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Age and Sex Related Variations in Haemoglobin Level

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Abstract

Haemoglobin (Hb) is the functional protein in Red Blood Cells, which mainly involve in transportation of Oxygen from lungs to peripheral tissues. The objective of this study is to analyse the age and sex specific variations of haemoglobin level in a group of individuals. The study was conducted at Ceymed Healthcare Services laboratories, Nugegoda, where data from full blood count reports of 100 individuals were collected for 5 consecutive days. Among the 100 individuals, 51 were males and 49 were females. The analysed data showed that the average Hb level was 12.27 ± 2.05 g/dL (mean ± SD). It was lower in females; 11.73 ± 1.51 g/dL (mean ± SD) than in males; 12.79 ± 2.37 g/dL (mean ± SD). Most of the individuals in the sample we collected were males. Haemoglobin level of 45% of individuals were within the normal range while 54%, had low haemoglobin levels. Also 1% of high hemoglobin individuals were found. Most of the anaemic males belonged to the age group 60-70, whereas most female anemic patients belonged to the age group 30-39. Prevalence of anemia in the studied population was equal among both sexes. The new findings of this study showed the distribution of Hb levels relate to age and gender.

Keywords: Anemia; Haemoglobin; Red blood cells; Full Blood Count.

1. Introduction

Haemoglobin level in blood of normal subjects is highly variable and it is a complex trait determined by both hereditary and environmental factors. Haemoglobin is a respiratory pigment present in blood which are bound to red blood cells [2]. A principle function of haemoglobin in blood is the delivery of oxygen, present in inspired air, from the lungs to every cell in the body and delivery of carbon dioxide from cells to the lungs, for elimination from the body in expired air, thus maintaining homeostasis.

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These vital gas transport functions are dependent on the protein haemoglobin contained in erythrocytes. Each of the 5×10^{10} erythrocytes normally present in 1 mL of blood contains around 280 million haemoglobin molecules [5].

The haemoglobin (Hb) molecule is roughly spherical and comprises two pairs of dissimilar subunits. Each of the subunits is a folded polypeptide chain (the globin portion) with a heme group (derived from porphyrin) attached. At the center of each heme group is a single atom of iron in the ferrous (Fe^{2+}) state. Thus heme is a metallo-porphyrin, incidentally responsible for the red color of blood. The oxygen binding site of Hb is the heme pocket present in each of the four polypeptide chains; a single atom of oxygen forms a reversible bond with the ferrous iron at each of these sites, so a molecule of Hb binds with four oxygen molecules, the product is oxyhaemoglobin (O_2Hb). The oxygen delivery function of Hb that is its ability to pick up oxygen at the lungs and release it to tissue cells is made possible by minute conformational changes in quaternary structure that occur in the haemoglobin molecule and which alter the affinity of the heme pocket for oxygen. Hb has two quaternary structural states which is low oxygen affinity and the high oxygen affinity [5].

Normal healthy adults carry three types of haemoglobin in blood. The most abundant component is haemoglobin A which consists of molecular structure $\alpha_2\beta_2$. Haemoglobin F contains γ chains instead of β chains and haemoglobin A_2 carry δ globin chains instead of β chains. The genes responsible for globin chains are associated with chromosome 11 and 16 of the human genome. All the globin genes contain three coding regions known as exons and two non-coding regions which carry unexpressed DNA in the finished protein molecules. Any mutations or deletions associated with these DNA sequences can cause diseases or malfunctioning conditions [6].

This research will be carried out with the purpose of investigating the variability of haemoglobin level in females and males. Usually haemoglobin levels are determined as a component of Full Blood Count (FBC). We will categorize the blood reports according to age categories as 18-29, 30-39, 40-49, 50-59 and 60-70 years of age and according to the gender**.**

2. Materials & Methodology

This study was conducted by using complete blood count reports of 100 individuals from Ceymed Healthcare Services laboratories, Nugegoda, Sri Lanka after obtaining the written consent. The ethical clearance was from Ethics Review Committee, CINEC campus, Malabe, before the research was done. The collected blood reports were categorised into 5 age groups 18 to 29, 30 to 39, 40 to 49, 50 to 59 and 60 to 70 years respectively with respective to the reference range of males as 13.5-17.5 g/dL and females as 12.0 -15.5 g/ dL and Hb levels were recorded. The severity of anaemic individuals was considered as mild within the range of 11-12.9 g/dL in males and 11-11.9 g/dL in females, moderate within the range of 10-10.9 g/dL in both sexes, and severe within the range of <10.0 g/dL in both sexes as per the World Health Organization classification. Data were analysed using IBM SPSSS version 20.0.

