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AGE-RELATED HAEMATOLOGICAL VARIATIONS IN RELATION TO SERUM ERYTHROPOIETIN LEVELS OF INDIVIDUALS IN ELELE, RIVERS STATE

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ABSTRACT

Age –Related Haematological Variations in relation to Serum Erythropoietin Levels of Individuals in Elele, Rivers State was carried out amongst children, adolescents and geriatrics at Madonna University Teaching Hospital Elele, Rivers State. A total of 116 Subjects were recruited for the study. It comprised 20 males and 16 females for children, 20 males and 20 females for adolescent's group, 20 males and 20 females for geriatrics. Erythropoietin level was determined using Enzyme Linked Immuno- Sorbent Assay (ELISA), packed cell volume, haemoglobin level; total white blood cell count, differential white blood cell count, platelet count and red blood cell count were determined using standard method. Results from children showed statistical increase in neutrophil and lymphocytes in male children while serum Erythropoietin and other haematological parameters were statistically insignificant (P>0.05).Children showed significant correlation of serum erythropoietin which was negative for packed cell volume and haemoglobin in children. On the adolescents category, serum erythropoietin increased statistically on the females while packed cell volume, haemoglobin level, total white blood cell counts showed statistical increase in males (P<0.05).Other haematological parameters on the adolescents were statistically insignificant. Correlation of serum erythropoietin with other haematological parameters in adolescents showed significant negative correlation with packed cell volume and haemoglobin level while it showed significant positive correlation with red blood cell count.Geriatrics result displayed that serum erythropoietin,platelet count and neutrophil had statistical increase in the female while packed cell volume, haemoglobin level and lymphocytes of geriatric males showed statistical increase(P<0.05). Correlation of serum erythropoietin with some haematological parameters of geriatrics showed significant negative correlation of serum erythropoietin with packed cell volume and haemoglobin while it was positive for total white blood cell count and neutrophils. In conclusion, serum erythropoietin increases as packed cell volume and Hb decreases in children, adolescents and geriatrics. Among other haematological parametres, packed cell volume and haemoglobin increases at a higher rate in adolescent stage than other stages of life (childhood and geriatric stage). Serum erythropoietin has negative correlation with packed cell volume and haemoglobin in children, adolescents and geriatrics while it has positive correlation with red blood cell in adolescents.

KEYWORDS: age-related haematological variations, erythropoietin, Elele.

INTRODUCTION

Erythropoietin also known as Epo is a glycoprotein hormone that controls erythropoiesis (Obeagu, 2015). It is a cytokine for erythrocyte precursors in the bone marrow. Human erythropoietin has a molecular weight of 30.4kDa (Obeagu, 2015). It is produced by interstitial fibroblasts in the kidney in close association with peritubular capillary and tubular epithelial tubule. It is also produced in the perisinusoidal cells in the liver (Sandra *et al*., 2007). While liver production of erythropoietin predominates in the fetal and perinatal period, renal production is predominant during adulthood. In addition to erythropoiesis, erythropoietin also has other known biological functions. For example, it plays an important role in the brain's response to neuronal injury (Siren *et al.,* 2001). Erythropoietin is also involved in the wound healing process (Haroon *et al*., 2003).

The primary role of erythropoietin is an essential hormone for red blood cell production. Without it, definitive erythropoiesis does not take place. Under hypoxic condition, the kidney will produce and secrete

erythropoietin to increase the production of red blood cells by targeting CFU-E, proerythroblast and basophilic erythroblast subsets in the differentiation. Erythropoietin has its primary effect on red blood cell progenitors and precursors by promoting their survival through protecting these cells from apoptosis (Jelkamann, 2007). Erythropoietin has a range of actions including vasoconstriction-dependent hypertension, stimulating angiogenesis and inducing proliferation of smooth muscle fibres. It can increase iron absorption by suppressing the hormone hepcidin (Ashby *et al.,* 2010).

Multiple studies have suggested that Erythropoietin improves memory. This effect is independent of its effect on haematocrit. Rather, it is associated with an increase in hippocampal response and effects on synaptic connectivity, neuronal plasticity and memory –related neural network. Erythropoietin may have effect on mood. Erythropoietin has been shown to exert its effects by binding to the erythropoietin receptor (EpoR) (Livnah *et al.,* 1998).

