Haematological Parameters of Acute Stroke Patients Managed at a Tertiary Hospital in Abakaliki Nigeria: A Case-Control Study

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ABSTRACT

Background: Changes in the haematological indices could have implications for stroke risk, management plan and outcome. There is limited data on the pattern of haematological parameters of acute stroke patients in Nigeria despite its impact on stroke risk, management and outcome. **Objectives:** To determine the pattern and the prognostic implications of the haematological parameters in acute stroke patients managed over a nine-year period at a Tertiary Hospital in Abakaliki Nigeria. **Methodology:** This was a retrospective hospital-based case-control study of the haematological parameters of acute stroke patients seen over a nine-year period at a tertiary hospital in Abakaliki Nigeria. **Results:** The mean total white blood cell count and percentage neutrophil in the case group were significantly higher than the control group while the mean packed cell volume did not show any significant difference. Further analysis of the case group revealed that the mean packed cell volume was significantly lower among female patients, the elderly age group, those with low education attainment, impaired renal status, short admission duration, haemorrhagic stroke and admitting hypertension. **Conclusions:** Elevated total white blood cell count and differential neutrophilia were significantly associated with acute stroke. Changes in haematological parameters have implications for stroke risk and outcome.

Keywords: Acute stroke, Case-control study, Neutrophils, Packed cell volume, White blood cells

INTRODUCTION

Stroke is an acute focal injury of the central nervous system (CNS) of vascular origin and includes cerebral infarction, intracerebral haemorrhage (ICH), and subarachnoid haemorrhage (SAH) .[1] It is a neurological emergency, and it is highly prevalent, especially in developing countries, and in resource-poor settings.[2] Globally, it is the second most common cause of mortality after ischemic heart disease, and it is expected to remain so till 2030. [3,4] It has a global prevalence of 1,300.6 per 100,000 in

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Article Metrics

***Submitted:** 23 Sept. 2023*
***Accepted:** 27 Oct 2023*
***Published:** July-Dec 2024*

Journal Metrics

***p- ISSN:** 1115-0521*
***e-ISSN:** 3027-2890*
***Website:** www.orientjom.org.ng*
***E-mail:** editorojm@gmail.com*

Publisher

cPrint, Nig. Ltd
E-mail:
cprintpublisher@gmail.com

How to cite this article

Eze O. C, Afolabi F. O, Nnachi C. O. Haematological Parameters of Acute Stroke Patients Managed at a Tertiary Hospital in Abakaliki Nigeria: A Case-Control Study. Orient J Med, 2024;36(3-4):69-82. DOI:10.5281/zenodo.13902886

Access to the article

Website: *http://www.orientjom.org.ng*
: DOI: 10.5281/zenodo.13902886

2017. [5]

Ischemic stroke occurs when a cerebral blood vessel is occluded by either a thrombus or an embolus leading to a focal brain ischemic necrosis. Conversely, haemorrhagic stroke occurs when a cerebral blood vessel ruptures due to severe hypertension, bleeding diathesis, or defects in vascular wall integrity, leading to hematoma formation within the brain parenchyma, subarachnoid space, or ventricles. The overall pathogenesis of stroke involves the disruption of blood flow within the cerebral blood vessels.

Changes in the haematological indices could influence the stroke risk, type, management plan and outcome. Extremes of haemoglobin concentrations have been reported to be associated with a higher risk of incident stroke and increased overall stroke mortality.[6,7,8,9] Polycythaemia which results in increased blood viscosity is a risk factor for ischaemic stroke.[10] On the other hand, severe anaemia has been reported to be a risk factor for both haemorrhagic and ischaemic stroke.[11,12]

Higher admitting white blood cell count has also been reported to be associated with unfavourable outcomes of both ischaemic and haemorrhagic stroke.[13,14,15] Several studies have also concluded that lower platelet count can lead to more severe strokes and worsen the prognosis of ischemic stroke.[16] Thrombocytopenia can be a risk factor in an ischemic stroke, a risk factor for haemorrhagic stroke, and a risk factor for haemorrhagic stroke conversion.[17] Thrombocytosis is a risk factor for ischemic stroke.[18] There is limited data on the pattern of haematological indices of acute stroke patients in Nigeria despite its impact on stroke risk, management plan and outcome. There has not been any such study at Abakaliki Nigeria. Against this backdrop, we embarked on this study of the pattern and the prognostic implications of the haematological parameters in acute stroke patients managed over a nine-year period at Trinity Group of Specialist Hospital Abakaliki Nigeria.

