OVERTRAINING: Causes, Recognition and Prevention

PASO Swimming Coaches Clinic
US Olympic Training Center
Colorado Springs USA
27 October 2014

Gracias / Obrigado!
Kamsa hamnida
Danke schön
Спасибо
Thank you

Randall L. Wilber, PhD, FACSM
US Olympic Committee

TRACK/CC COACH (1976-1993)
- Titusville High School (Florida)
- University of Wisconsin-Eau Claire
- Florida State University

SPORT PHYSIOLOGIST (1993-present)
US Olympic Committee
- Salt Lake City 2002
- Athens 2004
- Torino 2006
- Beijing 2008
- Vancouver 2010
- London 2012
- Sochi 2014
Baron Pierre de Coubertin
Founder of the Modern Olympic Games

"There is no higher ideal for the human race, than promoting peace through international sport."

Overtraining and Under-Performance: Causes, Recognition and Prevention

- Terminology / Nomenclature
- What Causes Overtraining / Under-Performance
- Treatment & Prevention
- Summary & Resources
OVERTRAINING (OT) vs UNDER-PERFORMANCE (UP)

- Chronic poor performance is the only characteristic that we can be sure of.
- OT implies that "training" per se is the root cause . . . may not be true.
- Semantics of UP are less threatening to coaches.

UNDER-PERFORMANCE Continuum

Legend:

- TL = Training Load
- WO = Workout
- V = Volume
- I = Intensity
- TS = Training Stimulus
- R = Recovery
- FOR = Functional Overreaching
- NFOR = Non-Functional Overreaching
- OTS = Overtraining Syndrome

USING

- Acute TL
- Rest & Cross-training
- FOR
- +
- TS = R
- NFOR

UNDER-PERFORMANCE Continuum

- Chronic TL
- Mesocycle
- Moderate V / I
- Mesocycle
- High V / I
- TS > R
- + / -
- OTS
- -
**TERMINOLOGY**

- Training Load (TL)
- Workout (WO)
- Volume (V)
- Intensity (I)
- Functional Overreaching (FOR)
- Non-Functional Overreaching (NFOR)
- Overtraining Syndrome (OTS)

**OVERTRAINING AND UNDER-PERFORMANCE:**

- Causes, Recognition and Prevention
  - Terminology / Nomenclature
  - What Causes Overtraining / Under-Performance
    - Treatment & Prevention
    - Summary & Resources

**CYTOKINE HYPOTHESIS OF OVERTRAINING / UNDER-PERFORMANCE**

**Dr. Lucille Lakier Smith**

- WWII: 327-331, 2000
- JSCR: 185-193, 2004
**Excessive Musculoskeletal Stress**  
[2-3 training sessions / day]

+  

**Insufficient Recovery**  
[sleep, nutrition, psychological down time]

Pro-Inflammatory Cytokines

Chronic Musculoskeletal Inflammation

**Overtraining and Under-Performance:**  
**Causes, Recognition and Prevention**

- Terminology / Nomenclature
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- Summary & Resources
SCENARIO 1
“...what can I do to get back to 100%?”

SCENARIO 2
“I think I might have overtrained last season... how can I prevent that from happening again this year?”

ACTION PLAN = Reactive / Therapeutic
1. Comprehensive Health Screen

COMPREHENSIVE HEALTH SCREEN
- Blood Chemistry
- Urinalysis
USA TRACK & FIELD
Female
24 yr

| TSH (mIU/mL) | 4.65 H | [0.45-4.50] |
| Free T3 (pg/mL) | 3.0 |
| T3 uptake (%) | 32 |
| T4 (µg/dL) | 6.1 |
| Free T4 (mg/dL) | 1.09 H | [0.82-1.80] |
| Free Thyroxine Index | 2.0 |
| Thyroid peroxidase Ab (IU/mL) | 427 H |
| Anti-Thyroglobulin Ab (IU/mL) | 29 |

| Estradiol (pg/mL) | 13.7 |
| FSH (mIU/mL) | 3.8 |
| LH (mIU/mL) | 6.0 |
| Progesterone (ng/mL) | 11.4 |
| Prolactin (ng/mL) | 6.9 |

| DHEA-Sulfate (µg/dL) | 206.9 |
| Testosterone, serum (ng/mL) | 25 |
| Hemoglobin A1c | 5.6 |