Erythropoietin is highly glycosylated (40% of total molecular weight), with half life in blood around five hours. Erythropoietin's half life may vary between endogenous and various recombinant versions. Additional glycosylation or other alterations of erythropoietin via recombinant technology have led to the increase of erythropoietin's stability in blood (thus requiring less frequent injections).Erythropoietin binds to the erythropoietin receptor on the red cell progenitor surface and activates a JAK2 signaling cascade. Erythropoietin receptor expression is found in a number of tissues, such as bone marrow and peripheral central nervous tissues. In the bloodstream, red cells themselves do not express erythropoietin receptor, so cannot respond to erythropoietin. However, indirect dependence of red cell longevity in the blood on plasma erythropoietin levels have been reported, a process called neocytolysis (Mocini *et al.,* 2007).

Erythropoietin levels in blood are quite low in absence of anaemia, around 10mU/ml. However, in hypoxic stress, erythropoietin production may increase 1000-fold, reaching 10,000mU/ml of blood (Jelkmann, 2004). Erythropoietin is produced mainly by peritubular capillary lining cells of the renal cortex, which are highly specialized, epithelial- like cells .It is synthesized by renal peritubular cells in adults, with a small amount being produced in the liver (Obeagu, 2015). It's regulation is believed to rely on a feedback mechanism measuring blood oxygenation (Jelkam *et al*.,2007).Constitutively, synthesized transcription factors for erythropoietin, known as hypoxia –inducible factors are hyroxylated and proteosomally digested in the presence of oxygen.

Children, adolescents and geriatrics exhibit profound haematological differences from one another because children mature at different rates, quantitative and qualitative differences are present as a reflection of the developmental changes during foetal haematopoiesis which correlate with gestational age (Esan, 2016).

A full blood count also known as complete blood test is a panel requested by a doctor or other medical professional that gives information about the cells in a patient blood.The cells that circulate in the blood streams are generaly divided into three types. Leuckocytes, erythrocytes and thrombocytes. Abnormally high or low counts may indicate the presence of many forms of disease,hence blood counts are amongst the most commonly performed blood test in medicine,as they can provide an overview of patient's general health status.(Mike, 2014).Red blood cells carry oxygen from the lung to the rest of the body. They also carry carbon dioixide back to the lungs so that it can be exhaled. If the red blood cell count is low, it points towards anaemia but if it is too high, polycythaemia is indicated (Brady, 2017).

Geriatrics are the elderly people in the society. The age group is associated with progressive decline in the functional reserve of multiple organs system, increasing the probability of dysfunction and diseases with changes in erythropoietin level. Haemopoiesis modulation becomes imbalanced with aging. Studies suggest a decline in the stem cell population reserve, imbalance in the haematopoietic cytokine production, decreased sensitivity of stem cells and precursor cells to the action of cytokine and alteration in the microenvironment (Okoroiwu *et al.,* 2015).

Anaemia, generally mild is a common problem in the elderly,especially in men.The incidence of anaemia increases with age. Untreated anaemia in geriatrics has been associated with high mortality, increasing the prevalence of comorbidity and functional impairment (William *et al.,* 2005).This age group has not been given adequate attention in developing countries. Most of them are sickly and not properly taken care of by immediate families due to economic situation in the country. Some of them from well to do home live in a very healthy life.
The aim of this study is to evaluate the relationship between serum erythropoietin level and some haematological parameters of children, adolescents and geriatrics in Elele, Rivers State, Nigeria.

MATERIALS AND METHODS

Study area

The Study was carried out at the Madonna University Teaching Hospital, Elele.

Advocacy, mobilization, survey contacts and pre survey contact

The study was approved by Madonna University Research and Ethical Committee before the study commenced. Oral consent was obtained from children, adolescents and geriatrics who were not literate.

Study Population and Enrollments
A total of 116 persons were recruited for the study: 20 male children.
16 Female children.
20 Male adolescents
20 Female adolescents
20 Geriatrics
20 Geriatrics.

