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What happens to your body at altitude?

So, you've made the decision to tackle some of the best travel adventures offered by South Africa Adventures?! Let's discuss the changes your body will experience while moving into higher altitudes, but before that we should go back to the basics.

The Basics

Your body is comprised of multiple organs systems which work either independently of each other or in unison and live in a state of harmony till disturbed by external or internal influences. We know these systems as the: Cardiovascular system (heart and lungs), Neurological system (brain and nerves), Haematological system (blood), Endocrine system (hormones and glands), Skeletal system (bones, joints and cartilage), Muscular system (muscles and tendons), Digestive system (stomach, liver, gallbladder and intestines), Urinary system (kidneys and bladder), Integumentary system (skin, hair and nails), Lymphatic system and Reproductive system. Today we will be focusing on 2 of these systems, chiefly the Cardiovacular and Haematological systems.

As we learnt in school biology, the air we breathe contains oxygen, a requirement for life and proper tissue function. Air enters our lungs which then passes over into the blood by binding to red blood cells. The blood is then carried through our entire body by means of blood vessels and the pumping action of the heart. The purpose of this is to oxygenate the tissues of the body. When we are in a state of balance, this system runs on autopilot as it is used to the surroundings in which we live and breathe on a daily basis.

The daily balance of our bodies involves a steady heart (an average of between 60 to 80 beats per minute) and a respiratory rate (around 14 breaths per minute). This balance also includes a specific number of circulating red blood cells, with a normal oxygen saturation (above 95%) and a healthy blood pressure (this can range anywhere between 110/70 to 120/80). Each system must receive the correct amount of blood supply and oxygen to maintain normal function, but these all change as we enter higher altitudes because the balance is disturbed by external factors and the body must then adjust in order to set a new balance so that the body can cope. These changes are known as acclimatization.

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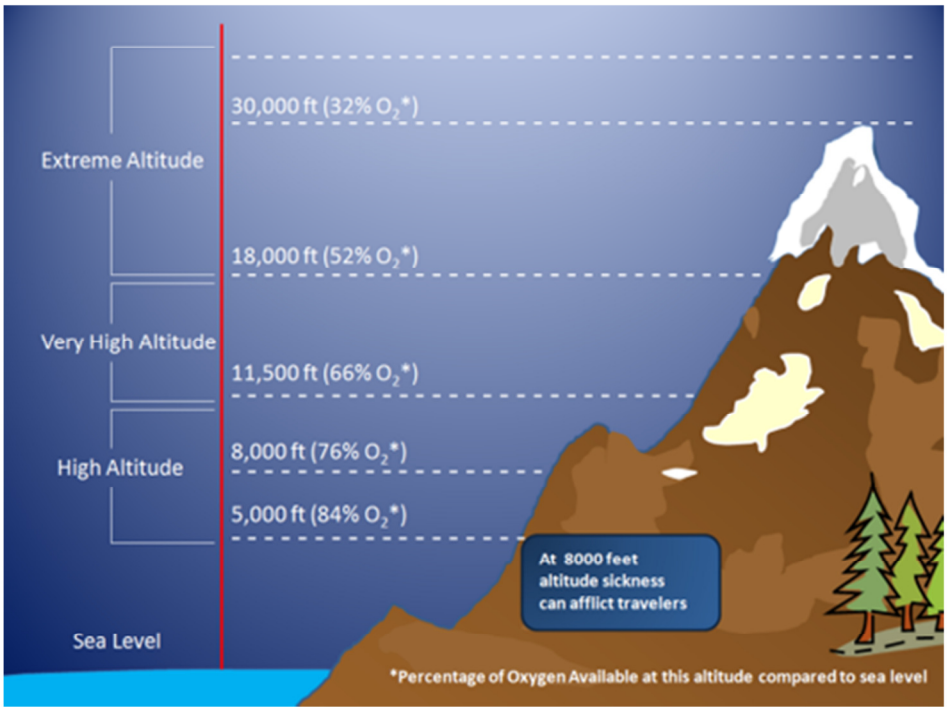

Thinning of the air

We've all heard the expression "air gets thinner the higher we go". This statement at times is misinterpreted by many as theres's less oxygen at higher altitudes. In fact, the percentage of oxygen present in the air at sea level or on a mountain remains relatively the same at 21%. In fact, the actual issue is with the pressure of the air. At sea level the air we breathe is a lot more dense and therefore the oxygen particles are closer together and can pass much more easily across the lung membrane into the blood. When at higher altitudes, the density gradually drops the higher you go thus causing the oxygen particles to become further apart. So, even though we breath in air, the amount of oxygen entering our lungs and passing across the semi permeable membrane into the blood is significantly lower.

It is similar to thinking of being in a boat with hole in the hull - no matter how deep or shallow you are in the water, the amount of water is this same, but there is a pressure difference. So, the closer to the surface, the pressure is lower so the water comes through the hole gently. The deeper you go, the pressure increases and this forces the water through the hole harder and faster. The air pressure is what is most important as our lungs are set at the same pressure as the atmospheric pressure at sea level. Once the external pressure drops, the percentage of saturation also decreases.

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Physiological Changes

We have now discussed the normal balance of the body and the changes in the air as we ascend into higher altitudes. Let us now focus on the physiological changes you will go through when these two opposing factors meet. When you venture into higher altitudes and your body undergoes physical stresses and is deprived of oxygen, it enters into a state known as Hypoxia. Your body will undergo short term and long term changes in order to compensate for the drastic changes it is experiencing. The short-term changes are more mechanical in nature, and include:

- increased respiratory rate and depth, this allows for more oxygen to be brought into the lungs;
- increased heart rate to improve the supply of oxygenated blood to the tissues, organs and cells of the body. With the heart pumping faster, the amount of blood filling the right ventricle and entering systemic flow is slightly reduced as it doesn't have enough time to fill completely between beats;
- increased blood pressure because there is an increased demand on the body and heart to maintain normal function; and
- a suppression of all non-essential bodily functions. This is mainly seen in the digestive system where the blood supply to this area is decreased in favour of the brain, lungs, heart and muscles hence why the digesting of food is more difficult.

The longer-term effects may take a couple of days to weeks to present themselves. The extent of these changes will depend on the altitude achieved. The purpose of these physiological changes is aimed at increasing the saturation, delivery and utilization of oxygen in order to restore a balance to the body. These include:

- Increased red blood cell production and number – these improve the oxygen saturation levels;
- Increased red blood cell mass – this will improve the oxygen carrying capacity of each RBC;
- A decrease in lactate production as there is a reduction in glucose breakdown;
- Increased number of capillaries in skeletal muscle – this aids in improving blood supply for better physical performance;
- Increased numbers of mitochondria which will increase energy production within the body;
- Pulmonary artery pressure increases – this allows for higher pressure in lungs to force more oxygen across the semi-permeable tissues of the lungs into the blood; and
- right ventricular hypertrophy – this allows for a stronger contraction of the heart muscle to deliver more blood systemically but causes a decreased stroke.