

Collaborative writing project **Biology of Trauma.**

Understanding the freeze response in elite athletes.

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OUTLINE

Introduction

Lifestyle & Physiological Load

- Physical & psychological load of an athlete.
- Recovery, sleep & Non-steroidal anti-inflammatory drugs (NSAIDs).
- The importance of Heart rate variability (HRV) as a marker of overall physiological load.

The freeze response

- ABC of Autonomic nervous system (ANS).
- Signs & symptoms of freeze in athletes.
- Post traumatic stress disorders (PTSD) in athletes.

Early indicators and red-flags

- Circadian rhythm & hypothalamus pituitary axis (HPA) (sleep imbalances).
- Leaky gut, the microbiome & neurotransmitters (depression).
- Inflammation & oxidative stress (slow recovery).

Summary

INTRODUCTION

Outsmarting pain, both physically and mentally is what takes you to the top of your game! In professional sports being headstrong, pushing through boundaries and to never give up are essential qualities, even admired characteristics, among the world's top athletes. The athlete learns at a very young age to constantly override their own boundaries and ignore the physical and mental cues.

A fundamental question is what forms these top athletes to become these almost unnatural physical machines? What drives an athlete? I believe that it is a question too wide and big for this writing project, with too many foundational answers. However just the physical training load may be enough to shut the athletic body down, with that said being a pro athlete does not equal being healthy!

Understanding recovery is the future of sport - the athletes are already pushing themselves beyond measure, with their training load. Measuring HRV, tracking sleep and other overtraining markers may help today's athletes & coaches to optimize recovery and nervous system regulation, in order to both prevent injury as much as mental health challenges.

Our nervous system has the capability to shut down both mind and body if it loses homeostasis. With this information as a fundamental fact and baseline... let's take a closer look at how understanding the nervous systems freeze response - our bodies shutdown/survival system and the importance of self regulation as the way back, out of the shutdown and freeze response.

Understanding the freeze response has been life changing for me as a retired olympic medalist (*swimming Sydney 2000*). I now understand, as I look back, that my "set back periods" was a dysregulation in the nervous system, and it gives me more self compassion, something that doesn't come naturally to an athlete, at least not for me! I now understand that I used my swimming both as a blessed escape and a way to numb my early discomfort in life. When the results were not in my favor the only solution at the time was to train even harder, so I did, without anyone asking me or guiding me to take a closer look at the root cause, the nervous system and the lack of its regulation.

My intention with this topic is to empower and inform coaches, teams, parents and athletes that are stuck, prone to injury, depressed or frustratingly not getting out what they are putting in. Let's take a look beyond the performance, go deeper by understanding the balance of the nervous system and overall picture of the athlete.

LIFESTYLE & PHYSIOLOGICAL LOAD

The term allostatic load was coined by McEwen and Stellar in 1993. It sums up "the wear and tear on the body" which has accumulated as an individual is exposed to repeated or chronic stress. The focus of this project is on elite athletes that push themselves daily, from a very young age both mentally and physically, more than often being on the line of burnout yet they need to keep face and keep going. The wear and tear of the body defines both mental and physical load and the nervous system does not differentiate between the two, and nor does the HPA axis, your stress response.

Since all sports have their own unique physical and mental requirements, let's estimate an average of hours spent per day on the sport - for many elite athletes that would be anything between 2-3 sessions a day or 3-6+ hours per day.

On top of that, we add the "normal" everyday pressure such as schoolwork, grades, traveling, finances and expectations from family members, coaches and sponsors that also accumulates and adds up to the overall wear and tear on the body. We know that in order to perform better, we need to increase our training load. Increased loads are tolerated only through interspersed periods of rest and recovery, however overreaching is considered an accumulation of training load that leads to a gradual decrease in the quality (or quantity) of their performance, requiring days to weeks to recover. (1)

RECOVERY, SLEEP & NSAIDs.

