

Physical and Psychological Factors Affecting Sport Performance

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Physical and Psychological Factors Affecting Sport Performance

At the end of lecture students should know about:-

- 1-Muscle metabolic systems in exercise
 - Adenosine triphosphate
 - Phosphocreatine-creatine system
 - Glycogen-lactic acid & aerobic system
- 2-Recovery of the muscle metabolic systems after exercise& Oxygen debt& Recovery of muscle glycogen
- 3-Nutrients used during muscle activity
- 4-Effect of smoking on pulmonary ventilation in exercise
- 5-Effect of heart disease and old age on athletic performance
- 6-Body fluids and salt in exercise
- 7-Drugs and athletes
- 8-Body fitness prolongs life

**Reference book// GUYTON & HALL medical physiology
Twelfth Edition/Chapter 84 (SPORT PHYSIOLOGY)**



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**

1-Adenosine Triphosphate:-

- Adenosine-PO₃ ~ PO₃ ~ PO₃

- Each one of the last 2 high energy phosphate bonds store 7300 calories, 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.

2-Phosphocreatine-creatine system= Creatine-phosphate system(creatine ~ Po₃)

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

Phosphagen energy system

Phosphagen energy system:-

-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 useful for maximal short bursts of muscle power (8-10 seconds).

3-Glycogen-lactic acid system

a-Anaerobic metabolism (glycolysis):-

-During glycolysis :- glycogen of the muscle split into glucose without use of O₂

-Then each glucose split into:

2 pyruvic acid + energy to form 4 ATP for each one glucose molecule

b-Oxidative stage:-

- Pyruvic acid in the mitochondria in presence of O₂ will form more ATP.

- When there is insufficient O₂ most of pyruvic acid converts into lactic acid which diffuse to blood stream

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Characteristics of Glycogen-lactic acid system

- 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 to moderate periods** of muscle contraction ($\frac{1}{2}$ as rapid as phosphagen system)
- Glycogen-lactic acid system provide **1.3-1.6 minutes** of maximal muscle activity

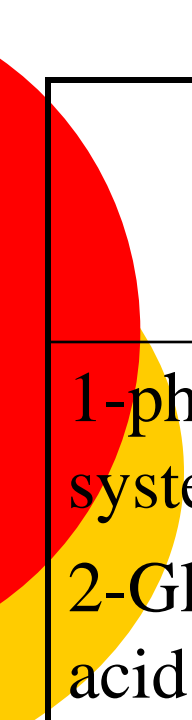


Aerobic process:-

-Oxidation of foodstuffs glucose, A.A, F.A in the mitochondria in presence of O₂ produces energy that converts AMP to ADP to ATP

(figure 84-1,table 84-1, page 1033)





System	Moles of ATP/min	Endurance time
1-phosphagen system	(4) moles	8-10 seconds
2-Glycogen-lactic acid system	(2.5) moles	1.3-1.6 minutes
3-Aerobic system	(1)	(unlimited time as long as nutrients last)





Recovery after exercise

1-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**

-Reconstitution of Lactic acid system(removal of lactic acid):-
Lactic acid causes fatigue so it should be removed by:-

1-portion converted into pyruvic acid which is oxidated by all body tissues

2-remaining is changed into glucose in liver to replenish glycogen stores of muscles

2-Recovery of aerobic system after exercise:-

-Oxygen Dept:-

This is approximately about 11.5 Litres of O₂ should be repaid after exercise is over.

-These are:-

a- 2 Litres of stored O₂ (0.5 L in lungs + 0.25 L dissolved in body fluids + 1 L combined with Hb + 0.3 L stored in muscle myoglobin)

-This is used within a minute of heavy exercise or for aerobic metabolism & replenished by breathing extra amounts of O₂ above the normal needs.

b- 9 Litres more O₂ must be consumed to reconstitute phosphagen & lactic acid system

-At first O₂ uptake is high & fast to replenish stored O₂ & phosphagen system (this is called alactacid O₂ dept = 3.5 L)

- The later portion of O₂ dept takes 40 minutes for lactic acid system removal, it is of lower level breathing , it is called (lactic acid O₂ dept =8 L)

3-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



-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



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

- Cardiac disease reduce C.O& reduce muscle power**
- patient with CHF 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**



-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**
- Loss of enough sweat reduce performance
- 5-10%** loss of weight lead to cramps , nausea & serious effects , so should be replaced
- Sodium tablets or supplemental fluids contain potassium and sodium **in form of fruit juice**
- Effect of aldosterone??




Drugs and athletes

1- Caffeine increase athletes performance

2- Unusual androgens (male sex hormone) & anabolic steroids intake increase athletes performance in men & women but they increase risk of heart attacks due to hypertension

-In males male sex hormones decrease testicular functions & decrease natural testosterone secretion

- Women develop facial hair, stoppage of menses, ruddy skin and bass voice



3- 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 cholesterol ,low LDL, and high HDL

-Body fitness reduce insulin resistance and typy 2 diabetes

-Improved body fitness reduces the risk of cancer breast & prostate& and colon

- Improved body itness reduces obesity