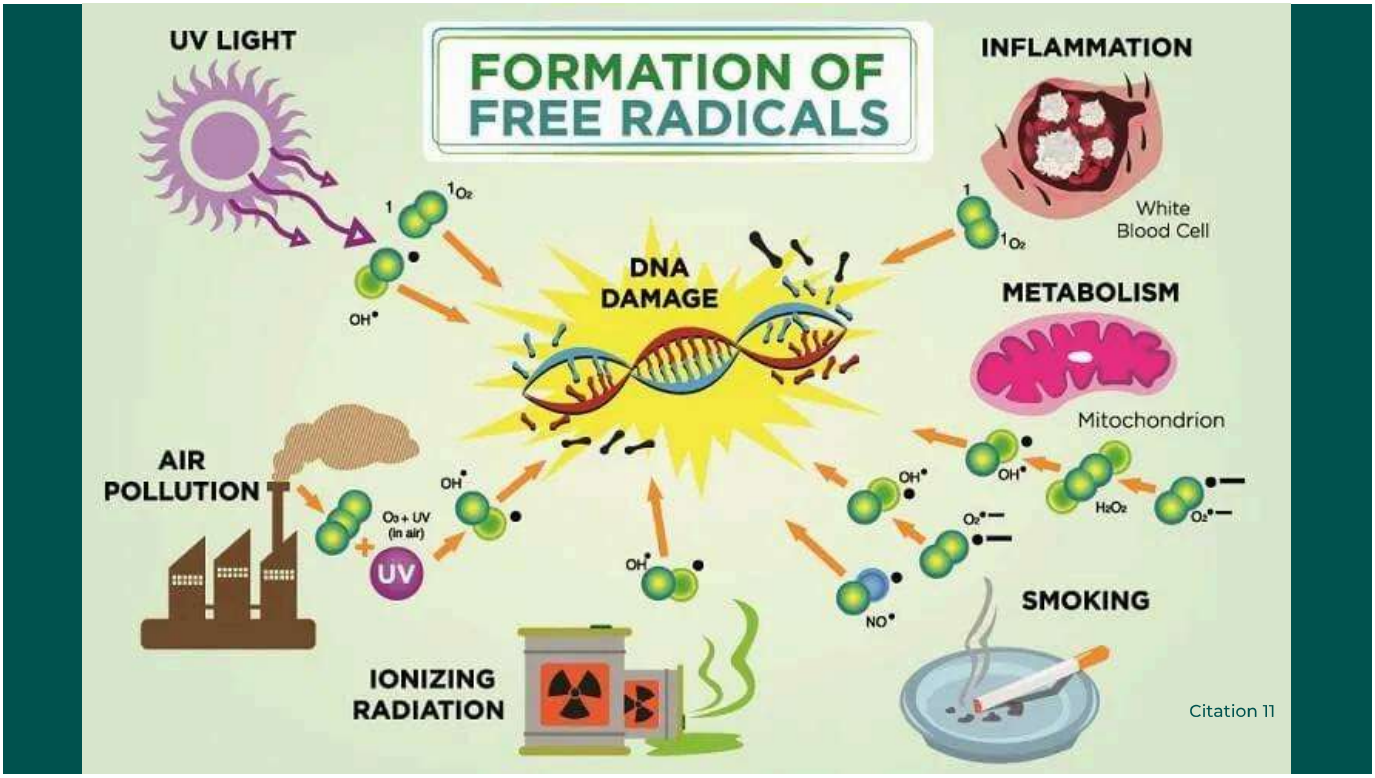
RECOVERY	3
CRP 2147 G>A	GG
MNSOD Val16Ala T>C	TT
GPX1 Pro198Leu C>T	CT
IL-6R Asp358Ala A>C	AC
CAT –262 C>T	CC
IL-1 +/–	+
IL-6 –174 G>C	GG
TNFA –308 G>A	GA

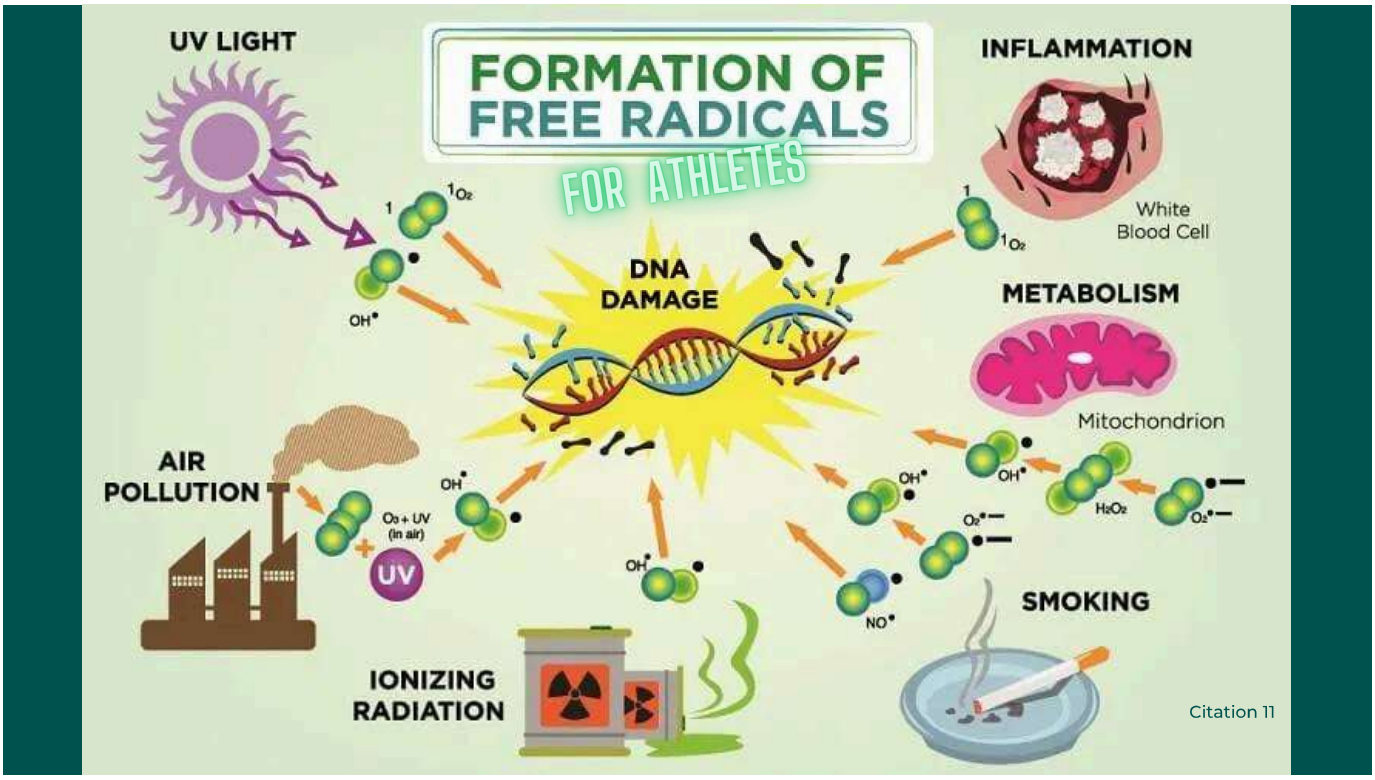
Compromised Areas:
Bone Matrix Repair/Remodeling
Collagen Repair or Ligament Laxity
Inflammation/Oxidative Stress Factors