METODOLOGY

***Study Design*:** This was a Retrospective and observational case-controlled Hospital-based study of the pattern and the prognostic implications of Haematological parameters of Acute stroke patients managed at Trinity Specialist Hospital Abakaliki from January 2014 to December 2022.

Study Setting and Population: This study was conducted at the Trinity Group of Specialist Hospital, a tertiary Hospital situated in Abakaliki South-Eastern Nigeria. Abakaliki is the capital city of Ebonyi State in South-Eastern Nigeria, situated 64 kilometres southeast of Enugu with a population of 198,100 in 2016 according to the Nigerian National Population Census. The predominant ethnic group is Igbo and most of them are farmers. The Hospital is administered by a group of medical specialists in different specialties of Medicine ranging from Internal Medicine, Surgery, Paediatrics, and Obstetrics with resident medical officers and well-qualified nurses that cover 24-hour clinical service every day. There is the availability of 24-hour outpatient, and inpatient clinical services with basic life support facilities like supplemental oxygen, and continuous cardiac monitoring. There is also the availability of bedside blood glucose assay, serum electrolytes assay, complete blood count, and oxygen saturation measurement. There are 2 consulting rooms and twenty (20) adjustable beds for admissions. The medical officers admit the inpatients and inform the corresponding medical Specialist who in turn promptly reviews the patient and continues management until the patient is due for discharge.

The case group was the acute stroke patients managed in the hospital over the study period of nine years while the controls were the age and sex-matched patients seen over the same period at the hospital for stroke risk factors like hypertension, diabetes mellitus or heart failure but did not have stroke.

The case notes of all the consecutive acute stroke

patients of both sexes that were ≥ 18 years whose diagnosis was confirmed with neuroimaging that were managed at the hospital from January 2014 to December 2022 (9 years) were retrieved and relevant data extracted and analyzed. The data extracted included the socio-demographic characteristics, selected stroke risk factors (hypertension, diabetes mellitus, and heart failure), duration from stroke onset to presentation, length of admission, discharge modified Rankin score, stroke outcome, complete blood count, admitting blood glucose assay, serum sodium, serum creatinine, serum lipid profile and month of admission.

The case notes of the control subjects were also retrieved, and relevant data were extracted and analyzed. The data extracted included the socio-demographic characteristics, selected cardiovascular risk factors, and the complete blood count results.

The sample population was grouped into the case group and the control group. The socio-demographic characteristics and the selected cardiovascular risk factors of both groups were compared and matched. The means of the packed cell volume (PCV), the total white blood cell (WBC) count, and the neutrophil count percentage of the two groups were also compared.

The case subjects were then classified into two groups based on age, sex, education attainment, admission duration, stroke type, renal status, admitting blood pressure, admitting blood glucose, stroke outcome, and discharge modified Rankin score, and their mean PCV, WBC count, and neutrophil percentage compared. Student t-test was used to test for the significance of the comparison of the means of the haematological parameters among the groups.

Variables: The dependent variables included the haematological parameters (PCV, WBC count, Neutrophil percentage) while the independent variables included the demographic characteristics (age, sex, educational attainment), selected stroke risk factors (Hypertension, diabetes mellitus, heart failure), admission duration, stroke type, renal status, admitting blood pressure, admitting blood glucose, stroke outcome and discharge modified Rankin score**.**

Data resource and measurement

Data Collection Tool: A pretested and structured proforma was used to extract relevant information from the case notes of all the cases and the controls.

