Scientific Research Publishing

Open Journal of Blood Diseases, 2023, 13, 69-77
https://www.scirp.org/journal/ojbd
ISSN Online: 2164-3199
ISSN Print: 2164-3180

Some Haematological Parameters in Primary Hypertensive Subjects Attending a Tertiary Hospital in Nigeria

Eledo Benjamin Onyema[1,2*], Akanno Kelechi[1], Ajugwo Anslem[1], Onuoha Emmanuel Chinedu[3]

[1]Department of Medical Laboratory Science, Madonna University, Elele, Nigeria
[2]Department of Haematology and Blood Transfusion, Federal Medical Centre, Yenagoa, Nigeria
[3]Department of Medical Laboratory Science, Federal University, Otuoke, Nigeria
Email: *bewelldiagnosticsyen@gmail.com

How to cite this paper: Onyema, E.B., Kelechi, A., Anslem, A. and Chinedu, O.E. (2023) Some Haematological Parameters in Primary Hypertensive Subjects Attending a Tertiary Hospital in Nigeria. *Open Journal of Blood Diseases*, **13**, 69-77.
https://doi.org/10.4236/ojbd.2023.132009

Received: February 24, 2023
Accepted: June 3, 2023
Published: June 6, 2023

Abstract

Background: Hypertension is a persistent elevation of blood pressure in the arteries which if not properly managed can lead to stroke, heart failure, atrial fibrillation, peripheral vascular disease and other life threatening outcomes. This study investigated some haematological parameters of Primary hypertensive subjects. **Objectives:** To compare some haematological parameters (haematocrit, haemoglobin concentration, Platelets count, White Blood Cells count, red blood cell count and Red Cells Indices between hypertensive and normotensive subjects. **Materials and methods:** Blood samples were collected from 76 known hypertensive subjects between 30 - 70 years attending the Cardiology clinic of the University of Abuja Teaching Hospital Gwagwalada. Another 37 normotensive subjects between 30 - 65 years served as the control. All subjects gave their consents. Platelets count, Haemoglobin estimation, Packed Cell Volume, Red Blood Cell Count, Mean Cell Volume, Mean Cell Haemoglobin, Mean Cell Haemoglobin Concentration and White Blood Cell count were determined using Mythic 22 five parts haematology analyzer. **Results:** Results for Hypertensive and Control subjects were, White Blood Cell, 5.76 ± 1.45 × 10^9/l and 4.76 ± 1.03 × 10^9/l, Platelet count, 248.7552.45 × 10^9/l and 284.95 ± 27.66 × 10^9/l, Mean Cell Volume, 91.81 ± 3.05 fl and 85.68 ± 6.48 fl, Mean Cell Haemoglobin, 30.59 ± 1.04 pg and 27.922 ± 2.74 pg, Mean Cell Haemoglobin Concentration, 33.34 ± 0.61 g/dl and 32.32 ± 0.93 g/dl, Red Blood Cell, 4.33 ± 0.39 × 10^9/l and 4.50 ± 0.52 × 10^9/l, Packed Cell Volume, 39% ± 3.15% and 40% ± 4.41% and Haemoglobin, 13.21 ± 1.10 g/dl and 13.50 ± 1.63 g/dl respectively. Mean Cell Volume, Mean Cell Haemoglobin, Mean Cell Haemoglobin Concentration (Red cells indices) were significantly higher in hypertensive compared to normotensive subjects

($P < 0.05$), total White Blood Cell count was also higher in hypertensive than normotensive but not statistically significant ($P > 0.05$). However, Platelet counts, Red Blood Cell, Packed Cell Volume and Haemoglobin were significantly lower in hypertensive compared to normotensive ($P < 0.05$). All the parameters were within established reference ranges for the age and sex of the subjects. Our findings show that hypertension may lead to haematological derangement, if not properly managed. Conclusively, haematological parameters can be used to monitor the prognosis of the disease and manage hypertensive related complications. It is important to assess haematological parameters for hypertensive individuals which may help to prevent complications associated with haematological disorders.

