

# Physical and Psychological Factors Affecting Sport Performance

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# Objectives

## 1- At the end of this lecture the student should:-

- 1-Know the 3 metabolic systems exceedingly important in understanding the limits of physical activity
- 2- know recovery of the aerobic system after exercise and O<sub>2</sub> dept.
- 3-Understand the Effects of smoking on pulmonary ventilation in exercise &effect of heart disease
- 4-Know effect of some drugs on athelets performance
- 5- Know effect of some psychological factorson athelets performance
- 6- Understand overtraining syndrom

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There are 3 metabolic systems exceedingly important in understanding the limits of physical activity.

These are:

1-Phosphocreatine-creatine system

2-glycogen-lactic acid system

3-aerobic system

# Adenosine Triphosphate:-

Adenosine-PO<sub>3</sub> ~ PO<sub>3</sub> ~PO<sub>3</sub>

-Each one of the last 2 high energy phosphate bonds store 7300 calories , which are used to energize the muscle contractile process.

-removal of one bond converts ATP to ADP then removal of one more forms AMP

-all ATP in muscle is sufficient for only 3 seconds of muscle power.(enough for one half of a 50-meter dash)

-It is essential to form new ATP continuously even during performance of short athletic events. •

# Phosphocreatine-creatine system= Creatine-phosphate system(creatine ~ $\text{P}_i$ )

- contain high energy phosphate bond has 10300 calories/mole •
- S0 CP provide enough energy to reconstruct high energy bond of ATP
- Most muscle cells have 2-4 times as much CP as ATP
- Energy transference from CP to ATP occurs within a small fraction of a second .Therefore, energy of muscle CP is instantaneously available for contraction just as stored energy of ATP.
- •

# Phosphagen energy system

Phosphagen energy system:- it is formed of combined amounts of cell ATP+CP, together provide maximal muscle power for 8-10 seconds(enough for 100 meter run)

-Energy of phosphagen system is used for maximal short bursts of muscle power.

# Glycogen-lactic acid system

- Anaerobic metabolism( glycolysis):- •
- During glycolysis glycogen of the muscle •  
split into glucose without use of O<sub>2</sub>
  - then each glucose split into: •  
2 pyruvic acid + energy to form 4 ATP for •  
each one glucose molecule

-Then pyruvic acid in the mitochondria in presence of O<sub>2</sub> will form more ATP(oxidative stage)

When there is insufficient O<sub>2</sub> most of pyruvic acid converts into - lactic acid ,diffuse to blood stream.

-Glycogen-lactic acid system can form ATP molecules( - anaerobically) 2.5 times as rapidly as can oxidative mechanism of mitochondria

- Anaerobic Glycolysis can provide large ATP amounts needed for - short –moderate periods of muscle contraction( ½ as rapid as phosphagen system)

Glycogen-lactic acid system provide 1.3-1.6 minutes of maximal - muscle activity + 8-10 seconds provided by phosphagen system



# Aerobic process:-

Oxidation of foodstuffs glucose, AA,FA in the mitochondrai in presence of O<sub>2</sub> produces energy that coverts AMP to ADP to ATP

(figure 84-1,table 84-1)



## Moles of ATP/min

-phosphagen system

4 moles

-Glycogen-lactic acid system 2.5 moles

-Aerobic system

1 moles

## Endurance time

- -phosphagen system

8-10 seconds

-Glycogen-lactic acid system

1.3-1.6 minutes

-Aerobic system (unlimited time as long as nutrients last)

# Recovery of muscle metabolic systems after exercise:-

- Energy from CP reconstitute ATP
- Energy from glycogen-lactic acid system reconstitute both CP&ATP
- Energy from oxidative metabolism of aerobic system reconstitute all other systems:-glycogen-lactic acid system & CP&ATP
- Lactic acid causes fatigue so it is removed in (lactic acid system reconstitution means removal)2 ways:-
  - 1-portion converted into pyruvic acid and oxidated by tissues
  - 2-remaining is changed into glucose in liver to replenish glycogen stores of muscles