Educating coaches & athletes about the importance of holistic recovery is essential for elite athletes. "There is no such thing as overtraining, there is only 'under-recovery' !" We want to understand how to generally and individually recover *smarter and more effectively*, through using self-regulation tools such as:

- Breathing (nose breathing during night & coherence breath).
- Body awareness exercises for mental focus and calming the HPA axis.
- Addressing nutrition status, as well as being informed about the consequences of ignoring recovery when needed.

Understanding the link between under-recovery and its effect on the immune system and injury susceptibility.

Using tools like measuring HRV, (see below), having a daily fatigue scale for athletes to address, looking at the sleep quality (not just hours spent in bed) are additional tools for the team around the athlete to use, to support his/her performance. Encouraging the team when chronic inflammation is present to address the root cause for long term health - and only when necessary, to lean on using NSAIDs or cortisone to numb the pain. It is not advisable to make this the daily choice. It is not advisable to make this the daily choice, due to aggressive negative effects on digestive and immune health.

HRV - Heart Rate Variably

HRV is a marker reflecting the cardiac modulation of the sympathetic and parasympathetic (vagal) components of the ANS. A continuous measurement of HRV suggests to help the athlete maintain homeostasis, and to regulate the training load to support recovery. (10) According to the Heartmath Institute, HRV is both a physical and a mental marker indicating the dynamic and self regulatory capacity of the individual, not a direct measure of the sympathetic or the parasympathetic branches per-say.

HRV is not a stand alone diagnostic marker but an excellent marker overall and gives an early indication when homeostasis is off. It was first used in the 1960s as an indicative marker for sudden infant death and later in the 80s used as an early indication of diabetes. HRV is measured using a standard ECG - Electrocardiogram and gives us the variation in-between heart beats in milliseconds. The greater the variation in between heart beats, the higher HRV. A higher HRV tells us the athlete has a greater ability to "regulate" to its different needs. For example an athlete with high HRV - is recovering well, both physically and mentally. Their sympathetic nervous system is responding well to challenges as is their parasympathetic nervous system to rest and recover, there is a preferable modulation of the ANS.

The pattern recognition of the HRV throughout a 24 hour measurement may give an indication of the body's ability to maintain homeostasis or record different compensating imbalances early, like sleep disturbance in overtrained athletes. (9) The Heart beat (HB, pulse) and HRV go hand in hand. In general a low HRV equals activation and a higher pulse, and a higher HRV during rest equals a lower pulse.

THE FREEZE RESPONSE

ABC OF THE ANS

Why should we focus on the nervous system when we talk about athletic recovery? The nervous system runs deep and oversees all other systems in the body. It touches every cell, every organ of the body and is intertwined with our cardiovascular system and our structural fascia, as it oversees all functions in our body. The two primary branches of the nervous system are:

- Central nervous system (brain & spine) (CNS).
- Peripheral NS - nerves to and from the CNS.

Our peripheral nervous system includes our:

- Somatic nervous system
- Enteric nervous system
- ANS
 - Sympathetic SNS
 - Parasympathetic PNS
 - Mainly represented by the vagus nerve (10th cranial nerve)
 - Ventral Vagal (social engagement)
 - **Dorsal Vagal (freeze response)**

The sympathetic (arousing) and the parasympathetic (calming) are complementary systems which both are needed not only for psychological balance but for survival. Without a parasympathetic modification, the heart would beat too quickly to sustain life. Ideally there is a smooth balance between the two, an automatic self regulation. The sympathetic is dominant in exercise, athletics, emotional as well as in stressful situations. The parasympathetic takes over in relaxation, sleep, meditation, massage, gentle touch, connecting deeply with another person, and nurturing.

When stress is highly prominent, the sympathetic system automatically goes to a fight or flight response, this is a built-in response. It can happen in response to external threat or the perception of threat. Either fighting or fleeing can resolve the stress. If neither is possible or successful, the sympathetic arousal can get so extreme that it is too much for the body to handle. At this point, we have a failsafe survival mechanism. The parasympathetic system spikes. It comes in so strongly that it overwhelms the sympathetic arousal and sends the person into a state of freeze. This can be a full collapse, dissociation, or a more partial freeze such as an inability to think clearly or access words or emotions, or to move parts of the body. This can be momentary, short term—such as a possum freezing and becoming reanimated after the predator leaves, or, in humans, it can continue indefinitely.

