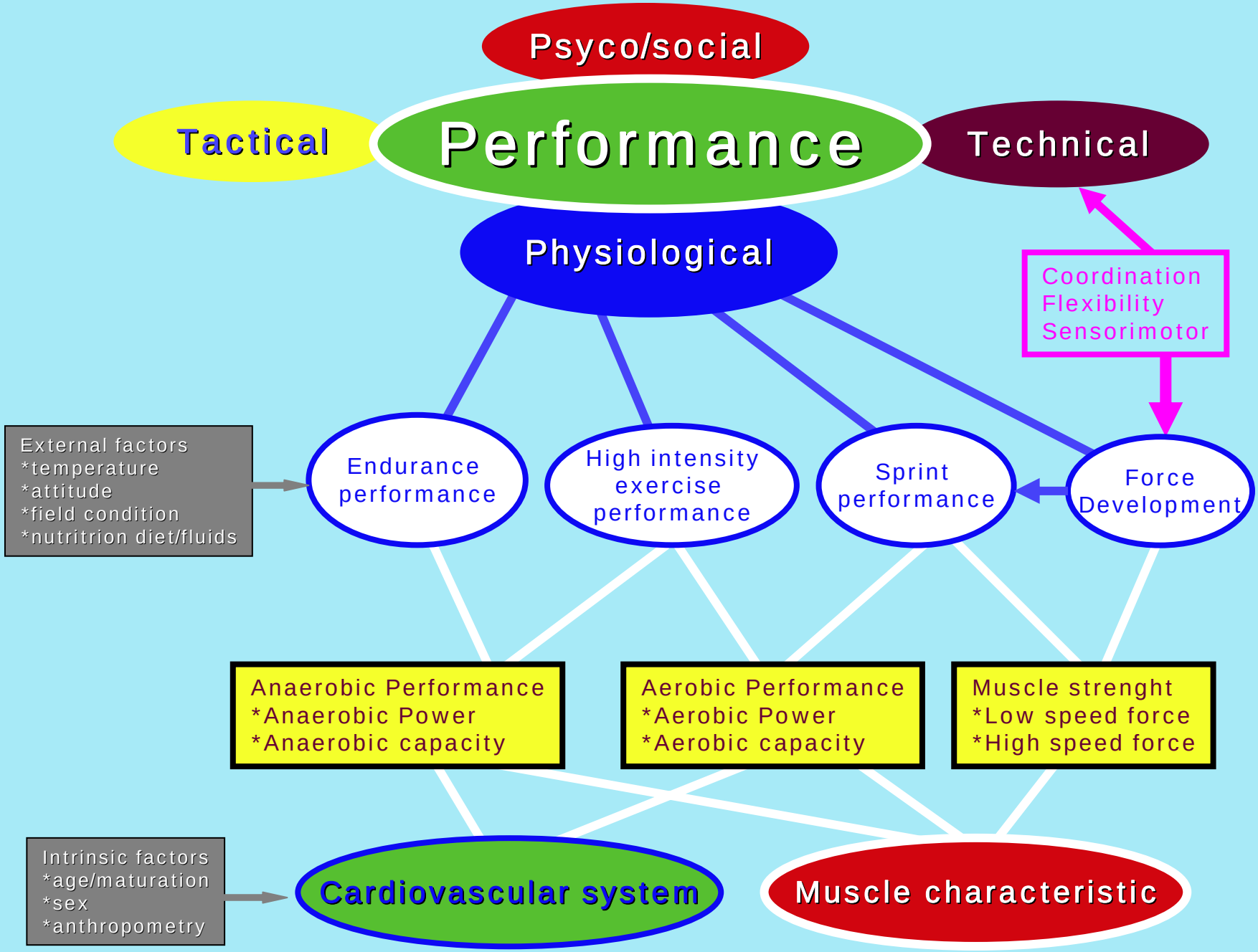
Università degli Studi di Firenze
Scuola di Specializzazione di Medicina dello Sport
Direttore Prof.Giorgio Galanti

Over and bad Training

“ Condizione Atletica”

L’insieme di caratteristiche cardiorespiratorie, neuromuscolari e psicologiche ,naturali od acquisite,che permettono all’atleta di effettuare la prestazione sportiva con il massimo rendimento e con il minimo pericolo di infortunio.


Psyco/social
Tactical
Performance
Technical
Physiological
Coordination
Flexibility
Sensorimotor
External factors
*temperature
*attitude
*field condition
*nutritrion diet/fluids
Endurance performance
High intensity exercise performance
Sprint performance
Force Development
Anaerobic Performance
*Anaerobic Power
*Anaerobic capacity
Aerobic Performance
*Aerobic Power
*Aerobic capacity
Muscle strenght
*Low speed force
*High speed force
Intrinsic factors
*age/maturation
*sex
*anthropometry
Cardiovascular system
Muscle characteristic

Sports Performance

Resistence or Drag

- Gravity
  - Barbell Mass
  - Body mass
  - Opponent's body mass
- Drag
  - Air
  - Water
- Surface friction
  - Snow
  - Ice
  - Asphalt

Sustainable power output

- Neuromuscolar Skill
- Mechanical Efficiency Or Movement economy
- Muscle efficiency
- Aerobic power
- Sustainable Energy espenditure
- Lactate thresold
- Anaerobic Power And Anaerobic capacity

The interrelationship of major factors determining sport performance.

- Performance is determined by how effectively the athlete can sustain sufficient power output to overcome various types of resistance or drag, depending on the sport event.
- Sustainable power output depends on the rate of energy expenditure that can be sustained throughout the event and the efficiency with which that energy can be converted into mechanical power.

- Depending on the sport event, sustainable energy expenditure will be a function of the ability to sustain the production of energy by anaerobic and/or aerobic means.
- Mechanical efficiency is dependent on muscle efficiency, i.e., the efficiency with which muscles convert the energy stored in carbohydrate and fat into muscle shortening, and the neuromuscular skill with which the athlete performs the event, i.e., the degree to which the athlete has learned to recruit only those motor units required to produce maximal power output in a skillful way.

Sports training

It is the process that make the athletes able to improve their exercise performance, efficency and tolerance to physical stress.

It represents the body adaptations to chronic exposure to exercise.

These adaptations are higly specific to the type of training, and their magnitude are related to the volume (quantity) and intensity (quality) of Training.

Basic Training Principles

1. The Principle of Individuality
2. The Principle of Specificity
3. The Principle of Progressive Overload
4. The Principle of Hard / Easy
5. The Principle of Periodization
6. The Principle of Disuse

Basic Training Principles

1. The Principle of Individuality

Different people respond to the same training in different ways. Heredity plays a major role in determining how quickly and to what degree the athlete adapts to a training program.

For these reasons any training program **"must take into account the specific needs and abilities of the individuals for whom it is designed."**

Basic Training Principles

2. The Principle of Specificity

To maximize the benefits, training must be specifically matched to the type of activity the athlete use to be engaged in. (endurance vs strenght and power training).

By this principle the training program must stress the physiological systems that are critical for optimal athlete's performance, in order to achieve specific adaptations for specific sports.

Basic Training Principles

3. The Principle of Progressive Overload

Overload and **Progressive Training** are the foundation of all training programs.

A well-designed Training Program must involve working the muscles, respiratory and cardiovascular systems harder than normal (**overload**); as the body adapts, Training progresses to a higher work level (**progressive training**)

Basic Training Principles

4. The Principle of Hard / Soft

Bill Bowerman (former U.S. Olympic track coach and founder of NIKE) developed a training strategy for his distance running that became known as **'The principle of hard / soft'.**

According to this principle, one or two days of hard training should be followed by one day of soft training, allowing the fully recover of body and mind and prevent the athlete's overtraining.

Importance of the diet

Endurance athletes must pay particular attention to their carbohydrate intake in the periods of hard training, in order to avoid the depletion of glycogen reserves.

Basic Training Principles

5. The Principle of Periodization

Periodization is the gradual cycling of specificity, intensity and volume of training to achieve peak levels of fitness for competition.

Basic Training Principles

6. The Principle of Disuse

"Use it or loose it"

According to this principle, training benefits are lost if training is either discontinued or reduced too abruptly.

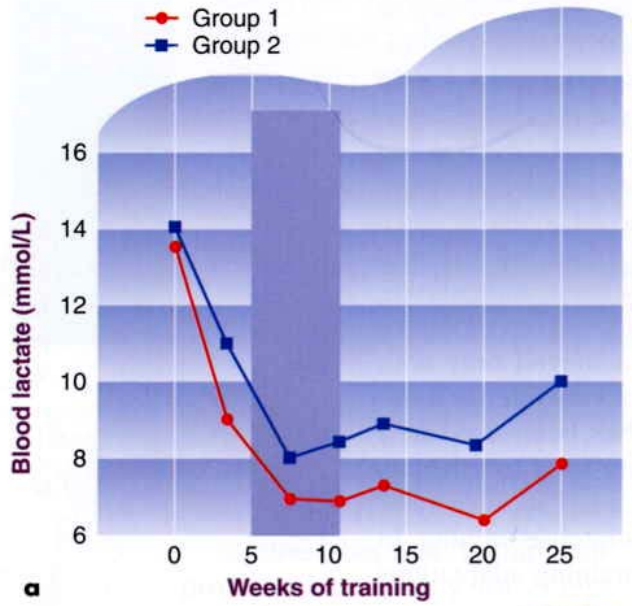
To avoid this, all training programs must include a maintenance program.

