



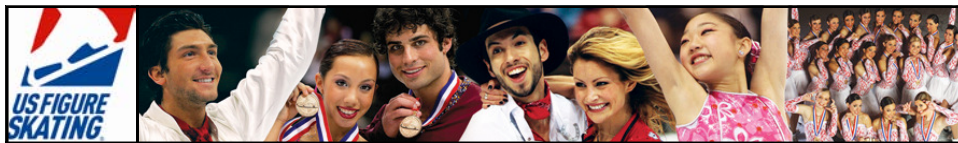
***Hidden Training:***  
**What we don't see and why it matters.**

**2008 Summer Competition Series**

Liberty ~ Skate Detroit ~ Silicon Valley

**Charlene Boudreau**

Director, Sports Sciences & Medicine, U.S. Figure Skating



***No-see-ems...***



...Those biting gnats you can barely see, who can pass right through a screen-wire window, and whose bite hurts more than a mosquito's, though they are only a small fraction of a mosquito's size.



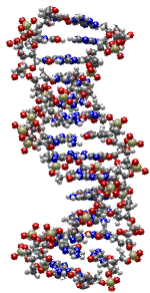
**No-see-ems in Training:**  
*Little things that make a BIG difference.*

	Physical Training	Attitude	Nutrition	Sleep	Recovery	Alcohol	Cortisol	GH	Physique	Mental Stress	Immune System
Physical Training							x		x	x	x(cort)
H-Attitude	x									x	
H-Nutrition	x			x	x		x		x	x	x
H-Sleep	x				x(gh)		x	x	x(cort)	x	x
H-Recovery	x									x	
H-Alcohol	x			x				x	x	x	x(sleep)
H-Cortisol	x(*)								x		x
H-GH	x				x				x		
H-Physique	x									x	
H-Mental stress	x	x	x	x	x(*)	x	x		x(cort)		x(cort)
H-Immune system	x			x	x					x	



**MYTH:** All training occurs during exercise.  
**FACT:** A lot of training occurs during rest/recovery.\*

**Enter: Hidden Training!**



- Everything affects physical training.
- Almost everything affects mental stress.
- Mental stress affects almost everything.
- Nutrition and sleep affect a lot.
- Cortisol is the worst no-see-em.

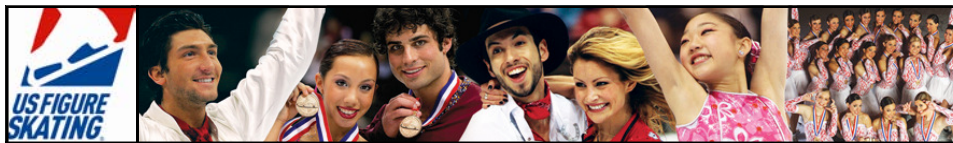
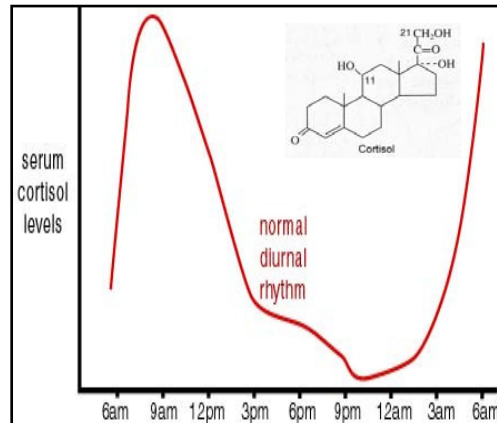
\*Physiological training effect, excludes technique.



## Cortisol 101

(aka hydrocortisone)

- A stress hormone involved in carbohydrate metabolism and immune function.
- Daily rhythmic fluctuation, with levels highest in morning and lowest at night.
- Disruption of rhythm is partially responsible for feeling of jet lag.
- Responds to physical and mental stress.
- Highest during times of stress and severe illness.



### Some cortisol supports immunity...

- ✓ Anti-inflammatory and immunosuppressive properties.
- ✓ Important in normal immune responses.
- ✓ Can speed tissue repair.
- ✓ Can maintain blood pressure and blood sugar in times of need.