Selection criteria
The United Nations Convention on the Rights of the Child defines a child as "a human being below the age of 18years unless under the law applicable to the child, majority is attained earlier"(UNCRC,2016).The same authority(United Nations) defined Adolescents as those between the ages of 10 and 19 while geriatrics are defined as a chronological age of 65 years old or older.(William *et al*.,2005). With above definitions, individuals below 18 were recruited as Children, those between 17 and 19 as Adolescents while 65years and above were selected as Geriatrics.

Sample Collection
About 5mls of venous blood was aseptically collected from each subject with the standard venipuncture technique after pretest counseling. About 3mls were dispensed into plain tube for Erythropoietin assay and the remaining 2mls was dispensed in an EDTA bottle for packed cell volume, Hb estimation, red blood cell count, total and differential counts. The blood samples for serum Erythropoietin were allowed to clot before centrifugation for 20 minutes at approximately 1000xg.

Laboratory Procedures
All reagents and kits were commercially purchased from reputable company. The Standard Operating Procedure of the manufacturer was strictly followed.
(a)Evaluation of Serum Erythropoietin Level (Sandwich Elisa Method)(Robin and Stevenson, 2005).

Method
1. 100µL of standard or sample were added to each well and incubated for I hour at 37℃.
2. 100µl of detection reagent were aspirated and added. It was incubated for I hour at 37°C.
3. It was aspirated and washed three times.
4. 100µl of detection Reagent B was added and incubated for 30 minutes at 37°C.
5. It was aspirated and washed 5times
6. 90µL substrate was added, incubated for 10-20 minutes at 37°C
7. 50µL stop solution was added. Absorbance was read at 450 nm immediately.

Packed Cell Volume (microhaematocrit method)(Scott *et al*.,2016).
Method
1. Blood samples were properly mixed and the capillary tubes filled with blood up to ¾ by capillary action.
2. One end of the tube was sealed with plasticine, a sealant.
3. The tube was spun at 1200g for five minutes using the haematocrit centrifuge.
4. The haematocrit *reader was used to read the packed cell volume in percentage.*

Haemoglobin Estimation
Method: Cyanmethaemoglobin (Himanshu *et al*., 2014).

Procedure
1. 20 µl (0.02ml) of well mixed venous blood was measured and dispensed into 4ml of Drabkins solution.
2. The tube was stoppered, mixed and left at room temperature, kept away from sunlight for 4-5minutes.
3. The wavelength was set at 540nm
4. The colorimeter was balanced at zero with drabkins fluid and the absorbance was read.
5. A chart was used to read the haemoglobin value.

Red Blood Cell Count
Method
1. 0.02ml of EDTA blood sample was added to 4ml of the diluent (formol citrate).It was well mixed.
2. By capillary action, a drop of the mixture was introduced into a counting chamber using pasture pipette and was left to stand for about 10 minutes.
3. The squares of the central value area was counted under x40 objective lens and calculated.

Total white blood cell count (TWBC)
Procedure
1. 0.38ml of Turks fluid was pipetted into khan tubes.
2. 0.02ml of blood was added to the Turks fluid, mixed and allowed to stand for about 5 minutes.
3. A clean cover slip was placed on the counting chamber until Newton rings appeared on the slide.
4. The chamber was charged with mixtures and the white cells allowed to settle for a while.
5. The white cells were counted with the 100mm objective and x10 eye piece in the four $1mm^2$ area.
6. The total white cell count was calculated as follows

$$TWBC = \frac{N\ X\ DF\ X\ 10^6}{DXA}$$

Where N is the number of cells calculated, DF is the dilution factors, D is the depth of the chamber, A is the area of the chamber, and 10^6 converts the number to 10^9 per liter.

Differential count
Procedure
1. A thin peripheral blood film was made on a clean grease free glass slide.
2. The film was allowed to air dry.

3. The slide was placed on a staining rack and the blood film was covered with
4. Buffer water of PH 6.8 was added (volume twice that of the stain) after 2 minutes and was allowed to stay for 8 minutes.
5. The stain was washed off with tap water after 8 minutes and was allowed to air dry
6. Immersion oil was added and using x100 objective to focus, the cells were counted.