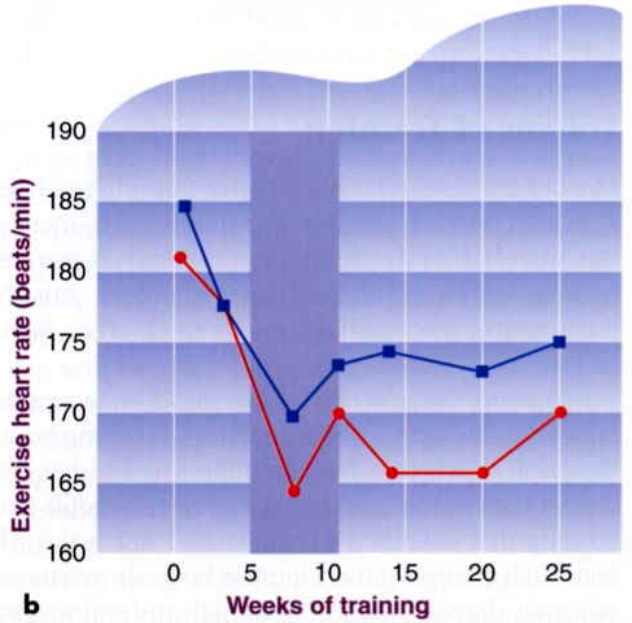
The Volume of Training

Training volume can be increased by increasing either the duration or the frequency of training bouts.
Numerous studies have shown no significant differences in improvment between athletes who train with typical training volumes and those who train withtwice the volume

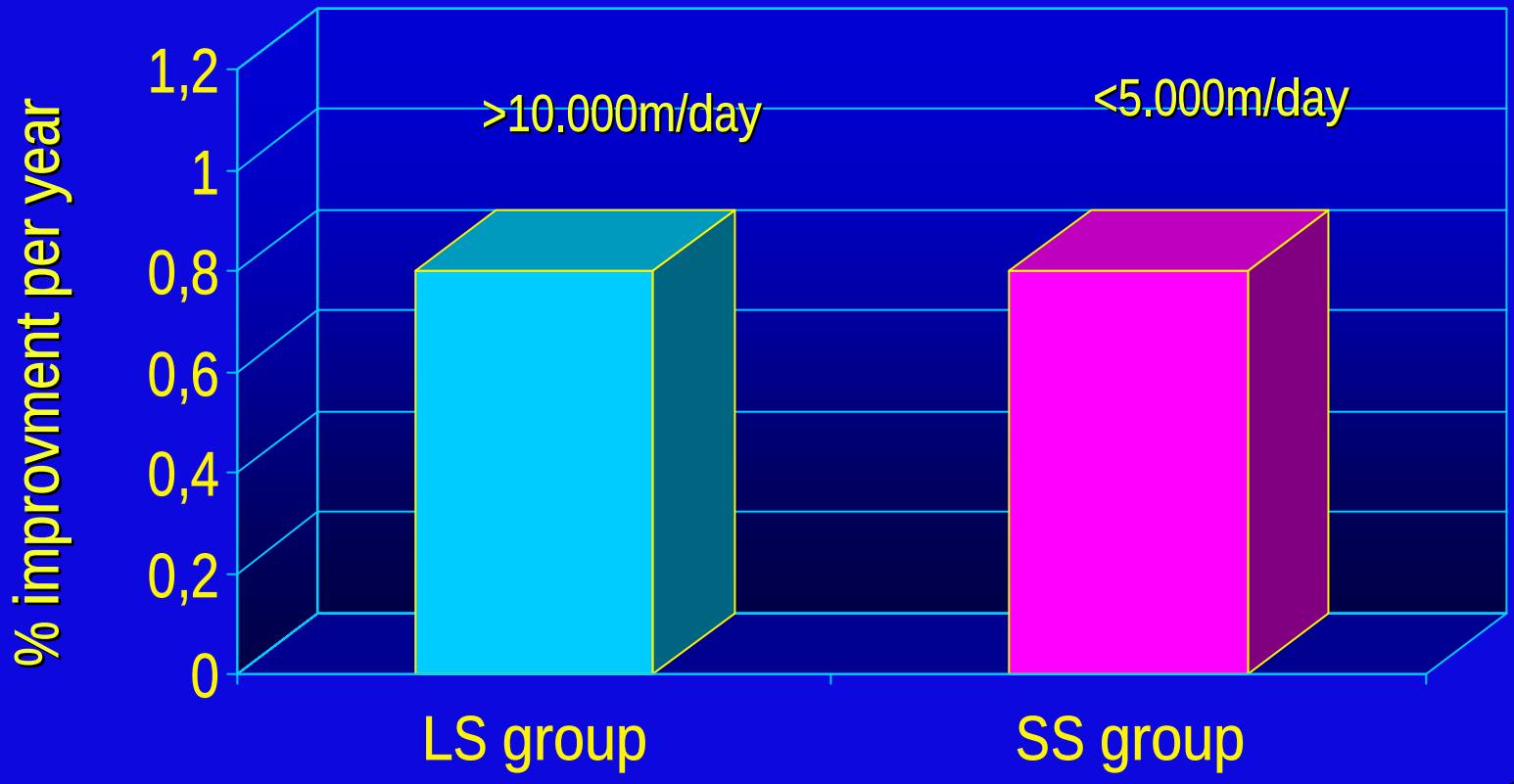
Volume of Training

Changes in swimmers's
(a) blood lactate levels
(b) heart rate
during standarized swim
during 25 wk of training,
once (group1) or twice
(group2) day





Performance improvement of different trained male swimmers



Intensity of training

Training intensity relates to both the force of muscle action (strength and power training) and the stress placed on the cardiovascular system (aerobic training).

Training Intensity is typically relate to the % of the athlete's VO2 max.

Intensity of training

Training intensity of between

50% and 90% VO2max

produce marked improvement in aerobic capacity for most people

Quantifying Sport Training

- Demands of Training
  - Basic Principles
  - Volume
  - Intensity
- Over Training
  - Effects of OT
    - ANS
      Hormon
      Immunity
  - Predicting OTS
    - Blood Enz
      O2 cons
      ECG
      HR
  - Treatment OTS
- Tapering of Peak Performance
- Detraining
- Retraining
  - Musc Strength
    Musc Power
    Musc End
    CardioRe End
    Flexibility


OVERTRAINING
More is not always better

The only way to continue to improve exercise performance with training is to progressively

increase the training stress.

However, when this concept is carried too far, pushing the body beyond its ability to adapt, the training may became excessive.

An excessive training produces no additional improvement in conditioning or performance and can lead to a chronic state of fatigue that is associated with muscle glycogen depletion.

This condition is termed **Overtraining**.

Overtraining

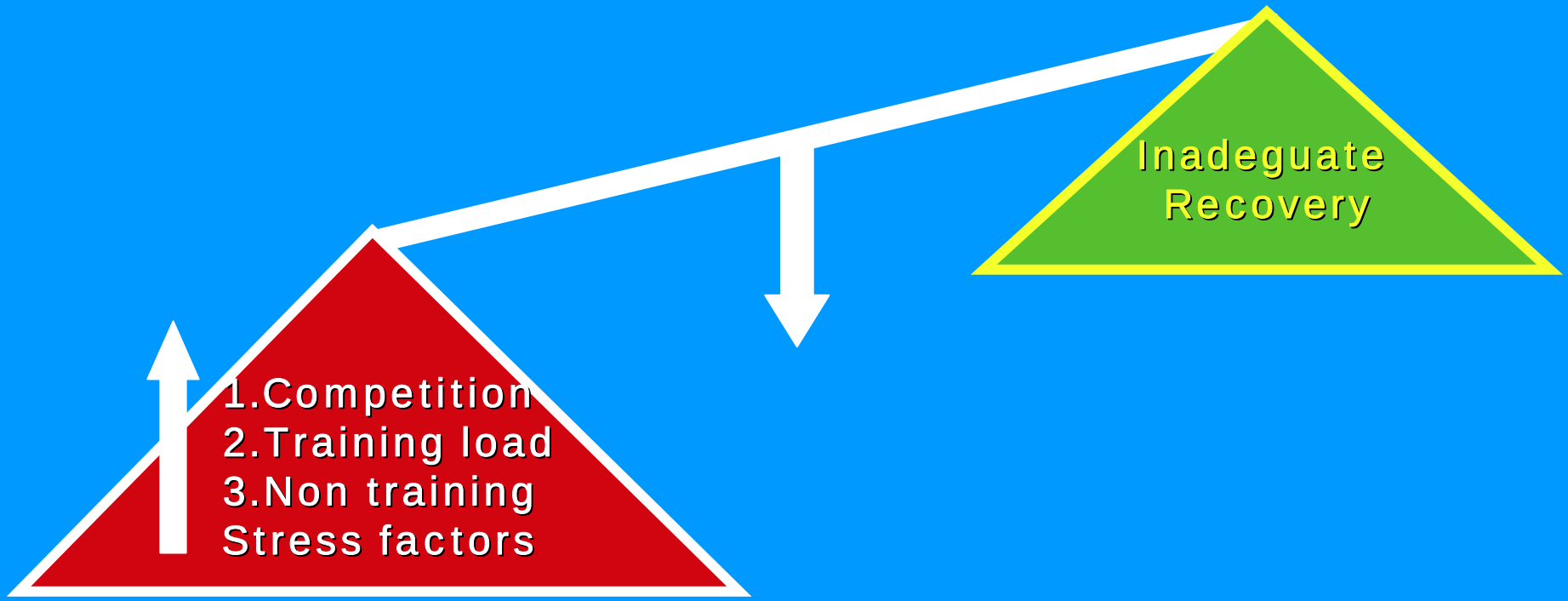
Overtraining is an imbalance between exercise and recovery in which the athlete's training program execeeds the body's physiologic and psycologic limits and causes fatigue and reduced functional capacity.
This problem results from a short-to medium-term increase in training volume and/or intensity over the athlete's previously substantial baseline.

