The Athlete’s Paradox
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Exercise Biology

The percentage of your blood that is made up of red blood cells is called your hematocrit. An average hematocrit is between 42% and 54% for males and 38% and 46% for females. The rest of your blood is plasma which is made up mostly of water but also contains glucose, hormones, and a handful of other substances that do not greatly affect its volume. An abnormally high hematocrit can be a sign of dehydration or congenital heart disease while an abnormally low one can be a sign of leukemia, nutritional deficiencies, kidney disease, traumatic injury, or being a well-trained endurance athlete.

The last one doesn’t really make sense does it? Red blood cells are the mode of transportation for oxygen around our bodies. Since athletes have greater demands for oxygen, logic tells us that they should have more red blood cells and consequently, higher hematocrits. On the contrary, a normal hematocrit for a male athlete (who isn’t blood doping, which I’ll hit on later) is somewhere in the range of 38%-40%; quite lower than a male non-athlete. So what causes this athlete’s paradox? It most certainly is not kidney disease, otherwise endurance sports would be an incredibly sad thing to behold.

The answer is in total blood volume. With intense training, blood volume may increase by 25% or more, going from 5 liters to 6.25 liters in a normal sized human. At the same time, hematocrit may drop from 45% to 40%. Now if we do some math...

\[5L \times \frac{45}{100} = 2.25L \text{ of red blood cells}\]

\[6.25L \times \frac{40}{100} = 2.50L \text{ of red blood cells}\]

As you can see, there is an increase of 0.25L or a little more than 1 cup (for those of you that don’t do metric) of red blood cells. But wait, the good news continues. A high hematocrit signifies high blood viscosity which causes it to flow more slowly. A well-trained athlete’s blood will be less viscous, causing it to flow more rapidly. Through training it is possible to have thinner blood, with superior oxygen delivering power. When first teaching us about this effect, my Exercise Physiology Professor, Dr. James D. Shaffrath, exclaimed, “It’s like having your cake and eating it too!”

Sometimes professional endurance athletes are caught with elevated hematocrits. The implications of having a hematocrit that is too high for how good of shape you are in can be grounds for an investigation. Blood doping is the practice of artificially increasing red blood cell volume by taking growth hormones or blood transfusions; this increase in red blood cells enhances aerobic performance. It is also illegal. Additionally, the practice of blood doping is potentially hazardous as it boosts blood viscosity and increases the risk of blood clots forming which are the cause of cerebral infarction (stroke) and myocardial infarction (heart attack).

For those of you that are in extremely good cardiovascular condition, if your doctor is alarmed by your “low” red blood cell count, you might want to inform him or her of your ability to go on a 30 mile bike ride like it ain’t no thing. Hopefully, your doctor will get it.