3. Results

Among the 100 individuals, 51 were males and 49 were females. The analysed data showed that the average Hb level was 12.27 ± 2.05 g/dL (mean ± SD). It was lower in females; 11.73 ± 1.51 g/dL (mean ± SD) than in males; 12.79 ± 2.37 g/dL (mean ± SD). Most of the individuals were males.(Figure 1)

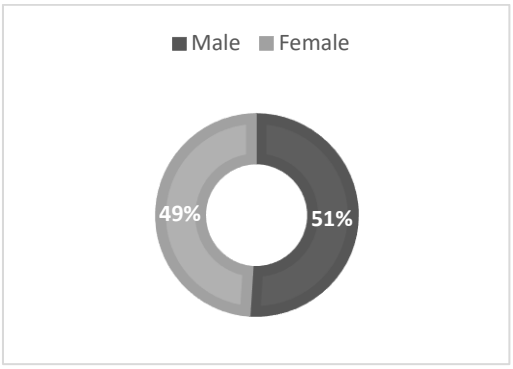

Figure 1: Gender categorization of 100 full blood count reports

According to the 5 age groups, 4 males, 15 females from 18-29, 7 males, 15 females from 30-39, 17 males, 11 females from 40-49, 11 males, 2 females from 50-59, and 12 males, 6 females from 60-70 age groups were found systematically. (Table1)

Table 1: Blood Reports Categorized According to Gender & Age Groups

Age Group	Male	Female
18-29	4	15
30-39	7	15
40-49	17	11
50-59	11	2
60-70	12	6

Haemoglobin level of 45% of individuals, where 24% males and 21% females were within the normal range while 54%, where 27% in both males and females had low haemoglobin levels, which is also known as anemia and 1% of only females had high haemoglobin levels. (Fig.2)

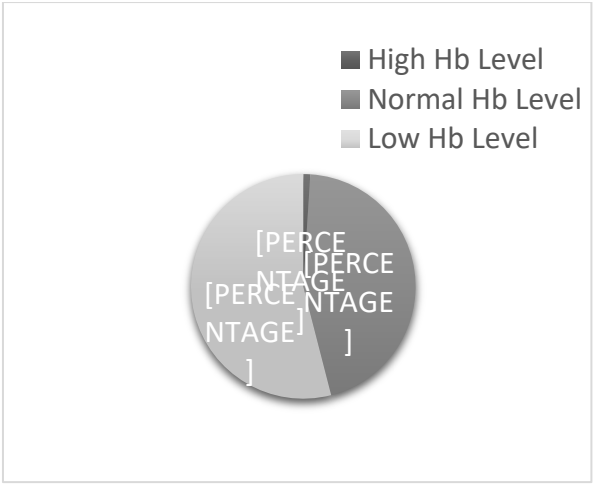

Figure 2: Hb level variation (%) in 100 blood reports

Most of the anaemic males were belonged to the age group 60-70, whereas most female anemic patients were belonged to the age group 30-39. (Figure3)