Citation 11


THE VICIOUS CYCLE OF OXIDATIVE STRESS AND INFLAMMATION
SCIENCE BIT:
Free radicals accumulate in the cytoplasm of cells.
Free radicals accumulate in the cells.
1
Signals are detected that activate the pathway
Response
2
HOW TO STOP THE CYCLE?
The vicious cycle can be stopped by going upstream! Gathering genetic information about oxidative stress on a cellular level and implementing nutrigenomic solutions.
Oxidative stress
HIGH
The functions of cellular defence mechanisms affect each other and a rather vicious cycle forms between oxidative stress and inflammation.
5
Tissue damage produces more free radicals and the vicious cycle continues.
SCIENCE BIT:
It is the NF Kappa Beta pathway that activates the expression of pro inflammatory genes.
TRANSCRIPTION
TRANSLATION
PROTEIN
3
4
SCIENCE BIT:
The switched on genes produce cytokines which heal tissue damage.
The pro inflammatory gene expression is increased. These genes are turned on as an acute response to heal damage
If these genes are constantly switched on, it can cause chronic inflammation and tissue damage.
PATHOGENS
PHAGOCYTES
3X4 GENETICS


FORMATION OF FREE RADICALS
UV LIGHT
INFLAMMATION
White Blood Cell
DNA DAMAGE
METABOLISM
Mitochondrion
AIR POLLUTION
O3 + UV (in air)
UV
SMOKING
IONIZING RADIATION
Citation 11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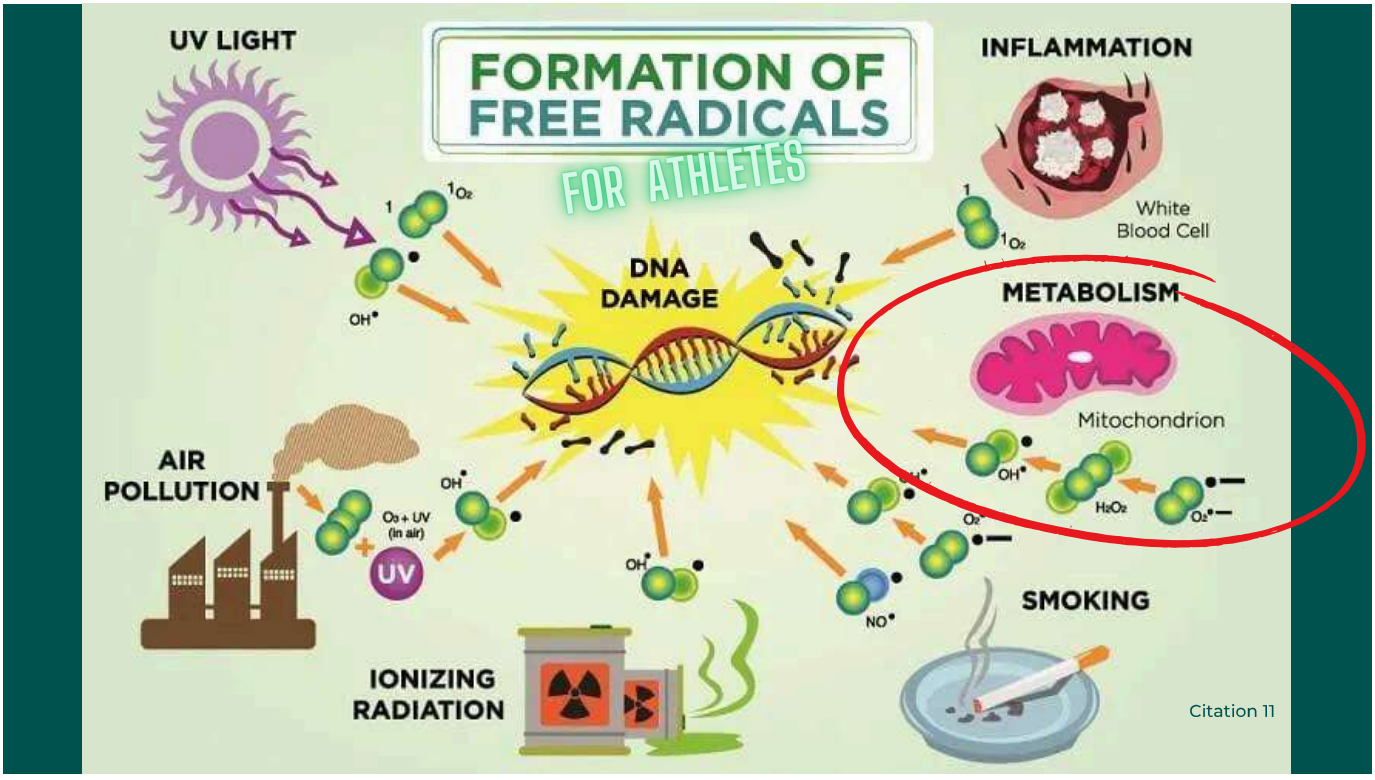
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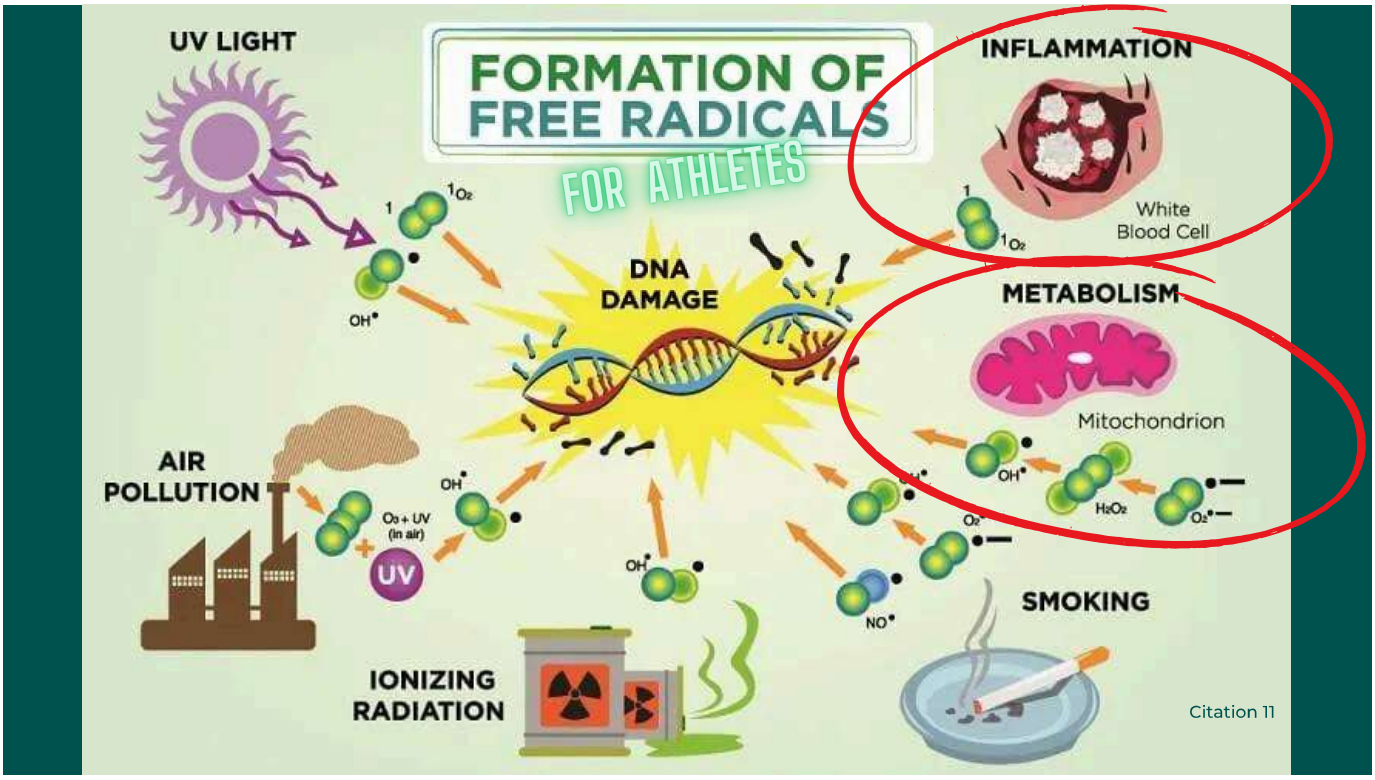
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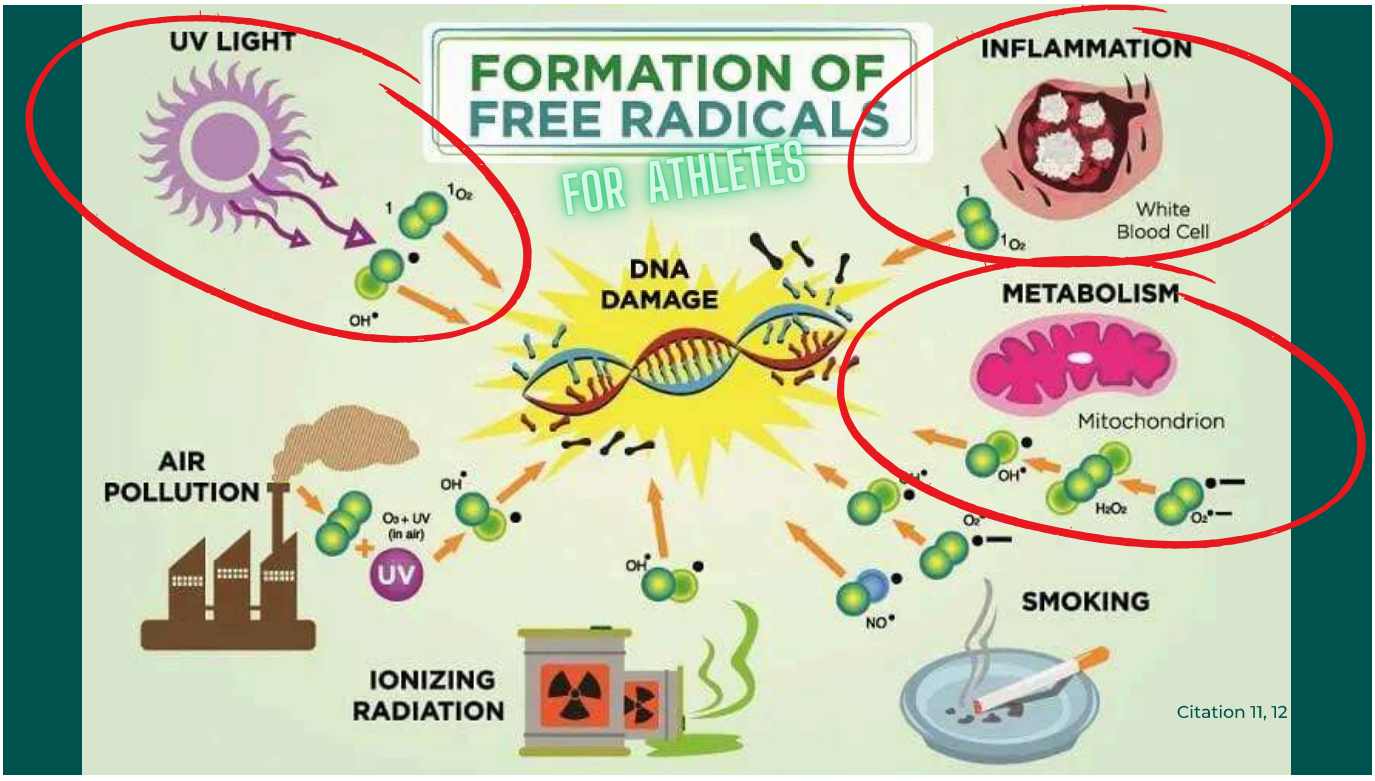
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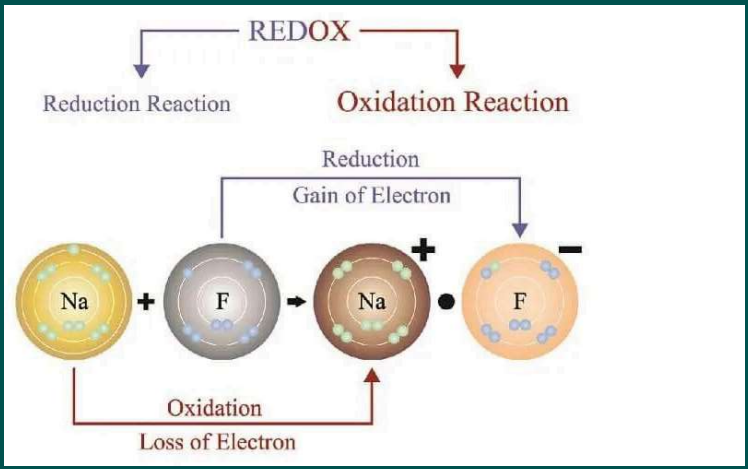
Citation 11, 12

