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Variations in Platelet Indices among Healthy Nigerian Population

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Authors' contributions

This work was carried out in collaboration between both authors. Author DEE designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author OK managed the analyses of the study. Authors DEE and OK managed the literature searches. Both authors read and approved the final manuscript.

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ABSTRACT

Background: The degree of platelet activation may be assessed by platelet indices such as platelet count (PC), mean platelet volume (MPV) and platelet distribution width (PDW). Platelet indices are potentially predictive, diagnostic and prognostic useful markers for platelet-related disorders.
Objective: The aim of this study was to evaluate platelet indices in a Nigerian population.
Methods: One hundred and eighty-six (186) subjects were enrolled for this study (102 females and 84 males). Thirty (30) of the subjects were ≤30 years, 108 were aged between 30 years-60years while 48 of the subjects were above 60 years. Three (3) ml of venous blood was collected from each consenting subjects into an ethyl diamine tetra-acetic acid (EDTA) anticoagulant bottle at a concentration of 1.5 mg/ml of blood. Full Blood Count (FBC) was determined using the haematology autoanalyzer-Mindray BC-5300. Pearson correlation and one-way analysis of variance and student's t-test were performed using the statistical package for social sciences-value was set at ≤0.05.
Results: Among the subjects enrolled for the study those with blood group A were 41, blood group B, 28 blood groups AB were 5 and blood group O, 112. The mean values for the platelet indices were MPV (fl) 9.547±1.170 and 9.682±1.054, PDW 14.69±5.181 and 14.54±1.946, Plateletcrit (PCT)

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(ml/l)1.362±1.173 and 1.47±1.150, among females and males respectively. The PDW varied significantly in the age groups except for ages <30 versus age>60, while PCT which measures the total volume of platelets in a given volume of blood, showed a significant difference for all the age groups. MPV and PDW correlated negatively with platelet in all the age groups and sexes while PCT correlated positively with platelet in all the age groups.

Conclusion: Platelet indices correlate with age, differ among age groups. This underlines the importance of reference ranges among different age groups.

Keywords: Platelets; mean platelet volume; platelet distribution width; gender and age.

1. INTRODUCTION

Platelets or thrombocytes are fragments of cytoplasm derived from megakaryocytes with a diameter between 1.5-3.0µm and about 1/3 or ¼ of the size of erythrocytes. They have an irregular outline, a bluish grey, oval-round shape with many purple-red granules on light microscopy.

The primary function of the platelet is to maintain the vascular integrity by sealing ruptures in the vascular bed; they can also function in both innate and adaptive immunity. Bacteria endotoxin can activate platelets, promote platelet-neutrophil interactions, and enhance bacterial trapping by stimulating the production of neutrophil extracellular traps (NETs). This can degrade pathogens and confer resistance to a variety of pathogens both gram-positive and gram-negative organisms [1]. The MPV is a marker for platelet age; smaller platelets are more mature than large ones. The MPV is increasingly used as a marker for bone marrow stress; a low platelet count with high MPV indicates that the bone marrow is producing platelets and releasing them rapidly into circulation. MPV serves as a marker for inherited platelet disorders; Bernard-Soulier Syndrome(GP1BA,GP1BB,GP9,FLNA),Gray Platelet Syndrome(NBEAL 2) and MYH9-related diseases(MYH9) are associated with very giant platelets [2] while, Wiskoh-Aldrich Syndrome (WAS, ARPC 1B) is associated with small platelets. MPV is also a marker for platelet reactivity, young platelets released from bone marrow are more reactive than old smaller platelets, and MPV is used to find new genetic variants [3]. The PDW is an indicator of volume variability in platelet size and is increased in the presence of platelet anisocytosis [4]. PDW directly measures variability in platelet size, changes with platelet activation and reflects the heterogeneity in platelet morphology. It is useful in distinguishing between reactive thrombocytosis (PDW normal) from thrombocytosis associated with myeloproliferative disorders (PDW increased) [4]. Both MPV and PDW are increased during platelet activation and are useful in the differential diagnosis of aplastic anaemia and ITP. Plateletocrit (PCT): it is an independent risk factor in patients with mitral stenosis [5]. PCT is the volume occupied by platelets in the blood and can be used to determine if a patient needs platelet transfusion, it is a useful screening tool for platelet quantitative disorders. There is variability in platelet count and platelet indices because of potential covariants (confounders), age, sex, study Centres [4] etc. Ethnic differences have also been reported in platelet count [6].

