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Evaluation of Some Haematological Parameters in Alcoholics' Residents in Bayelsa State, Nigeria

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ABSTRACT

Background and Objective: Most forms of disease that may lead to death can be caused by Alcohol. The toxic effects of alcohol on haematological parameters need serious attention. Therefore, the study aimed to evaluate the effects of alcohol consumption on haematological parameters that will aid us in forming a diagnostic tool for the diseases associated with alcohol consumption with good management outcomes. **Materials and Methods:** The study included 200 participants, comprising males and females within the age bracket of 15-65 years. A well-structured pre-tested questionnaire was administered to obtain information used to categorize participants into groups, group 1 (non-alcohol consumers (<1 drink monthly)), group 2 (occasional alcohol consumers (1-3 drinks/month)), group 3 (moderate alcohol consumers (1-5 drinks/week)) and group 4 (heavy alcohol consumers (>2 drinks/day)). **Results:** The white blood cell count (6.12±1.2×10^9/L), lymphocytes (47.5±5.5×10^9/L), mean cell volume (91.6±3.49 fL), mean cell haemoglobin (29.3±1.40 pg) and mean cell haemoglobin concentration (32.0±0.55 g dL^{-1}) were significantly higher in group 4 while packed cell volume (40.8±3.9%), neutrophils (42.2±5.8%) and platelet count (184±41×10^9/L) were significantly lower in group 4 showing a consistently pattern of decrease from group 2 to 4. **Conclusion:** The chronic alcohol consumption induces anaemia, macrocytosis and thrombocytopenia.

KEYWORDS

Haematological parameters, alcohol consumers, platelets, anaemia, macrocytosis, thrombocytopenia

INTRODUCTION

Records indicate that alcohol is as ancient as human history and its consumption in diverse socio-cultural milieus extends beyond the earliest stages of man's development[1]. Alcohol (chemical name ethanol) is a psychoactive substance or drug which exists as an active ingredient in alcohol preparations such as wine, beer and liquor[2]. Alcohol has been attributed as one of the foremost and most common recreational substances causing the characteristics effect of alcohol drunkenness or intoxication[3]. Published articles have adjudged alcohol to produce various psychomotor changes such as mood lift, euphoria and anxiety, increased sociability, sedation, impaired cognitive memory, motor and sensory function and generalized depression of central nervous system[2].

Various sociocultural beliefs consider alcohol consumption as common, particularly when taken moderately as observed in Africa and other parts of the world. There is proof that wine, beer, spirit and other fermented alcoholic beverages were taken in customary organizations and even in contemporary

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settings. Various reports have suggested the consumption of these alcoholic beverages particularly palm wine, burukutu, etc., for pleasure after brewing or tapping[4,5].

In the South, palm wine extracted from the palm tree[6] was common while the native gin locally termed "ogogoro" or "kai-kai" was popular particularly among the Ijaw ethnic group[7,8] "akpuru-achia" or "Sapele water" anextracted formed from the fermented palm wine was commonly consumed, specifically in the Niger-Delta Region.

Furthermore, the International Classification of Diseases (ICD) describes alcohol use as ingestion of alcohol in any form and alcohol abuse as all forms of risk and malfunction associated with harmful alcohol consumption[9].

Anaemia, leukopenia and thrombocytopenia are typical abnormalities associated with alcohol dependence in relation to alcohol abuse and the amount of alcohol consumed[10-12].

Alcohol has been identified as a causal factor in most forms of disease, which results in death. The toxic effects of alcohol on haematological parameters need serious attention. Therefore, the study aimed to evaluate the effects of alcohol consumption on haematological parameters that will aid us in forming a diagnostic tool for the diseases associated with alcohol consumption with good management outcomes.

MATERIALS AND METHODS

Study area: This study was carried out in communities of Bayelsa State coordinate 4.8678°N, 5.8987°E. Bayelsa State is a state in Southern Nigeria in the core Niger Delta Region between Delta State and River State with a total land mass of about 10,773 km^2 (4,159 sq mi). Its capital is Yenagoa on coordinates 4°55'29"N, 6°15'51"E. The main language spoken is Ijaw language having English as the official language. The state was created in 1996 from part of Rivers State with an estimated population of 1,704,515 according to the 2006 census. Bayelsa State has 8 Local Government Areas and the state's capital is Yenagoa. The study was conducted from April, 2018 to May, 2021.

