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# Role of Haemoglobin and their Diseases

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## Abstract

**Haemoglobin is an iron containing metalloprotein found in the red blood cells. It is red protein carries oxygen from the lungs to the body tissues. It carries oxygen from the respiratory organs to the tissues. To the tissues it releases oxygen to allow aerobic respiration to provide energy to functioning the organism. And it also transport the carbon dioxide out of the back to the lungs. Each red blood cell contains approximately 280 million haemoglobin molecules.**

***Keywords: Haemologbin, Anemia, Oxygen, Thalassemia***

## Introduction

It was discovered by Hünefeld in 1840. Each RBC (Red Blood Cell) contains over 600 million haemoglobin molecules. Mainly it is to carry oxygen from the lungs to the tissues and return carbon dioxide ($CO_2$) from the tissue to the lungs. It is the oxygen carrying component of RBCs [1-9]. Oxygen binds to haemoglobin with high affinity in an oxygen-rich environment and leaves haemoglobin in an environment where there is not enough oxygen. Due to the presence of Hb pigment the blood is red in colour [10-16].

It is also found outside red blood cells and their progenitor lines. Some other cells contain haemoglobin include the A9 dopaminergic neurons in the substantia nigra, macrophages, alveolar cells, and mesangial cells in the kidney [17-25]. In these tissues, haemoglobin has a non-oxygen-carrying function as an antioxidant. It acts as a regulator of iron metabolism.

Haemoglobin is a tetramer and quaternary structure it is composed four globin chains: 2 alpha and 2 beta. These chains are derived from chromosome, mainly chromosome 16 and 11. The globin chains are expressed different from fetal to adult. During the fetal period, from about two months until birth, the dominant globin chain is alpha and gamma and this is known as fetal haemoglobin (HbF) [26-32]. However, shortly after birth about 3-6months, one will notice a fall in fetal haemoglobin (HbF) and a there will be a rise in adult haemoglobin (HbA). An alteration to the alpha or beta globin will result in abnormal haemoglobin.

Each molecule of haemoglobin is made up of 4 polypeptide chains. There are four polypeptide chains with each of those containing a single heme (Fe) group. The iron molecules can each absorb one molecule of oxygen [33-38]. This gives each

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haemoglobin the ability to transport four oxygen molecules. Based on the oxygen affinity haemoglobin is of two types: oxyhaemoglobin and deoxyhaemoglobin.

Oxyhaemoglobin has a higher affinity for oxygen and the deoxyhaemoglobin is having less affinity to oxygen and more attracted to carbon dioxide. This means that the oxygen in the lungs binds to the oxyhaemoglobin to be transported into the body and be absorbed. The deoxyhaemoglobin picks up the carbon dioxide that is left after the body absorbs the oxygen and takes it back to the lungs to complete its process. When haemoglobin picks up its first molecule of oxygen the affinity actually increases so that it picks up more oxygen. This domino effect continues until the molecule is full of oxygen [39-45].

Open access journals provide more visibility and accessibility to the readers in gaining the required information. The researches all over the world, which are being exhibited and acquiring knowledge through open access journals, serve as the main source of information in various fields.

People can gain the knowledge and know the information thorough Open access journals. It provide more information and accessibility to the readers in gaining the required information [20-26].

To create awareness among the people, researchers and scientists together form a society. The main aim of these societies is to visualize and create awareness to people and also sharing the knowledge to the world.

Open access journals in Cancer share the recent and scientific research publications to the society. Journal of Blood Disorders & Transfusion provides information on blood disorders. Journal of Blood & Lymph is a peer reviewed journal focused on the areas such as acute myeloid leukemia, Lymphangiogenesis, hematological-malignancies, blood-transfusion, serum protein electrophoresis, hematopoietic stem cell transplantation, photoacoustics, lymph node biopsy, b-cell-lymphoma, invivo flow cytometry, mojtaba akhtari, molecular weight aspirin. Haematology Journals gives the information of overall research, investigations and current innovations on the blood and their disorders, medicine etc. Guido J.K. Tricot is one of the Editor-in-Chief for the journal of blood and Lymph. He has been researching and treating multiple myeloma for over twenty years. He is the principal investigator on many myeloma clinical trails [46-50]. His work published extensively and having great importance in current research field. Some upcoming conferences are going to discuss their ideas in 7th World Hematologists Congress. Not only discussing their ideas, but the scientists given their research importance participating in the debate related to the hematological oncology. It is going to held on Hematology and Hematological Oncology on November 08-09, 2017 Las Vegas, Nevada, USA.

