EFFECT OF EXERCISE

VISHAL.O.BANNE

Cardiovascular fitness

- It is very important to remember that cardiovascular fitness is not just for top sportspeople
- It is the most important aspect of fitness for all of us because it involves the circulatory and the respiratory systems
- The heart or cardiac muscle is different to any other muscle in that it never tires. It must continually pump blood — without it, we would die. If the blood vessels become blocked or hardened, angina or heart attack occurs
- Improved cardiovascular fitness increases the number of blood vessels in and around the heart, so reducing the risk of a heart attack

The cardiovascular system serves five important functions(during exe.)

- 1) Delivers oxygen to working muscles
  2) Oxygenates blood by returning it to the lungs
  3) Transports heat (a by-product of activity) from the core to the skin
  4) Delivers nutrients and fuel to active tissues
  5) Transports hormones

Heart Rate

- Resting heart rate averages 60 to 80 beats/min in healthy adults . below 60 called bradycardia
- In sedentary, middle aged individuals it may be as high as 100 beats/min . above 100 called trachycardia
- In elite endurance athletes heart rates as low as 28 to 40 beats/min have been recorded .
- Heart rate in excess above 250 called flutter or fibrillation.

Before exercise even begins heart rate increases in anticipation. This is known as the **anticipatory response.** It is mediated through the releases of a neurotransmitters called **epinephrine** and **norepinephrine** also known as adrenaline and noradrenaline

During prolonged steady-state exercise, particularly in a hot climate, a steady-state heart rate will gradually increase. This phenomenon is known as **cardiac drift** and is thought to occur due to increasing body temperature and decreased stroke volume.

Stroke Volume

- Stroke volume is the amount of blood ejected per beat from left ventricle and measured in ml/beat.
- Stroke volume increases proportionally with exercise intensity. In untrained individuals stroke volume at rest it averages 50-70ml/beat increasing up to 110-130ml/beat during intense, physical activity. In elite athletes resting stroke volume averages 90-110ml/beat increasing to as much as 150-220ml/beat
- Stroke volume may increase only up to 40-60% of maximal capacity after which it plateaus. Beyond this relative exercise intensity,

- Stroke vol = end diastolic- end systolic vol
- Left ventricular EDV means the amount of blood in left ventricle at the very end of diastole, just prior to the next contraction .
- and left ventricular ESV means the amount of blood that remain in the left ventricular just after the heart has finished contracting, just before it begins to refill. It introduces new term ejection fraction.
- Ejection fraction= $\frac{EDV - ESV}{EDV} \times 100$

Ejection fraction

- In a healthy 70-kg (154-lb) man, the SV is approximately 70 ml and the left ventricular EDV is 120 ml, giving an ejection fraction of 70/120, or 0.58 (58%).
- Right ventricular volumes being roughly equal to those of the left ventricle, the ejection fraction of the right ventricle is normally equal to that of the left ventricle within narrow limits.
- Healthy individuals typically have ejection fractions between 50% and 65%

•Measure	Typical value	Normal range
end-diastolic volume (EDV)	120 mL	65–240 mL
end-systolic volume (ESV)	50 mL	16–143 mL[
stroke volume (SV)	70 mL	55–100 mL
ejection fraction (E_f)	58%	55–70%[2]
heart rate (HR)	75 bpm	60–100 bpm
cardiac output (CO)	5.25 L/minute	4.0–8.0 L/min[

Cardiac Output

- Cardiac output is the amount of blood pumped by the heart in 1 minute measured in L/min. It is a product of stroke volume and heart rate (SV x HR). If either heart rate or stroke volume increase, or both, cardiac output increases also.
- Cardiac output increases proportionally with exercise intensity - which is predictable from understanding the response of heart rate and stroke volume to activity. At rest the cardiac output is about 5L/min. During intense exercise this can increase to 20-40L/min .

Cardiac Output

- Increase cardiac output(Q) closely related to VO_2 over the entire range rest to maximum.
- however in comparison to men ,women have a slightly higher (Q) when exercising at same VO_2 .this differences amounts to between 1.5 and 1.75 L. min-1. the reason for this difference is probably due to the women's lower oxygen- carrying capacity of blood, resulting from lower levels of hemoglobin. Also, the maximal cardiac output of both trained and untrained women is generally lower than that of their male counterparts.