Keywords

Hypertension, Haematological Parameters, Tertiary Hospital, Nigeria

1. Introduction

As of 2014, approximately one billion adults or 22% of the population of the world have hypertension. It is slightly more frequent in men, in those of low socioeconomic status, and it becomes more common with age. It is common in high, medium, and low income countries [1]. In 2004, rates of high blood pressure were highest in Africa, (30% for both sexes) and lowest in the Americas (18% for both sexes). Rates also vary markedly within regions with rates as low as 3.4% (men) and 6.8% (women) in rural India and as high as 68.9% (men) and 72.5% (women) in Poland [2] Rates in Africa were about 45% in 2016 [3].

Hypertension is a major global health problem and public health challenge, demanding a vast proportion of health care resources directly and indirectly because of its high and increasing prevalence and the concomitant risks of cardiovascular and kidney disease, disability, adjusted life years and mortality [2]. Various risk factors have been implicated in the development of hypertension, some of which include genetic, environmental, psychosocial and inflammatory factors [4].

It has been hypothesized that increased adherence of the stimulated leukocytes to the vascular endothelium, causes capillary leukocytosis and subsequent increased vascular resistance; a raised WBC count may therefore indicate increased catecholamine levels or enhanced sympathetic nervous system activity, thus causing an increase in blood pressure and eventually resulting in sustained hypertension [5]. Recent reports suggest that people with hypertension have lower MCVs than subjects with normal blood pressure [6]. Haematocrit is a determinant of whole blood viscosity. Viscosity affects peripheral resistance to blood flow, and peripheral resistance affects blood pressure [7]. Most hypertensive patients exhibit increased blood viscosity compared with healthy controls [8]. There are indications that systolic blood pressure (SBP) and diastolic blood

pressure (DBP) may increase with increasing haemoglobin (Hb) levels [9]. In previous research among haemodialysis patients, the administration of erythropoietin, an erythropoiesis-stimulating protein used for the treatment of anaemia, was related to an elevated blood pressure [10]. Formation of platelet plug (primary haemostasis) is associated with activation of the coagulation cascade with resultant fibrin deposition and linking. Normal platelets can respond to an abnormality on the vessel wall rather than to haemorrhage, resulting in inappropriate platelet adhesion/activation and thrombosis; the formation of a clot within an intact vessel which can lead to hypertension (secondary haemostasis) [11].

The study is therefore aimed to evaluate some haematological parameters in primary hypertensive subjects attending a tertiary hospital in Nigeria.

2. Materials and Methods

2.1. Study Population

This research population were drawn from a group of subjects with primary hypertensive cases who have been on medications for 6 - 12 months period in University of Abuja Teaching Hospital, Nigeria's Federal Capital Territory. The subjects were between 18 - 65 years of age.

2.2. Sample Size

A cross section of one hundred and thirteen (113) patients was assessed randomly for the presence of Hypertension.

The presence of Hypertension was evaluated using stethoscope and sphygmomanometer cuff.

Sample size was determined using the Leslie Kish formula (Kish, 1965).

$$n = Z^2 pq/d^2$$

where = n = sample size minimum

Z = 95% confidence interval = 1.96

p = proportion of the target population (8%) = 0.08

$q = 1.0 - p = 0.92$

d = degree of accuracy (95% interval) = 0.05%

$$\begin{aligned} n &= 1.96^2 \times 0.08 \times 0.92/0.05^2 \\ &= 3.8416 \times 0.08 \times 0.92/0.0025 \\ &= 0.28274176/0.0025 \\ n &= 113 \end{aligned}$$

2.3. Inclusion Criteria for Subjects

Samples were collected from Individuals with Hypertension attending Cardiology Clinic at the University of Abuja Teaching Hospital (UATH) Gwagwalada Abuja that willingly gave their consent.

The presence of the history of primary hypertension and elevated blood pressure is of ≥140/90 mmHg.

Not having any underlying causes and having no history of administration of anticoagulant therapy.