What we're doing is balancing a chemical equation:
REDOX - REDuction-OXidation

Redox for Athletes:
CELLULAR RESPIRATION

- Glycolysis
- TCA/Krebs Cycle
- Oxidative Phosphorylation



But what if you could better conceptualize an athlete's starting point to how & why their symptoms are manifesting? Citation 11

Case Studies

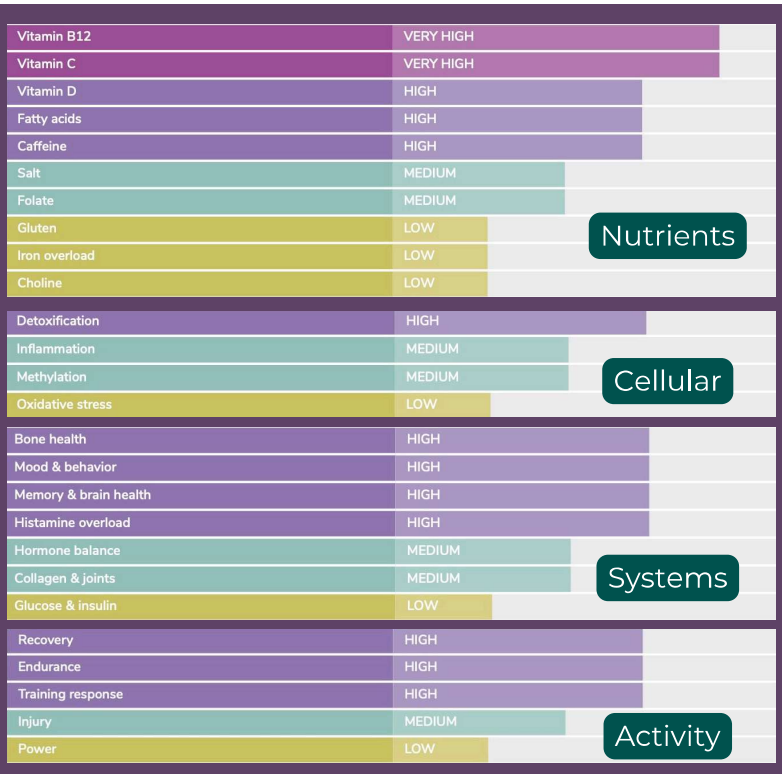
Client Case

Male beach volleyball athlete

- Low B12 levels
  - c/o low energy
- Low vitamin D
  - ***Never wears sunscreen***
- Chronic constipation
  - <1 BM/day

What do we see here in his DNA blueprint summary?