Data Collection: The data for the study were extracted from the case notes of the case subjects,and the control subjects using a pretested and structured proforma. The data collected included the demographic characteristics (age, sex, education attainment), selected stroke risk factors (hypertension, diabetes mellitus, heart failure), type of stroke based on neuroimaging, admitting blood glucose assay, admitting blood pressure, serum creatinine, admission duration, stroke outcome, modified Rankin score on discharge and complete blood count parameters.

Diabetes mellitus was defined as Random blood glucose of ≥ 200mg/dl and symptoms of hyperglycemia like polyuria and polydipsia or current use of antidiabetic medications.[19] Hypertension was defined as Systolic blood pressure (SBP) of ≥ 140mmHg and/or Diastolic blood pressure (DBP) of≥ 90mmHg or current use of antihypertensive medications.[20] Heart failure was defined using Framingham criteria as the presence of 2 major or 1 major and 2 minor criteria concurrently.[21] Education attainment was classified as low (≤ 12 years of formal education) and high (> 12 years of formal education) attainment based on the duration of formal education.[22] The age was classified into the working-class age group (18- 64 years) and the elderly age group (≥ 65 years).[23] The renal status was classified into normal (estimated glomerular filtration rate (eGFR) is ≥ 60ml/minute) and impaired (eGFR < 60ml/minute) by modification of diet in renal disease (MDRD) calculator.[24] The modified Rankin score was used to classify the case group into good recovery

(mRS 0- 2) and poor recovery (mRS 3-5).[25] Admission duration was classified into short (< 7 days) and long (≥7 days) duration.[26] Admitting blood glucose was grouped into normal (< 140mg/dl) and impaired (≥ 140mg/dl).[27] Admitting blood pressure was grouped into normal (SBP < 140mmHg and/ or DBP < 90mmHg) and impaired (SBP ≥ 140mmHg and/or DBP ≥ 90mmHg).[20] Stroke outcome was classified into stroke survivors and deceased group. The qualitative variables were expressed as proportions and percentages while the quantitative variables were expressed in means and standard deviations.

Sample Size: The sample size constituted 272 which was made of 172 case subjects and 100 age and sex matched control subjects.

Data Analysis: The data were analyzed with IBM Statistical Product and Service Solution (SPSS) version 25. Qualitative variables were presented as proportions and percentages while the quantitative variables were presented as means and standard deviations. Chi-square with Yate's correction was used as a test of statistical significance for qualitative variables while the student t–test at 95% confidence interval (CI) was used as a test of statistical significance for the quantitative variables, with a p-value of < 0.05 as significant.

Ethical Considerations: Ethical approval was received from the Research and Ethics Committee of the institution. Consent was received through phone calls to the patients and/ or their relatives as the study was a retrospective one, though patients' identities were not disclosed or compromised.

RESULTS

The total sample population was 272 and constituted 172 case subjects and 100 control subjects. The case group was made up of 98 (56.98%) males and 74 (43.02%) females with an age range of 28 to 93 years while the control group on the other hand was made up of 52 (52%) males and 48 (48%) females with an age range of 25 to 88 years (Chi^2 = 0.448, p- value= 0.5033). The mean age of the case subjects and the control subjects were 65.21 ± 10.91 years and 63.65± 11.53 years respectively (t- test= 1.1134, 95% CI= -1.1984 to 4.3184, p- value= 0.2665).

Those that have low educational attainment among the case group and the control group were 62.79% and 53% respectively (Chi^2 = 2.1205, p-value = 0.1205). Details are in Table 1.

Table 1: Demographical variables of the case and the control groups

Demographic variables		Case- n (%)	Control- n (%)	dF	Chi^2	P- value
Age Range (years)	18- 29	3 (1.74)	2 (2.00)	6	0.9847	0.9896
	30- 39	4 (2.32)	3 (3.00)			
	40- 49	11 (6.39)	7 (7.00)			
	50- 59	35 (20.35)	24 (24.00)			
	60- 69	52 (30.23)	30 (30.00)			
	70- 79	42 (24.42)	21 (21.00)			
	= 80	25 (14.53)	13 (13.00)			
Gender	Male	98 (56.98)	52 (52.00)	1	0.4480	0.5033
	Female	74 (43.02)	48 (48.00)			
Educational attainment	Low	108 (62.79)	53 (53.00)	1	2.1205	0.1453
	High	64 (37.21)	47 (47.00)			

