**Marked Variability in Platelet Count and Distribution Width in Apparently Healthy Individuals**

**ABSTRACT**

**Background:** Platelets indices (PI) are a class of derived parameters of platelet gotten as part of an automated full blood count including mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT).

**Aim:** This study was aimed at assessing platelet count and platelet indices of apparently healthy subjects in Port Harcourt, Nigeria.

**Method:** This was a cross sectional study involving a total of two hundred and sixty (260) apparently healthy subjects comprising of 167 females and 93 males between ages 18-80 years were recruited for this study. Five milliliters (5mls) of venous blood was collected aseptically by venipuncture technique from the subjects into vacutainer tubes for the analysis of full blood count using haematological autoanalyser, Sysmex Kx-21N.

**Results:** The mean values for PLT (×10³μL), MPV (fL), PDW (fL) and PCT (%) for female subjects were 233.74±8.57, 10.02±0.09, 13.54±0.21 and 1.15±0.38. The values for male subjects were 235.28±11.48, 9.90±0.12, 13.64±0.28 and 0.99±0.52 respectively. There was no significant difference in the PLT (p= 0.9147), MPV (p= 0.4430), PDW (p= 0.7866) and PCT (p= 0.8041). The mean values for the study subjects <25, 25-34, 35-44, 45-54, 55-64 and above 65 years for PLT (×10³μL) were 307.65±26.41, 228.51±16.23, 197.41±17.00, 234.10±13.11, 234.66±19.25 and 243.70±14.55 for PDW (fL) were 12.54±0.63, 14.29±0.39, 14.25±0.40, 14.11±0.31, 12.50±0.46 and 12.80±0.35 respectively. There was a significant difference in the PLT (p= 0.0261) and PDW (p= 0.0006).

**Conclusion:** This study shows that there is significant variation in platelet count and platelet distribution width due to differences in age. The platelet count was lowest among the middle aged while the platelet distribution width was higher among middle aged subjects.

**Keywords:** Platelet count, Platelet Distribution Width, Apparently Healthy, Port Harcourt

1. **INTRODUCTION**

Platelets or thrombocytes are small anucleated and colourless cell fragments formed by megakaryotes in the bone marrow which aid in maintaining haemostasis, thrombosis and wound healing [1]. Platelet count and platelet indices can be measured with haematological autoanalyser [2, 3]. Platelet indices which include mean platelet volume (MPV), platelet distribution width (PDW) and plateletcrit (PCT) function as biomarkers for the activation of platelet [4]. They are associated with the proliferation and morphology of platelets [5]. Platelet parameters are possible innovative biomarkers of both chronic and acute diseases due to easy accessibility and inexpensive measurement methods [6]. The functional activity of platelets primarily is to help in maintaining vascular intergrity and function also in both adaptive and innate immunity [5]. Platelets aid in controlling inflammatory processes by secreting many inflammatory factors such as chemokines and cytokines which aid in fighting cancerous cells and chronic diseases.

Platelets are formed and released into the bloodstream from megakaryocytes (MKs), which reside in the bone marrow. Their production is arguably the most elegant and distinct developmental process in eukaryotes [7]. While accounting for only 0.01% of nucleated bone marrow cells, MKs are also the largest cells, measuring between 50-100μm [7]. Both MK and platelet production, termed megakaryocytopoiesis and thrombopoiesis, are regulated by multiple cytokines, with thrombopoietin (TPO), a hormone produced by the liver and kidneys, being the key regulator. In response to TPO, HSCs differentiate into MKs by differential expression of various transcription factors [7].

Platelets prevent blood loss in primary haemostasis, the physiological process which halts bleeding at an injured blood vessel, while maintaining normal blood flow elsewhere in circulation, by the formation of a ‘platelet plug’ [8]. Secondary haemostasis refers to the deposition of insoluble fibrin that is generated by the coagulation cascade. Finally, fibrinolysis results in the breakdown of blood clots during wound healing involving the interplay of a number of enzymes [8]. A healthy endothelium provides a non-adhesive surface for platelets. However, in areas of vascular injury, the sub-endothelium is exposed and platelets may adhere quickly to different extracellular matrix components, and then form a platelet plug. This process is achieved through three distinct processes-platelet adhesion, platelet activation and secretion, and platelet aggregation [8]. Platelets aid in targeting neutrophils, lymphocytes and monocytes to the site of inflammation [9].

 The Mean Platelet Volume measures the average size of platelets present in the blood which is commonly used as biomarkers for bone marrow stress, platelet age and inherited platelet disorders. Reduced level of MPV could be associated with low-grade inflammation like rheumatoid arthritis [10]. The Platelet Distribution Width shows the heterogeneity in the morphology of platelets, variability in platelet size and changes linked with platelet activation [11]. Both MPV and PDW are elevated upon activation of platelet and aid in differential diagnosis of Idiopathic Thrombo Purpura (ITP) and aplastic anaemia [12]. Plateletcrit (PCT) measures the volume occupied by platelets in the blood which could serve as an indicator for platelet transfusion or for screening platelet qualitative disorders [5].