What could happen next?



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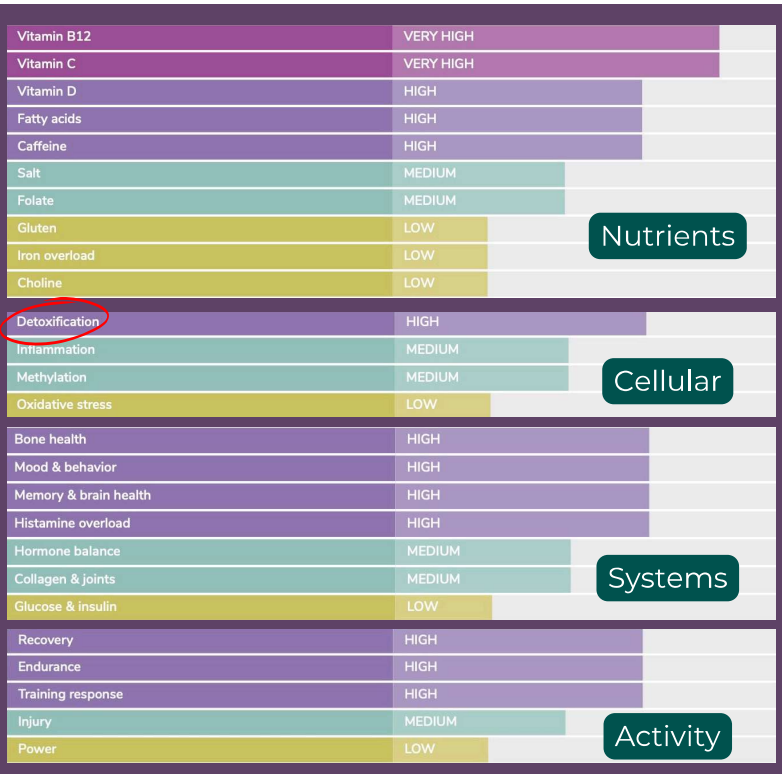

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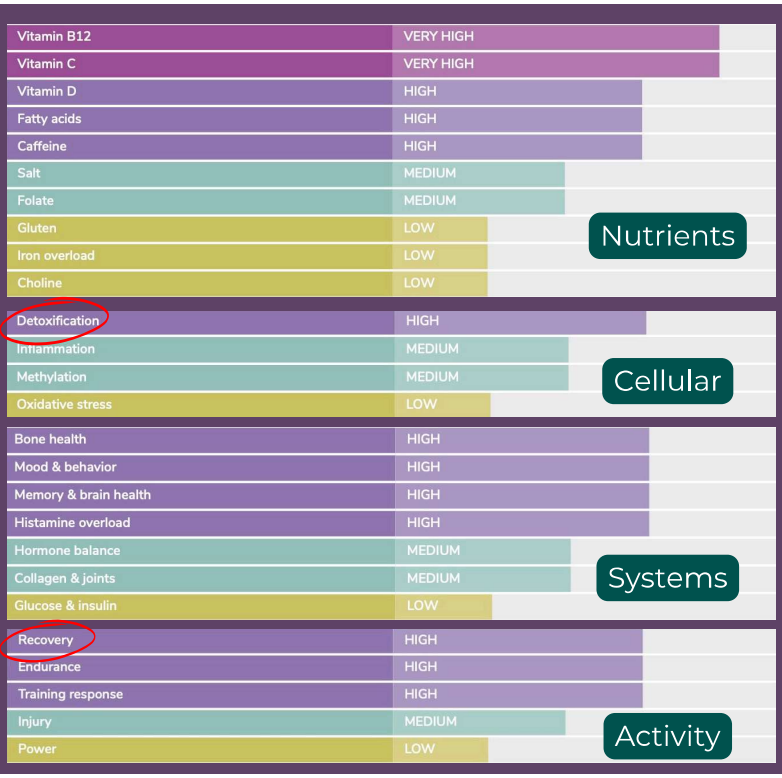

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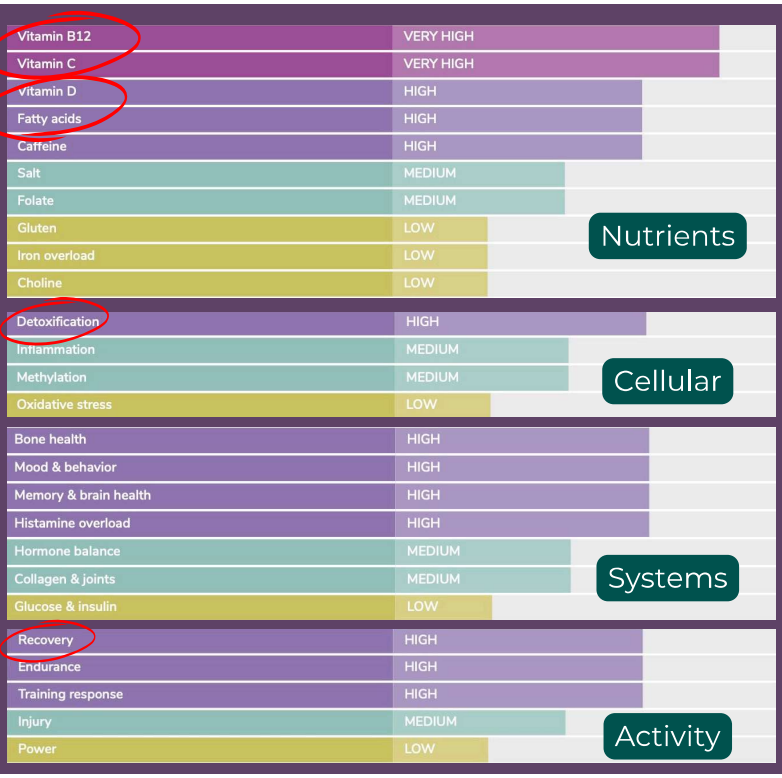


The Effects of Heavy Metals on Human Metabolism[13]