The prevalence of hypertension was 63.37% and 59% among the case and control groups respectively (Chi^2= 0.3434, p- value= 0.5578). The prevalence of diabetes mellitus among the case and the control groups were 24.42% and 24% respectively (Chi^2= 0.0048, p- value= 0.9449). The prevalence of heart failure was 14.53% and 12% among the case and the control groups respectively (Chi^2= 0.1637, p- value= 0.6858). Details are in Table 2.

Table 2: Clinical characteristics of the case and the control groups

Variable		Cases- n= 172 (%)	Controls- n= 100 (%)	Chi^2	p-value
Diabetes Mellitus	Present	42 (24.42)	24 (24.00)	0.0048	0.9449
	Absent	130 (75.58)	76 (76.00)		
Hypertension	Present	109 (63.37)	59 (59.00)	0.3434	0.5578
	Absent	63 (36.63)	41 (41.00)		
Heart failure	Present	25 (14.53)	12 (12.00)	0.1637	0.6858
	Absent	147 (85.47)	88 (88.00)		

The mean packed cell volume of the case and the control groups were 37.42% and 38.13% respectively and were not statistically significant (p-value = 0.2624).

The mean total WBC was statistically higher in the case group than in the control group (p- p-value= 0.0056). Similarly, the percentage neutrophil count was also statistically higher in the case subjects than in the control subjects (p- value= <0.0001). The details are shown in Table 3.

Table 3: Distribution of Haematological parameters of the case and the control groups

Haematological Parameters	Cases- Mean ± SD, N= 172	Controls- Mean ± SD, N=100	t- value	95% CI	p-value
Packed cell volume (%)	37.42 ± 4.99	38.13 ± 5.09	1.1232	-1.9548 to 0.5348	0.2624
White blood count (cells/uL)	7510 ± 2929	6508 ± 2710	2.7946	295.8155 to 1706.2245	**0.0056**
Neutrophils (%)	62.24 ± 12.24	54.6 ± 13.92	4.7164	4.4580 to 10.8292	**< 0.0001**

When the case subjects were subclassified, the mean PCV was noted to be significantly lower amongst female folks, the elderly age group, those with low education attainment, impaired renal status, shorter admission duration, haemorrhagic stroke, and admitting hypertension. Admitting hyperglycaemia, poor recovery at discharge, and admission mortality did not significantly affect the PCV level. Further details are shown in Table 4.

Table 4: Mean Packed cell volume and clinical parameters of the case group.

Clinical Parameters		PCV Mean ± SD	n (%)	t- value	95% CI	p-value
Gender	Male	38.99± 4.81	98 (56.98)	4.6623	1.9720 to 4.8680	**<0.0001**
	Female	35.57 ± 4.70	74 (43.02)			
Age range (years)	18- 64	39.34 ± 4.93	71 (41.28)	3.9677	1.4773 to 4.4027	**<0.0001**
	= 65	36.40 ± 4.68	101 (58.72)			
Educational Attainment	Low	36.70 ± 4.78	108 (62.79)	2.6167	-3.6316 to -0.5084	**0.0097**
	High	38.77 ± 5.39	64 (37.21)			
Renal status	Normal	38.33 ± 5.38	104 (60.46)	2.2802	0.2525 to 3.5075	**0.0238**
	Impaired	36.45 ± 5.14	68 (39.53)			
Modified Rankin Score on discharge	0- 2	37.70 ± 5.53	75 (51.37)	0.6695	-1.0932 to 2.2132	0.5042
	3- 5	37.14 ± 4.49	71 (48.63)			
Admission Outcome	Survived	37.46 ± 5.03	146 (84.88)	0.2408	-1.8713 to 2.3913	0.8100
	Dead	37.20 ± 5.31	26 (15.12)			
Admission Duration (Days)	< 7	36.06 ± 5.32	74 (43.02)	3.7740	-4.3102 to -1.3498	**0.0002**
	= 7	38.89 ± 4.40	98 (56.98)			
Stroke type	Ischemic	38.24 ± 5.26	119 (69.19)	3.6967	1.4073 to 4.6327	**0.0003**
	Haemorrhagic	35.22 ± 4.15	53 (30.81)			
Random Blood Glucose	Normal	36.99 ± 5.50	79 (45.93)	1.0009	-2.2886 to 0.7486	0.3183
	Impaired	37.76 ± 4.59	93 (54.07)			
Blood pressure	Normal	39.36 ± 5.39	63 (36.63)	3.2642	1.0158 to 4.1242	**0.0013**
	High	36.79 ± 4.72	109 (63.37)			