# Recovery of aerobic system after exercise:

## 1-Oxygen Debt:-

- this is 11.5litres of O<sub>2</sub> should be repaid after exercise is over
- 2 LITERS stored O<sub>2</sub> ( 0.5 L in lungs+0.25L dissolved in body fluids+1 l combined with Hb +0.3 L stored in muscle myoglobin) used within minute during exercise or for aerobic metabolism should be replenished by breathing extra amounts of O<sub>2</sub> over & above the normal needs
- 9 L more O<sub>2</sub> must consumed to reconstitute phosphagen system and lactic acid system
- At first O uptake is high & fast to replenish stored O<sub>2</sub> & phosphagen system ,then 40 minutes of lower level breathing O<sub>2</sub> for lactic acid system removal
- First portion of O<sub>2</sub> dept is called( alactacid O<sub>2</sub> dept about 3.5 L)
- The later portion is called lactic acid O<sub>2</sub> dept = 8 Litres
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## **-Recovery of muscle glycogen**

**-Depletion of glycogen stores by heavy exercise needs days to be replenished**

**-On high CHO diet ,recovery occurs in 2 days**

**-On high fat, high protein or on no food all show very little recovery**

**Message: \_**

**1- athlete should have high CHO diet before exercise**

**2- not to participate in exhausting exercise during 48 hours preceding the event**

## **Nutrients used during muscle activity:-**

**- During early stages of exercise & intense muscle activity body use CHO of muscle glycogen and blood glucose, also fats as F.A & acetoacetic acid & very little A.A.**

**-**

**- In endurance athletic last longer than 4-5 hours & during exhaustion muscle glycogen is depleted & muscle depend on fats**

**- CHO energy comes from muscle and liver glycogen**

**Glucose solution given to athletes to drink during athletic event supply 30-40% of energy required during prolonged event as marathon race**

## **2-Effects of smoking on pulmonary ventilation in exercise;-**

**-1-Nicotine causes constriction of terminal bronchioles&increases resistance of airflow into&out lung**

**2-smoke irritation causes increased fluid secretion into bronchial tree& swelling of epithelial linings**

**-3- nicotine paralyse the cilia on respiratory epithelial cell surface**

**-all lead to fluid & debris accumulation& level of performance reduced**

**-Chronic smokers may develop emphysema(obstruction of bronchiols+chronic bronchitis+destruction of alveoli) so slight exercise cause respiratory distress**

### **3-Effects of heart disease and old age on athletic performance:-**

- Cardiac disease reduce C.O& reduce muscle power**
- patient withCHF can not climb the bed**
- There is 50% decrease in C.O between 18-80 years& decrease in breathing capacity,muscle mass & power with age**



## 4-Effect of body fluids and salts in exercise

- Exercise for 1 hour during endurance athletic event causes 5-10 pounds of weight loss in hot humid atmosphere due to sweat loss to remove metabolic waste heat , if sweating is intense , may cause dehydration

Dehydration leads to:

1- constant rise in body temperature

2- increase in heart-rate

3- decreased stroke volume and cardiac output -4- Loss of enough sweat reduce performance

-5-10% loss of weight lead to cramps, nausea & serious effects

so should be replaced by:-

-sodium tablets or supplemental fluids contain potassium and sodium in form of fruit juice

- What is the effect of aldosterone?

## 5-Drugs and athletes



1- Caffeine increase athletes performance

2- Anabolic steroids and androgens ( e.g., Testosterone ) :

These are used by some athletes ( of both sexes ) to increase their muscle mass, allow the athlete to train harder and thereby enhance their physical performance . Their use in sport competitions is illegal .They have harmful side-effects such as

- raised blood pressure . •
- They increase risk of heart attacks due to hypertension
- In males male sex hormones decrease testicular functions& decrease natural testosterone
- In women develop facial hair,stoppage of menses,ruddy skin and bass voice

### **(3) Stimulants**

Stimulants increase reaction speed ( i.e., decrease reaction-time ) ,  
reduce perception of pain and raise aggression

They are highly addictive and have side-effects including high blood pressure,  
cardiac problems , strokes, and liver disease .

### **(4) Narcotic analgesics**

These are pain killers which athletes use to mask pain from an injury or  
overtraining

They are also highly addictive and cause withdrawal symptoms when  
the athlete stops using them.