Benefits Of Cardiovascular Exercise

- According to the ACSM, The American College Of Sports Medicine, the benefits of cardio respiratory exercise include the following*:
- Adaptive physiologic responses increases
- Aerobic work capacity increases
- All-cause mortality reduction
- Anxiety and depression decreases
- Blood pressure decreases
- Body fat stores decreases
- Capillary density and blood flow to active muscles increases
- Clinical symptoms of anxiety, tension and depression reduced
- Decreases resting heart rate
- HDL cholesterol (good cholesterol) increases
- Health benefits increases
- Heart volume increases

Benefits Of Cardiovascular Exercise cont…

- Incidence of some cancers decreases
- Increase in heart function
- Lactate threshold increases
- Lung diffusion capacity increases
- Maximal ventilation increases
- Maximum cardiac output increase
- Maximum oxygen consumption increases
- Mobilization and utilization of fat increases
- Mortality in post myocardial infarction patients decreases
- Reduction in glucose-stimulated insulin secretion
- Resting and maximum stroke volume increases
- Total blood volume increases
- Total cholesterol decreases

Adaptations Summary to Cardiovascular Aerobic Workouts / Cardio Respiratory Training

- Heart rate decreases at any sub maximal efforts, including resting (theoretically live longer, more relaxed)
- Cardiac output stroke volume increases at all intensities, including resting (higher cardiovascualr efficicieny)
- Increases maximum cardiac output (higher cardiovascualr efficicieny)
- Capillary density increases (higher cardiovascualr efficicieny)
- Mitochondria number increases (therefore more energy)
- Mitochondria enzymes / aerobic enzymes increased activity (more energy and higher cardiovascualr efficicieny)

Blood Flow

- The vascular system can redistribute blood to those tissues with the greatest immediate demand and away from areas that have less demand for oxygen.
- At rest 15-20% of circulating blood supplies skeletal muscle. During vigorous exercise this increases to 80-85% of cardiac output. Blood is shunted away from major organs such as the kidneys, liver, stomach and intestines. It is then redirected to the skin to promote heat loss

Blood Flow

- Athletes are often advised not to eat several hours before training or competition. This is advice worth adhering to, as food in the stomach will lead to competition for blood flow between the digestive system and muscles. It has been shown that gastrointestinal blood flow during exercise shortly after a meal is greater compared to exercising on an empty stomach

BLOOD PRESSURE

- blood pressure is the force of blood against the walls of your arteries. Blood pressure is recorded as two numbers -- systolic pressure and diastolic pressure. Systolic pressure --the higher number(200mmHg during exercise) -- is the pressure in your arteries as your heart beats and diastolic pressure --the lower number -- is the pressure in your arteries as your heart relaxes between beats.

BP and Exercise

- During exercise it is normal for your systolic pressure to increase throughout your workout and your diastolic pressure to remain the same or slightly decrease. This increase in systolic is due to increased bodily exertion and your need for more oxygen. This causes your heart to beat or pump faster, thus increasing systolic pressure. The decrease in diastolic pressure is due to the vasodilatation -- or expansion -- of the arteries during exercise. The widening of the arteries is what causes the slight decrease.

Category	Systolic BP (mm Hg)		Diastolic BP (mm Hg)
Optimal	< 120	and	< 80
Normal	120 - 129	and	80 - 84
High Normal	130 - 139	or	85 - 89
Hypertension			
Stage 1	140 - 159	or	90 - 99
Stage 2	160 - 179	or	100 - 109
Stage 3	≥ 180	or	≥ 110

Improved Cardiorespiratory Functioning

- when we exercise can be observed in increases in cardiac output and blood pressure, breathing rate, blood flow to the skeletal muscles, and sweating. In the short term, all these changes help the body respond to the challenge of exercise. When performed regularly, endurance exercise also leads to permanent adaptations in the cardiorespiratory system. These improvements reduce the effort required to do everyday tasks and make the body better able to respond to physical challenges

Endurance exercise enhances the heart's health by:

- Maintaining or increasing the heart's own blood and oxygen supply.
- Increasing the heart muscle's function, so it pumps more blood per beat. This improved function keeps the heart rate lower both at rest and during exercise. The resting heart rate of a fit person is often 10-20 beats per minute lower than that of an unfit person.
- This translates into as many as 10 million fewer beats In a course of year

Strengthening the heart’s contractions.

Increasing the heart’s cavity size (in young adults).

Increasing blood volume so the heart pushes more blood into the circulatory system during each contraction.

Reducing blood pressure

Improved Cellular Metabolism

- Regular endurance exercise improves the body's metabolism, down to the cellular level, enhancing your ability to produce and use energy efficiently.

- CARDIORESPIRATORY TRAINING IMPROVES METABOLISM BY DOING THE FOLLOWING:

1Increasing the number of capillaries in the muscles. Additional capillaries supply the muscles with more fuel and oxygen and more quickly eliminate waste products. Greater capillary density also helps heal injuries and reduce muscle aches.