### But prolonged elevations can...

- X Reduce white blood cell production by 38%.
- X Damage the thymus gland which produces these immune cells.
- X Depress the body's immune defense system.
- X Reduce the rate at which lymphocytes (immune cells) multiply.

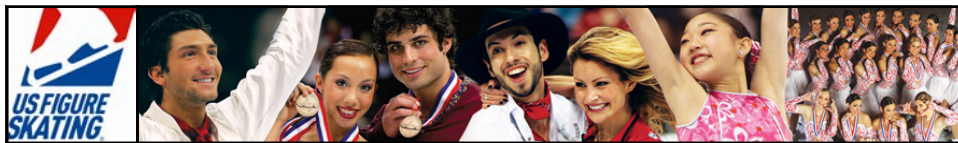
### **Did you know...**

When cortisol is elevated during the alarm reaction, there is almost a complete disappearance of lymphocytes from the blood. That is why your immune system is suppressed when you are under stress...on the other hand when circulating cortisol is low, its moderating effect on immune reactions is lost and lymphocytes circulate in excess. Remember: too little or too much are both bad.



**Prolonged elevations in cortisol can also lead to:**

- Impaired cognitive performance
- Suppressed thyroid function
- Blood sugar imbalances such as hyperglycemia
- Decreased bone density
- Decrease in muscle tissue
- Elevated blood pressure
- Reduced inflammatory response
- Increased abdominal fat



People are biologically 'wired' to react differently to stress.

**TRAINING~HEALTH**  
**LIFESTYLE~ENVIRONMENT**

Volume, intensity, recovery, taper, technique, competition, colds, fever, GI infection, menstrual dysfunction, sleep, daily schedule, nutrition, housing conditions, leisure activities, family, roommates, teammates, coach, job, school

**Did you know...**

IF you secrete higher levels of cortisol in response to stress...

You MAY also tend to eat more...

Compared to people who secrete less cortisol.



Therefore...Cortisol secretion *varies* among individuals.

One person may secrete higher levels of cortisol than another in the same situation.



### Nutrition can be stressful.

#### w.r.t. Training.

- Eat foods that *support* daily training requirements in terms of total energy, fuel sources and metabolic catalysts.
- Cover the basics of variety, color, timing, carbs, protein, and fluids, and extend this to recovery.

#### w.r.t. Recovery.

- Take advantage of the post-exercise insulin response to replenish glycogen, attenuate tissue breakdown and promote tissue accretion.
- 20-40 grams carb plus 10-20 grams protein within 20-30 min of workout; Followed by a mixed meal.

#### w.r.t. Cortisol.

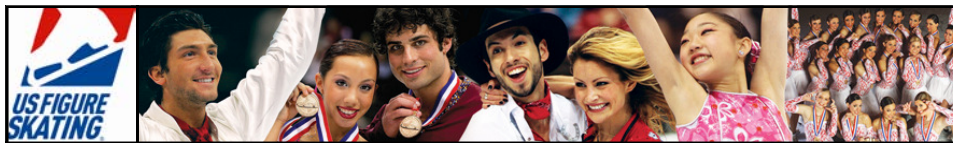
- Insufficient carbohydrate can lead to elevated cortisol.
- 6-10 grams/kg body weight. 130 lbs: 354-590 grams; 190 lbs: 516-860 grams.

#### w.r.t. Physique.

- Balance calorie intake with training expenditures.
- Time calorie intake to maximize use and storage.
- Obtain calories from sources that enhance metabolism and minimize waste and unnecessary hormonal responses.

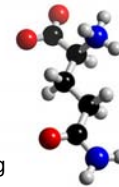
#### w.r.t. Mental stress.

- Address / overcome nutrition and food related challenges that can increase mental stress.