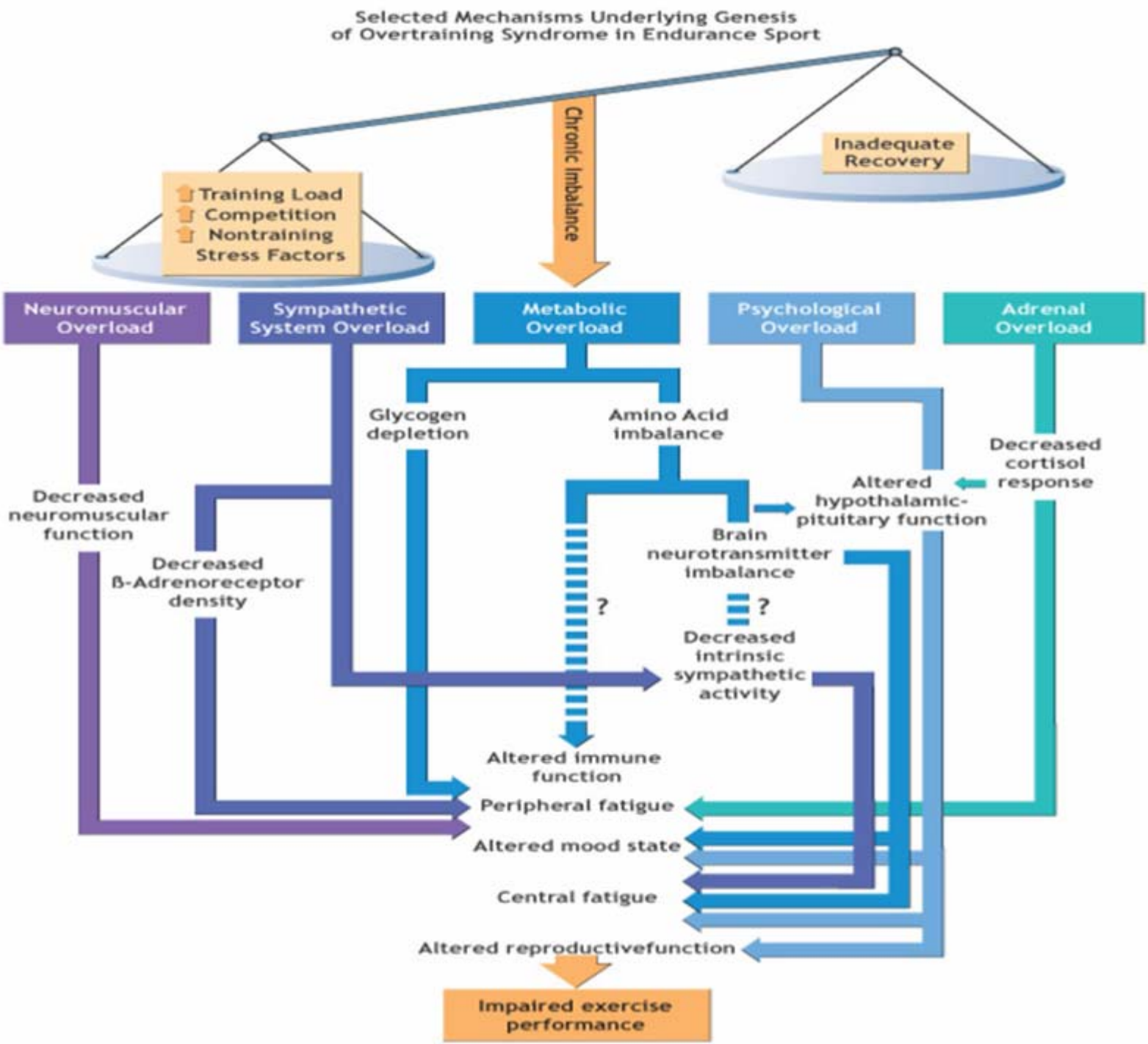
Overtraining Syndrome

Overtraining is characterized by a **sudden decline in athlete's performance** that cannot be remedied by a few days of rest and dietary manipulation.

It must be distinguished from **Fatigue** that often follows one or more exhaustive training session that is usually corrected by a few days of rest and a carbohydrate-rich diet.

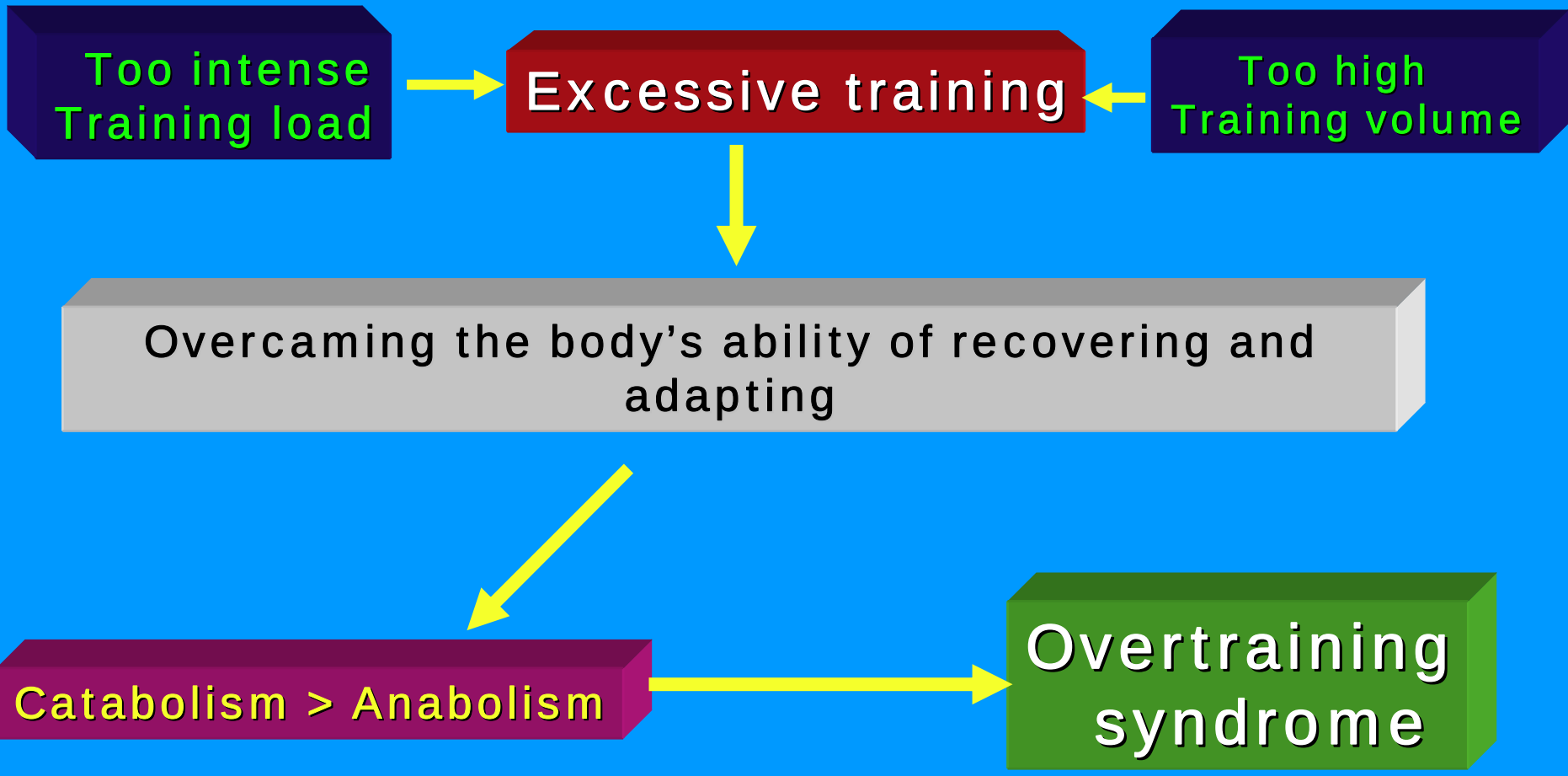
Selected mechanism underlaying Genesis of OS in endurance sport




Selected Mechanisms Underlying Genesis of Overtraining Syndrome in Endurance Sport
Chronic Imbalance
Training Load
Competition
Nontraining Stress Factors
Inadequate Recovery
Neuromuscular Overload
Sympathetic System Overload
Metabolic Overload
Psychological Overload
Adrenal Overload
Glycogen depletion
Amino Acid imbalance
Decreased cortisol response
Altered hypothalamic-pituitary function
Decreased neuromuscular function
Decreased ß-Adrenoreceptor density
Brain neurotransmitter imbalance
?
?
Decreased intrinsic sympathetic activity
Altered immune function
Peripheral fatigue
Altered mood state
Central fatigue
Altered reproductivefunction
Impaired exercise performance