## Normal Haemoglobin values

Haemoglobin reading measures the oxygen-carrying protein in red blood cells, per deciliter of whole blood. Hemoglobin levels decrease with age, and men tend to have higher hemoglobin counts than women. Based upon the sex and age of the persons the haemoglobin value is different (Table 1). Below are the normal values ranges of haemoglobin that are widely accepted worldwide [51-58].

### Diseases of Haemoglobin

Majority the disorders of haemoglobin is mainly changes in the structure of heme protein. Below are the some of the disorders which are seen commonly.

**Anaemia**

The decrease in the total amount of red blood cells of haemoglobin in the blood is anaemia. It can also be defined as a lowered ability of the blood to carry oxygen [59-65]. Iron deficiency is one cause of anaemia, as it directly affects the ability to produce heme molecules.

**Table 1:** Haemoglobin values

| Age | Haemoglobin Value (g/dl) |
|---|---|
| Birth | 13.5-24.0 g/dl |
| <1 Month | 10.0 – 20.0 g/dl |
| 1-2 Months | 10.0 – 18.0 g/dl |
| 2-6 Months | 9.5 – 14.0 g/dl |
| 0.5-2 Years | 10.5 – 13.5 |
| 2-6 Years | 11.5 – 13.5 g/dl |
| 6 – 12 Years | 11.5 – 15.5 |
| **Female** | |
| 12 – 18 Years | 12.0 – 16.0 g/dl |
| >18 | 12.1 – 15.1 g/dl |
| **Male** | |
| 12 – 18 Years | 13.0 – 16.0 g/dl |
| >18 Years | 13.6 – 17.7 g/dl |

**Sickle Cell Anaemia**

It affects the shape of the red blood cell, changing them from a flattened disc to a sickle or crescent shape. These are hard, inflexible and tend to clump together, causing them to get stuck in blood vessels as blood clots, thereby blocking the flow of blood. Abnormal sickle shape is due to the presence of abnormal haemoglobin (haemoglobin S), which contains abnormal beta polypeptide with a single amino acid substitution at position 6 along the polypeptide chain. The Alpha chain is normal [66-69]. However, heterozygote carriers of the disease are better protected against malaria than people with two normal beta chain genes because heterozygotes, where one beta chain is affected and other one is normal. But in homozygote both beta chains are effected so that sickle cell disease is seen.

**Thalassemia**

It is caused due to the haemoglobin chains are impaired. Affecting the alpha globin chain is Alpha Thalassaemia and the beta globin chain is beta thalassemia [70-78]. The deficiency in globin chains can cause the an abnormal association of globin chains in the case of alpha Thalassemia, beta globin chains combine to produce abnormal beta tetramers that cannot bind oxygen, whereas with beta Thalassemia no such alpha tetramers exist – instead the alpha globin chains become degraded in the absence of beta globin chains [79-89].

**Hemoglobinopathy**

It is genetic defect that causes an abnormal structure of one of the globin chains of the haemoglobin molecule [90-96]. Common hemoglobinopathies include sickle-cell disease. Hemoglobinopathy and Thalassaemia both may cause anaemia. Some haemoglobin variants such as sickle-cell anaemia and congenital dyserythropoietic anaemia are responsible for diseases, and are considered hemoglobinopathies.

## Conclusion

Haemoglobin not only distributes oxygen as it is required by the tissues but is also an important store of the gas. According to American Red Cross for each pint of blood lost, the human body takes 24 hours to regenerate plasma and four to six weeks to replace red blood cells [97-100]. Haemoglobin synthesized in the mitochondria and the cytosol of immature red blood cells, while the globin protein parts are synthesized by ribosomes in the cytosol.

Data are given as the mean ± SD of six experiments.

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