When exposed to too little for too long or too much too fast, the freeze response (overwhelm) and the dorsal vagus nerve may shut down the entire system, in order to save the system. In athletes this might show up as:

- *Shock trauma, for example in the form of an injury, concussion or fracture but, also being kicked off a team, a terminated contract.*
- *Overtraining and not enough time for recovery leading to nutrient deficiencies, insomnia and chronic low-grade inflammation and poor tissue repair.*
- *Mental pressure, from coaches, parents, team-mates or from within and a lack of emotional support / connection independent of the results of the athlete.*

SIGNS & SYMPTOMS OF THE FREEZE RESPONSE IN ATHLETES.

It is important to understand that the freeze response is a survival mechanism, an instinctive response to serve in order to survive. In order to recover from this dysregulated state one has to understand what got them there in the first place. It might not always be as obvious as a shock trauma.

Typical symptoms to notice when experiencing the freeze response is:

- Poor circulation / poor recovery.
- Low pulse

- Low HRV
- Insomnia
- Altered mood, doesn't care about anything anymore, avoidance, isolation and disassociate behaviors.
- Loss of appetite, digestive issues/imbalance
- Extreme fatigue
- Abusive dynamics within sports teams
- Direct physical injury, secondary/witnessed traumatic events

Symptoms of PTSD - another symptom of the freeze response - may significantly impact athletes' psychosocial and sport-related function through avoidance, hypervigilance and dissociative behaviors, which, in turn, may delay recovery from musculoskeletal injury. (4)

According to research from 2021, around 24% of Olympic and Paralympic athletes reported experiencing high or very high psychological distress after the Games (12). Devoting a four year period of your life to being at your very best, in a specific moment including the Olympic hype and attention from the world will take its toll when the lights go out and the games are over. In a recent article in the NY times, Tennis No1 ranked player Naomi Osaka shared her vulnerability around her mental conditions and depression from withdrawing from the grand slam. Joining her are names like Micheal Phelps and swimmer Amanda Beard. (13)

PTSD IN ATHLETES

Athletes are more prone to PTSD than the general population, with estimates ranging from 13 to 25 percent (4). While difficult to precisely quantify, an estimated 1 in 8 elite athletes suffers from PTSD (2). While PTSD may be common among elite athletes, recognition by providers who do not routinely screen for trauma-related disorders may be challenging because of the tendency of athletes to mask symptoms of PTSD and other trauma-related disorders. Early identification of athletes suffering from trauma-related symptoms, including those of acute stress disorder, may prevent progression to PTSD, while treatment of athletes already meeting criteria for PTSD may improve life functioning and sports performance outcomes.

Current evidence supports increasing awareness of PTSD in athletes and use of screening tools to identify athletes who may benefit from trauma-informed medical or psychotherapeutic interventions, and should involve the athlete's multidisciplinary team of clinical experts to account for unique demands and preferences in the context of sport. (4)

EARLY INDICATIONS & RED FLAGS

CIRCADIAN RHYTHM, INSOMNIA & HPA AXIS (sleep imbalances)

A large focus of research has been devoted to how sleep and circadian rhythms impact athletic performance. Sleep deprivation and time of day are both known to influence performance. (11) Honoring the body's circadian rhythm may more than often be compromised with athletes, constantly traveling through time zones, early mornings and late night games/practice will disrupt the body's own natural rhythm.

Late night games or practice will affect the adrenal/cortisol production to increase HPA axis activity, towards sympathetic when according to our circadian rhythm we shall calm down (parasympathetic) before bedtime in order to get good quality sleep, late games makes it harder to go to bed on time of course, missing out on important deep sleep and total quality of sleep. Number of hours in bed is correlated to improved HRV, and nervous system regulation. When these early makers are imbalanced for a longer period of time it is not long until an infection or injury comes knocking on the door.