Developement of Overtraining

Physical factors



Developement of Overtraining

Emotional factors

- Demands of competition
  - Desire to win
  - Fear of failure
  - Unrealistically high goals

→ OVERTRAINING

↓

Decline in performance accompained by a loss in competitive desire and a loss in enthusiasm for training

Changes associated with overtraining syndrome

- Abnormal ANS Response
- Abnormal Hormonal response
- Abnormal Immunitary response

Abnormal responses of Autonomic Nervous System

Sympathetic mediated symptoms (more frequents)

- increased resting heart rate
- increased blood pressure
- loss of appetite
- decreased body mass
- sleep disturbances
- emotional instability
- elevated basal metabolic rate

Elevated blood levels of epinephrine and norepinephrine

Abnormal responses of Autonomic Nervous System

Parasympathetic mediated symptoms (less frequents)

- early onset of fatigue
- decreasing resting heart rate
- less rapid HR recovery after exercise
- decreased resting blood pressure

Hormonal response to Overtraining

↓ Testosterone

↑ Cortisol

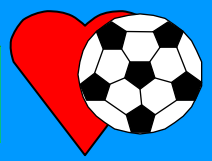
↓ Thyroxine

↓ Testosterone/Cortisol

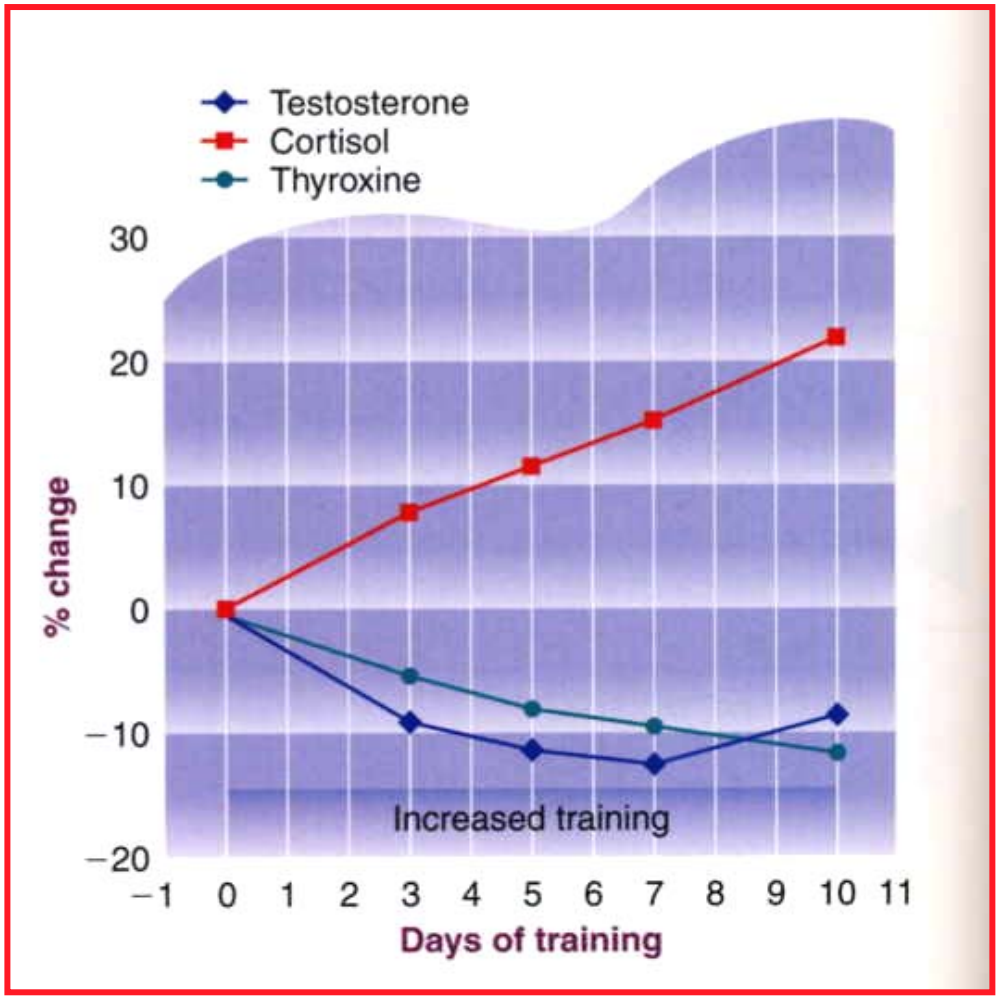
?

↑Protein catabolism
(↑ blood urea)

Loss in lean body mass



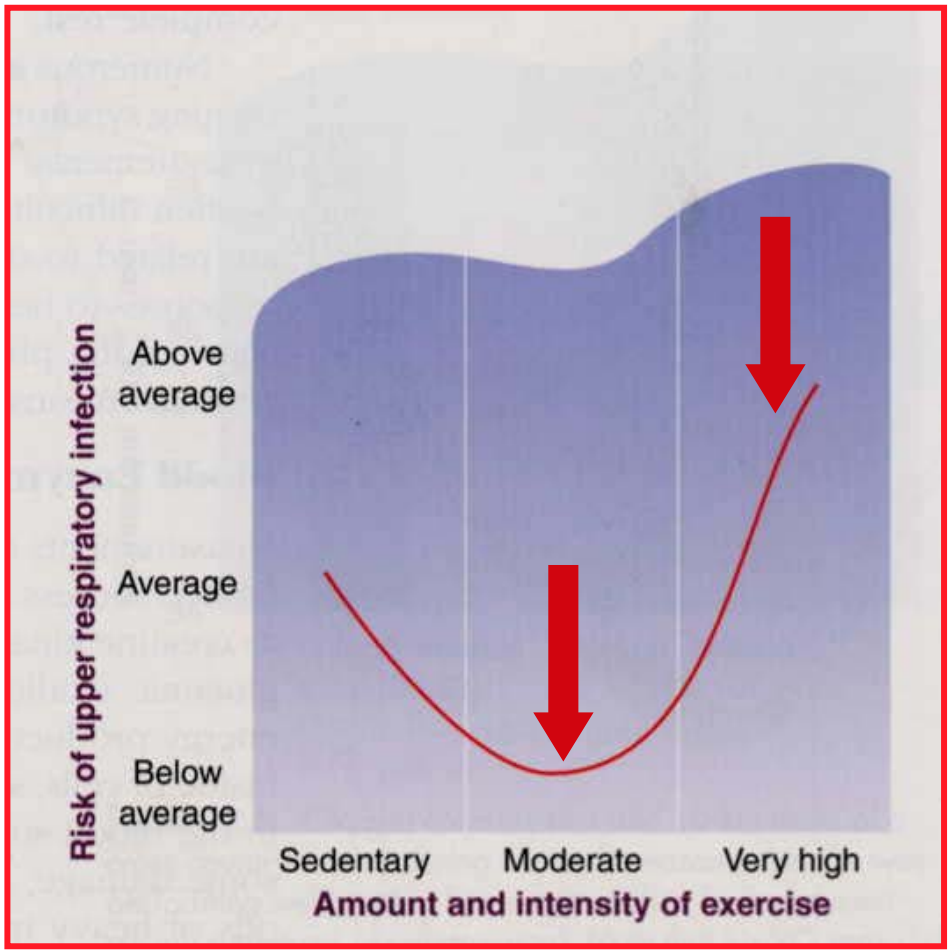
Changes in hormone blood levels during a period of intensified training



Overtraining and Immunity

One of the most serious consequences of overtraining is the **depression of the immune response** that places the athlete at an increased risk for infection and increase the risk of even greater complications.

Amount of exercise and risk of upper respiratory tract infections



Overtraining Syndrome

Principal symptoms

- Subjective sense of loss in muscular strenght, coordination and maximal working capacity
- Decrease appetite and body weight loss
- Muscle tenderness

Overtraining Syndrome

Other symptoms

- Head colds, allergic reaction or both
- Occasional nausea
- Sleep disturbances
- Elevated resting heart rate
- Elevated blood pressure

Overtraining Syndrome

The presence of one or more of these symptoms is sufficent to alert the coach or trainer that an athlete migth be overtrained

The symptoms of overtraining are highly individualized and subjective, so they cannot be universally applied.