Platelet Count Procedure

1. 20 µl(0.02ml) of well mixed anti coagulated venous blood was added to 380µl (0.38ml) of ammonium oxalate and mixed.
2. The counting chamber was assembled (as for total WBC count) and filled with
3. well mixed sample.
4. The chamber was left undisturbed for 20 minutes in a damp petri dish.
5. Using the xIO objective; the rulings of the grid were focused and the central square of the chamber was brought into view.
6. It was changed to 40x objective and platelets were focused. They were seen as small bright fragments (refractile).
7. Platelets were counted in small squares. Report the number of platelets as the actual number.

Statistical Analysis

The statistical package used was Statistical Package for the Social Science(SPSS) version 20.The data was analysed using t-test and Pearson correlation method while results were presented as mean values and standard deviation(SD) in tables.

RESULTS

Table 1: Mean and standard deviation of Serum Erythropoietin and some Haematological parameters in male and female Children.

Variables (Mean±SD)	Male Children (n=20)	Female Children(n=16)	t-value	p-value
EPO(mU/ml)	16.33±1.18	16.41±0.88	-.243	0.809
PCV(%)	33.10±1.78	32.43±1.67	1.150	0.259
Hb(g/dl)	10.89±0.77	10.71±0.63	0.753	0.456
TWBC($x10^9$/l)	6.39±1.03	6.30±0.65	0.295	0.770
Platelet($x10^9$/l)	185.50±68.23	162.75±89.02	0.843	0.406
RBC($x10^{12}$/l)	4.68±2.26	4.13±0.60	1.036	0.311
Monocytes(%)	4.15±0.74	3.62±1.45	1.312	0.203
Neutrophils(%)	44.50±7.26	49.68±4.19	-2.683	0.012
Lymphocytes(%)	47.10±1.18	42.50±5.05	2.180	0.036
Eosinophils(%)	3.75±1.16	4.50±2.16	-1.251	0.224

Table 1: Shows the mean and standard deviation of Serum Erythropoietin and some Haematological parameters in Male and Female Children. In this category, (PCV, Hb, RBC, TWBC, EPO) were not statistically significant while Neutrophil and Lymphocyte were significant. The mean of the Neutrophil count in Males was 44.50±7.26 (%) while that of the females was 49.68±4.19 (%), this indicates significant increase in the female (P<0.05). The Mean of Lymphocyte Count in male children was 47.10±7.55 (%), while in female it was 42.50±5.05 (%) (p. value<0.05).The mean of the Packed Cell Volume in Male Children was 33.10±1.77(%) while that of the female children was 32.43 ±1.67(%) (P>0.05) .In the haemoglobin level, the mean of the Male was 10.89±0.77g/dl while that of female was 10.71±0.63g/dl which showed an insignificant decrease(P>0.05). Total White blood cell count has an insignificant decrease in female with the Mean as $6.30\pm0.65x10^9$/L while that of Male was $6.39\pm1.03x10^9$/L. (P >0.05). There was also an insignificant increase in monocyte with mean as 3.62±1.45 (%) in female Children while in male it was 4.15±0.74 (%) (P>0.05). Eosinophil count in males had mean as 3.75±1.16 (%) while it was 4.50±2.16 (%) in females showing insignificant increase in females (P>0.05). The mean of Red blood cell count in male Children was $4.68\pm2.26x10^{12}$/L while that of Female was $4.13\pm0.60x10^{12}$/L. Erythropoietin level in male children has mean as 16.33±1.18mU/ml while that of female was 16.41±0.88mU/ml showing an insignificant decrease(P>0.05).

Table 2: Correlation of serum Erythropoietin with some Haematological parameters in Children (Male and Female).

Dependent variables	N	r-value	p-value
PCV	36	**-.**835*	**.**000
Hb	36	-.905*	.000
TWBC	36	0.328	0.50
Platelets	36	0.33	0.846
RBC	36	-.020	0.906
Monocytes	36	-.087	0.616
Neutrophils	36	0.320	0.057
Lymphocytes	36	-.256	0.132
Eosinophils	36	-.095	0.581

Table 2: Correlation of serum Erythropoietin with some Haematological parameters in children (Male and Female). Result showed significant negative correlation

in PCV and Hb whereby other Haematological parameters were not statistically significant.

Table 3: Mean and standard deviation of Serum Erythropoietin and Some Haematological parameters in Male and Female Adolescents.

