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Is There a Difference in Hemoglobin Concentration Between Male and Female Horses?

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ABSTRACT

This study looks at the difference in hemoglobin concentration between males and females. To this, I used horses of different age ranges. The male horses were Geldings and the mares consisted of the child producing group and a non-child producing group. The first thing done was to compare the hemoglobin concentration between the two sexes; next further comparison was done within the same age. I found that there wasn't any difference between the geldings and the mares. The difference was seen when I compared the hemoglobin concentration between the mares. I found that mares that had recently had foals, had a higher hemoglobin concentration that the ones that were over or under the age of having offspring. Using both the t-test and the Mann-Whitney rank sum test, each data either proved or disproved the null hypothesis. The Mann-Whitney test Rank test showed that there is no significant difference between male and female and hence proving my first null hypothesis. Using the t-test the standard deviation for the non-reproductive group, which included the geldings and some of the mares, was 0.305 and for the reproducing horses (mares) was 0.495. The difference in the means between the non-reproductive and reproductive was statistically significant hence disproving the second null hypothesis.

Keywords: *Hemoglobin Concentration, Mare, Gelding, Child-Producing age, t-test, Mann-Whitney Rank Test*

INTRODUCTION

Hemoglobin is the oxygen-carrying molecule of the red blood cells of vertebrates. It is responsible for transporting oxygen from the lungs to the body tissue and transporting carbon dioxide from the tissue to the lungs. Some of the carbon dioxide is transported on the Heme and some dissolved in the plasma as bicarbonate ions. Vertebrate hemoglobin consists of four polypeptide chains that are held together by noncovalent bonds. There are two different kinds of polypeptide subunits in the hemoglobin of the normal adult human (abbreviated HbA). One is called the alpha chain and contains 141 amino acid residues. The other is called the beta chain and contains 146 amino acid residues. (Stryer, 1999).

The normal values for hemoglobin concentration for species vary with respect to the amount of muscle they have. Within the species there is further difference in hemoglobin concentration depending on the sex, age, hormones and muscle density. Horses, like humans have different values for both male and female. For humans, the female hemoglobin concentrations ranges from 12-16 g/dl and for males the ranges are between 14-18g/dl. Hemoglobin concentration of a hot-blooded horse is 2 to 4 g higher. (Coles, et al.1974)

Another factor impacting hemoglobin is that pregnant females that take vitamin A and Iron supplements tend to have higher hemoglobin concentration than males (Muslimatun, et al., 2001). There are some cases where you will find both male and female have the same amount of hemoglobin in their blood. My research was based on the null hypotheses: 1) the hemoglobin concentration will not be different for male and female, and 2)hemoglobin concentration will not be higher for pregnant horses or females who have recently gave birth.

MATERIALS AND METHODS

First and foremost I prepared *Drabkins reagent* by dissolving 1.0 gm of sodium, 50 mg of potassium cyanide, and 200 mg of potassium ferricyanide to 1.0 liter of distilled water. Drabkins reagent is sensitive to light, so I stored the reagent in a bottle wrapped with aluminum foil to prevent light from penetrating.

I obtained 0.02ml of the sample blood and added it to a test tube containing 5.0 ml of the Drabkins solution, mixed it thoroughly, and allowed it to stand for ten minutes. I took the blood solution and placed it in a Spectronic 20 with a blank containing the Drabkins solution. I adjusted the blank to read 100% T and read the hemoglobin mixture against the blank solution at 540mμ. I repeated the procedure above with all the blood samples.

After acquiring all the readings, I referred to the table provided to convert the %T to gm / 100ml. (Spectronic 20 guide book) and (Coles, et al.1974)

RESULTS

The results of the blood samples are shown in Table 1.

Table 1. Hemoglobin concentration of horses.

Sex	Age	Absorbance	%T	Hemoglobin (gm/100ml)
Male	21 yrs	0.221	48.7	10.2
Male	4 yrs	0.221	48.6	10.1
Male	3 yrs	0.232	46.9	10.7
Female	19 yrs	0.235	46.5	10.8
Female	9 yrs	0.300	37.8	13.7
Female	4 yrs	0.402	39.6	13.0
Female	1.5 yrs	0.227	47.6	10.5

Note the difference in hemoglobin concentrations first between the mares and the geldings. Also, pay close attention the hemoglobin concentrations and the age of the mares.