COMPREHENSIVE HEALTH SCREEN

Blood Chemistry
Urinalysis
Dietary Analysis

Stage 3: IRON-DEFICIENT ANEMIA (IDA)

USA TRIATHLON
Female
24 yr
The primary findings with B's data indicate that he pronates more on his left foot (note slanted COF lines). However, his right foot is applying, on average, approximately 100 lbs more force than his left foot. The colors show the areas of the feet involved with handling these high forces.

Data courtesy of Dr. William Sands.
Exercise-Induced Bronchoconstriction (EIB)

Normal Bronchiole  Constricted Bronchiole

Vocal Cord Dysfunction (VCD)
Exercise-Induced Laryngeal Obstruction (EiLO)

Scénario 1
"I'm under-performing . . . what can I do to get back to 100%?"

Action Plan = Reactive / Therapeutic

1. Comprehensive Health Screen
2. Modify training back to “Active Recovery” Phase
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SCENARIO 1
“I’m under-performing . . . what can I do to get back to 100%?”

ACTION PLAN = Reactive / Therapeutic

1. Comprehensive Health Screen
2. Modify training back to “Active Recovery” Phase
3. Monitor conservative progression from “Active Recovery” back to “Chronic TL”

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<table>
<thead>
<tr>
<th>Perceived Recovery Status Scale</th>
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<tr>
<td>Rating</td>
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<tr>
<td>10</td>
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<td>4</td>
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<tr>
<td>3</td>
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<tr>
<td>2</td>
</tr>
</tbody>
</table>

Figure 1. The Perceived Recovery Status Scale.

SCENARIO 1

“I’m under-performing . . . what can I do to get back to 100%?”

ACTION PLAN = Reactive / Therapeutic

1. Comprehensive Health Screen
2. Modify training back to “Active Recovery” Phase
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4. Retroactive inspection of Training Log

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February
Diagnosed with IM

January
Chronic “under performance” reported by Coach and Athlete

Female
20 yr
2008 Olympian
Modern Pentathlon

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2. Modify training back to “Active Recovery” Phase

Active Recovery
Acute TL
Chronic TL
Chronic TL
Rest & Cross-training

WD
Mesocycle [Moderate V / I]
Mesocycle [High V / I]

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SCENARIO 2

“I think I might have overtrained last season . . . how can I prevent that from happening again this year?”

ACTION PLAN = Proactive / Preventive

1. Recognition of OT “risk factors”

ATHLETE

- Perfectionist / Obsessive-Compulsive personality
- Excessive level of motivation
- “More is better” training approach . . . based on bad or good performance
- Resistant to taking time off . . . during injury/illness or non-injury/illness
- Sport specialization at an early age
- Eating disorders or disordered eating
- Competition schedule designed to chase “points” or “money”
- External stressors . . . home, school/job, relationships, financial

SPORT

- Ultra-sport (e.g., Ironman events, multi-day cycling events)
- Multi-sport (e.g., triathlon, pentathlon)
- Endurance-sport (e.g., marathon)
- Sport that allows for little or no individualization of training load
- “Meat grinder” sports (e.g., DR in Kenya; soccer in Brazil; swimming in USA)
1. Recognition of OT “risk factors”

TRAINING

- Overloading adolescent athletes during growth spurts
- Transition from junior/developmental level to senior level . . . and accompanying increase in training load
- Lack of scientifically-based periodization leading to stress-recovery imbalances and OT
- “Knee jerk” response to under-performance leading to excessive increase in training load


1. Recognition of OT “risk factors”

TRAINING

- Training individually with minimal or no “face-to-face” coaching and objective monitoring
- Training with significantly more skilled/fit athletes
- Poor monitoring of “recovery” workouts
- Olympic / World Championship season
- Lack of scientifically-based taper
- Coaching directed by a former successful elite athlete
- Change in training environment . . . heat + humidity, altitude


SCENARIO 2

“I think I might have overtrained last season . . . how can I prevent that from happening again this year?”