2. MATERIALS AND METHODS

This was a cross-sectional study designed to determine the value for platelet indices in a Nigerian population. Subjects were enrolled at different sites: University of Nigeria, Enugu Campus and Enugu State University of Science and Technology all in Enugu State Nigeria. The Research Ethics committee of the University of Nigeria Teaching Hospital, Enugu State approved the study (NHREC/05/01/2008B-FWA00002458-1RB00002323). The subjects gave their written informed consent in accordance with the declarations of Helsinki 2013. One hundred and eighty-six (186) subjects were enrolled for this study (102 females & 84 males), 30 were of the subjects were ≤30years, 108 were aged between 30years and 60years while 48 of the subjects were above 60 years of age. Those with blood group A were 41, blood group B 28, blood group AB 5 and blood group O 112. Three (3) ml of venous blood was aseptically, without stasis collected from each subject into tripotassium Ethylene diamine tetra-acetic acid (K3EDTA) anti-coagulant bottles, and mixed by gentle inversion. All samples were analyzed with the heamatology auto-analyzer Mindray BC-5300, within two hours of collection.

2.1 Inclusion Criteria

Participants were none smokers, none alcoholics, have not received blood transfusion in the previous six month, HIV negative, no urine protein or sugar, no history of malaria, no recent history of blood loss and no history of drug abuse etc.

2.2 Exclusion Criteria

Anaemic patients, HIV positives, smokers, alcoholics, subjects with liver or kidney related diseases, recently transfused subjects, diabetics, subjects on medications, menstruating and pregnant women were excluded.

2.3 Statistical Analyses

The Statistical Package for Social Sciences (SPSS) version 20.0 software and Graphpad Prism v5 were used. Correlation was assessed by the Pearson's correlation coefficient (r). Significance differences between the age groups was assessed by one way analysis of variance (ANOVA), students t-test was used to analyze the difference between the sexes and the statistical significance was set at $P<0.05$.

3. RESULTS

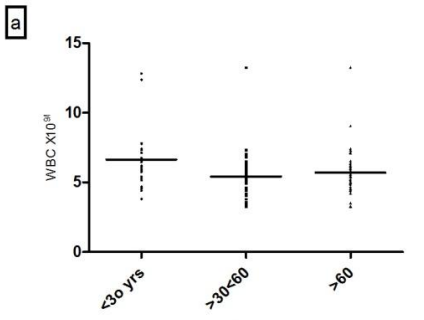
The results are as shown in the table and figures. MPV and PDW correlated negatively with PLT in all the age groups ($r = -0.024$, $p>0.05$; under 30 years), ($r = -0.265$, $p>0.05$; between 30-60 years) and ($r = -0.677$, $p<0.001$; above 60 years) (data not shown) and sexes

4. DISCUSSION

There was a significant difference in platelet count between subjects less than 30 and other age groups. Platelet counts declined from childhood to adulthood as reported in Western countries [7,8] and [9]. This study recorded no significant difference in platelet count between the sexes; this may be accounted for by differences in auto analyzers used. Many studies suggested platelets vary with gender being higher in females than in male, [10,7,11,8, and 9], because of the hormone estrogen which plays a key role in platelet production [12,13]. In vivo and in vitro studies on mouse showed that estrogen favours platelet formation in mouse, but no data is available in humans [13]. Reduction in haematopoietic stem cell reserve during ageing may be the mechanism responsible for the age-related reduction in platelets [14]. These variations occurred after 15 years of age and puberty is the implicating factor [15,16]. The low body iron recorded in females at puberty, which resulted in low haemoglobin level, might be due to acute blood loss during menstruation [15,16]. The acute blood loss triggers erythropoietin release to compensate for the red blood cells loss and simultaneously led to thrombopoiesis. This low body iron promotes platelet production observed in iron deficiency anaemia. Variations in platelets have also been attributed to differences in lifestyle, diet habit, climate, geographical location, genetic, environmental, ethnic or tribal factors [17,18,19,20] and [22]. Decrease in platelet count in apparently healthy elderly males and females may be as a result of increased replacement of bone marrow by fatty

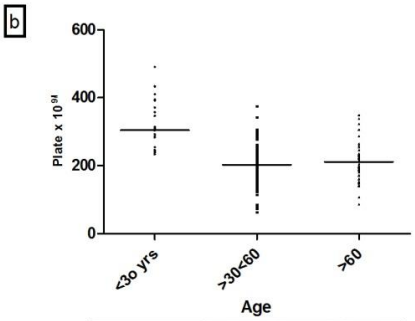
Table 1. Haematological profile of study population