Table 2. Hemoglobin concentration between non-reproductive and reproductive males and females

NR (AGE)	[Hg]	R(AGE)	[Hg]
M-21 yrs	10.2	F- 9 yrs	13.7
M-4 yrs	10.1	F- 4 yrs	13.0
M-3 yrs	10.7	-	-
F-19 yrs	10.8	-	-
F-1.5 yrs	10.5	-	-

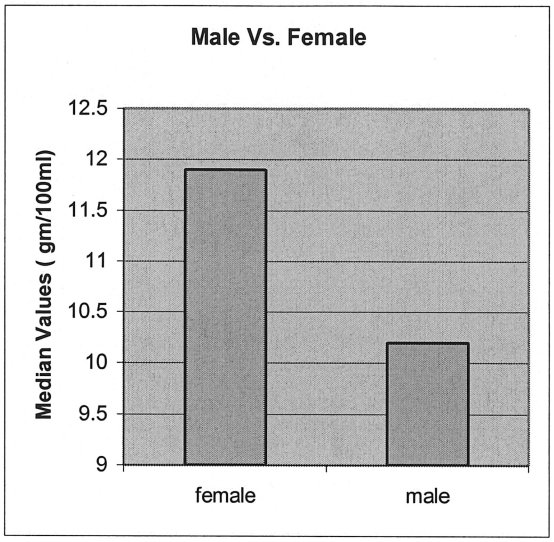

Figure 1. Hemoglobin concentration between geldings and mares

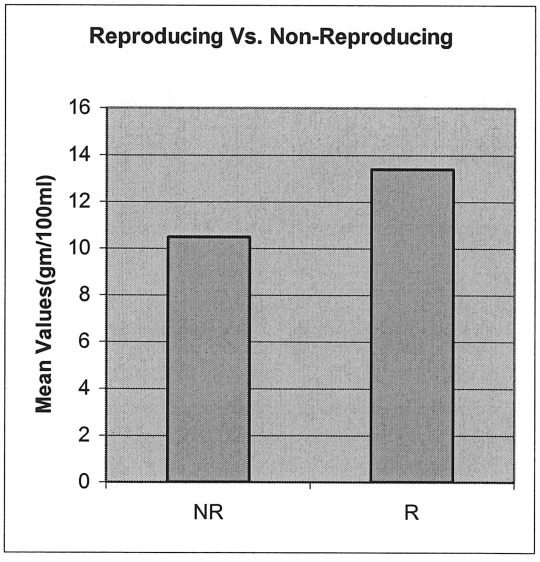

Figure 2. Hemoglobin concentration between non-producing and producing age

DISCUSSION

The first time I carried out the experiment with six subjects, three of each gender. The difference was not significant since I couldn't tell the hemoglobin difference based on the sample with the exception of one horse. She had higher hemoglobin concentration than all the others. Later, I added to the sample two other mares that had foals within the last year. I found out that their hemoglobin concentration were higher than the rest of the mares who hadn't had any foals as seen in Table 1.

The increase in hemoglobin concentration of horses that had produced offspring is due to the increase in hormones in their blood. It is also due to the fact that the amount of blood was increase during pregnancy for the embryo or fetus nutritional purposes.

First I used the t-test and the normality test passed but the equal variance test failed. Due to this I used the Mann-Whitney Rank Sum test as suggested to me by the computer software. The difference in median values between the two groups was found not to be of a great difference using the Mann-Whitney Rank Sum test. The test further shows that there is no significant difference hence proving my first null hypothesis to be true.

In Figure 1, the median hemoglobin concentration between male and female, in this experiment was showing that female had higher concentration than the male, approximately <2.0gm/100ml. Again this is because of the hormones present at the time the blood was drawn from the female and the conditions that lead to the presence of those hormones. (Coles, et al.1974)

Age was a very important factor contributing to hemoglobin concentration. As shown in Figure 2, younger and older mare had approximately the same and lower hemoglobin concentration than the mares that are at child producing age, which I believe to be from age 4 to 12 years. The data seen in this figure was obtained using the t-test. Here, the standard deviation for the non-reproductive group, which included the geldings and some of the mares, was 0.305 and for the reproducing horses (mares) was 0.495. The difference in the means between the non-reproductive and reproductive was statistically significant hence disproving the second null hypothesis. (Coles, et al.1974)

I didn't expect the hemoglobin concentration of the two sexes to be almost in the same ballpark. I guess if I had a much larger sample and if the male horses were stallions, the difference in the hemoglobin may have been visible.

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