ACTION PLAN = Proactive / Preventive

1. Recognition of OT “risk factors”
2. Robust DB to monitor negative response to “Chronic TL”
2. Robust DB to monitor negative response to “Chronic TL”

Acute TL | Chronic TL | Chronic TL | UNDER-PERFORMANCE

Rest & Cross-training

WO Mesocycle [Moderate V/E]

Mesocycle [High V/E]

PHYSIOLOGICAL + PSYCHOLOGICAL METRICS

PRACTICAL/INEXPENSIVE – NON-INVASIVE – VALID – REPEATABLE

Training Questionnaire
Questions:

 Should I train when I’m sick?

YES
- Symptoms of a common cold with NO systemic involvement.
- Submaximal exercise (sub-HLa TH) is OK.
- Short duration maximal exercise is OK.

NO
- Symptoms of systemic involvement (fever, extreme fatigue, muscle aches, swollen lymph glands, etc.).
- Submaximal exercise and maximal are contraindicated.
- Allow time off from training for recovery (minimum 1 week).

Physiological + Psychological Metrics

Practical/Inexpensive – Non-invasive – Valid – Repeatable

Training Questionnaire

Blood Chemistry
Stage 1: IRON-DEPLETION

USA CYCLING
Female
25 yr

Stage 2: IRON-DEFICIENT NON-ANEMIA (IDNA)

USA TRIATHLON
Female
18 yr

IRON SUPPLEMENTATION

If serum Ferritin is low:
- Attention to “heme Fe” in diet.
- Moderate Fe supplementation
  - 120-130 mg “elemental Fe” divided into 2 doses
  - taken with Vitamin C
  - taken 30 min before or 60 min after meals to increase absorption and decrease GI distress
  - taken daily

Ferrous sulfate
**IRON SUPPLEMENTATION**

Hemoglobin

Cytochrome Oxidase

**Classification**

<table>
<thead>
<tr>
<th>Classification</th>
<th>Vitamin D, 25-DH</th>
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<tr>
<td>Deficient</td>
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<td>&lt; 32 ng/mL</td>
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<tr>
<td>Sufficient</td>
<td>&gt; 32 ng/mL</td>
</tr>
<tr>
<td>Ideal / Optimal</td>
<td>50-80 ng/mL</td>
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**PHYSIOLOGICAL + PSYCHOLOGICAL METRICS**

PRACTICAL/NEXPENSIVE – NON-INVASIVE – VALID – REPEATABLE

- Training Questionnaire
- Blood Chemistry
- Sleep Monitor
Evidence of Disturbed Sleep and Increased Illness in Overreached Endurance Athletes

Chronic Lack of Sleep is Associated With Increased Sports Injuries in Adolescent Athletes
PHYSIOLOGICAL + PSYCHOLOGICAL METRICS

PRACTICAL/INEXPENSIVE – NON-INVASIVE – VALID – REPEATABLE

Training Questionnaire
Blood Chemistry
Sleep Monitor
Salimetrics

IPro™ Salimetrics

IgA
IgM
Testosterone
Cortisol

Salivary IgA and prediction of URTI

Method: Immuno-chromatographic lateral flow
Cross-validation with ELISA, r=0.96, P<0.001

MSSE 34: 411-417, 2002
MSSE 31: 67-73, 1999
SCENARIO 2

“I think I might have overtrained last season . . . how can I prevent that from happening again this year?”