LEAKY GUT & NEUROTRANSMITTERS

Fatigue, mood disturbances, under performance and gastrointestinal (GI) distress are common among athletes during training and competition. The psychosocial and physical demands during intense exercise initiates the hypothalamus-pituitary-adrenal (HPA) axis, resulting in the release of stress and catabolic hormones, inflammatory cytokines and microbial molecules. The gut and its microbial microorganisms have fundamental roles in many aspects of our physiology including metabolism, endocrine, neuronal and immune function. The gut microbiome influences the intestinal barrier and immune function which are believed to be a critical aspect of the brain-gut axis. (6)

Research is suggesting that the GI tract can become even more permeable while running or engaging in other sports that have repetitive up and down mechanical motions. A hot environment can also exacerbate these effects. An athlete

who is doing intense exercise-to-exhaustion (like HIIT training or Crossfit) or long duration/endurance exercise is most susceptible. (13)

Serotonin, a neurotransmitter (made up to 90% in the gut) is related to increased sensitivity to negative stimuli (such as perceived fatigue or effort), and also increases perceived exertion. Additionally, neurotransmitters such as dopamine and serotonin are involved in feelings of motivation or the lack thereof. (7) Both important internal communication molecules affect the decisions and behavior of the athlete to be on top of her/his game, all related to gut health and permeability.

INFLAMMATION & OXIDATIVE STRESS (slow recovery)

Muscle contraction and repetitive joint action cause microtrauma to tissues (3). That is preferable, as tissue healing and strengthening occurs via activation of a local inflammatory response and recruitment of cytokines. So far that part of inflammation is wished for... however with continued intense training and absence of adequate rest, this inflammatory response can become chronic and pathologic. Eventually a systemic inflammatory response can result in negative consequences throughout the body, leading to shut down (aka the freeze response).

To some extent even oxidative stress is desired during exercise because reactive oxygen species released from damaged muscles regulate cellular repair. However, when oxidative stress becomes pathologic, reactive oxygen species can cause inflammation, muscle fatigue, and soreness with resultant inhibition of athletic performance. Looking after the athletes nutritional status is essential for preventing oxidative stress symptoms.

For example, vitamin D has many functions important to the athlete, including muscle function, injury recovery, NS health and cognitive / mood. Studies in athletic populations suggest that maintaining adequate vitamin D status may reduce stress fractures, total body inflammation, common infectious illnesses, impaired muscle function and may also aid in recovery from injury.

Emerging evidence is finding that vitamin D deficiency can have a profound effect on immunity, inflammation and muscle function. Studies in athletes have found that vitamin D status varies among different populations and is dependent on skin color, early- or late-day training, indoor training and geographic location. (5)

My personal favorite and the one that is closest to my heart is research showing that loneliness or feeling a sense of being alone in the world will enhance the inflammatory response in the body. (6) When you lose out on 1/100th of a second after dedicating your life to the sport or, you made that wrong shot/pass that ended the game in the opponent's favor, you don't feel a lot of connection. The "neutral" social support for the athlete is essential for a sense of safety and being able to recover both mentally and physically until they try again.

SUMMARY

Understanding both the mental and physical contributors to why an athlete experiences shut down, overwhelm (aka the freeze response) is essential in order to either prevent further decline, or bring them back to regulation. Current evidence supports us that this needs to be addressed with a holistic perspective addressing the whole team around the athlete, as it is a complex and highly individual journey. We need to educate the trainers, coaches as well as the athletes themselves about the red-flags of the freeze response and lack of self regulation.

Most athletes do not want to hear about life after the career is over - focus is understandable on the 'here and now'. However, as a coach, I believe there is a responsibility to the whole athlete - for life. I dare to say that creating this awareness both mentally and physically will not only improve their performance, but it will also help them to transition later in life.

I love what my mentor Pip Waller, an author & herbalist, told me when she initially listened to my life story...
"The life of the pro athletes are equivalent to glorified slavery". For the athlete this is a sense of passion mixed with a sense of life and death, an addictive feeling!

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