Furthermore, a higher mean total WBC count was significantly associated with female folks, working-class age, lower educational attainment, longer admission duration, and haemorrhagic stroke. Further details are in Table 5.

Table 5: Mean White blood cell count and clinical parameters of the case group.

Clinical Parameters		WBC Mean ± SD	N (%)	t- value	95% CI	p-value
Gender	Male	6797.22±2771.62	98 (56.98)	3.4437	-2397.79 to -647.76	**0.0007**
	Female	8315.00±2977.45	74 (43.02)			
Age range	18- 64	8870.00±3550.54	71 (41.28)	5.9096	1618.99 to 3243.10	**<0.0001**
	= 65	6438.95±1780.37	101 (58.72)			
Educational Attainment	Low	8333.64±3104.73	108 (62.79)	5.4414	1484.39 to 3174.54	**<0.0001**
	High	6004.17±1871.37	64 (37.21)			
Renal status	Normal	7576.11±2662.06	104 (60.46)	0.4462	-627.93 to 994.69	0.6560
	Impaired	7392.73±2593.87	68 (39.53)			
Modified Rankin Score on discharge	0- 2	7850.00±3028.97	75 (51.37)	1.8303	-74.76 to 1945.54	0.0693
	3- 5	6914.61±3146.07	71 (48.63)			
Admission Outcome	Survived	7130.69±3062.84	146 (84.88)	0.8747	-1789.04 to 690.42	0.3830
	Dead	7680.00±2186.77	26 (15.12)			
Admission Duration (Days)	< 7	6540.00±2567.88	74 (43.02)	4.4081	-2780.61 to -1060.50	**<0.0001**
	= 7	8460.56±3010.67	98 (56.98)			
Stroke type	Ischemic	6893.48±2370.38	119 (69.19)	4.1030	-2829.16 to -991.15	**<0.0001**
	Haemorrhagic	8803.64±3637.60	53 (30.81)			
Random Blood Glucose	Normal	7122.67±3045.14	79 (45.93)	1.3207	-1506.26 to 0298.66	0.1884
	Impaired	7726.47±2938.54	93 (54.07)			
Blood pressure	Normal	7995.00±3622.65	63 (36.63)	1.4230	-265.24 to 1635.24	0.1566
	High	7310.00±2651.16	109 (63.37)			

Finally, high mean neutrophil percentage was significantly associated with female folks, lower educational attainment, haemorrhagic stroke, and admission mortality. Further details are in Table 6.

Table 6: Mean Neutrophil percentage and clinical parameters of the case group.