ACTION PLAN = Proactive / Preventive

1. Recognition of OT “risk factors”
2. Robust DB to monitor negative response to “Chronic TL”
3. Meticulous attention to Recovery

WO and Post-WO Fluid Intake

1. WATER
2. ELECTROLYTES
3. GLUCOSE
4. PROTEIN
During WO

GLUCOSE

Post WO

GLUCOSE

GLYCOGEN

CHO-Electrolyte Drinks

Nutrition Facts

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<th>Serving Size: 8 oz. (240 ml)</th>
<th>Servings Per Container: 4</th>
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<tr>
<td>Total Fat (0g)</td>
<td>0% Daily Value</td>
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<tr>
<td>Saturated Fat (0g)</td>
<td>0% Daily Value</td>
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<tr>
<td>Trans Fat (0g)</td>
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<tr>
<td>Sodium (0mg)</td>
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<tr>
<td>Total Carbohydrate (14g)</td>
<td>5% Daily Value</td>
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<tr>
<td>Sugars (0g)</td>
<td>0% Daily Value</td>
</tr>
<tr>
<td>Protein (0g)</td>
<td>0% Daily Value</td>
</tr>
</tbody>
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Not a significant source of Cholesterol. Fat, Saturated Fat, Cholesterol, Dietary Fiber, Vitamin A, Vitamin C, Calcium, Iron.

Per bottle, per serving, and based on a 2,000 calorie diet.
Post WO Nutrition
Compression Garments
Massage
Sauna
Ice Vest
Normatec™
Hot/Cold Bath
Low Frequency Vibration
Hydrotherapy
Anti-gravity Treadmill

Stone et al. in review
The Effects of Sleep Extension on the Athletic Performance of Collegiate Basketball Players

Normal Sleep (2-4 weeks)
- AVG = 6 hr: 41 min

Sleep Supplementation (5-7 weeks)
- AVG = 8 hr: 27 min

- Reaction Time (ms)
- 3 Pointers (out of 15)
- Free Throws (out of 20)

SCENARIO 2

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1. Recognition of OT “risk factors”
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3. Meticulous attention to Recovery
4. Execute a scientifically-based taper
Intensity, Volume & Frequency during Taper

Intensity, Volume & Frequency during Taper

- **Intensity** ↔ or ↑
  - “Work ‘em hard!”
- **Volume** ↓ 40-60%
  - “Send ‘em home early”
- **Frequency** ↔
  - “Train every day”

Positive Adaptations of Scientifically-Based Taper

- **Hormones**
  - ↓ Cortisol (catabolic)
  - ↑ Testosterone (anabolic)
- **Enzymes**
  - ↓ CK
  - ↑ Oxidative enzymes
  - ↑ Myofibrillar ATPase
- **Substrates**
  - Liver & Muscle glycogen
- **Skeletal Muscle**
  - ↑ Fiber size
  - ↑ Fiber power
Multiple Tapers in One Season

NCAA
Early June 2004

US Olympic Trials
Mid July 2004

Athens 2004
Late August 2004

Terminology / Nomenclature

What Causes Overtraining / Under-Performance

Treatment & Prevention

Summary & Resources

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Legend:

TL = Training Load; WO = Workout; V = Volume; I = Intensity; TS = Training Stimulus; R = Recovery; FOR = Functional Overreaching
NFOR = Non-Functional Overreaching; OTS = Overtraining Syndrome
+ = Positive Training; - = Negative Training

OVERPERFORMANCE

Acute TL
Chronic TL
Mesocycle [Moderate V/I]
Mesocycle [High V/I]
Rest & Cross-training
TS = R
TS > R
FOR
NFOR
OTS

Continuum
SCENARIO 1

“I’m under-performing… what can I do to get back to 100%?”

**ACTION PLAN = Reactive / Therapeutic**

1. Comprehensive Health Screen
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2012

January
Chronic “under performance” reported by Coach and Athlete

February
Diagnosed with IM

June
Resumed normal training

August
4th Place (<1 sec out of Bronze)

September
Junior World Champion: INDIVIDUAL
Junior World Champion: TEAM

Female
20 yr
2008 Olympian
Modern Pentathlon

SCENARIO 2

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2. Robust DB to monitor negative response to “Chronic TL”
3. Meticulous attention to Recovery
4. Execute a scientifically-based taper
“More performances are spoiled by slight overtraining than by slight lack of fitness.

An athlete who is 90% conditioned for an event will do better than an athlete who is 0.5% overtrained.”

Bobby McGee