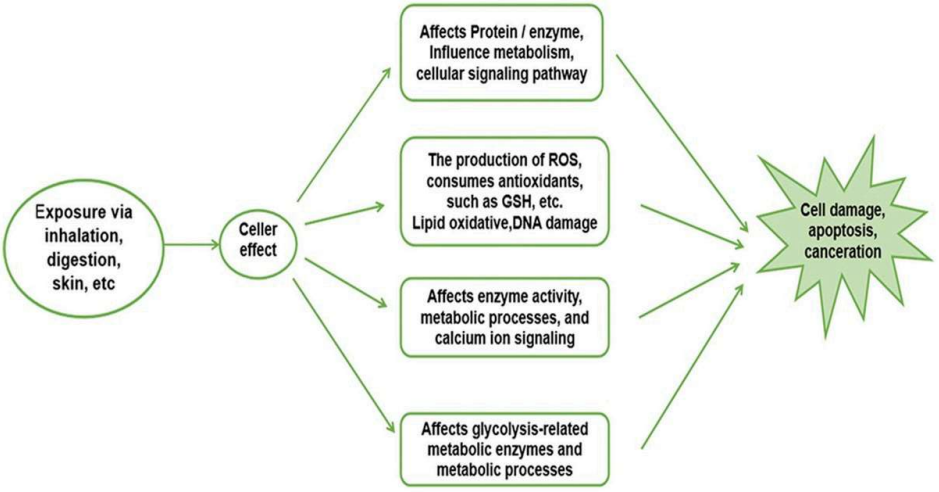
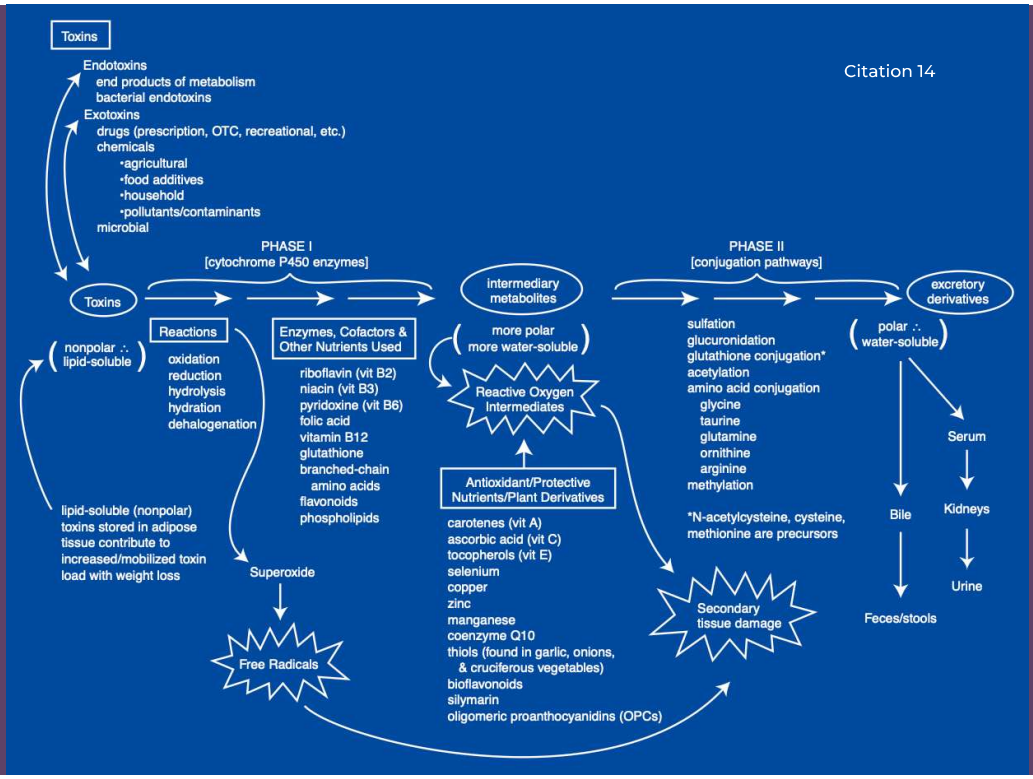


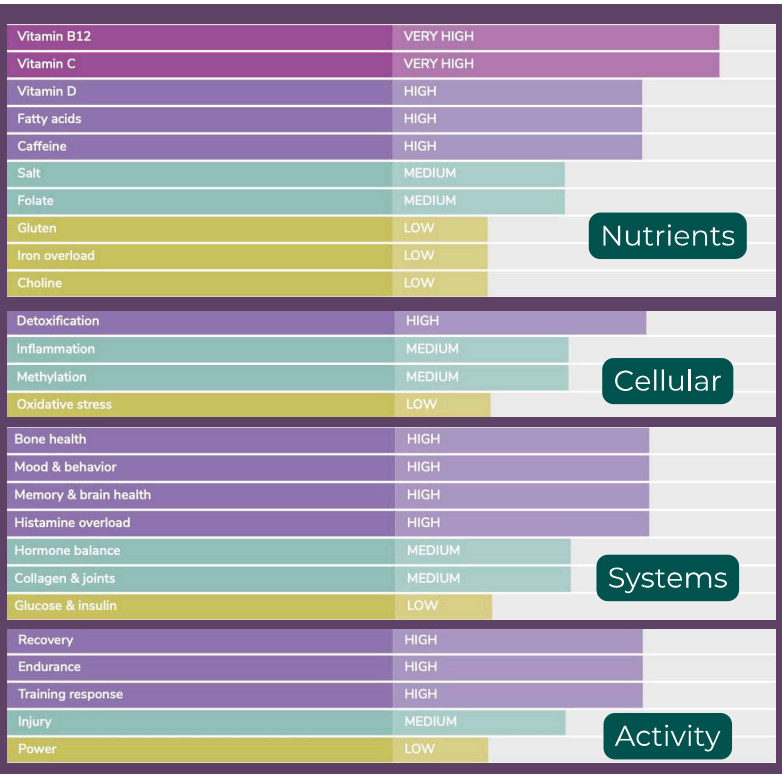
Figure 1. Toxic effect mechanism of heavy metals.



Client Case

Plan

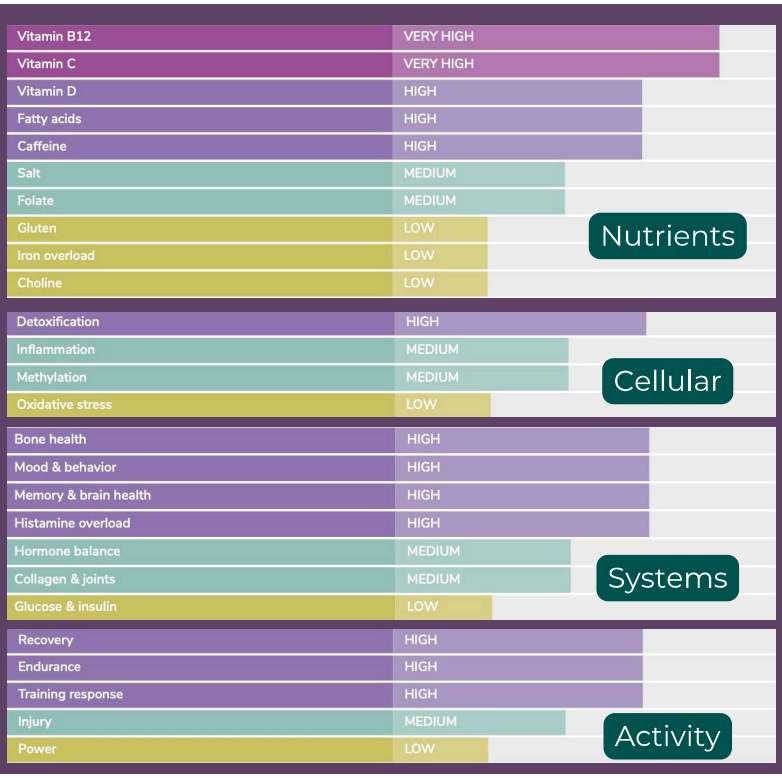
- Topical castor oil packs - support digestion, detoxification, upregulate glutathione and bile flow
  - Goal of daily BM
- Cruciferous veggies + sulforaphane (DefenCell) to support phase 2 detoxification and hopefully see elevated mercury toxicity resolve and Vitamin B12 & Vitamin D levels normalized by removing this metabolic disruption
- Cod liver oil - fatty acids + Vit A & D
- Vitamin C-rich food emphasis, supplement if an illness
- Magnesium - co-factor for detoxification, histamine and support digestion
- Creatine - support methylation, recovery and ease pull on methyl donors