No history of chronic viral infection or liver diseases (HBV, HCV and HIV).

2.4. Exclusion Criteria for Subjects

Normotensive individuals who refused consent and also those without any Family history of Hypertension. Known cases of clotting and bleeding disorders, pregnant subjects and those suffering from hepatitis B and C, Tuberculosis, diabetes and HIV were excluded from the study.

2.5. Ethical Clearance

Ethical approval was obtained from University of Abuja Teaching Hospital (UATH) Ethical committee with approval number of UATH/HREC/PR/2019/023.

2.6. Research Protocol

Using aseptic precaution, 5 mls of blood were collected from each subject and dispensed into K_3EDTA bottle for complete blood count. The samples were analyzed within six hours using MYTHIC22 five parts haematology analyzer (by PZ CORMAY).

2.7. Statistical Analysis

The data obtained were analyzed using SPSS software version 16. Comparisons of different means were done using independent students T-test and one-way analysis of variance (ANOVA).

3. Results

Table 1 was the comparison of some haematological parameters between hypertensive and normotensive subjects. Mean Cell Volume, Mean Cell Haemoglobin, Mean Cell Haemoglobin Concentration (Red cells indices) were significantly higher in hypertensive compared to normotensive ($P < 0.05$). Total White Blood Cell count was also higher in hypertensive than normotensive but not statistically significant ($P > 0.05$). However, Platelet counts, Red Blood Cell, Packed Cell Volume and Haemoglobin concentrationwere significantly lower in hypertensive subjects when compared with normotensive subjects ($P < 0.05$).

Table 2 was the Comparison of some haematological parameters in hypertensive and normotensive subjects in different gender. The platelets count, total white cell count, mean cell volume, mean cell haemoglobin concentration were significantly lower among male hypertensive subjects when compared with the females, while the mean cell haemoglobin, red blood cell count, packed cell volume and haemoglobin concentration were significantly higher ($P < 0.001$).

Table 3 was the comparison of some haematological parameters in hypertensive subjects in different age groups. When the haematological parameters were compared among the different age groups, they showed no significant difference ($P > 0.05$).

Table 1. Comparison of some haematological parameters between hypertensive and normotensive subjects.

Parameter	Control	Hypertensive	T	P
PLT	284.95 ± 27.66	248.75 ± 52.45	4.79	0.002
WBC	4.76 ± 1.04	5.76 ± 1.45	4.18	0.399
MCV	85.68 ± 6.48	91.81 ± 3.04	5.46	0.000
MCH	27.92 ± 2.74	30.59 ± 1.04	5.76	0.000
MCHC	32.32 ± 0.93	33.34 ± 0.61	6.11	0.009
RBC	4.51 ± 0.53	4.33 ± 0.0.39	1.83	0.040
PCV	40.58 ± 4.41	39.63 ± 3.16	1.17	0.041
HB	13.50 ± 1.63	13.21 ± 1.10	0.97	0.007

Table 2. Comparison of some haematological parameters between hypertensive and normotensive subjects in different gender.

Parameter	Male Control	Female Control	Male Hypertensive	Female Hypertensive	F	P
PLT	285.03 ± 24.53	283.50 ± 84.15	235.52 ± 59.17	253.32 ± 50.4	6.13	0.001
WBC	4.71 ± 1.04	5.65 ± 0.49	5.66 ± 1.45	5.82 ± 1.51	4.91	0.003
MCV	85.57 ± 6.65	87.45 ± 1.06	91.56 ± 3.42	91.92 ± 2.94	15.42	0.000
MCH	27.82 ± 2.79	29.55 ± 0.92	30.48 ± 0.96	29.71 ± 2.1	19.22	0.000
MCHC	32.31 ± −0.95	32.40 ± 0.42	33.28 ± 0.67	33.36 ± 0.59	15.86	0.000
RBC	4.49 ± 0.522	4.80 ± 0.57	4.64 ± 0.30	4.16 ± 0.32	10.57	0.000
PCV	40.50 ± 4.47	42.00 ± 4.24	42.44 ± 2.02	38.16 ± 2.56	10.95	0.000
HB	13.47 ± 1.65	14.10 ± 1.41	14.13 ± 0.75	12.73 ± 0.92	8.67	0.000

Table 3. Comparison of some haematological parameters in hypertensive subjects in different age groups.