Variables Mean±SD)	Male Adolescents (n=20)	Female Adolescents (n=20)	t-value	p-value
EPO(mU/ml)	11.50±1.47	12.79±0.58	-3.473	0.002
PCV(%)	47.20±4.59	41.40±2.39	5.047	0.000
Hb(g/dl)	15.75±1.52	13.80±0.80	5.052	0.000
TWBC($x10^9$/L)	6.0±2.33	4.89±0.60	2.149	0.043
Platelets($x10^9$/L)	146.45±52.27	140.80±19.11	0.454	0.654
RBC($x10^{12}$/L)	2.27±1.41	2.68±1.30	-.965	0.341
Monocytes(%)	4.05±1.35	4.10±1.55	-1.108	0.914
Neutrophil(%)	46.10±11.02	42.00±8.66	1.307	0.199
Lymphocytes(%)	43.85±11.58	47.25±7.39	-1.106	0.277
Eosinophils(%)	5.05±2.18	5.70±2.99	-1.784	0.438

Table 3: Shows the mean and standard deviation of Serum Erythropoietin and some Haematological parameters in male and female Adolescents. Here, EPO, PCV, Hb and TWBC were statistically significant, while RBC, PLT, LYMPH, NEUT, EOS and Monocytes were statistically insignificant. The mean of EPO in male was 11.55±1.47 while that of the female was 12.79±0.58(mU/ml) showing a significant increase in females.($P<0.05$).The mean of Packed Cell Volume in the male was 47.25±4.59 (%) while that of the female was 41.40±2.39 (%)($P<0.05$) this shows a significant increase in the male. The mean of the hemoglobin estimation in male was 15.75±1.52g/dl while that of the female was 13.80±0.80g/dl, here ($P<0.05$) which shows a significant increase in male. Total White Blood Cell in male was $6.0±2.33x10^9$/l while that of the female was $4.89±0.60$ $x10^9$/l showing a significant decrease in females ($P<0.05$).

Table 4: Correlation of Serum Erythropoietin with some Haematological parameters in Adolescents (Male and Female).

Dependent variable	N	r-value	p-value
PCV	40	-.876	.000
Hb	40	-.879	.000
TWBC	40	0.287	0.073
Platelet	40	0.242	0.133
RBC	40	0.477	0.002
Monocytes	40	0.043	0.792
Neutrophils	40	0.276	0.085
Lymphocytes	40	-.315	0.048
Eosinophils	40	0.315	0.048

Table 4: Correlation of serum Erythropoietin with some Haematological parameters in Adolescents (male and female). Result showed significant correlation in PCV, Hb and RBC. This means that at adolescent stage in both male and female EPO is dependent upon these parameters.

Table 5: Mean and standard deviation of Serum Erythropoietin and some Haematological Parameters in Male and Female Geriatrics.

Variables (Mean ±SD)	Male Geriatrics (n=20)	Female Geriatrics (n=20)	t-value	p-value
EPO(mU/ml)	14.35±0.66	14.74±0.42	-2.227	0.033
PCV(%)	37.00±1.62	36.05±0.99	2.230	0.033
Hb(g/dl)	12.35±0.55	12.01±0.32	2.383	0.024
TWBC(x109/l)	5.81±1.16	6.30±0.87	-1.500	0.143
Platelets(x109/l)	152.40±33.04	184.0±29.00	-3.224	0.003
RBC(x1012/l)	4.42±0.65	4.27±0.25	0.953	0.350
Monocytes	4.55±2.01	4.45±0.82	0.206	0.839
Neutrophils(%)	36.40±9.47	52.50±3.12	-7.220	0.000
Lymphocytes(%)	54.80±10.16	39.50±2.92	6.468	0.000
Eosinophils(%)	5.25±1.61	3.52±1.51	-2.227	0.033

Table 5: Mean and standard deviation of Serum Erythropoietin and some Haematological Parameters in Male and Female Geriatrics. Result showed that EPO,PCV, Hb, NEUT, LYMPH, EOSIN and PLT were statistically significant while other parameters were not. The mean of EPO in male was 14.35±0.66mU/ml while

that of the female was 14.74±0.42 (mU/ml)showing a statistical increase in female. (P<0.05). The mean of PCV in male was 37.0±1.62(%) while that of the female was 36.05±0.99.(%) (P<0.05).In the haemoglobin level, the mean for male was 12.35±0.55(g/dl) while that of the female was 12.01±0.32(g/dl).(P<0.05). Neutrophil mean in male was 36.40±9.47(%) while that of female was 52.50±3.12(%). (P<0.05).In the male group; the mean of the lymphocyte was 54.80±10.16 (%) while that of female was 39.50±2.92 (%).(P<0.05).Eosinophil mean in male was 5.25±1.61 while in female it was 3.52 ±1.51(%).(P<0.05).The mean of the platelet in male was 152.40±33.04 while that of the female was 184.0±29.00($X10^9$/l).(P<0.05).