2Training muscles to make the most of oxygen and fuel so they work more efficiently.

3Increasing the size of and number of mitochondria in muscle cells, increasing cells' energy capacity.

4Preventing glycogen depletion and increasing the muscle's ability to use lactic acid and fat as fuels.

Cardio-respiratory training

Effects of this type of training include:

- The heart becomes more efficient
- The stroke volume is increased and, as a result, the resting heart rate becomes lower
- Recovery after exercise becomes quicker
- Blood volume, red cells and haemoglobin increase
- Arteries grow larger
- The diaphragm grows stronger
- The lungs become more expandable, increasing in volume

Short-term benefits of exercise

Healthier heart, muscles, bones and joints
More calories burnt
Increased energy levels
Reduced stress, depression and anxiety
Better sleep
Faster, sharper thinking

Effects of regular training

- Promotes bone strength and thickness — a physically fit person will have stronger and slightly thicker bones than an unfit person. This means the fit person will be more resistant to breaks and will be able to take much harder blows
- Keeps weight down — but only with a sensible diet

Weight loss

Exercising for 30 minutes a day can help weight loss

Reducing your weight by just ten lbs (4 kg) may be enough to lower blood pressure

Losing weight can help to enhance the effects of high blood pressure medication

It may also reduce the risk of other conditions, such as diabetes, heart attack, breast cancer, obesity, high blood cholesterol and stroke

Immediate effects

Increased levels of neurotransmitters; constant or slightly increased blood flow to the brain.

Increased heart rate and stroke volume (amount of blood pumped per beat).

Increased pulmonary ventilation (amount of air breathed into the body per minute). More air is taken into the lungs with each breath and breathing rate increases.

Reduced blood flow to the stomach, intestines, liver, and kidneys, resulting in less activity in the digestive tract and less urine output.

Increased energy (ATP) production.

Increased blood flow to the skin and increased sweating to help maintain a safe body temperature.

Increased systolic blood pressure; increased blood flow and oxygen transport to working skeletal muscles and the heart; increased oxygen consumption. As exercise intensity increases, blood levels of lactic acid increase.

Long-term effects

Improved self-image, cognitive functioning, and ability to manage stress; enhanced learning, memory, energy level, and sleep; decreased depression, anxiety, and risk for stroke.

Increased heart size and resting stroke volume; lower resting heart rate. Risk of heart disease and heart attack significantly reduced.

Improved ability to extract oxygen from air during exercise. Reduced risk of colds and upper respiratory tract infections.

Increased sweat rate and earlier onset of sweating, helping to cool the body.

Decreased body fat.

Reduced risk of colon cancer and certain other forms of cancer.

Increased number and size of mitochondria in muscle cells; increased amount of stored glycogen; increased myoglobin content; improved ability to use lactic acid and fats as fuel. All of these changes allow for greater energy production and power output. Insulin sensitivity remains constant or improves, helping to prevent type 2 diabetes. Fat-free mass may also increase somewhat.

Increased density and breaking strength of bones, ligaments, and tendons; reduced risk for low-back pain, injuries, and osteoporosis.

Increased blood volume and capillary density; higher levels of high-density lipoproteins (HDL) and lower levels of triglycerides; lower resting blood pressure; increased ability of blood vessels to secrete nitric oxide; and reduced platelet stickiness (a factor in coronary artery disease).

Summary-The circulatory system

The Heart

- The heart becomes BIGGER and its walls become THICKER.
- The heart is able to pump more blood per minute….
- ….and is therefore capable of higher HEART RATE and STROKE VOLUME.
- The heart need less beats per minute to supply the body with blood when at rest. Resting Heart rate is therefore lower at rest.

The Circulatory System continued…

The Blood and Circulation

- The number of red blood cells increases to cope with the demands of carrying extra oxygen.
- The capillary networks in muscles start to grow more and more branches and are therefore able to transport more blood.

The Respiratory System

- Increase in the maximum lung volume
- This allows greater gas exchange with each breath
- There is an increase in the size of the capillary networks around the alveoli which means….
- ….increased blood supply and more efficient gas exchange.

The Skeletal and Muscle Systems

- The muscles and their associated capillaries become more efficient at exchanging Oxygen and Carbon Dioxide.
- Muscles use the Oxygen more efficiently therefore muscles can contract for longer and do more.
- These two facts mean that the VO2 MAX of the body is increased meaning you can transfer energy more quickly.
- Muscles may or may not get bigger depending on the training you do.
- Tendons ligaments and bones get stronger to compensate for the increased work loads.

Do not encourage sports & education beggars.