5- amphetamine&cocaine improve performance but overuse reduce performance they  
are psychic stimuli

-reaction of these drugs with epinephrene and norepinephrene secreted during exercise  
cause death by ventricular fibrillation

## **Body fitness prolongs life:-**

**-Multiple studies have shown that body fitness,exercise&weight control have additional benefit of prolonged life(between 50-70)**

**Reasons:-**

**1-reduce CVD, heart attacks,brain stroke and kidney disease due to low blood pressure, low blood cholestrol ,low LDL, and high HDL**

**-Body fitness reduce insulin resistance and typy 2 diabetes**

**-Improved body fitness reduces the risk of cancer breast mprostatemand colon**

**- Improved body fitness reduces obesity**

## **6- Glucose Availability**

- \* Plasma glucose is maintained by an equal rate of glucose appearance (entry into the blood) and glucose disposal (removal from the blood).
- \* In the healthy individual, rate of appearance and disposal are essentially **equal** during exercise of moderate intensity and duration;
- \* However, prolonged , intense exercise can result in **a fall in blood glucose level and the onset of fatigue .**
- \* During exercise , rate of glucose appearance depends mainly on the liver ( **glycogenolysis & gluconeogenesis** ) , and to a lesser extent , on absorption from the gut .

## **7- Oxygen Availability**

Which depends upon →

- (1) cardiac output (the quantity of blood distributed by the heart ) ,
- (2) the ability of the lung to oxygenate the blood ,
- (3) arterio-venous (a-v) oxygen difference ( i.e., the ability of the exercising muscle to take up oxygen from blood ).

## **8-Age**

Youth are better in sport performance than elderly e.g., a footballer getting old may retire or be a coach

## **9-Gender**

- (i) Because of difference between genders of in body build and physical ability , men can perform better than women in contact sports such as boxing , rugby and wrestling .
  
- (ii) Menstruation : women may perform differently at different times during their monthly menstrual cycle



## 10-Sleep

Sufficient , restful sleep is important for physical and mental health .

Lack of sleep makes the athlete nervous and irritable , & deteriorates the physical performance

## 11-Disease

Musculoskeletal disease e.g., sprain , disk etc , or

General disease e.g., bronchial asthma , colds , flu , etc

All may affect muscular exercise performance

**What is the difference between strain and sprain?.**

## Sport psychology :-

is the study of the psychological factors that affect participation and performance in sports.

## Some of the most important skills taught from sports a

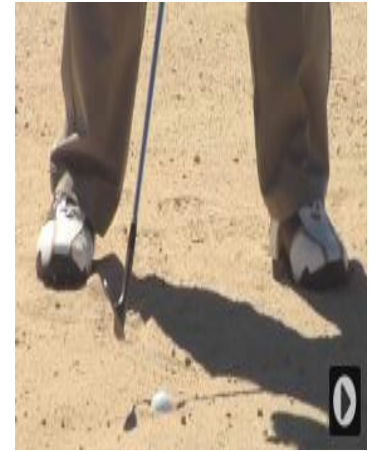
- goal setting
- relaxation
- visualization
- self-talk awareness and control,
- concentration,
- confidence,
- Sport in childhood. Association football, shown above, is a team sport which also provides opportunities to improve social interaction **skills**
- **Sports are most often played just for fun or for the simple fact that people need exercise to stay in **good physical condition**.**
- professional sport is a major source of **entertainment**.





# 1-Personality type

(i) **Introverts** tend to like sports which require:, precision , self-motivation , need low arousal levels & individual , golf and رمى السهام performances e.g., archery snooker





**(ii) Extroverts** prefer sports which are: exciting, team sports, & need high arousal level , need large, simple motor skills e.g. rugby and boxing

## **2-Other psychological factors**

**(i) Aggression** can sometimes be useful and sometimes harmful

**(ii) Depression and lack of motivation** are harmful

# THE OVERTRAINING SYNDROME

## Overtraining Syndrome

With increasing competitiveness in sport throughout the world , overtraining has become common among athletes .

Overtraining occurs when the athlete, while stale (impaired effectiveness ) is pushed/forced ( e.g. by a coach ) to continue training at high intensity

This frequently results in development of “Overtraining Syndrome” ,

( **موهن** Overtraining syndrome is a chronic , debilitating body-weakening ) condition .

It may impair an athlete during training or daily work, with  
-:signs of

- (1) decreased concentration,
- (2) irritability and increased anger,
- (3) slowed mental function,
- (4) diminished self-esteem.

**Symptoms of overtraining include fatigue ( feeling of tiredness ) , reduced levels of performance, الفائز inability to exceed former and a decreased ability to perform & recover**

**stages of overtraining include مضر Disadvantageous**

**(a) overtraining , → (b) staleness**

**©بلوغ overreaching (d) burnout, and → (e) injury/withdrawal  
الهدف**

**These conditions are not limited to mature adult athletes.**

**Young athletes are continuously confronted with increasing expectations, often resulting in unrealistic demands on time and physical performance**

**This may lead to early withdrawal from the sport environment.**