Proper Recovery From Training

Why do we need to recover from exercise?

Recovery from exercise is essential for several reasons. Exercise creates an overload on the body, and recovery allows it to adapt to that overload and establish a new homeostasis. Continually pounding on the body day in and day out takes its toll, and although exuding dedication, different levels of exercise require different recovery times:

- A single intense workout may require a few days to recover from. It's healing biology, people. The 24-hour circadian cycle is usually not adequate to fully replenish energy, heal, and adapt to the previous training stress.
- Functional overreaching (purposeful tapering) may require a few days to weeks. An example would be being completely recovered for a single significant event (e.g., end-of-season championship) where weeks and months of hard training and practice led up to it.
- Non-functional overreaching (the beginning stage of overtraining) requires weeks to recover from. This would be when your training and/or competition performance declines for several days and requires lengthy downtime to "get out of the hole."
- Overtraining is an extreme state that takes a long time to recover to baseline, and it often occurs. Your brain may say, "Let's go," but your body says, "I need a break." Train hard, but train smart.

Symptoms and signs of overtraining

Signs and symptoms of overtraining and non-functional over-reaching include:

- **Performance decrease**. You're regressing in your sport/event, and/or your workout numbers are not being achieved.
- **Constant fatigue**. You are overly tired before contests and training/practice sessions.
- **Poor sleep**. You often wake up tired, and obtaining proper sleep is crucial because that is when the body repairs tissues and restores energy.
- **Mood swings**: You become more agitated and fly off the handle more often
- **Changes in Biomarkers**. Blood and fluid tests reveal altered levels of:
  - Leukocyte responses to antigens (e.g., lymphocyte proliferation, neutrophil degranulation, NK cytotoxic activity).
  - Salivary IgA.
  - Neutrophil/Lymphocyte Ratio.
  - T-cell CD4+/CD8+ Ratio.

- T-cell CD4+CD45RO+ expression.
- Plasma cortisol or cortisol/testosterone ratio.
- Urinary steroids or catecholamines.
- Plasma urea.
- Plasma cytokines (e.g., IL-6).
- Blood lactate response to incremental or high-intensity exercise.
- Plasma or salivary cortisol response to high-intensity exercise. Cortisol is important in processing carbohydrates, fat, and protein, and impacts blood pressure, blood glucose levels, and the sleep/wake cycle.

Energy depletion and muscle damage

Training and competition naturally require muscle contraction and subsequent energy use. Therefore, it is essential to understand the muscle energy supply and the damage that occurs from repeated contractions, both in extended, low-intensity and short-term, high-intensity actions.

- **Energy depletion**. Glucose/glycogen, fat, ketones, and, in extreme circumstances, protein can all be converted into ATP for muscle energy. The body has an almost unlimited supply of fat, so most of the time fatigue and performance decline are due to the depletion and/or unavailability of ATP from glucose (in blood circulation) and stored glycogen (in the muscles and liver). Hence, ensuring adequate storage of those is essential, primarily when lengthy events are undertaken (e.g., > one hour).
- **Muscle soreness and damage**:
  - Muscle soreness and damage are a result of multiple factors.
  - Lactate is *not* a sign of soreness.
  - Soreness is not from the "tearing" of muscle tissue. If a tear occurred, immediate pain would ensue.
  - Pain receptors located in the muscles can be quelled temporarily by immediate rubbing/pressure to deactivate them.
  - Acute muscle inflammation is due to increased pressure from fluid accumulation, which affects pain receptors.
    - Alpha motor neurons initiate contraction.
    - Gamma neurons (muscle spindles) are proprioceptive and sensitive to stretching and send feedback to the CNS to signal muscle soreness.
  - Inflammatory signals may also come from the leaking of free radicals (hyperactive molecules missing an electron, opposite of antioxidants).
  - Low-level activity post-training is good for decreasing soreness because it "pumps" out fluid.
  - Massage and rolling also help remove residue that takes the pressure off pain receptors.