1. **MATERIALS AND METHOD**

**2.1 Study Design**

A cross-sectional study was employed to assess the haematological parameters of apparently healthy individuals.

**2.2 Study Area**

This study was carried out in Port-Harcourt, Nigeria. It is the capital of Rivers state which is a state (about 23 local government areas) that lies along the Bonny River, in the Niger Delta region of Nigeria. Port Harcourt is a metropolis that is considered the commercial center of the Nigeria oil Industry with an estimated population of 1,148,665. After Lagos, Kano, Ibadan and Benin, Port Harcourt is the fifth most populous city in Nigeria.

**2.3 Study Population**

A total of 260 apparently healthy individuals between the ages of 18-80 years who gave informed and written consents were recruited from Port-Harcourt, and used for the study. A convenient sampling technique was used to determine the sample size for this study, and a well-structured questionnaire was used to obtain relevant information (such as the age and sex) about each subject.

**2.4 Inclusion Criteria**

Both male and female apparently healthy individuals who gave their consent were recruited for this study.

**2.5 Exclusion Criteria**

1. Individuals who did not give their consent were excluded from the study.
2. Individuals with obvious ill-health were excluded from the study.

**2.6 Subject Selection**

Convenient sampling method was employed.

**2.7 Sample collection and Processing**

A total of 5 ml of blood was collected from each subject via venipuncture as described by Cheesebrough (2010) using vacutainer tubes containing 0.5 ml of 1.2 mg/ml K2-EDTA (dipotassium ethylenediaminetetraacetic acid) for the determination of haematological parameters.

**2.8 Laboratory Analysis**

Estimation of full blood count were analysed using Sysmex Kx-21N Haematology Analyzer.

**2.8.1 Procedure for using Sysmex Kx-21N Haematology Analyzer**

The samples in EDTA bottles were numbered appropriately and placed in a mixer. The mixer was plugged to an electric socket, which allows the blood to properly mix together. The Sysmex equipment was then cleaned and quality control checked. Each sample number was inputted into the equipment, followed by opening of the cap of each sample to be run. The tube of the equipment’s probe was set and ‘Start Switch’ put on. Each of the samples was held firmly beneath the probe which was inserted into the sample until it aspirated the sample, which was indicated by a ‘beep’ sound. After this, the sample was removed from the probe, and with within 60 seconds, the result was obtained in a printed format.

**2.9 Data Analysis**

Data analysis were conducted using SAS 9.4 software and graphical representations were carried out using the JMP statistical discoveryTM  software version 14.3.

3.0 **RESULTS AND DISCUSSION**

**3.1 Platelet Indices of Apparently Healthy Subjects in Port Harcourt by Sex**

The mean values for PLT (×10³μL), MPV (fL), PDW (fL) and PCT (%) for female subjects were 233.74±8.57, 10.02±0.09, 13.54±0.21 and 1.15±0.38. The values for male subjects were 235.28±11.48, 9.90±0.12, 13.64±0.28 and 0.99±0.52 respectively. There was no significant difference in the PLT (p= 0.9147), MPV (p= 0.4430), PDW (p= 0.7866) and PCT (p= 0.8041).

**3.2 Platelet Indices of Apparently Healthy Subjects in Port Harcourt by Age Group**

The mean values for the study subjects <25, 25-34, 35-44, 45-54, 55-64 and above 65 years for PLT (×10³μL) were 307.65±26.41, 228.51±16.23, 197.41±17.00, 234.10±13.11, 234.66±19.25 and 243.70±14.55 for MPV(fL) were 9.81±0.28, 10.13±0.18, 10.30±0.18, 9.88±0.14, 9.92±0.21 and 9.81±0.16 PDW (fL) were 12.54±0.63, 14.29±0.39, 14.25±0.40, 14.11±0.31, 12.50±0.46 and 12.80±0.35 for PCT (%) were 3.55±1.20, 1.71±0.74, 1.20±0.77, 0.72±0.59, 1.06±0.87 and 0.23±0.66 respectively. There was no significant difference in the MPV (p= 0.3184) and PCT (0.2214). However, there was a significant difference in the PLT (p= 0.0261) and PDW (p= 0.0006).