Parameter	31 - 40 years	41 - 50 years	51 - 60 years	61 years above	F	P
PLT	256.79 ± 54.27	245.56 ± 66.63	241.14 ± 51.54	253.58 ± 32.98	0.38	0.77
WBC	5.96 ± 1.24	5.96 ± 1.91	5.48 ± 1.00	5.36 ± 1.61	0.88	0.46
MCV	92.65 ± 2.87	91.50 ± 2.75	91.75 ± 3.04	92.40 ± 2.82	0.66	0.58
MCH	31.04 ± 0.92	30.53 ± 0.89	30.45 ± 1.11	30.72 ± 0.94	1.39	0.25
MCHC	33.53 ± 0.55	33.36 ± 0.61	33.24 ± 0.63	33.24 ± 0.65	1.00	0.39
RBC	4.27 ± 0.33	4.29 ± 0.35	4.38 ± 0.37	4.23 ± 0.45	0.38	0.77
PCV	39.53 ± 2.74	39.19 ± 2.81	40.04 ± 3.14	39.37 ± 3.97	0.26	0.85
HB	13.4 ± 0.91	13.08 ± 1.06	13.31 ± 1.10	13.09 ± 1.36	0.20	0.089

4. Discussion

Platelets and WBCs are essential parameters used in assessing thrombosis. The haematological indices reflect oxidative stress and inflammatory state that post-

ulate as major mechanisms of hypertension and its vascular complication. In this study, the Mean Cell Volume, Mean Cell Haemoglobin, Mean Cell Haemoglobin Concentration (Red cells indices) were significantly higher in hypertensive compared to normotensive, total white blood cell count was also higher in hypertensive than normotensive but not statistically significant. However, Platelet counts, Red Blood Cell, Packed Cell Volume and Haemoglobin were significantly lower in hypertensive compared to normotensive. The same pattern was observed in comparison of haematological parameters in hypertensive and normotensive subjects in different gender however, there was no significant difference among different age groups.

The elevated total White Blood Cell count in hypertensive patient may be as a result of abnormal function of vascular system in those patients that may cause activation of cytokine system to renew the endothelial injury; involve in differentiation and proliferation of hematopoietic cell [12]. An increase in blood pressure occurs when activated and differentiated total white blood cell counts release additional cytokines thereby raising attachment of the stimulated leukocytes to the vascular endothelium; resulting to capillary leukocytosis and subsequent elevated vascular resistance [13].

In this study the mean value for haemoglobin concentrations, Red Blood Cell and Packed Cell Volume were shown to be lower among hypertensive compared to normotensive subjects ($P > 0.05$). This could be attributed to the release of haemolysis, haemoglobin and arginase enzyme to circulation from erythrocytes. This free haemoglobin is a remover of nitric oxide that is produced in the endothelial cell that lines the blood vessels, which is important for relaxation of blood vessels while arginase enzyme reduces the substrate used for nitric oxide synthesis by conversion of arginine to ornithine, thereby reducing nitric oxide production [14].

This is in agreement with previous studies where hypertension is a complication of haemolysis and associated with haemolytic anaemia [15].

Our finding is also consistent with a previous report which indicated that haematological disorder was reported which may be a powerful signal of hypertensive end-organ damage, particularly kidney failure [16] [17] [18]. Precisely, low Haemoglobin levels causes anaemia and heart failure [19].

In this study, Platelet counts were significantly lower in hypertensive compared to normotensive. This could be as result of endothelial dysfunction that leads to platelet activation and clot formation. This is in agreement with previous work where during hypertension, there is endothelial dysfunction which leads to platelet activation and clot formation causing platelets to be consumed, thereby reducing the platelet count [20].