Variables	Females	Males	p-value
WBCx109L	5.746±1.962	5.639± 1.214	0.5999
Neu#	2.667±0.872	2.686±0.731	0.5344
Lym#	2.594±1.377	2.478±0.838	0.5945
Mon#	0.179±0.157	0.168±0.118	0.8997
Eos#	0.270±0.167	0.274±0.248	0.1433
Bas#	0.024±0.016	0.024±0.014	0.2227
RBCx1012L	4.102±0.759	4.210±0.766	0.5823
HGBgL	109.1±23.190	111.2±23.230	0.6290
HCTLL	0.356±0.085	0.352±0.068	0.8588
MCVfL	84.34±8.268	84.39 ±6.628	0.6136
MCHPg	26.31±2.852	26.75±6.846	0.4434
MCHCgl	313.7±24.390	316.8±17.850	0.6145
RDWSD FL	46.02±9.149	45.56±10.360	0.6945
PLTx109L	218.8±72.160	224.5±62.490	0.5785
MPVfL	9.547±1.170	9.682±1.054	0.7137
PDW	14.69±5.181	14.54±1.946	0.8316
PCT mL/L	1.362±1.173	1.47±1.150	0.3715



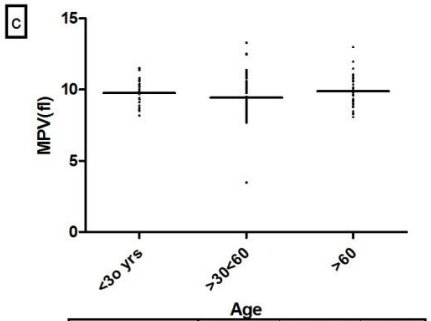
	<3o yrs	>30<60	>60
Mean	6.656	5.430	5.701
Std. Deviation	1.911	1.502	1.636

<3o yrs vs >30<60	***
<3o yrs vs >60	*
>30<60 vs >60	ns

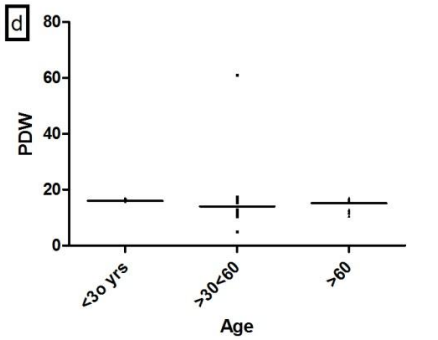


	<3o yrs	>30<60	>60
Mean	304.0	202.9	211.3
Std. Deviation	68.21	55.46	54.76

<3o yrs vs >30<60	***
<3o yrs vs >60	***
>30<60 vs >60	ns

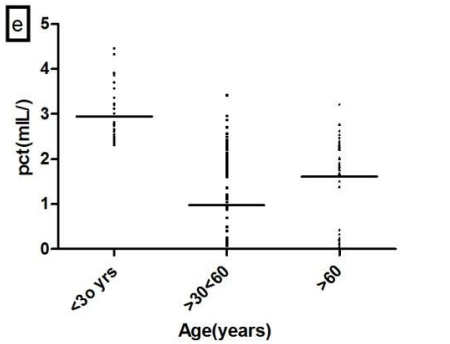


	<3o yrs	>30<60	>60
Mean	9.773	9.437	9.890
Std. Deviation	0.8638	1.188	1.042



	<3o yrs	>30<60	>60
Mean	16.04	14.00	15.15
Std. Deviation	0.3159	5.071	1.818

<3o yrs vs >30<60	***
<3o yrs vs >60	ns
>30<60 vs >60	***



	<3o yrs	>30<60	>60
Mean	2.949	0.9781	1.612
Std. Deviation	0.6077	0.9272	0.9231

<3o yrs vs >30<60	***
<3o yrs vs >60	***
>30<60 vs >60	**

Figure 1: variations in(a) WBC,(b)platelet(c)MPV(d)PDW(e)PCT& Age
Shows one-way ANOVA for the three age groups and platelet indices.key=*p<0.5,p<0.01,***p<0.001**