#### Table 1: Platelet Indices of Apparently Healthy Subjects in Port Harcourt by Sex

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Parameter | Female (n=167) | Male (n=93) | P-value | t-value Remark |  |
| PLT (x10³/µL) | 233.74±8.57 | 235.28±11.48 | 0.9147 | 0.107 | NS |  |
| MPV (fL) | 10.02±0.09 | 9.90±0.12 | 0.4430 | -0.768 | NS |  |
| PDW (fL) | 13.54±0.21 | 13.64±0.28 | 0.7866 | 0.271 | NS |  |
| PCT (%) | 1.15±0.38 | 0.99±0.52 | 0.8041 | -0.248 | NS |  |

#### Abbreviations: SD: Standard Deviation, PLT: Platelet count, MPV: Mean Platelet Volume, PDW: Platelet Distribution Width, PCT: Plateletcrit.

#### Table 2: Some Platelet Indices of Apparently Healthy Subjects in Port Harcourt by Age Group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Age Group (years) | n | PLT (x 10³/µL) | MPV (fL) | PDW (fL) | PCT (%) |
| < 25 | 17 | 307.65 ±26.41a | 9.81±0.28 | 12.54±0.63 abc | 3.55±1.20 |
| 25-34 | 45 | 228.51 ±16.23 ab | 10.13±0.18 | 14.29 ±0.39 a | 1.71±0.74 |
| 35-44 | 41 | 197.41 ±17.00 b | 10.30±0.18 | 14.25 ±0.40 ab | 1.20±0.77 |
| 45-54 | 69 | 234.10 ±13.11 ab | 9.88±0.14 | 14.11 ±0.31ab | 0.72±0.59 |
| 55-64 | 32 | 234.66 ±19.25 ab | 9.92±0.21 | 12.50 ±0.46 c | 1.06±0.87 |
| 65+ | 56 | 243.70 ±14.55 ab | 9.81±0.16 | 12.80±0.35 bc | 0.23±0.66 |
| P-value | 0.0261 \* | 0.3184 | 0.0006 \*\*\* | 0.2214 |
| F-value | 2.593  | 1.182  | 4.499  | 1.409 |
| Remark | S | NS | S | NS |

#### Abbreviations: SD: Standard Deviation, PLT: Platelet count, MPV: Mean Platelet Volume; PDW: Platelet Distribution Width, PCT: Plateletcrit. Within parameter, means with different superscript(s) are significantly different (p<0.05).

**Significance Level: \*=p<0.05; \*\*\*=p<0.001; ns= not significant (p>0.05).**

**Box Plot Analysis of Platelet Indices of Subjects in Relation to Sex and Age Group**

Figure 1 shows a decreased platelet count (PLT) among 35-44 age group and figure 2 shows a decrease in the Platelet Distribution Width (PDW) among 55-64 age group.

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#### Figure.1: Box Plot of Platelet count (PLT) of Healthy Subjects in Port Harcourt by

####  Age Group

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#### Figure 2: Box Plot of Platelet Distribution Width (PDW) of Healthy Subjects in

####  Port Harcourt by Age Group

**4. DISCUSSION AND CONCLUSION**

Significant variation in platelet count and platelet distribution width (PDW) among apparently healthy individuals was observed in this study. This study showed no significant difference in the PLT, MPV, PDW and PCT between the sexes which may be attributed to differences in haematological autoanalyzers used. Other studies have suggested that females have higher platelets than males due to estrogen hormone that aids in production of platelet [13]. The platelet count was lowest among the middle aged (35-44 years) than other age groups. Platelets play a major role in acute and chronic disease progression and platelet function is usually elevated during middle adult age [14]. Differences in platelet count is probably due to variations in age and gender. Reduced platelets in apparently healthy middle aged subjects could be as a result of elevated bone marrow replacement by fatty tissues and malaria parasite which is very common in Nigeria [15]. This finding was similar to Eyiuche and Kosiso [16]; Stella and Ebirien-Agana [17] which stated that there was a significant difference among all age classes. The PDW was significantly different among various age groups. The Platelet Distribution Width indicates volume variability in the platelet size and is elevated in the presence of platelet anisocytosis. This finding is supported by Eyiuche and Kosiso(2018) [16] that the PDW varied among different age groups. This may be as a result of the geographical location, sex and age. Determination of the PDW alongside the platelet count and MPV aids in diagnosis and differentiation of several pathologies. Significant variations in platelet count and PDW was observed due to age differences. The platelet count was lowest among the middle aged while the PDW was higher among middle aged subjects.

1. **RECOMMENDATION**

The PDW should be included as a major routine diagnostic tool and individuals should maintain a healthy lifestyle.

**ETHICAL APPROVAL**

Ethical approval for this study was obtained from the Research Ethics Committee of the Ministry of Health, State Secretariat Complex with a clearance from Rivers State Hospital Management Board, Port-Harcourt, Rivers State, Nigeria.

**Consent**

**As per international standards or university standards, Participants’ written consent has been collected and preserved by the author(s).**

**DISCLAIMER (Artificial intelligence):**

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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