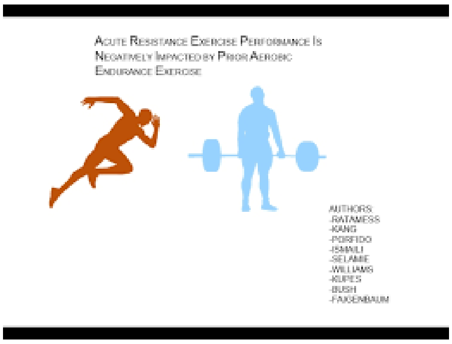
Effect of exercise on blood pressure and respiratory rate



Movement requires activation and control of the musculoskeletal system; the cardiovascular and respiratory systems provide the ability to sustain this movement over extended periods. When the body engages in exercise training several times a week or more frequently, each of these physiologic systems undergoes specific adaptations that increase the body's efficiency and capacity. The magnitude of these changes depends largely on the intensity and duration of the training sessions, the force or load used in training, and the body's initial level of fitness. Removal of the training stimulus, however, will result in loss of the efficiency and capacity that was gained through these training-induced adaptations; this loss is a process called detraining.

how

the body responds to an episode of exercise and adapts to exercise training and detraining on aerobic or cardiorespiratory endurance exercise (e.g., walking, jogging, running, cycling, swimming, dancing, and in-line skating) and resistance exercise (e.g., strength-developing exercises).

Physiologic Responses to Episodes of Exercise The body's physiologic responses to endurance and resistance exercise occur in the musculoskeletal, cardiovascular, respiratory, endocrine, and immune systems

Cardiovascular and Respiratory Systems

The primary functions of the cardiovascular and respiratory systems are to provide the body with oxygen (O2) and nutrients, to rid the body of carbon dioxide (CO2) and metabolic waste products, to maintain body temperature and acid-base balance. the cardiovascular system should be able to respond to increased skeletal muscle activity. Low rates of work, such as walking at 4 kilometers per hour (2.5 miles per hour), place relatively small demands on the cardiovascular and respiratory systems. However, as the rate of muscular work increases.

Cardiovascular Responses to Exercise

Blood Flow

The pattern of blood flow changes dramatically when a person goes from resting to exercising. At rest, the skin and skeletal muscles receive about 20 percent of the cardiac output. During exercise, more blood is sent to the active skeletal muscles, and, as body temperature increases, more blood is sent to the skin. This process is accomplished both by the increase in cardiac output and by the redistribution of blood flow away from areas of low demand, such as the splanchnic organs. This process allows about 80 percent of the cardiac output to go to active skeletal muscles and skin at maximal rates of work With exercise of longer duration, particularly in a hot and humid environment, progressively more of the cardiac output will be redistributed to the skin to counter the increasing body temperature

Cardiac Output

Cardiac output (Q) is the total volume of blood ˙ pumped by the left ventricle of the heart per minute. It is the product of heart rate (HR, number of beats per minute) and stroke volume (SV, volume of blood pumped per beat). Cardiac output plays an important role in meeting the oxygen demands for work. As the rate of work increases, the cardiac output increases in a nearly linear manner to meet the increasing oxygen demand, but only up to the point where it reaches its maximal capacity (Q max). cardiac output and heart rate increase over the entire range of work whereas stroke volume only increases up to approximately 40to 60 percent of the person's maximal oxygen uptake

Blood Pressure

Mean arterial blood pressure increases in response to dynamic exercise, largely owing to an increase in systolic blood pressure, because diastolic blood pressure remains at near-resting levels. Systolic blood pressure increases linearly with increasing rates of work, reaching peak values of between 200 and 240 millimeters of mercury in normotensive persons. Because mean arterial pressure is equal to cardiac output times total peripheral resistance, the observed increase in mean arterial pressure results from an increase in cardiac output that outweighs a concomitant decrease in total peripheral resistance. This increase in mean arterial pressure is a normal and desirable response, the result of a resetting of the arterial baroreflex to a higher pressure. Without such a resetting, the body would experience severe arterial hypotension during intense activity .Hypertensive patients typically reach much higher systolic blood pressures for a given rate of work, and they can also experience increases in diastolic blood pressure.

Respiratory Responses to Exercise

The respiratory system also responds when challenged with the stress of exercise. Pulmonary ventilation increases almost immediately, largely through stimulation of the respiratory centers in the brain stem from the motor cortex and through feedback from the proprioceptors in the muscles and joints of the active limbs. During prolonged exercise, or at higher rates of work, increases in CO_2 production, hydrogen ions (H^+), and body and blood temperatures stimulate further increases in pulmonary ventilation. At low work intensities, the increase in ventilation is mostly the result of increases in tidal volume. At higher intensities, the respiratory rate also increases. In normal-sized, untrained adults, pulmonary ventilation rates can vary from about 10 liters per minute at rest to more than 100 liters per minute at maximal rates of work.

Ventilation rates can reach more than 200 liters per minute at maximal rates of work.

Resistance Exercise The cardiovascular and respiratory responses to episodes of resistance exercise are mostly similar to those associated with endurance exercise. One notable exception is the exaggerated blood pressure response that occurs during resistance exercise.