Study population: The study population comprised males and females within the age bracket of 15-65 years who consume alcohol and alcohol-based products and a control group comprised of individuals who have not consumed alcohol or alcohol-based products. The study populations of 200 participants were divided into 4 groups:

- **Group 1:** Fifty non-alcohol consumers (<1 drink monthly)
- **Group 2:** Fifty occasional alcohol consumers (1-3 drinks/month)
- **Group 3:** Fifty moderate alcohol consumers (1-5 drinks/week)
- **Group 4:** Fifty heavy alcohol consumers (>2 drinks/day)

Inclusion criteria: All consenting individuals within the age bracket of 15-65 years who consume alcohol with no physical sign of illness.

All consenting individuals who do not consume alcohol and are within the stipulated age.

Exclusion criteria: Individuals with reported or confirmed cases of liver disease, myocardial infarction, inflammatory bowel, immune deficient or on antiretroviral therapy, tuberculosis:

- Pregnant women or women on contraceptive drugs
- Individual on drugs such as anticoagulant therapy, cytotoxic drugs, antidiabetic therapy and anti-hypertensive therapy
- Non-consenting individuals were excluded from the study

Sample size: The formula below as proposed by Lewis *et al.*[13] was used:

$$N = \frac{Z^2pq}{d^2}$$

where, Z is the critical value and in a tailed test, this is equal to 1.95, P is estimated prevalence of alcoholics in the Niger Delta Region (3.2%), q is the probability which is 1-p and d is the absolute sampling error that can be tolerated. In this study, it will be fixed as 5% of the minimum sampling size N.

$$Z^2 = 1.96^2 = 3.8416$$

$$P = 3.2\% = 0.032$$

$$Q = 1\text{-}0.0.32 = 0.968$$

$$d^2 = 0.05^2 = 0.0025$$

$$N = \frac{3.8416 \times 0.032 \times 0.968}{0.0025} = 47.6$$

A minimum sample size of 48 is needed but for this study, 50 participants in each group were randomly recruited in communities in Bayelsa State. The test group is composed of individuals who consume alcohol and alcohol-based products and the control group is composed of individuals who do not consume alcohol and alcohol-based products.

Collection of sample: Aseptically, using a 5 mL syringe, 3 mL of venous blood was collected and dispensed into an EDTA (Ethylenediaminetetraacetic Acid) tube for haematological analysis. Analysis was done within 2 hrs of sample collection using whole blood to avoid hemolysis and platelet breakdown. A total 200 blood samples were collected.

Ethical approval: With a letter of introduction from the Head of Medical Laboratory Science Department, University of Benin ethical clearance was obtained from the Bayelsa State Ministry of Health and ethical research committee for the approval to collect samples from consenting individuals at communities in Bayelsa State.

Statistical analysis: Statistical package for Social Sciences (SPSS) (version 20.1 for Windows 10) was used to analyze data, differences in the various parameters were evaluated using Kolmogorov-Simirnov Z statistics, One-way ANOVA was used to assess differences within the group and statistically significant values were determined at 95% confidence level.

Method of analysis: A complete blood count was done by Mindray automated haematology analyzer B-20 (Shenzhen, China). Within 2 hrs of sample collection in an EDTA container. This instrument uses the electronic low-voltage direct current resistance principle: Cells are sized and counted by detecting and measuring changes in electrical resistance when a particle passes through a small aperture.

RESULTS

The comparisons of assayed haematological indices by participant groups. Highest mean and SD of white blood cell count ($6.12\pm1.2\times10^9$/L), lymphocytes ($47.5\pm5.5\times10^9$/L), mean cell volume (91.6±3.49 fL), mean cell haemoglobin (29.3±1.40 pg) and mean cell haemoglobin concentration (32.0±0.55 g dL^{-1}) were obtained in group 4 (heavy alcohol consumers) while highest mean and SD of packed cell volume