Client Case

Results

- Having daily BM
- Wasn't complaining of poor sleep, but now states, "my sleep is amazing!"
- Wasn't complaining of brain fog or memory concerns, but now states, "I can remember the score and whose serve it is during practice and didn't realize that was gone until it returned."
- "Since starting with recommendations, I've felt more energized, resilient, and ready to push my limits in training. The results are noticeable and my overall well-being has never been better."



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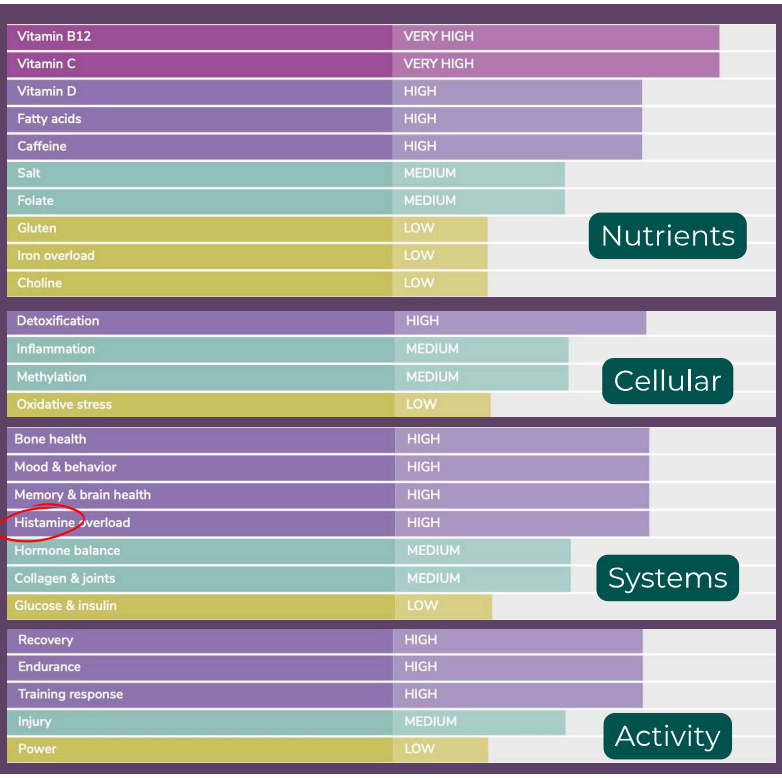
Results 2.0

- Histamine showed up last fall as a gout attack during competition: I knew exactly what to do and how to treat it on site nutritionally/therapeutically - and he made it to the FINALS!



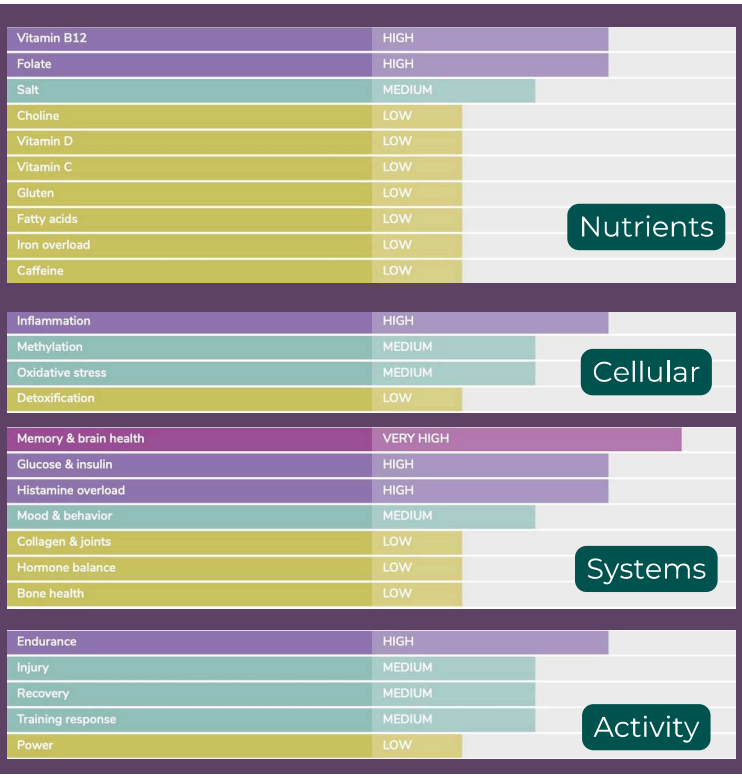
Client Case

Female beach volleyball athlete

- Chronic pain - back & joints
- "Injury Prone"
- Low hormones + anti-doping
- Brain fog
- Low energy
- PCOS - Hx of BC

What do we see here in her DNA blueprint summary?

What could happen next?



Collagen & Joints - *Low Impact, BUT...Inflammation is turning the knob up in gene expression/turnover*

- COL12A1 - AA - Increased risk for ligament laxity; this emphasizes cross-training and special attention to decreasing inflammation and oxidative stress to prevent injury.
- VEGFA - AA - This allele has reduced VEGFA expression (and therefore poorer tissue remodeling) and needs to pay special attention to recovery and cross-training to reduce injury risk. Particularly true of knees (ACL) and achilles tendon, but any connective tissue could be at risk with overuse.

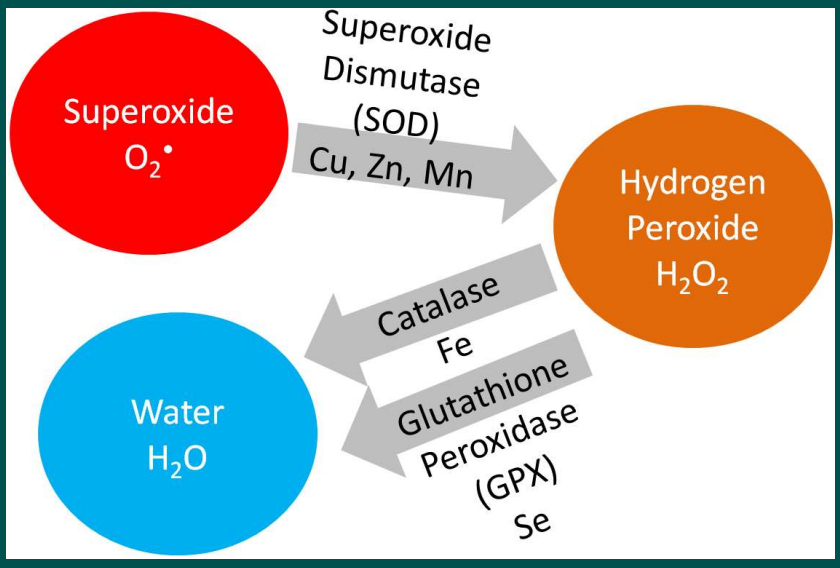
COLLAGEN & JOINTS	5	HORMONE BALANCE	6	BONE HEALTH	7
COL12A1 Ala[AA]	AA	CYP1B1 Leu432Val C>G	CG	COL1A1 1546 G>T	GT
VEGFA -2578 C>A	AA	MNSOD Val16Ala T>C	TT	CYP2R1 A>G	AG
MMP1 -1607 1G/2G	1G/2G	SULT1A1 Arg213His G>A	AA	DIO2 Thr92Ala T>C	TC
COL1A1 1546 G>T	GT	CYP17A1 34 T>C	TC	VDR Bsm1 G>A	GA
GDF5 5'UTR C>T	CC	CYP19A1 C>T	CT	GDF5 5'UTR C>T	CC
COL3A1 Ala698Thr G>A	GA	MTHFR 677 C>T	CT	TIMP4 -55 T>C	CT
MMP3 A>G	AG	CYP1B1 Asn453Ser A>G	AG	VDR Fok1 T>C	CC
		COMT Val158Met G>A	GG	VDR Taq1 T>C	TC
		CYP1A1	AA		