### Nutrition and the Immune System

- Adequate carbohydrate intake maintains glycogen stores and therefore plasma/muscle glutamine. *Glutamine* is a fuel source for immune system cells.
- Adequate carbohydrate intake keeps glutamine levels higher during intense training and helps return levels to normal after exercise.
- Adequate carbohydrate intake also attenuates the cortisol response to exercise.
- Note: Carbohydrate during exercise is used to maintain blood sugar levels, not for glutamine synthesis.
- A diet low in carbohydrate *and* high in protein may create a condition of acidosis, which requires buffering with glutamine, reducing its availability and increasing susceptibility to infection.
- Supplemental glutamine will not be effective... It only prevents muscle breakdown for glutamine and preserve immune cell integrity in very extreme exercise conditions.





### A compromised immune system...

- Reduces tolerance for high intensity work.
- Limits ability to attend practice.
- Increases risk of spreading of germs to team-mates.
- Reduces adaptation due to lower tolerance and longer time required to recover from workout.
- Creates compounding stress from missing workout, class, upcoming competition, etc.
- Disrupts sleep.

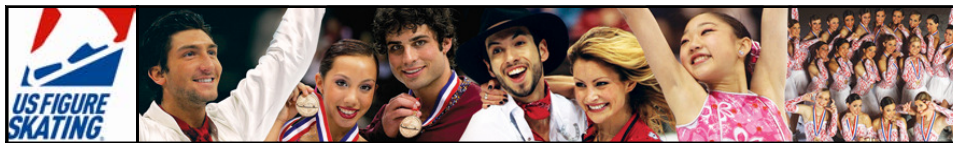


Large changes in sleep patterns can occur during infection.

Sleep changes can be a major sign of infection.

During infection and illness there is an increased tendency to sleep.

It is suspected, but not proven, that sleep facilitates the healing process.



### Speaking of SLEEP...

Humans sleep in 90 minute cycles of the non-REM\* and REM phases:

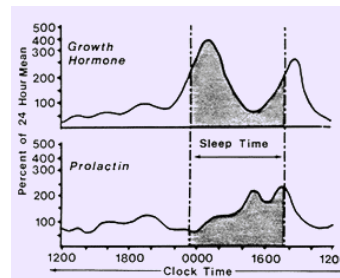
- z Non-REM occurs during the first half of the cycle (deep sleep, difficult to wake).
- z REM occurs during the second half of the cycle ("dream state", not as deep, easier to wake, but don't like to).

Age and the amount and quality of sleep on previous nights can alter this pattern.

**Non-REM sleep is an anabolic state marked by physiological processes of growth and rejuvenation of the body's immune, nervous, muscular, and skeletal systems.**

\*REM = Rapid Eye Movement

- z **Growth hormone** secretion in humans is directly tied to **sleep**:  
(and sleep inhibits cortisol!)



- z If sleep is either advanced or delayed from its normal time, the peak episode of growth hormone secretion is advanced or delayed to coincide with the early part of *sleep*.



**Shhh... Why are we talking about Growth Hormone?**

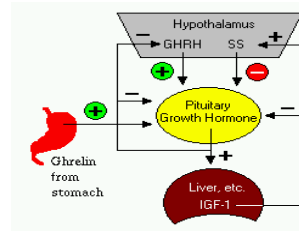
A protein hormone of about 190 amino acids that is synthesized and secreted by cells in the anterior pituitary.

***In young adults, the most intense period of growth hormone release is shortly after the onset of deep sleep.***

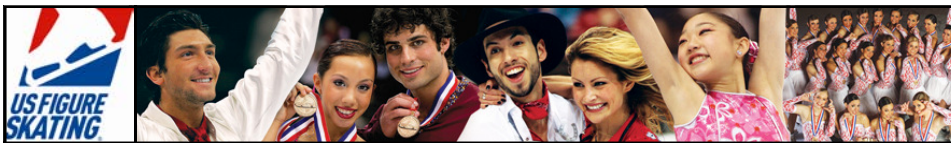
A major participant in control of growth and metabolism:

***It's FREE TRAINING!!!***

- **GH** stimulates protein anabolism (increases amino acid uptake, increases protein synthesis, decreases protein oxidation).
- **GH** enhances the utilization of fat (stimulates triglyceride breakdown and oxidation).
- **GH** helps maintain blood glucose within a normal range.