Table 6: Correlation of Serum Erythropoietin to some Haematological Parameters in Geriatrics.

Table 6: Correlation of serum Erythropoietin with some Haematological Parameters in Male and Female Geriatrics. Result showed significant correlation in PCV, Hb, TWBC and Neutrophils in Geriatrics.

Dependent variables	N	r-value	p-value
PCV	40	-.987	.000
Hb	40	-.991	.000
TWBC	40	.343	.030
Platelet	40	-.049	.763
RBC	40	-.254	.114
Monocytes	40	.046	.776
Neutrophils	40	.348	.028
Lymphocytes	40	-.189	0.243
Eosinophils	40	-.198	.243

Table 7: Serum Erythropoietin and some Haematological Parameters in Children, Adolescents and Geriatrics.

Variables (Mean±SD)	Children (n-36)	Adolescents (n=40)	Geriatrics (n=40)	F- value	p- value
EPO	16.4±1.05	12.2±1.27	14.6±0.58	166.458	0.000
PCV	32.8±1.73	44.3±4.68	36.5±1.41	144.914	0.000
Hb	10.8±0.71	14.8±1.55	12.2±0.48	145.57	0.000
TWBC	6.4±0.88	5.5±1.78	6.1±1.05	4.525	0.013
Platelet	175 ± 77.82	143 ±38.95	168 ±34.6	3.825	0.025
RBC	4.4±1.74	2.5±1.36	4.3±0.50	28.936	0.000
Monocytes	3.9±1.13	4.1±1.44	4.5±1.52	1.842	0.163
Neutrophils	46.8±6.55	44.1±10.01	44.5±10.72	0.944	0.392
Lymphocytes	45.1±6.88	45.6±9.75	47.2±10.7	0.534	0.588
Eosinophils	4.1±1.70	5.4±2.61	4.4±1.77	4.016	0.021

Table 7: Serum Erythropoietin and some Haematological parameters in Children, Adolescents and Geriatrics. Results showed statististical significance in EPO, PCV, Hb, TWBC, PLT and Eosinophil. Other Haematological parameters were statistically not significant.

DISCUSSION

Looking at the laboratory results of the study, the statistical analyses of the results and comparing them with previous related studies conducted by other researchers, it was found that there were changes in some parameters and some of them were in line with the results of the previous related studies.

Studying Table 1 which shows the mean and standard deviation of serum Erythropoietin and some Haematological parameters in male and female children, it was seen that the mean Neutrophil count in female children was 49.68 with a standard deviation of 4.19, this implies a wide increase in the Neutrophil count. Due to sex differences, Neutrophil count tends to be higher in female than in male. Other causes of increased Neutrophil count are bacterial infection which poor sanitary condition of children can cause.

The mean Lymphocyte count in the female children was 42.50 with a standard deviation of 5.05 showing a reduction in the Lymphocyte count of the female children. This is a deviation from the normal striking difference in lymphocyte count between children and adults. Children are known for high Lymphocyte counts as was observed by (Genien *et al*., 2012).

The correlation analysis conducted for serum Erythropoietin with some Haematological parameters in male and female children showed a negative correlation of serum Erythropoietin with Packed Cell Volume and Haemoglobin concentration which were statistically significant(P<0.05) as seen in table 2.This means that as the Packed Cell Volume and Hb decreases, Serum Erythropoietin increases and vice versa. Decreased production of erythrocytes which reduces Packed Cell Volume and Haemoglobin in Children is associated with iron deficiency, although other factors such as bone marrow disorders, toxoplasmosis, rubella, cytomegalovirus and herpes virus can contribute. Congenital leukaemia and nutritional deficiencies are also inclusive. Immune haemolytic anaemia such as Rhesus disease and ABO incompatibility are responsible for cases of anaemia that reflects in reduced Packed Cell Volume and haemoglobin. Other factors like glucose -6-phosphate dehydrogenase deficiency, Red Blood Cell membrane defects, sepsis and haemoglobinopathies are among.

