Overtraining Syndrome

Carrie A Jaworski, MD, FACSM
Director, Primary Care Sports Medicine Fellowship and Division
NorthShore University HealthSystem
• No Disclosures
Overtraining

“A condition difficult to detect and still more difficult to describe. Evaluation should focus on training load, nutrition, sleep, rest competition stress, and psychological state”

Dr. Parmenter, 1923
Common terms

• Training
• Adaptation
• Recovery
• Periodization
• Overreaching
• Overtraining
Training Principles

• Periodization = approach to training
  – Year is divided into 4 macrocycles. Each week is a microcycle where intensity varies.
  – Preparation phase = flexibility, strength and building aerobic base
  – Precompetitive cycle = intervals, speed work and sports-specific tasks
  – Competition season = some flexibility and strength, emphasis on performance
  – Post-competition = athlete rests, recreational activities, low intensity
Training Principles

• Training response = When a system is stressed and then allowed to rest/recover → it adapts to tolerate greater stress in the future
  – Athletes “overreach” in order to make gains in performance

• Overtraining Syndrome is at the far end of the training spectrum where balance is lost between stress and recovery
Definitions

• Functional Overreaching (FO) - Increased training = temporary performance decrement = improved performance after rest
  – Days to weeks

• Non-functional overreaching (NFO) - Intense training = longer performance decrement but with full recovery after rest
  – Accompanied by increased psychologic and/or neuroendocrinologic symptoms
  – Weeks to months
Definitions

• Overtraining Syndrome (OTS) - Extreme nonfunctional overreaching but with:
  – Longer performance decrement (> 2 months)
  – More severe symptomatology and maladapted physiology (psychologic, neurologic, endocrinologic, immunologic systems)
  – An additional stressor not explained by other disease
Epidemiology of OTS

• Prevalence unknown
  – Estimates of 5-15% of elite athletes
  – Many groups report episodes of NFO
  – Higher in amateur athletes, females, individual sports

• Diagnosis is elusive

• Often retrospective

• Best treatment is prevention
Physiologic changes with training

**Immune**
- Decreased salivary IgA
- Increased WBC, lymphocytes, natural killer cells, and PMN activity
- Transient decrease in T helper/T suppressor ratio
- Decreased serum glutamine

**Endocrine**
- Increased testosterone stimulates glycogen regeneration and protein synthesis (anabolism)
- Transient increase cortisol (stress response/catabolism)
- Increase NE = lipolysis
- Effects on Epi, SHBG, GnRH, GH
Many hypotheses for OTS...

- Chronic glycogen depletion
- Autonomic imbalance
- Central fatigue hypothesis
- Glutamine (immune dysfunction) hypothesis
- Cytokine hypothesis
- Oxidative stress hypothesis
- Hypothalamic hypothesis
Pathophysiology

• Complex neuroendocrine response

• Hypothalamus, pituitary and endocrine glands involved

• Training causes a release of cortisol, epinephrine, growth hormone and prolactin
Pathophysiology

• Cortisol levels return to normal and free testosterone rises within a few hours after exercise
  – Signals anabolic process where muscles hypertrophy, expand their capillary beds, the density of mitochondria per cell increase and store more glycogen
  – Critical step is the downregulation of cortisol
Pathophysiology

• If inadequate rest, maladaptive response occurs
• Cortisol remains high = suppression of the testes and increase in sex hormone-binding globulin which compromises the effect of testosterone.
  – Women present with menstrual irregularity due to disruption of pituitary-ovarian axis
Pathophysiology

• Circulating cortisol binds to muscle and induces catabolism
  – Negative nitrogen balance, urea produced
• Immune system releases monocytes → they produce pro-inflammatory cytokines (IL-β, IL-6 and TNF-α)
• Systemic inflammation induces CNS response
Diagnosing Overtraining Syndrome

• Diagnosis is clinical
• Highly motivated individuals, not necessarily the most successful
• Many interpret sx as being inadequately prepared and respond by increasing training
• Labs are often nonspecific
  – Many helpful only if baseline data exists
  – Avoid shotgun approach
  – Consider: CBC, ESR, CMP, TSH, ferritin, B-HCG, Monospot
Fatigue workup

- Improved
  - Physiologic = modify schedule

- Not improved
  - Pathologic = Overtrained. POMS, RD consult, relative rest 3-6 months

H&P, diet eval, training review, basic labs, decrease load for 2-3 weeks
Differential Diagnosis

• Common
  – Allergies, caffeine withdrawal, EIA, mono, poor sleep, iron deficiency, mood/stress, URI

• Less common
  – Dehydration, DM, eating disorder, hepatitis, thyroid, inadequate nutrition, lower resp infection, pregnancy, med side effects, substance abuse

• Rare
  – Adrenocortical insufficiency or excess, CV issues, HIV, Lyme, malabsorption, malignancy, neuromuscular disorders, renal disease
Signs and Symptoms

- **MSK**
  - Overuse injuries, myalgias, decreased strength/efficiency
- **Physiologic**
  - Decreased VO$_2$, glycogen stores and max lactate production. Increased submax HR, basal metabolic rate, negative nitrogen balance
- **Immunologic**
  - Frequent infection, poor wound healing
- **Endocrine**
  - Delayed menarche, irregular menses, decreased libido (males), decreased sperm count
- **Psychologic**
  - Depressed mood, malaise, sleep disorders, poor concentration, anorexia, anhedonia
# Autonomic effects

## Sympathetic
- Increased resting pulse
- Prolonged pulse recovery
- Disordered sleep
- Increased sweating
- Emotional instability

## Parasympathetic
- Decreased resting pulse
- Rapid pulse recovery
- Poor digestion
- Decreased BP
- Early fatigue

## Early OTS?

## Late/chronic OTS?
Treatment

• Rule out other causes of fatigue first
• Psychiatric indicators appear before biologic markers
• Profile of Mood State (POMS) is cheap and reliable
• Time to fatigue is better marker than actual performance times
• Promising research on a 2-bout maximal exercise test to differentiate FO, NFO and OTS
Treatment

• REST (relative rest)
• 6-12 weeks
• Anticipate a grief reaction
• Consider SSRI – first 3 months
• Consider amitriptyline or trazadone for sleep in beginning
• Build volume before intensity
Prevention

• Education

• Screening
  – Use POMS to adjust training
  – Resting HR and HR recovery have been used
    • These don’t differentiate FO, NFO, OTS
  – Tests such as VO2, lactate done periodically if appropriate

• ? Free testosterone to cortisol ratio.
  – A decrease in ratio of > 30% implies catabolism & can indicate inadequate recovery
  – More a measure of physiologic strain of training than athlete’s response to such
  – Lack of data to support
Future directions

• Research on measuring changes in metabolism by Fourier transform infrared spectroscopy before symptoms and objective performance decrements are clinically appreciated

• Research on differences in psychomotor speed between NFO/OTS athletes and control athletes