***GH is also affected by stress, exercise, and nutrition!***

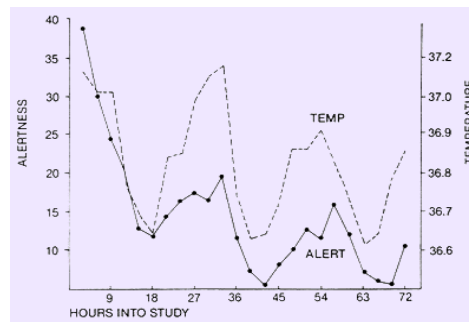


**Sleep No-see-ems:**



- z A decline in **sleep** quality and quantity increases cortisol and decreases growth hormone.
- z Chronic **sleep** deprivation is very stressful and elevates cortisol release.
- z **Sleep** deprivation can lead to glucose intolerance, diabetes and weight gain.
- z **Sleep** deprivation can also reduce alertness.

z **Sleep** deprivation can also reduce alertness:





Alcohol causes disrupted and fragmented sleep, and consistently disrupts the proportions of the various sleep stages:

- Suppression of REM sleep during the first half of the sleep period
- "Rebound effect" after 4-5 hrs, longer-than-normal REM periods when alcohol has cleared from the body.



Tolerance to alcohol's sedative and sleep-stage effects can develop within 3 nights.



Alcohol before bedtime can suppress growth-hormone secretion at a dose-related rate.



Alcohol-related suppression of growth-hormone secretion can persist over repeated nights of alcohol administration, despite sleep-stage tolerance.



Alcohol contains almost twice as many calories as juice (7 kcal/gram vs 4 kcal/gram).



***It all comes down to STRESS.***

Stress is a mentally, emotionally or physically disruptive or upsetting condition occurring in response to adverse external influences and can affect physical health.

Stress is usually characterized by increased heart rate, a rise in blood pressure, muscular tension, irritability, depression, an impaired immune system and propensity to increase the risk of other diseases.



Stress affects all aspects of training:

- Training itself – reduced resilience
- Attitude – reduced motivation
- Nutrition – loss of appetite
- Sleep – loss of or disrupted sleep
- Recovery – impaired due to compounding of other factors
- Alcohol – increased tendency to use/abuse
- Cortisol – marked and prolonged elevation
- Physique - impaired to due chain reaction with other factors
- Immune system – impaired due to chain reaction with other factors



To manage stress and maintain healthy cortisol levels:

**Maximize recovery time between workouts!**

1. Refuel with nutritious foods and fluids.
2. Get enough sleep.
3. Activate your body's relaxation response.

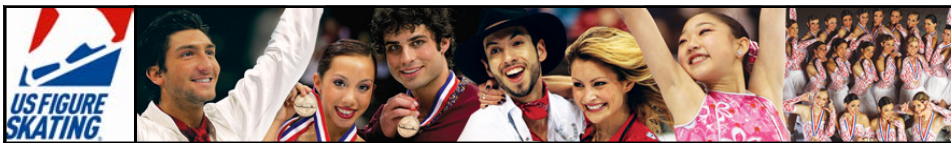
**MANAGE STRESS & ENHANCE Performance**

Develop a *cohesive, scientifically sound, professionally-supported training program that integrates and balances training, recovery, evaluation and monitoring.*

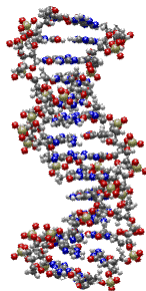
*Remember:*

If you're more sensitive to stress, it's especially important for you to learn stress management techniques and maintain a *stress-managed lifestyle*.

*Guided Imagery ~ Journaling ~ Self-Hypnosis  
Yoga ~ Meditation ~ Rhythmic Breathing  
Listening to Music ~ Leisure Activities*



**No-see-ems are small, but can sting bad.**



- Everything affects physical training.
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- Mental stress affects almost everything.
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- Cortisol is the worst no-see-em.



**Be aware of your hidden training.**