Overtraining Syndrome

Differential symptoms

- Viral infection
- Anemia
- Hypotiroidism
- Infectious Mononucleosis
- Addison's Disease
- Diabete mellitus
- Cardiac Disease
- Iron Deficiency
- Cronic Fatigue Syndrome
- Psycological Illness
- Atsma/allergies
- Muscle disease

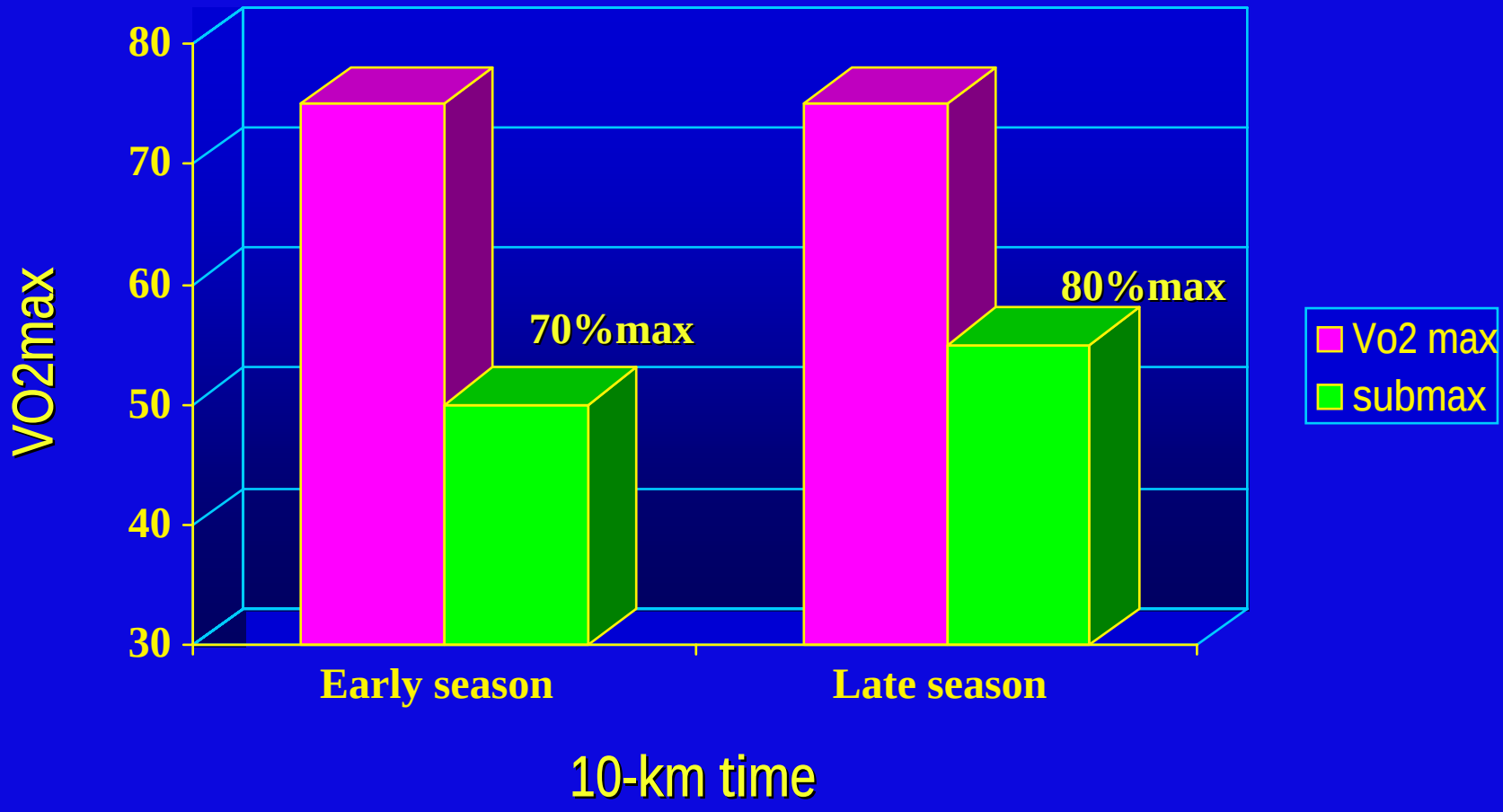
May Overtraining syndrome be predictable?

Predicting overtraining syndrome

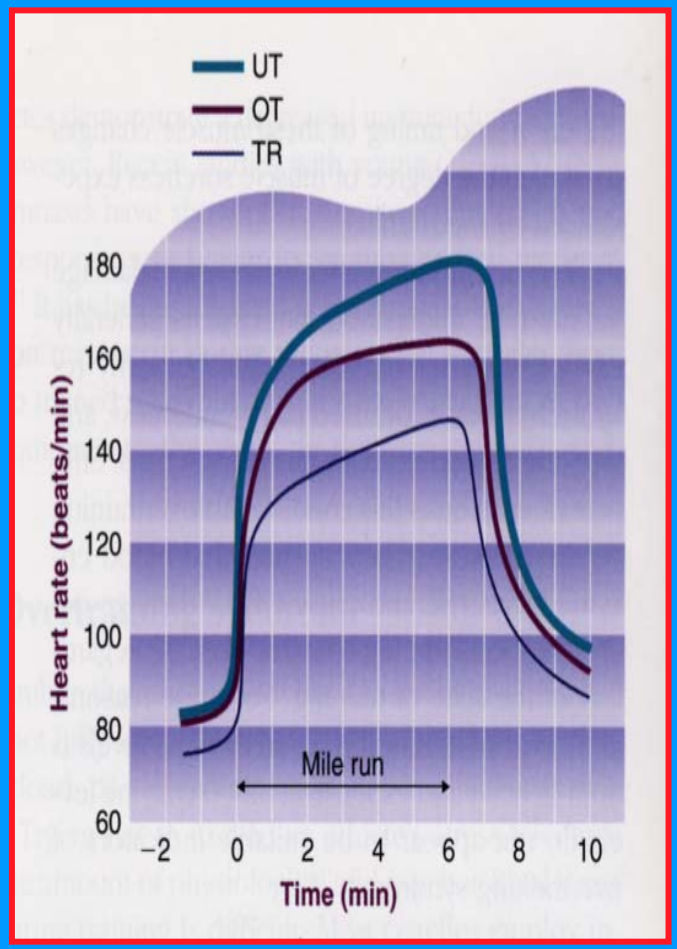
Signs that have been considered for diagnosing overtraining

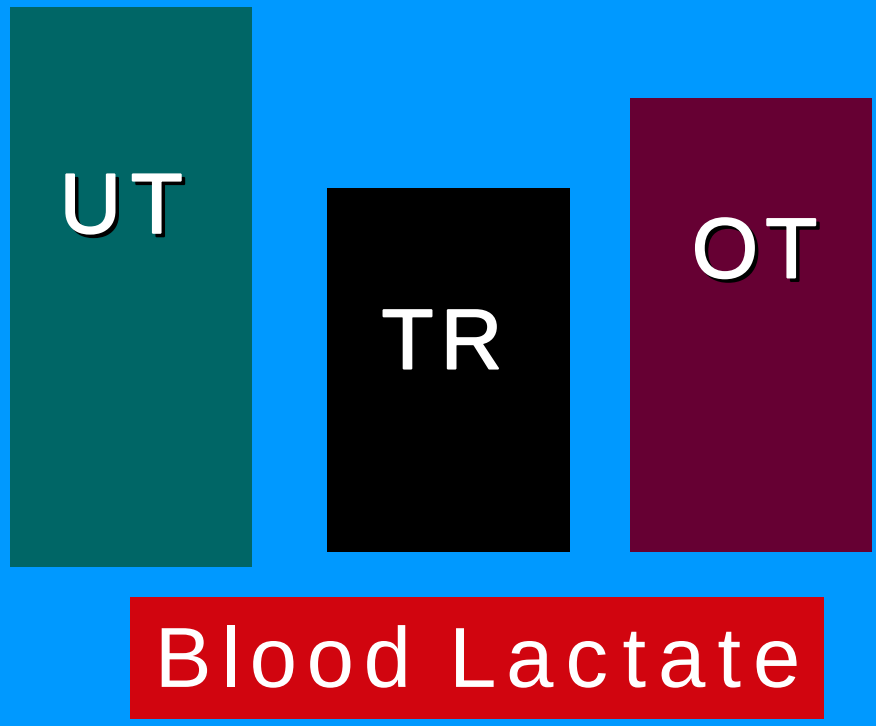
1. Changes in blood levels of muscular enzymes (CK, LDH, SGOT)
2. Abnormal resting ECGs showing T wave inversion
3. Increased oxigen consumption **at a fixed rate of work** as performance becomes less efficent
4. Increased heart rate and blood lactate responses to **a fixed rate of work**