Erythropoietin level in adolescent females increased as shown in table 3 with mean as 12.79 and standard deviation of 0.58. The monthly blood loss in adolescent girls through menstruation accounts for this increase as Erythropoietin's regulation relies on feedback mechanism measuring blood oxygenation as was seen in the reduced haemoglobin level of the adolescent female. It was observed that there was a statistical increase in the adolescent's male haemoglobin and packed cell volume with mean as 47.20 and 15.75 respectively ($P<0.05$).The reason for this is that gender related differences in haemoglobin concentration begin to emerge in adolescence stage. In females, the haemoglobin level reaches a plateau during early puberty, while it continues to increase in males throughout puberty to higher levels characteristics of adult men due to the stimulatory effect of androgen secretion and also reflect in their packed cell volume. The observation of (James, 2000) also supported this.

The correlation of serum Erythropoietin with some haematological parameters in adolescents showed that Epo has negative correlation with Packed Cell Volume and Haemoglobin while it showed positive correlation with Red Blood Cell Count which were statistically significant as shown in Table 4.

A decreased Lymphocyte count was observed in female geriatrics with mean as 39.50 and standard deviation of 2.92 in addition to decreased Eosinophil count of 3.52 and standard deviation of 1.51 in Table 5. To support this is the fact that during ageing, there is a decreased respiratory burst response to soluble signal and defective phagocytosis caused by age related alteration in actin cytoskeleton and receptor expression in leukocytes. Differential mRNA and micoRNA expressions, increase in oxidative stress and changes in platelet receptors can account for the statistical increase in female geriatric platelet level with mean of 184.0.($P<0.05$).The World Health organization defines anaemia as a hemoglobin level of less than 13g/dl in adult males and less than 12g/dl in adult female. A reduction was observed in the female packed cell volume and haemoglobin. During ageing, modulation of haematopoiesis becomes disordered, impairing the ability of older people to respond appropriately to the demand for the blood cell replacement triggered by stimuli such as blood loss or cytoreductive chemotherapy.

The increase in serum Erythropoietin in geriatric females with mean as 14.74 with standard deviation of 0.42 was statistically significant as shown in Table 5. This is to compensate for subclinical blood loss or increased erythropoietin resistance of red blood cell precursors. The correlation of serum Erythropoietin and some haematological parameters in geriatrics in Table 6 showed negative statistically significance with Packed Cell Volume and Haemoglobin while it was positive for Total White Blood Cell and Neutrophil. On comparison of Mean of serum Erythropoietin and some haematological parameters in Children, Adolescents and Geriatrics using Anova in table 7, a statistical significant increase was observed in Serum Erythropoietin of Children with mean as 16.4 and a standard deviation of 1.05 while their Packed Cell Volume decreased. Explanation given on the negative correlation of Serum Erythropoietin with PCV and Hb still stand here. The platelet count of the children increased on comparison with that of Adolescents and Geriatrics. Infants tend to produce higher units as part of acute phase reaction more frequently. Eosinophils are known to increase in allergic and parasitic infections, the Adolescents may have underlying allergy or parasitic infection which caused the statistical increase in Eosinophil count with mean as 5.4 and standard deviation of 2.6.

CONCLUSION

Serum Erythropoietin increases as Packed Cell Volume and Hb decreases in Children, Adolescents and Geriatrics.

Among other Haematological parameters, Packed Cell Volume and Haemoglobin increases at a higher rate in Adolescent stage than in other stages of life (Childhood and Geriatric stage) because of androgenic stimulation.

Serum Erythropoietin has negative correlation with Packed Cell Volume and Haemoglobin in Children, Adolescents and Geriatrics while it is positive with Red Blood Cells in Adolescents. This means that Serum Erythropoietin increases in Adolescents as Red Blood Cell increases.

Based on the above, there is established relationship between Serum Erythropoietin and some Haematological Parametres.

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