Cellular	
Inflammation	HIGH
Methylation	MEDIUM
Oxidative stress	MEDIUM
Detoxification	LOW

Systems	
Memory & brain health	VERY HIGH
Glucose & insulin	HIGH
Histamine overload	HIGH
Mood & behavior	MEDIUM
Collagen & joints	LOW
Hormone balance	LOW
Bone health	LOW

Activity	
Endurance	HIGH
Injury	MEDIUM
Recovery	MEDIUM
Training response	MEDIUM
Power	LOW

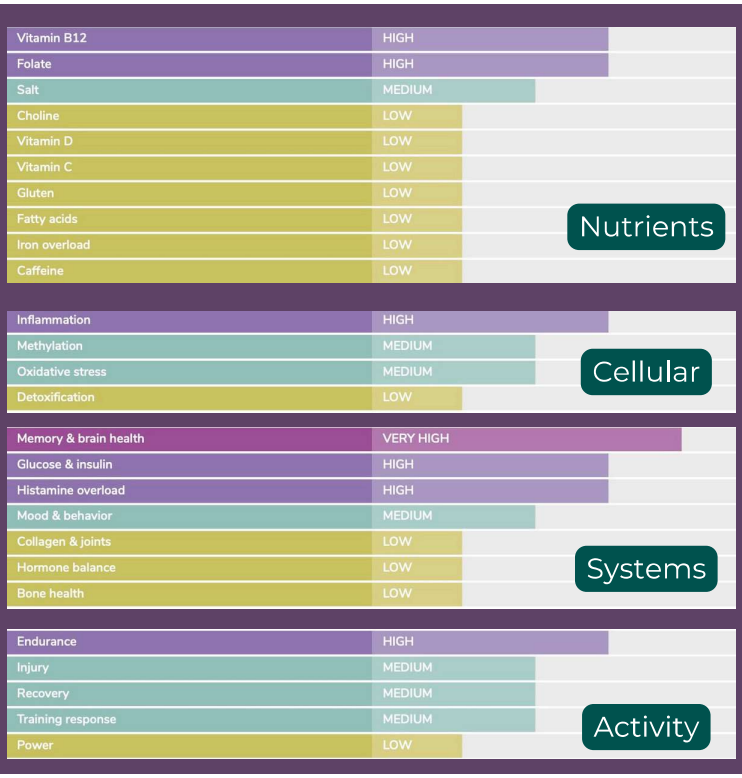
Impact of Superoxide Dismutase Deficiencies[15] [16]



Client Case

Plan

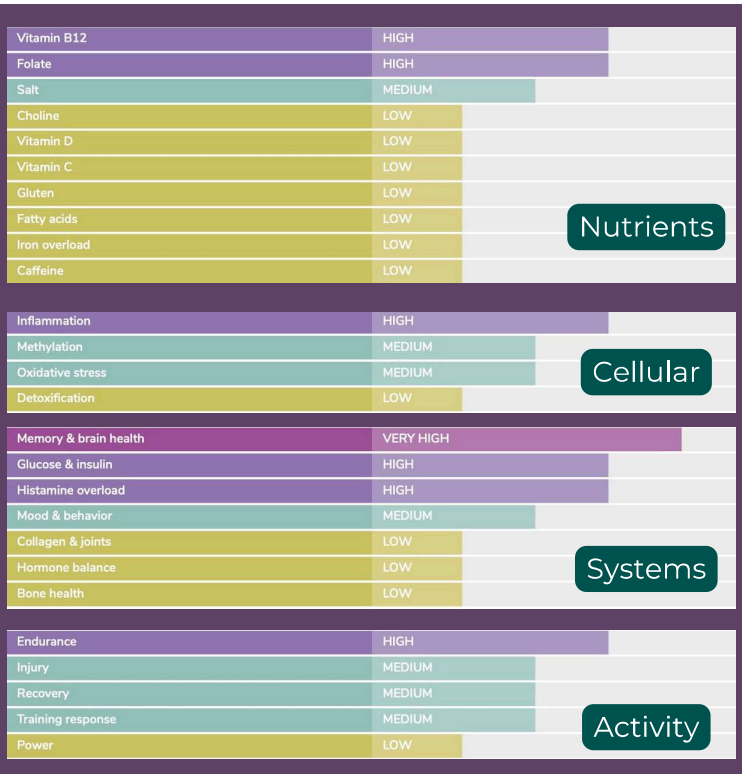
- Collaborated with USA RD/Team MD to run additional labs (& DEXA) besides just hormones to get the big picture
- I see inflammation as our big disruptor of hormones, which is a challenge to change training frequency at this level, but there's a balance before injury risk goes up. MNSOD SNP has a role with inflammation + hormones. Cantaloupe melon/extract activates SOD, Omega 3s /SPMs upregulate SOD, cruciferous veg.
- Boron - ↑ bone density and steroid hormone metabolism
- Ashwagandha - ↑ DHEA & downstream hormones, decreases perceived stress
- Creatine (cognition, muscle mass, methylation); collagen; magnesium