Clinical Parameters		Neutrophil Mean ± SD	n (%)	t- value	95% CI	p-value
Gender	Male	58.00 ±12.96	98 (56.98)	4.8647	-12.3006 to -5.1994	**<0.0001**
	Female	66.75 ± 9.72	74 (43.02)			
Age range (years)	18- 64	62.64 ± 14.30	71 (41.28)	0.3001	-3.2356 to 4.3956	0.7645
	= 65	62.06 ± 11.03	101 (58.72)			
Educational Attainment	Low	64.55 ± 11.96	108 (62.79)	3.6864	-3.2098 to 10.6102	**0.0003**
	High	57.64 ± 11.75	64 (37.21)			
Renal status	Normal	61.82 ± 12.92	104 (60.46)	1.4409	-5.4209 to 1.4409	0.2538
	Impaired	63.81 ± 7.65	68 (39.53)			
Modified Rankin Score on discharge	0- 2	63.50 ± 9.34	75 (51.37)	1.4597	-1.0623 to 7.0623	0.1466
	3- 5	60.50 ± 14.99	71 (48.63)			
Admission Outcome	Survived	58.64 ± 11.88	146 (84.88)	4,2282	-15.4901 to -5.6299	**<0.0001**
	Dead	69.20 ± 10.64	26 (15.12)			
Admission Duration (Days)	< 7	60.29 ± 10.84	74 (43.02)	1.8026	-7.1025 to 0.3225	0.0732
	= 7	63.68 ± 13.15	98 (56.98)			
Stroke type	Ischemic	57.70 ± 10.60	119 (69.19)	9.0151	-18.2845 to -11.7155	**<0.0001**
	Haemorrhagic	72.70 ± 8.77	53 (30.81)			
Random Blood Glucose	Normal	61.07 ± 10.61	79 (45.93)	1.3936	-6.0098 to 1.0298	0.1644
	Impaired	63.56 ± 12.47	93 (54.07)			
Blood pressure	Normal	60.82 ± 10.93	63 (36.63)	1.0970	-5.8508 to 1.6708	0.2742
	High	62.91 ± 12.63	109 (63.37)			

This case-control study is the first report on the haematological parameters in acute stroke patients at Abakaliki Nigeria. The case and the control subjects were matched not only in age and sex but also in the level of educational attainment, prevalence of hypertension, diabetes mellitus, and heart failure. The above matching of the case and the control subjects reduced the effects of the confounding variables and inferred that the observed difference in haematological indices is strongly associated with stroke.

The mean PCV was lower among the case group compared to the control subject, though not statistically significant. A similar trend has been reported in other hospital-based studies with statistical significance.[28,29] The cause of the association between reduced PCV and stroke may not be well understood but it may result from the direct connection between the central nervous system, blood supply and tissue oxygen delivery.[30] In the presence of anaemia, there is a compensatory augmentation of blood flow, and turbulence may result in endothelial injury, thrombus formation, and migration of this thrombus, thus producing artery-to-artery embolism.[30]

Further analysis of haematological parameters among the case subjects showed that the mean PCV was significantly lower among female patients, elderly patients, lower education attainment, impaired renal function, haemorrhagic stroke, admitting hypertension and early discharge.

The association of reduced PCV with female stroke survivors is not unexpected as healthy women normally have lower haemoglobin levels than healthy male counterparts.[31] This is because of the effects of female sex hormones and regular monthly blood loss in women as menses.[32]

The association of reduced PCV with old age is also expected and could result from the presence of co-morbidities in elderly stroke survivors that could impair erythropoiesis like renal dysfunction, malnutrition, and malignancies.[33]

The preponderance of low PCV among stroke survivors of low educational status was reported in other studies and could result from the possible associated poverty, attendant malnutrition and nutritional anaemia.[34]

Low PCV was noted to be significantly associated with renal impairment. This association is well established as anaemia is commonly seen in renal impairment and could result from erythropoietin deficiency, increased haemolysis, increased blood loss, recurrent infection, inflammation and malnutrition.[35]

The association between low PCV and admitting hypertension is bidirectional, as anaemia can be a cause and also a consequence of hypertension.[36] Anaemia can give rise to systolic hypertension through a compensatory increase in cardiac output. Hypertension can induce anaemia through renal impairment, haemolysis and malnutrition.[37] Hypertension may be associated with vascular changes that affect the absorption of nutrients in the intestines. Reduced absorption of essential nutrients, such as iron, vitamin B12, and folate can lead to nutritional deficiencies that contribute to anaemia.

The association between anaemia and haemorrhagic stroke has been reported in other studies .[38,39] The mechanisms may not be well established, but they could be related to impaired coagulation and platelet aggregation induced by anaemia.[40] Additionally, anaemia can induce systolic hypertension, which is a risk factor for haemorrhagic stroke.