Heat and Cold Factors

- **Heat**
  - Training in ambient heat can negatively impact muscle tissue health, modify enzyme structures, and decrease their function. Overheating, in general, is detrimental.
  - In hot weather, sweating dumps heat, but it is more difficult in humid weather.
  - The enzyme pyruvate kinase (needed in the last step of glycolysis) cannot function in high heat.
  - ATP is best generated under 102 degrees Fahrenheit.
  - Cardiac drift occurs more in higher ambient heat. Even with no increased workload, an elevated heart rate diverts more blood to the skin and kidneys to maintain body temperature and hydration, which decreases stroke volume.
  - Myth: heat leaves through the top of the head.
  - Truth: it leaves through the face, palms, and the bottom of the feet.
- **Cold**
  - Training in ambient cold positively impacts ability because heat dumping/sweating evaporates faster.
  - There is a negligible risk of overheating.
  - Has more variability of range.
  - Blood vessels contract (vasoconstriction) to maintain heat via an autonomic nervous system response.
  - Goosebumps: An inherited trait from our ancestors when they had many hair follicles. They would "bend up" (piloerection) to increase insulation to preserve heat.
  - Three main body compartments for cooling: face, palms, and the bottom of the feet.
  - Glabrous skin – has no hair and can dump heat effectively due to vascular arteriovenous capillaries and venous anastomosis.
    - Normally blood flows from arteries → capillaries → veins → heat.
    - The avas-arterial capillaries bypass other capillaries, so it goes directly from the arteries to → veins to allow more heat to dump and more cooling to enter the body.
  - STUDY: Cooling the palms increases performance because the pyruvate kinase cannot function in high heat.
  - STUDY: On pull-up and bench press muscular endurance: Cooling the palms significantly increased the number of reps completed.

Dietary and Behavioral Considerations for Proper Recovery

- **Omega-3 Fatty Acids**: Consuming 1-2 grams per day is recommended.
- **Creatine Monohydrate**: A daily intake of 5-15 grams, depending on body size, is advised. For example, a 185 lb person might take 10-15 grams per day. Phosphocreatine is also considered brain fuel.

- **Antioxidants**: Getting antioxidants from food is preferable, but too many from supplements can be detrimental.
- **Rhodiola Rosea**: This can act as a cortisol monitor and enhance mental and physical performance. A dose of 100-200 mg/day is suggested. It may be taken 10-15 minutes before a high-intensity training (HIT) workout.
- **Alcohol**: Avoid before and after training as it can acutely decrease blood pressure, increase heat loss, and dehydrate the body.
- **Caffeine**: Those not adapted to caffeine use (non-coffee drinkers) do not use it because it is a vasoconstrictor of blood vessels, increasing heat.
- **NSAIDs**: Longer endurance athletes sometimes use NSAIDs, which decrease body temperature, but they can affect the liver, kidneys, and electrolyte balance
- **No Pre-Workout Supplements**: They increase body temperature, which can be dangerous.
- **Breathing Techniques**: Down-regulating breathing through techniques like box breathing from 3:00 to 5:00 can aid recovery. Emphasizing exhales can help down-regulate the parasympathetic system.
- **Individual Physiological Characteristics**: Factors such as age, fitness level, genetics, and pre-existing conditions can all influence how quickly a person recovers from exercise.
- **Wear Compression** or tight-fitting clothing post-training.
- **Cold Immersion** (<45 degrees) up to the neck can decrease muscle soreness but can compromise hypertrophy, but it can decrease good inflammation (after injury) and the function of M-Tor.
  - Can combine cold with breathing techniques and compression clothes.
  - Do not cool the core by itself.
  - Do not use direct cold immersion on the back of the neck or chest.
  - Specific areas to apply cold are the palms, face, and bottoms of the feet.
  - When cooling the specific areas, only get the body back to resting temperature.