Oxigen consumption in overtrained athletes



Increased HR and blood lactate responses after 1mile/6min run





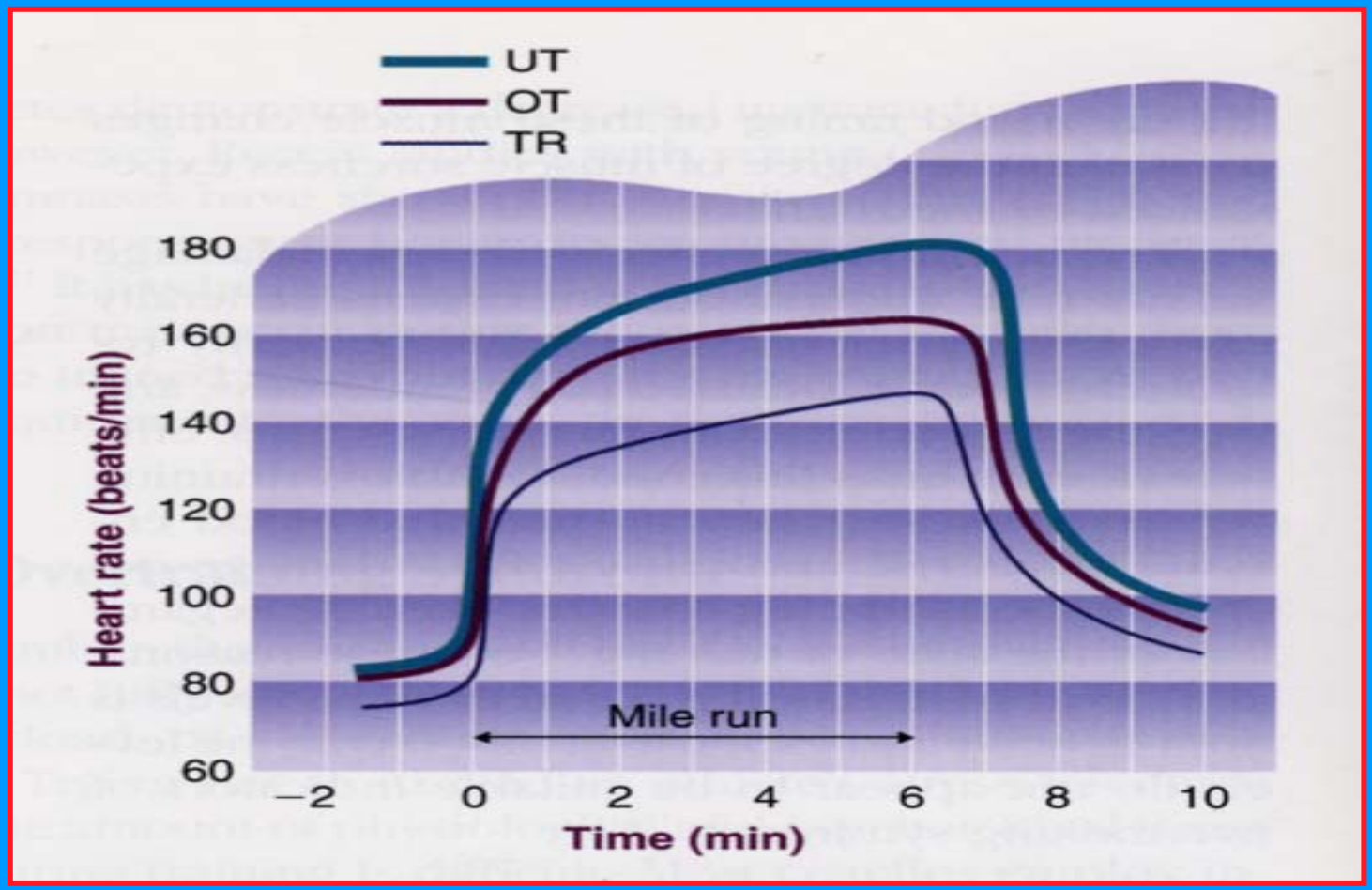
Predicting overtraining syndrome

The best predictor of overtraining syndrome seems to be HR response to a standardized bout of work.

The advantages of this test are :

- providing an easly obtained , objective measurement of the athlete's cardiovascular response to a given rate of work
- providing a warning signal of developing overtraining syndrome

Overtraining on runner's heart rate response




May the athlete recover from overtraining syndrome ?

Treatment of overtraining syndrome

Recovery from overtraining syndrome is only possible with a marked reduction in training intensity or complete rest.


Prevention of
overtraining syndrome

The best way to minimize the risk of overtraining is to follow cycling training procedures, alternating easy, moderate and hard periods of training

Quantifying Sport Training

- Demands of Training
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  - Volume
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Tapering for peak performance

Many athletes decease their training intensity before a competition to avoid reductions in strength, power and performance capacity that accompany high-intensity training.

This practice is called Tapering.

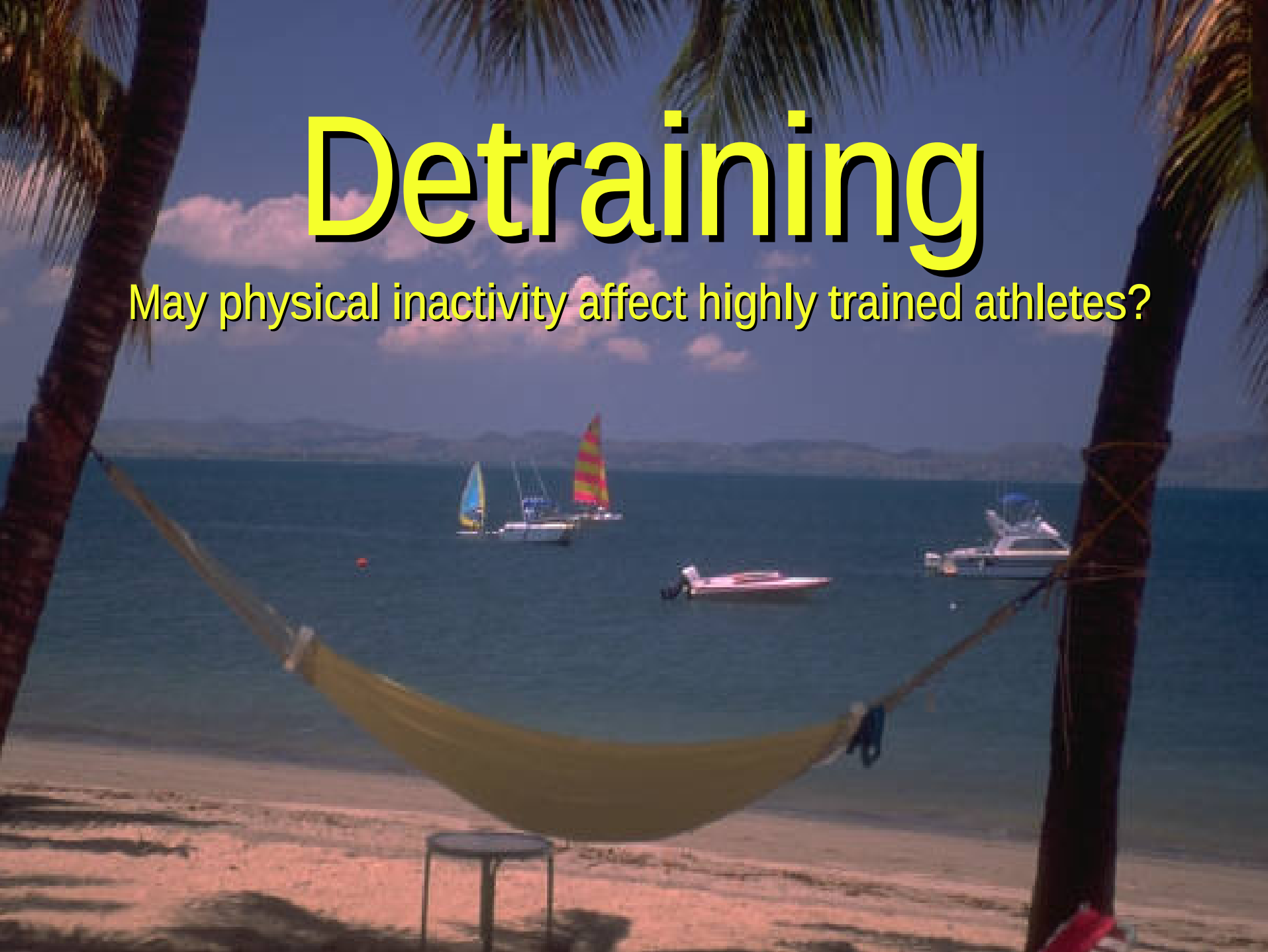
Less training is needed to maintain the gains previous attained with an intense training
So Tapering does not lead to a loss of condictioning

Tapering for peak performance

The most notable change during the Taper period is a marked increase in muscular strength which best explains the performance improvement that occurs.

Tapering for peak performance

Tapering also allows time for the muscle to repair any damage incurred during intense training and for the energy reserves (muscular and liver glycogen) to be restored



Detraining

May physical inactivity affect highly trained athletes?

Physiological responses to detraining

- Muscular strength and power
- Muscular endurance
- Speed, agility and flexibility
- Cardiorespiratory endurance

Physiological responses to detraining
Muscular strength and power

Detraining causes losses in muscular strenght and power.

However muscles require only minimal stimulation to retain these qualities during periods of reduced activity