Low PCV was also associated with a reduced duration of hospital admission. This association could result from the lower PCV among the deceased, which the event mostly occurred within the first week of admission.

The total white blood cell count and percentage neutrophil count were significantly higher among the stroke survivors than in the control group. High WBC count has been noted as both a risk factor for all types of stroke and a reaction to stroke.[41,42] A high total WBC count is a stroke risk factor because it can induce accelerated atherosclerosis and impaired glucose tolerance.[43] Acute stroke, as an inflammatory condition, induces inflammatory reactions and elaboration of inflammatory markers like neutrophilic leucocytosis.[44] Furthermore, leucocytosis can induce increased blood viscosity which is a risk factor for

ischaemic stroke.

Further analysis of the total WBC count showed that Neutrophilic leucocytosis was associated with female sex, working-class age group, low educational attainment, longer admission duration, and haemorrhagic stroke. The WBC count was also higher among the deceased, though not statistically significant.

The explanation of the association of neutrophilic leucocytosis with female sex is multifactorial. Firstly, the total WBC count has been reported to be higher in healthy females compared to their male counterparts due to delayed apoptosis induced by female sex hormones.[45] Secondly, women have more severe stroke than men and invariably develop more severe inflammatory responses which leads to neutrophilic leucocytosis.[46]

The higher level of neutrophil and total WBC in the working-class age group compared to their older counterparts is not unexpected because the WBC counts progressively decline from birth to adulthood.[47]

The association of neutrophilic leucocytosis, and low educational attainment may be related to their higher risk of developing more severe stroke with complications such as sepsis due to attendant delay in accessing healthcare occasioned by ignorance and poverty.[48]

Those who were on admission for more than one week had higher levels of neutrophils and total WBC count because of their increased risks of developing nosocomial infections following a long hospital stay.[49]

The association between neutrophilic leucocytosis and haemorrhagic stroke was noted in this study. Haemorrhagic stroke is usually more severe than cerebral infarction, and it will most likely induce a stronger level of inflammatory response and leucocytosis .[50]

The association of neutrophilia with admission mortality has been reported in previous studies.[14,51] Neutrophilia is well known to be associated with stroke mortality and stems from risk factors of stroke mortality like sepsis, and haemorrhagic stroke, which could induce neutrophilia.[52]

CONCLUSION

There was no significant difference in the mean PCV of acute stroke patients and their age, sex, and selected cardiovascular risk factors matched control subjects. Among the acute stroke patients, reduced packed cell volume (PCV) was significantly associated with female folks, elderly age group, low education attainment, renal dysfunction, short admission duration, haemorrhagic stroke, and admitting hypertension.

Elevated total white blood cell count and differential neutrophilia were significantly associated with acute stroke patients compared to their sex, age, and selected cardiovascular risk factors matched the control group. Further analysis showed that neutrophilic leucocytosis was associated with female folks, the working age group, low educational status, and admission mortality.

Recommendations

It is recommended that every acute stroke patient should be screened for anaemia, and neutrophilic leucocytosis, as both have implications for stroke risk, management, and prognosis. Any haematological derangement noted should be well investigated and managed accordingly.

Study Limitations

This is a retrospective study and the parameters analyzed were limited to the ones contained in the folder. A prospective study would have yielded a more robust conclusion. The findings from this study have formed baseline data for future reference purposes and health policy planning.

Declarations

Funding

No funding was received for conducting this study.

Competing interests

The authors have no relevant financial or non-financial interests to disclose.

Ethics approval

Approval was obtained from the ethics committee of Trinity Specialist Hospital Abakaliki. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Data availability statements

The datasets generated during and/or analysed during the current study are available from the corresponding author upon reasonable request.

Acknowledgment

The authors acknowledge the Medical Directors of Trinity Group Specialist Hospital for granting approval for the above study. The authors also acknowledge Nurse Florence Onu and Nurse Rita for their assistance in case note retrieval.

Authors' contributions

All authors contributed to the study's conception and design. COE and OFA performed material preparation, data collection, and analysis. The first draft of the manuscript was written by COE and all authors commented on previous versions. All authors read and approved the final manuscript.

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