Furthermore, this study showed that Mean Cell Volume, Mean Cell Haemoglobin, Mean Cell Haemoglobin Concentration (Red cells indices) were significantly higher in hypertensive compared to normotensive subjects. The trend is comparable to the findings of Bamlaku *et al.* (2017) on a comparative cross-sectional study of some haematological parameters of hypertensive and normo-

tensive individuals at the university of Gondar hospital, Northwest Ethiopia [21].

5. Conclusion

Our findings show that hypertension may be associated with haematological derangement if not properly managed. Therefore, haematological parameters can be used to monitor the prognosis of the disease and manage hypertensive related complications. It is important to assess haematological parameters for hypertensive individuals which may help to prevent complications associated with haematological disorders. Anaemia is associated with higher cardiovascular risk, higher blood pressure values, and lower dipping status in hypertensive patients, and haemoglobin concentration should be monitored in hypertensive patients

Recommendations

Based on these findings, it is recommended that a drastic awareness/education on the dangers and need to check blood pressure more frequently be made. Also, red cell indices such as PCV, HB, MCV, MCH and MCHC are made routine tests during evaluation of hypertensive subjects.

Contribution to Knowledge

This research contributes to knowledge by exposing the frontiers of researchers to the knowledge that some haematological parameters (red cell indices) such as MCV, MCH and MCHC play significant roles in hypertension management.

Conflicts of Interest

Authors have declared that no competing interests exist.

References

[1] Carretero, O.A. and Oparil, S. (2000) Essential Hypertension. Part I: Definition and Etiology. *Circulation*, **101**, 329-335. https://doi.org/10.1161/01.CIR.101.3.329

[2] Kearney, P.M., Whelton, M., Reynolds, K., Muntner, P., Whelton, P.K. and He, J. (2005) Global Burden of Hypertension: Analysis of Worldwide Data. *The Lancet*, **365**, 217-223. https://doi.org/10.1016/S0140-6736(05)17741-1

[3] Damilola, O. (2018) Hypertension Affects about One Third of Nigerians. To What Social Stratum Patients belong Makes a Difference in How They Handle Their Condition. Last Contributed to D+C/E+Z in Spring of 2018 as Senior Correspondent at THISDAY Newspaper in Abuja, Nigeria.

[4] Boos, C.J. and Lip, G.Y. (2005) Elevated High-Sensitive C-Reactive Protein, Large Arterial Stiffness and Atherosclerosis: A Relationship between Inflammation and Hypertension? *Journal of Human Hypertension*, **19**, 511-513. https://doi.org/10.1038/sj.jhh.1001858

[5] Shankar, A., Barbara, E.K. and Klein, R. (2004) Relationship between White Blood Cell Count and Incident Hypertension. *American Journal of Hypertension*, **17**, 233-239. https://doi.org/10.1016/j.amjhyper.2003.11.005

[6] Bao, W., Dalferes, E.R., Srinivasan, S.R., Webber, L.S. and Berenson, G.S. (1993) Normative Distribution of Complete Blood Count from Early Childhood through Adolescence: The Bogalusa Heart Study. *Preventive Medicine*, **22**, 825-837. https://doi.org/10.1006/pmed.1993.1075

[7] Rampling, M.W. (1999) Haemorheological Disturbances in Hypertension: The Influence of Diabetes and Smoking. *Clinical Hemorheology and Microcirculation*, **21**, 183-187.

[8] Sandhagen, B. (1999) Red Cell Fluidity in Hypertension. *Clinical Hemorheology Microcirculation*, **21**, 179-181.