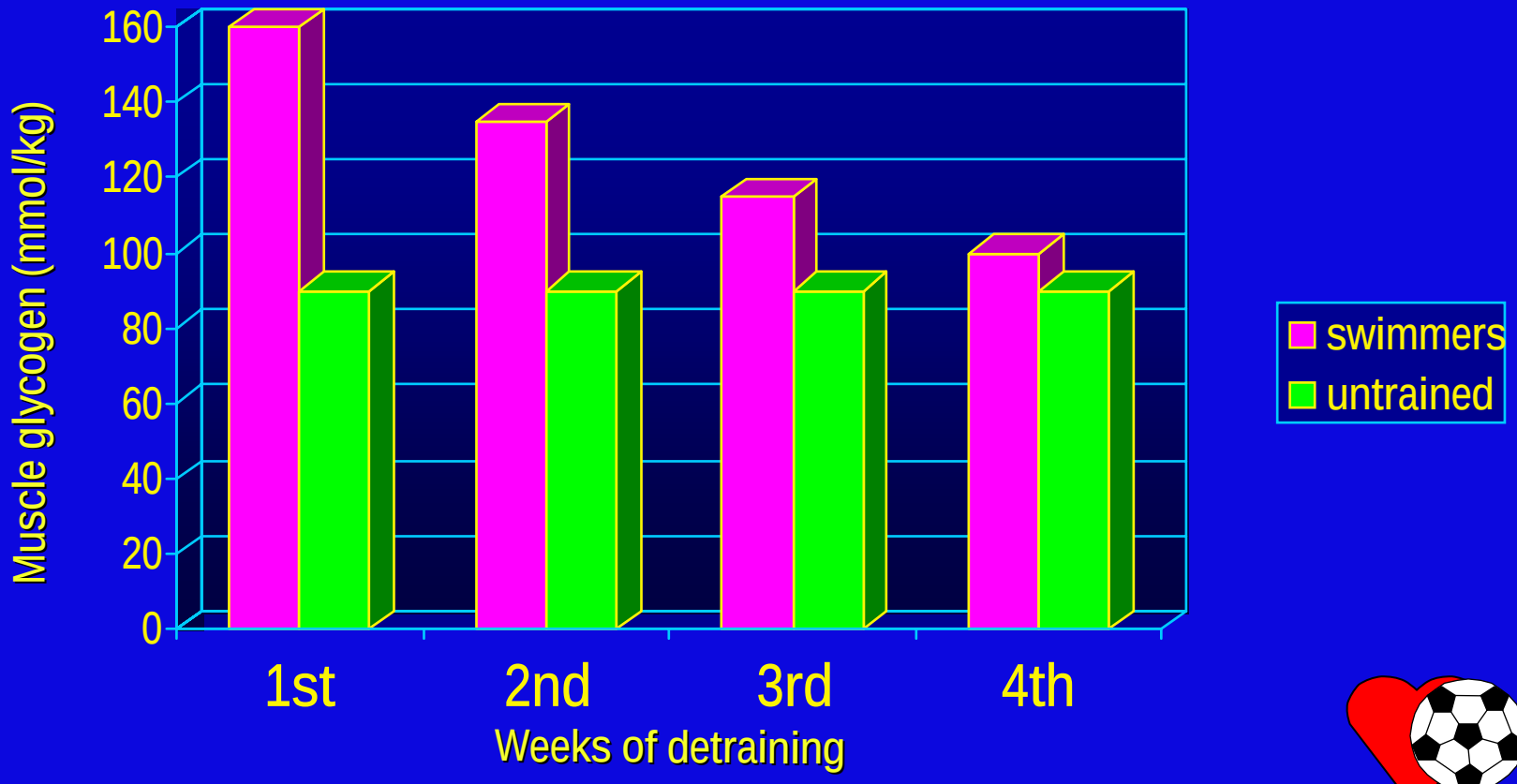
(a training session once every 10 to 14 may be sufficent)

Physiological responses to detraining
Muscular endurance

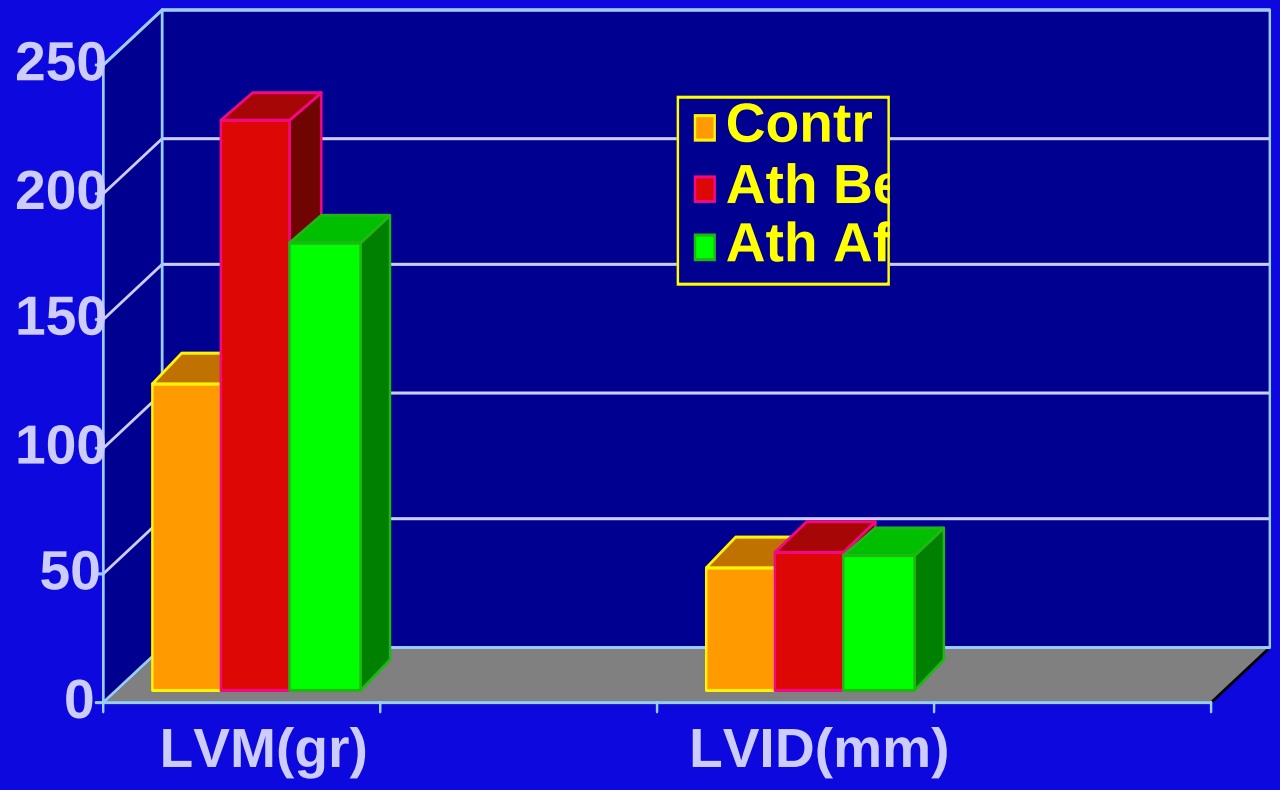
Muscular endurance decreases after only **2 weeks of inactivity**.
Possible explanations for this are:

- decreased oxidative enzyme activity
- decreased muscle glycogen storage
- disturbance of the acid-base balance
- decreased blood supply to the muscles

Physiological responses to detraining Muscular Endurance

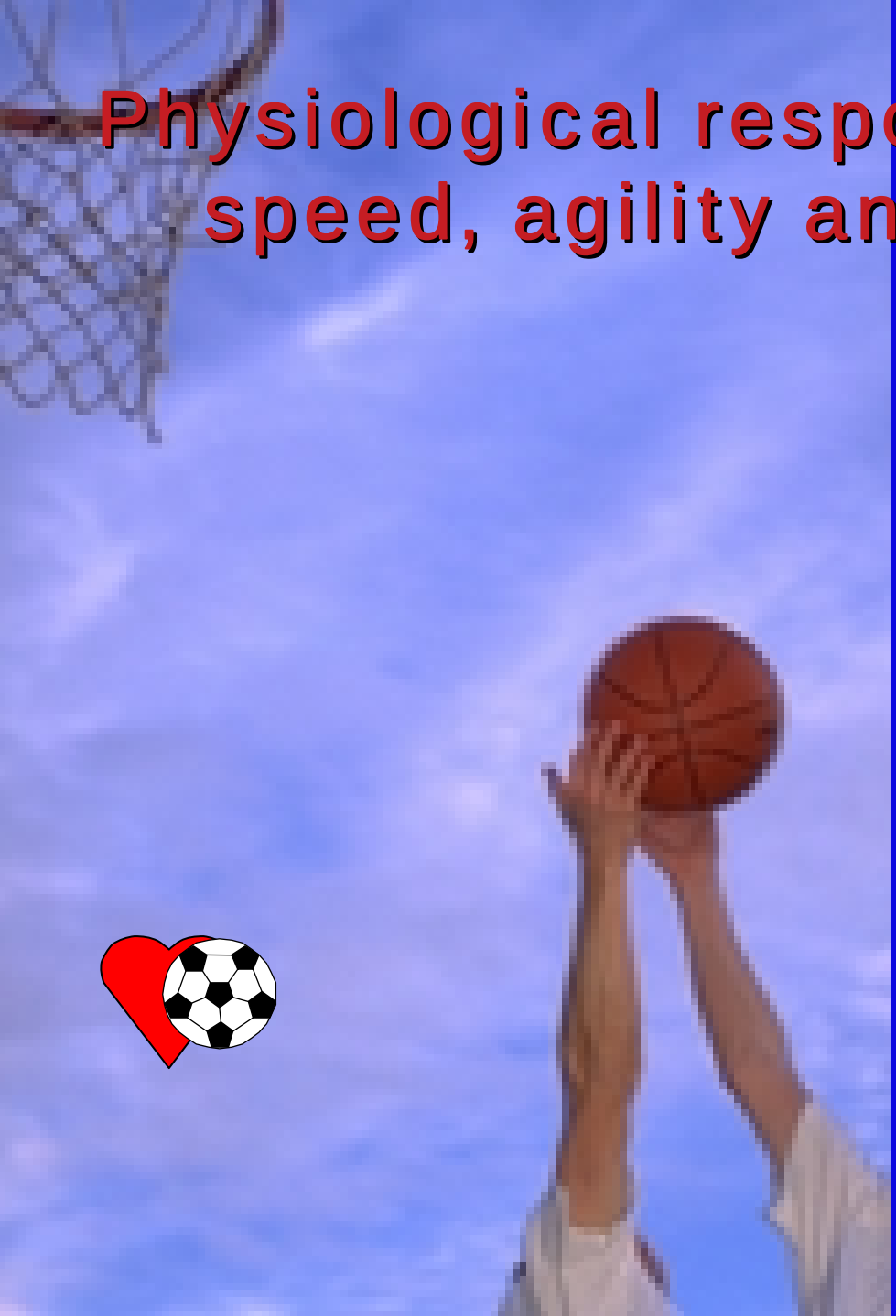


Regression of Athlete's Hypertrophy



G.Galanti et al. Cardiologia 1989

Physiological responses to detraining speed, agility and flexibility



Detraining losses in speed and agility are small.