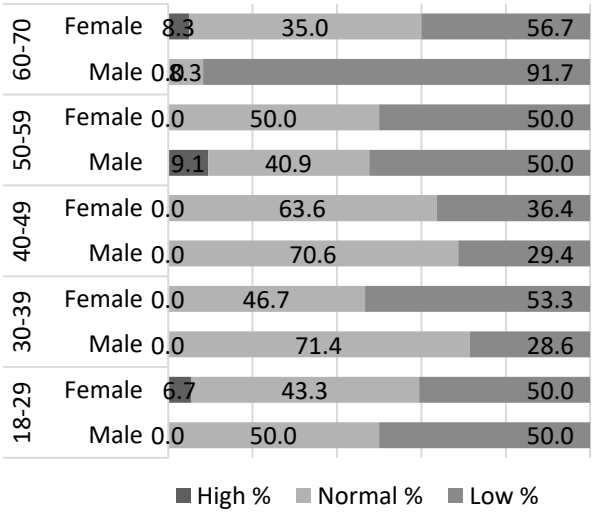

Figure 3: Hb level variation with respect to age and gender

Prevalence of anemia in the studied population was equal among both sexes. Prevalence of anemia was 27%. The prevalence rates of mild anemic patients were 41%, where 12% in males and 10% in females, moderate anemic patients were 41%, where 10% in males and 12% in females and severe anemic patients were 18%, where 5% in both males and females respectively. (Figure4)

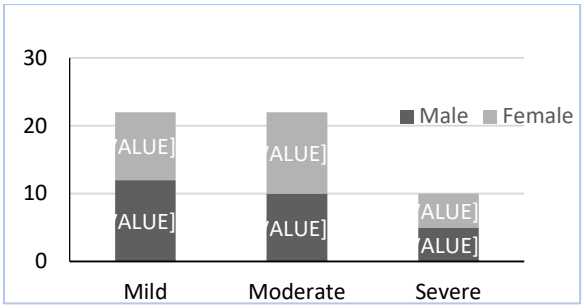

Figure 4: Anaemia classification (%) according to severity

Anaemic patients exhibited a decrease in Hb level with the age, where the lowest average Hb levels were recorded in the age group of 60-70 in both sexes, where average Hb level of female is 9.95 g/dL and 10.24 g/dL in case of males.

4. Discussion

Usually, haemoglobin levels increase gradually throughout the childhood and reach ~~almost~~ the adult levels by puberty. The usual haemoglobin count of a normal healthy adult may fluctuate depending on various factors such as age, gender, genetic factors, and other prevailing disease conditions [7]. Besides age and sex, acquired factors such as diet, smoking, body weight, hypoxia, and infections influence the Hb levels, whereas genetic determinants remain largely unknown. Haemoglobin or hematocrit tests are the main blood tests used to diagnose anemia. Mean cell haemoglobin and mean cell haemoglobin concentration are utilized as diagnostic tools and their abnormal variations indicate disease conditions. Also the haemoglobin levels may vary according to source of sample, sampling site, tourniquet used, body position, diurnal variation, dehydration, altitude etc. When carrying out comparative Haemoglobin testing for studies or evaluations, the samples should be taken under identical conditions [8]. Haemoglobin diseases are a group of blood disorders passed down mostly through families that have an abnormal production or structure of haemoglobin protein. There are over 600 haemoglobin diseases that have been medically defined by American College of Medical Genetics. Sickle cell anemia, sickle C disease, haemoglobin C disease and E disease are some of haemoglobin diseases. Inadequate haemoglobin production (Hypochromia), dimorphic red blood cell production (Anisochromasia) and high mean cell haemoglobin concentration (hyperchromasia) are some underlaying causes behind the diseases and abnormal functioning associated with haemoglobin ranges [2]. Sickle cell anemia is the most common haemoglobin disease that affect red blood cells. These diseases can be led to pain in hands, feet and joints, shortness of breath, dizziness, headache, enlargement of spleen and liver [3]. There is no cure exists for the inherited disorders of haemoglobin. Blood transfusion, iron chelation, immunization, splenectomy, bone marrow transplantation are generally applicable for inherited disorders of haemoglobin [9].

5. Conclusion

Our research findings showed the distribution of Hb levels relate to age and gender. Most of the individuals of the studied population was anemic. It concludes that the anemia condition prevails commonly among the studied population. Patients with high Hb level was less frequent. When anemic patients were classified according to

the severity as per the WHO organization, mild and moderate individuals showed an equal population. Most of the anaemic males were belonged to the age group 60-70, whereas most female anemic patients were belonged to the age group 30-39

6. Recommendation

This study can be further developed to analyze the different types of anemic conditions, which prevails among each age groups & gender.

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