[9] Kawamoto, R., Tabara, Y., Kohara, K., Miki, T., Kusunoki, T., Katoh, T., Ohtsuka, N., Takayama, S. and Abe, M. (2012) A Slightly Low Hemoglobin Level Is Beneficially Associated with Arterial Stiffness in Japanese Community-Dwelling Women. *Clinical and Experimental Hypertension*, **34**, 92-98. https://doi.org/10.3109/10641963.2011.618202

[10] Kanbay, M., Akcay, A., Delibasi, T., Uz, B., Kaya, A. and Koca, C. (2007) Comparison of Effects of Darbepoetin Alfa and Epoetin Alfa on Serum Endothelin Level and Blood Pressure. *Advances in Therapy*, ***24***, 346-352. https://doi.org/10.1007/BF02849903

[11] Berridge, M.J. (2014) Module 11: Cell Stress, Inflammatory Responses and Cell Death. *Cell Signaling Biology*, **14**, 261-289. https://doi.org/10.1042/csb0001011

[12] Brown, D., Giles, W.H. and Croft, J.B. (2001) White Blood Cell Count: An Independent Predictor of Coronary Heart Disease Mortality among a National Cohort. *Journal of Clinical Epidemiology*, **54**, 316-322. https://doi.org/10.1016/S0895-4356(00)00296-1

[13] Kim, D.J., Noh, J.H., Lee, B.W., Choi, Y.H., Chung, J.H. and Min, Y.K. (2008) The Associations of Total and Differential White Blood Cell Counts with Obesity, Hypertension, Dyslipidemia and Glucose Intolerance in a Korean Population. *Journal of Korean Medical Science*, **23**, 193-198. https://doi.org/10.3346/jkms.2008.23.2.193

[14] Babu, K.R., Kumar, N.L.G., Solepure, A.B. and Shaikh, R. (2015) Comparison of Haematological Parameters in Primary Hypertensives and Normotensives of Sangareddy. *International Journal of Biomedical Research*, **6**, 309-315. https://doi.org/10.7439/ijbr.v6i5.1994

[15] Jadeja, U., Jadeja, J. and Naik, S. (2011) Comparative Study of Haemoglobin Concentration in Hypertensive and Normotensive Subjects. *Indian Journal of Applied Basic Medical Sciences*, **13**, 7.

[16] Reis, R.S., Bensenor, I.J. and Lotufo, P.A. (1999) Laboratory Assessment of the Hypertensive Individual. Value of the Main Guidelines for High Blood Pressure. *Arquivos Brasileiros de Cardiologia*, **73**, 201-210. https://doi.org/10.1590/S0066-782X1999000800008

[17] Smebye, M.L., Iversen, E.K., Høieggen, A., Flaa, A., Os, I. and Kjeldsen, S.E. (2007) Effect of Hemoglobin Levels on Cardiovascular Outcomes in Patients with Isolated Systolic Hypertension and Left Ventricular Hypertrophy (from the LIFE Study). *American Journal of Cardiology*, **100**, 855-859. https://doi.org/10.1016/j.amjcard.2007.03.109

[18] Karabulut, A. and Karadag, A. (2015) Clinical Implication of Hematological Indices in the Essential Hypertension. *World Journal of Hypertension*, **5**, 93-97. https://doi.org/10.5494/wjh.v5.i2.93

[19] Schillaci, G., Pirro, M., Pucci, G., Ronti, T., Vaudo, G., Mannarino, M.R., Porcellati, C. and Mannarino, E. (2018) Prognostic Value of Elevated White Blood Cell Count

in Hypertension. *American Journal of Hypertension*, **20**, 364-369.
https://doi.org/10.1016/j.amjhyper.2006.10.007

[20] Inanc, T., Kaya, M.G., Yarlioglues, M., Ardic, I., Ozdogru, I. and Dogan, A. (2010) The Mean Platelet Volume in Patients with Non-Dipper Hypertension Compared to Dippers and Normotensives. *Blood Pressure*, **19**, 81-85.
https://doi.org/10.3109/08037050903516284

[21] Bamlaku, E., Nigist, A., Betelihem, T., Fikir, A. and Mulugeta, M. (2017) A Comparative Cross-Sectional Study of Some Hematological Parameters of Hypertensive and Normotensive Individuals at the University of Gondar Hospital, Northwest Ethiopia. *Boston Medical Center Hematology*, **17**, 93-99.
https://doi.org/10.1186/s12878-017-0093-9