Flexibility is lost rather quikly, so stretching exercises should be incorporated also into off-season training programs.

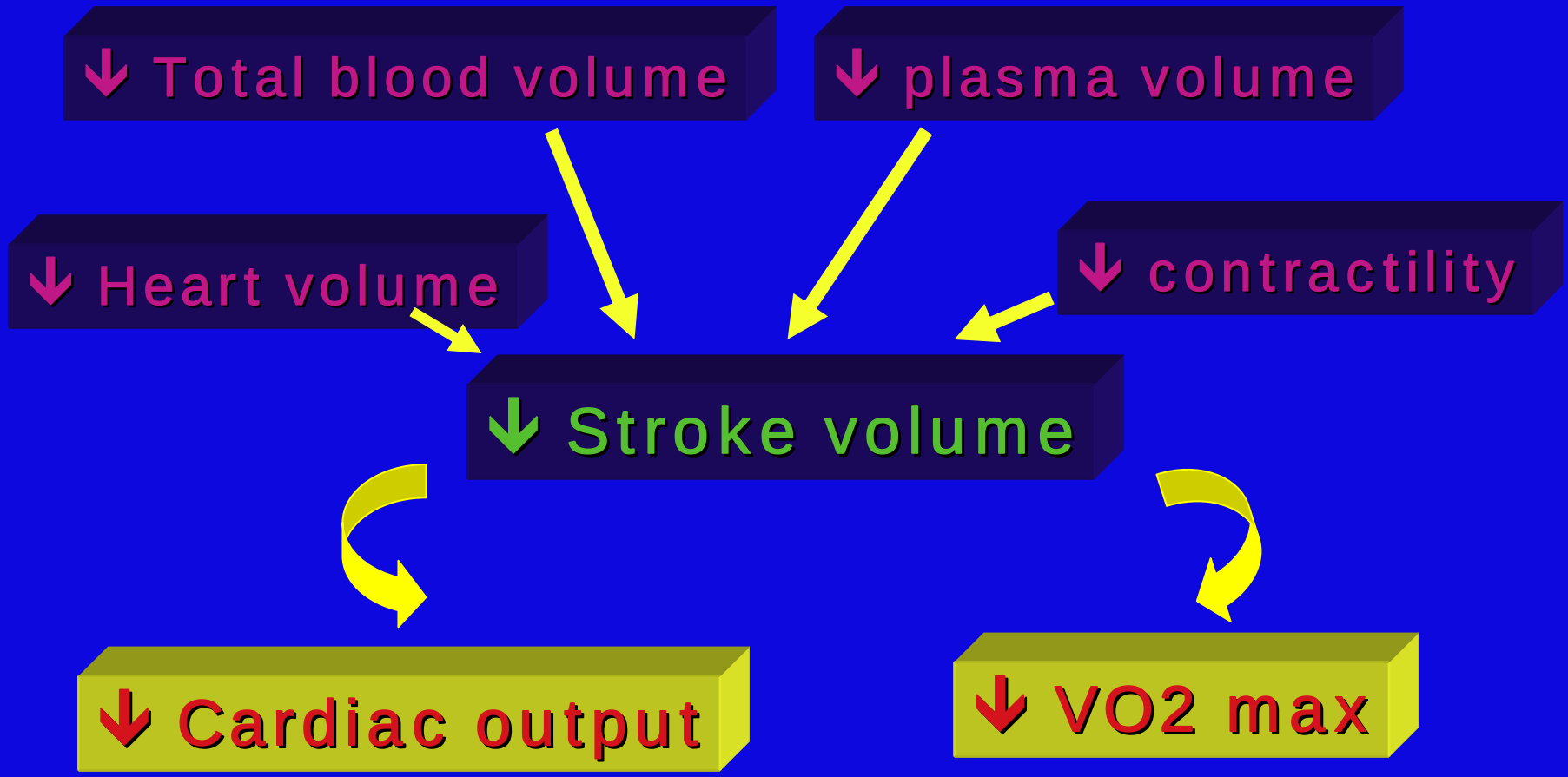
Physiological responses to detraining
Loss of speed agility and flexibility

Although flexibility can be reestabilished in little time, the athletes should maintain the desired flexibility level year-round.

Reduced flexibility has been proposed to increase athletes' susceptibility to serious injury.

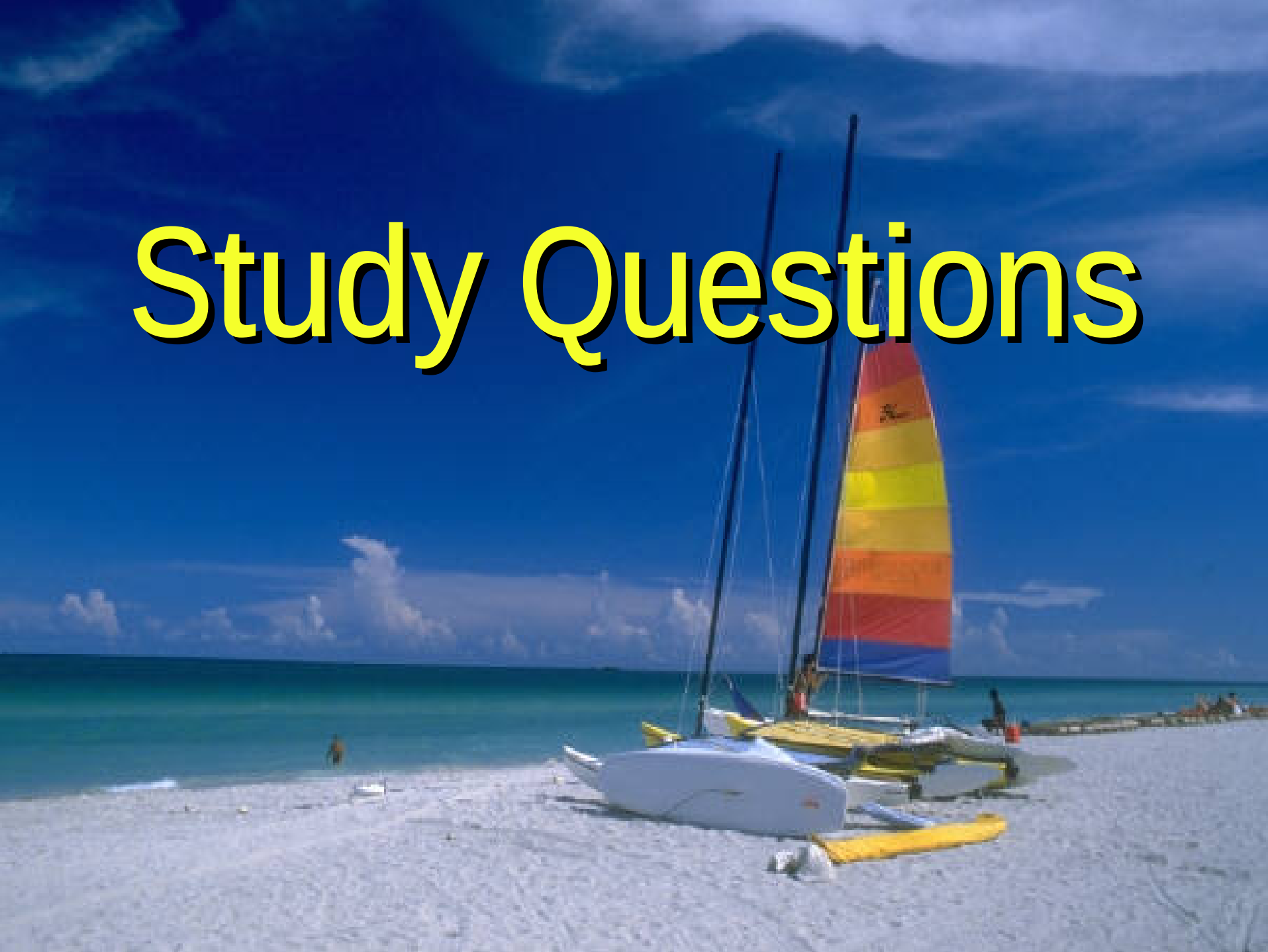
Change in cardiorespiratory endurance

Cardiovascular effects of complete rest



How much activity
is needed
to prevent losses of
physical conditioning?

To maintain cardiorespiratory endurance, training must be conducted at least 3 times per week at an intensity of at least. 70% VO2 max


Study Questions

- What are the causes of overtraining? How can it be identified? What is the suggested treatment for overtraining?
- What physiological changes occur during the taper period that can be cretied with improvements in performance?
- What alterations occur in strenght, power and muscular endurance with physical detraining?
- What changes take place in the muscle during periods of inactivity?

- What alteration occur in speed, agility and flexibility with physical detraining?
- What changes occur in the cardiovascular system as the athlete becomes deconditioned?
- During periods of reduced training what factores (frequency, duration, intensity) must be stressed in order to prevent a decline in long-term endurance and aerobic capacity?