Table 1: Comparisons of assayed haematological indices by participant groups

	Participant groups					
	Control (n = 50) Mean±SEM				Test statistics	
Parameter	Group 1	Group 2	Group 3	Group 4	F-ratio	Prob>F
PCV (%)	45.7±3.3	43.2±2.5	42.0±3.0	40.8±3.9	21.010	0.010*
WBC (×10^9/L)	4.65±0.8	5.18±1.0	5.62±0.7	6.12±1.2	21.895	0.002**
LYMP (×10^9/L)	39.7±2.09	45.8±8.7	46.6±4.8	47.5±5.5	18.798	0.000****
NEUTRO (%)	52.6±5.5	46.6±8.6	44.4±5.1	42.2±5.8	24.651	0.000****
PLT (×10^9/L)	227±39	225±44	206±39	184±41	12.228	0.004**
MCV (fL)	85.4±1.56	87.7±3.51	89.6±2.36	91.6±3.49	43.077	0.000****
MCH (pg)	26.0±0.47	26.9±0.74	28.1±0.86	29.3±1.40	119.505	0.000****
MCHC (g dL^{-1})	30.9±0.91	30.0±0.91	31.0±0.56	32.0±0.55	58.021	0.003**

SEM: Standard error of mean: Significance level: *p<0.05, **p<0.01, ****p<0.0001, ns: Not significant (p>0.05), Group 1 (control): Non-alcohol consumers (<1 drink monthly), Group 2: Occasional alcohol consumers (1-3 drinks/month), Group 3: Moderate alcohol consumers (1-5 drinks/week), Group 4: Heavy alcohol consumers (>2 drinks/day), PCV: Packed Cell Volume, WBC: White Blood Cells, LYMP: Lymphocytes, NEUTRO: Neutrophil, PLT: Platelets, MCV: Mean Cell Volume, MCH: Mean Cell Haemoglobin and MCHC: Mean Cell Haemoglobin Concentration

Table 2: *Post hoc* (Turkey's LSD Test) comparison of effect of alcohol consumption on some hematological indices among participants

Group comparison	PCV (%)	WBC (×10^9/L)	LYMP (×10^9/L)	NEUTRO (%)	PLT (×10^9/L)	MCV (fL)	MCH (pg)	MCHC (g dL^{-1})
Group 1 vs group 2	0.000[a]	0.006[a]	0.000[a]	0.000[a]	0.711[b]	0.000[a]	0.000[a]	0.000[a]
Group 1 vs group 3	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.008[a]	0.000[a]	0.000[a]	0.629[b]
Group 1 vs group 4	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]	0.000[a]
Group 2 vs group 3	0.059[b]	0.020[a]	0.459[b]	0.090[b]	0.022[a]	0.001[a]	0.000[a]	0.001[a]
Group 2 vs group 4	0.000[a]	0.000[a]	0.139[b]	0.001[a]	0.008[a]	0.000[a]	0.000[a]	0.000[a]
Group 3 vs group 4	0.059[b]	0.010[a]	0.459[b]	0.090[b]	0.008[a]	0.001[a]	0.001[a]	0.003[a]

Mean difference is significant at the 0.05 level, [b]Mean difference is not significant at the 0.05 level, Group 1 (control): Non-alcohol consumers (<1 drink monthly), Group 2: Occasional alcohol consumers (1-3 drinks/month), Group 3: Moderate alcohol consumers (1-5 drinks/week), Group 4: Heavy alcohol consumers (>2 drinks/day), PCV: Packed Cell Volume, WBC: White Blood Cells, LYMP: Lymphocytes, NEUTRO: Neutrophil, PLT: Platelets, MCV: Mean Cell Volume, MCH: Mean Cell Haemoglobin and MCHC: Mean Cell Haemoglobin Concentration

(45.7±3.3%), neutrophils (52.6±5.5%) and platelet (227±39×10^9/L) were obtained in the control group (non-alcohol consumers). The lowest mean and SD of all assayed haematological indices were obtained in the control group (non-alcohol consumers) except packed cell volume (40.8±3.9%), neutrophils (42.2±5.8%) and platelet count (184±41×10^9/L) which were lowest in group 4 (heavy alcohol consumers). The ANOVA showed a statistically significant difference (p<0.05) in comparison of the control mean and SD values of assayed haematological indices to other participant groups as shown in Table 1.