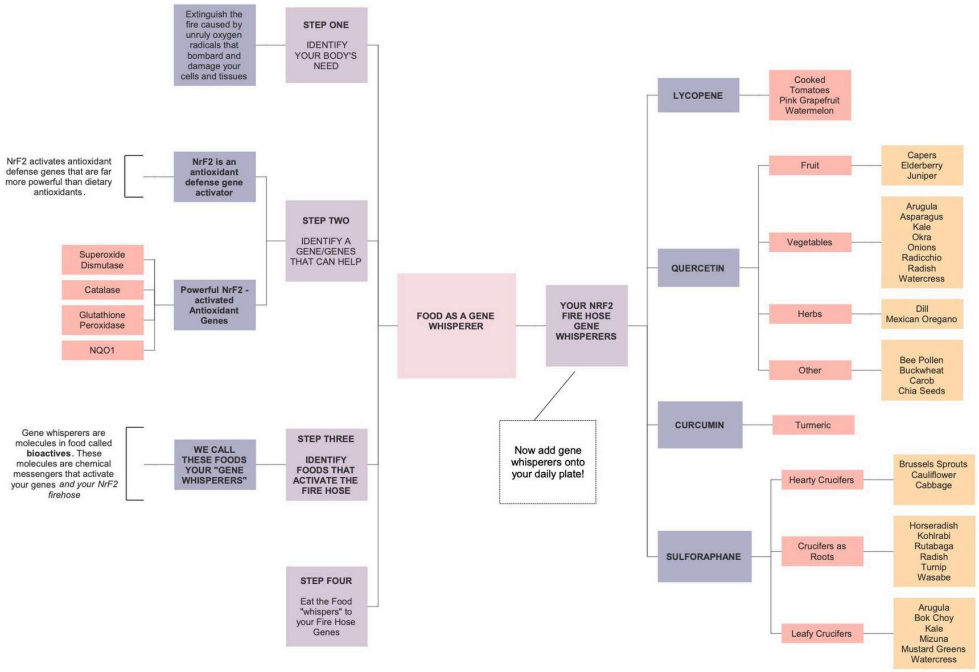
Client Case

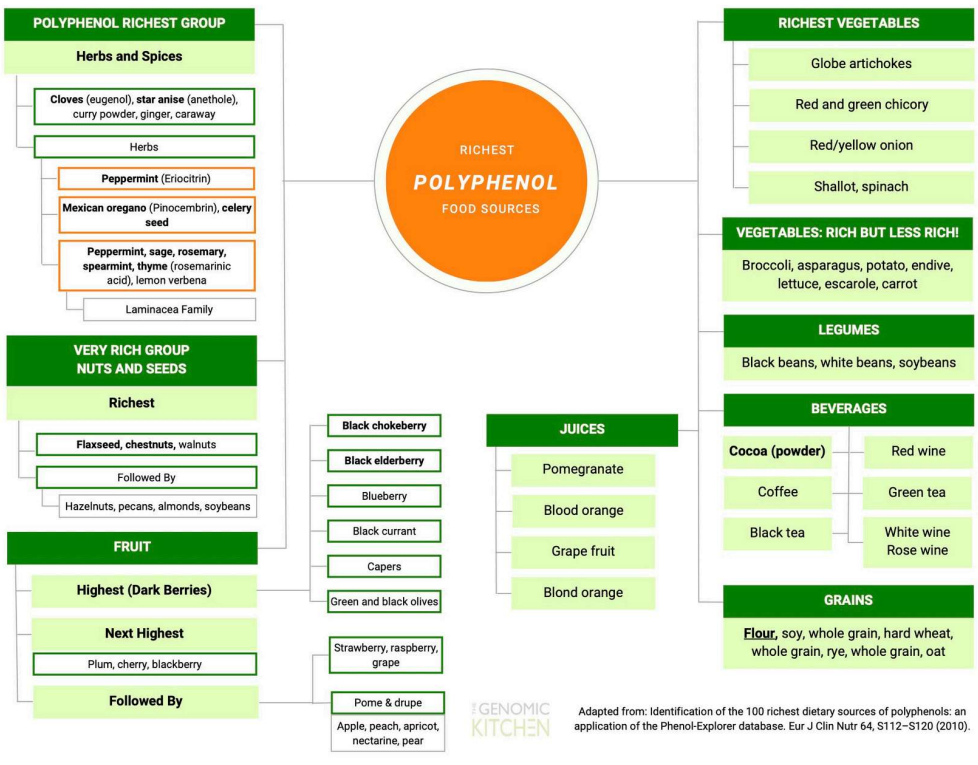
Results

- Less pain during training/competition
- Faster recovery
- Increased compliance and confidence in nutrition/supplement regimen, best ROI
  - Don't discount the mental load on indecisiveness with food and supplements when an athlete doesn't know what is/isn't helping; "why am I even doing this?"
- Improved sleep/more rested
- Greatly improved cognition/memory
- Met goal of post-season appearance late in career



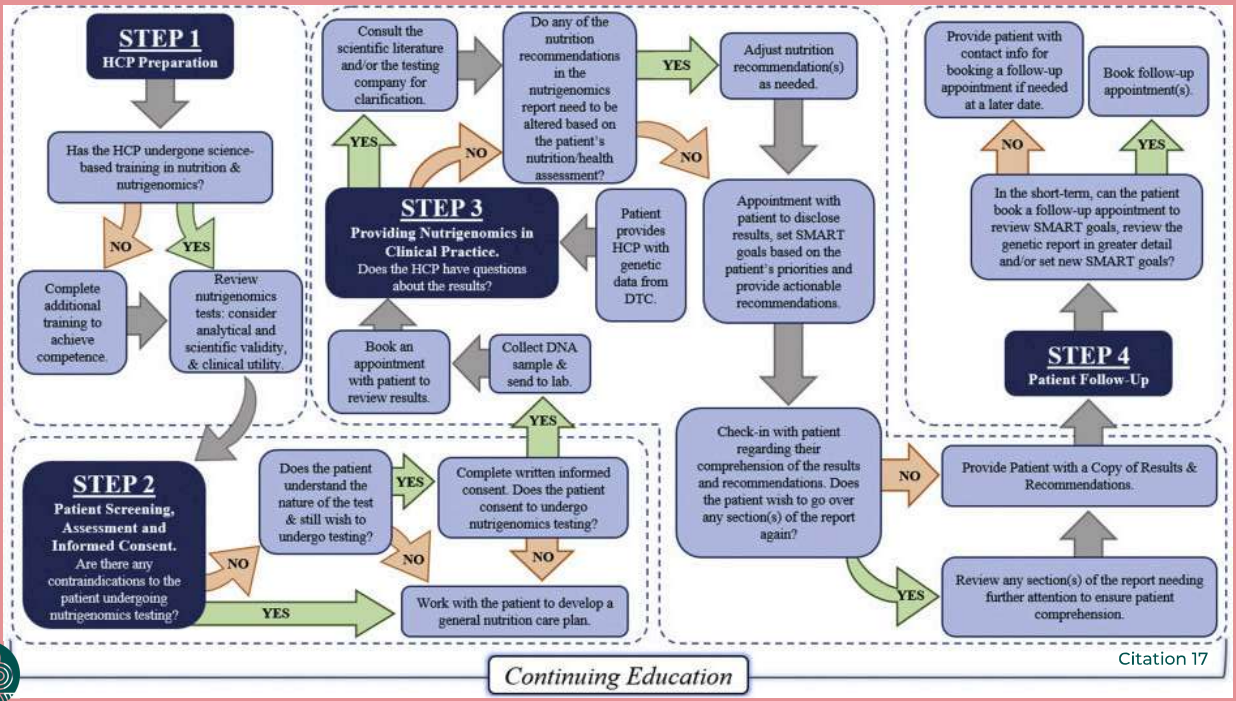
THE GENOMIC KITCHEN





THE GENOMIC KITCHEN

Adapted from: Identification of the 100 richest dietary sources of polyphenols: an application of the Phenol-Explorer database. Eur J Clin Nutr 64, S112–S120 (2010).



Citation 17

Precision Sports Nutrition

"We have to accept that this is the way that the field is going."

Gareth Wallis, PhD
Exercise Science, Integrative Biology, and Nutrition - U. of Birmingham, UK

Objectives:

- Understand the Role of Genomics in Athletic Performance
- Evaluate the Efficacy of Precision Nutrigenomic Interventions
- Analyze Case Studies of Elite Athletes
- Apply Sportomics Concepts to Injury Prevention and Management

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