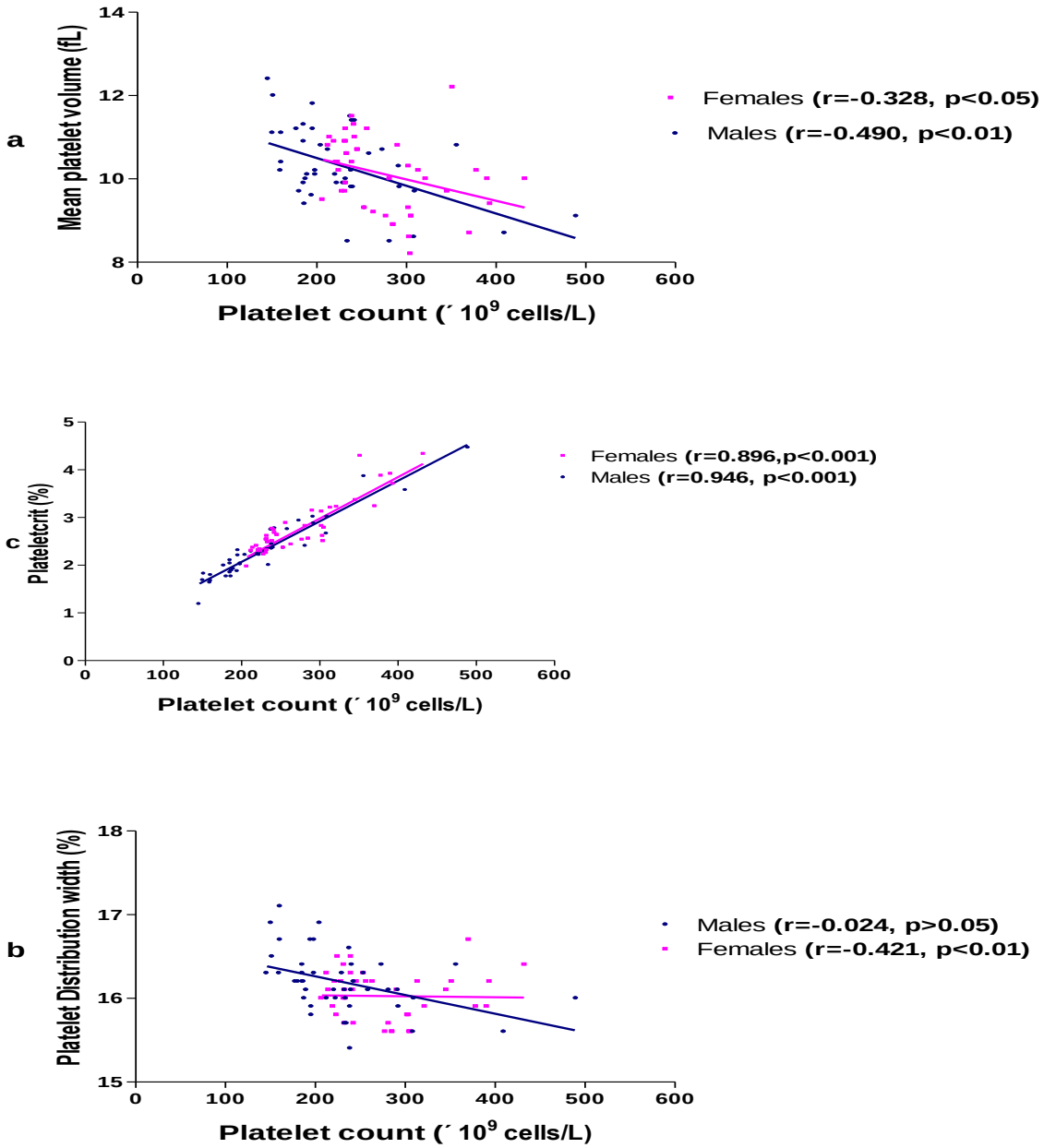


Fig. 2. Correlation of platelet count and platelet indices with the gender for the study population

tissues, deregulation of cytokines production in the elderly; low intake of micronutrients like iron, protein, vitamins and folic acid [21]. In addition, malaria parasite and hookworm infestation, which are common in Nigeria, could affect the platelet count. Nonetheless, all these mechanisms are still hypothetical and need further study.

There was no significant difference in MPV for all the age groups and between the sexes, although males had higher values than females. This is similar to the findings of Bain in 1986. The PDW showed a significant difference in some age groups. PCT, which measures the total volume of platelets in a given volume of blood, showed a significant difference for all the age groups.

MPV and PDW correlated negatively with PLT in all the age groups ($r = -0.024$, $p>0.05$; under 30 years), ($r = -0.265$, $p>0.05$; between 30-60 years) and ($r = -0.677$, $p<0.001$; above 60 years)(data not shown) and sexes. PCT correlated positively with PLT in all the age groups: under 30 years

(r = 0.923, p<0.001 ;), between 30-60 years (r = 0.929, p<0.001 ;) and above 60 years. (r = 0.922, p<0.001). Platelet count showed a negative correlation with MPV for under 30 years (r = -0.393,p<0.05;), between 30-60 years (r = -0.233, p>0.05;) and above 60 years (r = -0.509, p<0.01;). Similar correlations occur among these variables within the different genders.

5. CONCLUSION

Platelet indices correlate with age and differ among age groups for the studied population. This underlines the importance for reference ranges among different age groups.

CONSENT

As per international standard or university standard, patients' written consent has been collected and preserved by the authors.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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