Table 2 shows the *post hoc* (Turkey's LSD Test) comparison of the effect of alcohol consumption on some Hematological indices among participants. It was compared at a statistical confidence level of 95%. Packet Cell Volume (PCV), neutrophils and platelet count of heavy alcohol consumers were significantly reduced when compared to control (non-alcohol consumers) while white blood cell count, lymphocytes, mean cell volume and mean cell haemoglobin were significantly increased a contrast to mean cell haemoglobin concentration which was increased though not clinical significant similar to comparison of moderate alcohol consumers to the control group. Comparison of occasional alcohol consumers to the control group (non-alcohol consumers) showed that pack cell volume and neutrophils were significantly reduced and white blood cell count, lymphocytes and mean cell volume were significantly increased. The observed differences in platelet count were not statistically significant. Intercomparison showed statistically significant difference except for lymphocyte group 2 vs group 3, group 2 vs group 4 and group 3 vs group 4, neutrophils group 2 vs group 3 and group 3 vs group 4 same as packet cell volume.

DISCUSSION

The findings from this study showed that Packet Cell Volume (PCV), neutrophils and platelet count of heavy alcohol consumers were significantly reduced when compared to control (non-alcohol consumers)

while, white blood cell count, lymphocytes, mean cell volume and mean cell haemoglobin were significantly increased contrast to mean cell haemoglobin concentration which was increased though not clinical significant similar to comparison of moderate alcohol consumers to control group. Comparison of occasional alcohol consumers to the control group (non-alcohol consumers) showed that packed cell volume and neutrophils were significantly reduced and white blood cell count, lymphocytes and mean cell volume were significantly increased. These haematological changes observed especially in comparison of the heavy alcohol consumers and moderate alcohol consumers to the control group suggest macrocytosis with erythroblast vacuolization with mild cytopenia. These findings were in consonance with other reports by various authors[14-17]. The suggested mechanism for the induced haematological changes may be due to the interaction of alcohol and alcohol metabolite (acetaldehyde} with haemoglobin. Acetaldehyde is the first metabolite of alcohol-induced lipid peroxidation, ethanol-induced oxidative stress and inhibition of cellular progenitor cells resulting in increased cellular insult, destruction of lipoprotein structure of cell membrane and cellular constituents directly resulting in cytopenia evident by thrombocytopenia and non-clinical anaemia observed in heavy alcoholic consumers participant group. Furthermore, other authors suggested acetaldehyde binding to reactive amino acid residues in several target proteins forming allo-protein and acetaldehyde adducts which lose the primary amino acid property and therefore cannot be utilized in the haem cycle and other haempoietic pathways thereby resulting in haematological changes[18,19].

This study implies that alcohol consumption causes anaemia, macrocytosis and thrombocytopenia, affecting the haempoietic pathways. This may be the cause of some haematological disorders observed among alcohol consumers. This study could not address the pharmacological and molecular interactions of alcohol, hence further study is recommended.

CONCLUSION AND RECOMMENDATION

Most of the disease observed in the health institutions has been associated with alcohol consumption but some residents in Bayelsa State, Nigeria consume it as a culture. The findings of this study demonstrate that alcohol consumption altered the various hematological parameters as each test parameter was significantly increased or decreased ($p<0.05$). The observed effect might be linked to the interaction of alcohol and alcohol derivatives with various physiological pathways. From this study, the following could be concluded. Alcohol consumption may induce anaemia, macrocytosis and thrombocytopenia as packed cell volume and platelet count were significantly reduced while mean cell volume was significantly increased. The findings of this study can help in the management of those diseases associated with alcohol consumption. The study recommends that alcohol consumption be moderated to avoid the complications associated with heavy consumption of alcohol. The study also recommends further research on pharmacological and molecular interactions of alcohol.

SIGNIFICANCE STATEMENT

Alcohol has been identified as a causal factor in most forms of disease which results in death sometime. The effects of alcohol consumption on haematological parameters discovered in this study were anemia, macrocytosis and thrombocytopenia. This can be of diagnostic assistance in the management of alcohol-associated diseases. This study will help the researcher uncover the critical area of consumption of alcohol severity that many researchers were not able to explore. Thus, a new theory on the effect of alcohol consumption on hematological parameters may be arrived at.

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