

## Reference Values of Neutrophil-Lymphocyte Ratio, Platelet-Lymphocyte Ratio and Mean Platelet Volume in Healthy Adults in North Central Nigeria

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### Abstract

**Background:** Recently, Neutrophil-lymphocyte ratio (NLR), Platelet-lymphocyte ratio (PLR) and Mean platelet volume (MPV) have become increasingly useful as predictive and prognostic tools in patients with various medical conditions. To make for easy interpretation and application, the reference values of these parameters in healthy adults need to be established in our environment.

**Objectives:** To establish the reference values for NLR, PLR and MPV in healthy adults in a tertiary health facility in the North-central Nigeria.

**Methods:** Venous blood samples from five hundred (500) healthy adults were analyzed using a Sysmex automated haematology analyzer. The NLR and PLR were calculated while the MPV values were recorded from the print outs. The effects of some demographics on these parameters were assessed using the SPSS 19.

**Results:** The mean value for NLR was 2.8 (reference range, 1.2-4.4), PLR was 137 (reference range, 75-199) and MPV was 10.6 fl (reference range, 9.7-11.5 fl).

Individuals aged 18 to 50 years had significantly lower NLR ( $p=0.019$ ) and PLR ( $p<0.05$ ) than older individuals aged 51 to 85 years. PLR was also noted to be significantly higher in males than in females ( $p=0.003$ ), while NLR and MPV were not affected by gender.

**Conclusion:** The reference values for NLR vary with age while PLR vary with age and gender. These variations need to be considered while using these parameters for predictive and prognostic purposes in our environment.

**Keywords:** Reference values, Neutrophil-Lymphocyte ratio, Platelet-Lymphocyte ratio and Mean platelet volume

The above are few instances that demonstrated the widespread application of this parameter.

### Introduction

NLR is the ratio of absolute neutrophil count to the absolute lymphocyte count. It is regarded as a marker of the body's immune response to offending agents. It also regarded as a rapid and simple parameter indicative of systemic inflammation and stress [1]. Neutrophilia or lymphopaenia results in high NLR while lymphocytosis or neutropaenia results in low NLR. High NLR points to a predominance of inflammatory factors in the aetiopathogenesis of different conditions and possibly indicates subgroups of patients with similar disorder that will benefit from anti-inflammatory agents.

The prognostic role of NLR is continually being investigated. Studies have shown that elevated NLR predicted poorer overall survival and progression free survival in gastric cancer patients [2]. NLR has also been shown to increase in certain gynaecological, gastrointestinal cancers and cardiovascular diseases [3-5]. Increased NLR was noted to correlate with poor prognosis in sudden sensorineural hearing loss [6].

The second inflammatory marker is PLR. In various diseases like myocardial infarction, critical limb ischemia, end-stage renal failure, and ovarian epithelial carcinoma, PLR value has been shown to correlate with poor prognosis [7-10]. PLR value has also been reported to correlate with end-organ damage, high morbidity in non-ST myocardial infarction and peripheral vascular diseases [11].

The prognostic importance of PLR has also been noted in coronary artery diseases and hepatobiliary malignancies. In these conditions, elevated values of PLR confer poor prognosis [12].

The interest in the study of NLR and PLR has grown recently because they have been found to be predictive of the prognoses of patients with diverse inflammatory and ischemic conditions [7,13,14]. The absolute neutrophil, and platelet counts as well as lymphocyte count are easily obtained as parts of complete blood count (CBC) analysis. Hence, NLR and PLR do not require additional tests or costs as they are calculated from the haemogram. This makes it cost-effective and easy to be applied to virtually all patients.

MPV, another parameter that is commonly part of CBC report is the average size of platelets in the peripheral blood. An increased MPV indicates large platelets that usually results from increase in young platelets in circulation. Platelet size and activity are correlated. MPV have been shown to increase prior to acute myocardial infarction [15]. Patients with a severe cerebrovascular accident have significantly higher MPV levels [16].

The aim of our study was to establish the reference values and the effect of some demographics on these relatively novel, cost effective, inflammatory and prognostic markers in our locality [17].

## Materials and Methods

This is a descriptive cross sectional study seeking to establish the reference values for NLR, PLR, and MPV of healthy adults in a tertiary health facility in the North-central Nigeria. It was carried out in a tertiary health facility in the region. The sample population consisted of healthy adults aged 18 years and above attending to the facility for routine medical checks. Individuals with established ongoing medical conditions were excluded. Also excluded were those with marked abnormality in neutrophil, lymphocyte or platelet counts. The minimum sample size was calculated as 385 using the formula for sample size calculation for quantitative cross sectional study  $SS = (Z^2 SD^2) / d^2$ , where SS is the sample size, Z is the standard normal variate, SD is the standard deviation and d is the absolute error or precision.  $18 (Z \text{ at } 5\% = 1.96, SD=51 \text{ and } d=5)$ . Accordingly a sample size of 520 was chosen. Consecutive clients were recruited as they presented to the clinicians. Informed consent was obtained from participants, after which, 2 mls of venous blood was aseptically collected into an EDTA vacutainer bottle. Complete blood counts were done on the samples within six hours after phlebotomy. The samples were analyzed with sysmex automated haematology three-part analyzer KX 21N model. The NLR and PLR were calculated by dividing the mean neutrophil counts and the mean platelet counts by the mean lymphocyte count respectively. The MPV were recorded from the print outs and the mean calculated. Effects of age and gender on these variables were tested with Fisher's exact test. Analysis was done using the SPSS version 19, with the point of significance set at  $P < 0.05$ .

## Results

Five hundred healthy adults between the ages of 18 and 85 years gave consent and were enrolled for this study. They were made up of 290 (58.0%) males and 210 (42.0%) females. Three hundred and twenty (64.0%) candidates were aged 18 to 50 years while 180 (36.0%) were aged 51 to 85 years. Other characteristics of the study group are shown in Table 1.

Age range (median age)	18-85 (48) yrs	
Gender	N=500	Percentage (%)
Males	290	58
Females	210	42
Marital Status		
Single	115	23
Married	380	76
Widows	4	0.8
Widower	1	0.2
Educational status		
None	55	11
Primary	103	20.6
Secondary	230	46
Tertiary	112	22.4

**Table 1:** Demographic characteristics of the participants.

The mean value for neutrophil count was  $4.5 \times 10^9/l$ , mean platelet count was  $217 \times 10^9/l$ , and mean lymphocyte count was  $1.8 \times 10^9/l$ . The mean value for NLR was  $2.8 \pm 1.6$ , PLR was  $137 \pm 102$  and MPV was  $10.6 \pm 0.9$  fl.

PLR was noted to be significantly higher in males than in females ( $p=0.003$ ), while NLR and MPV were not affected by gender (Table 2).

Parameters	Gender		p-value
	Male (n=290)	Female (n=210)	
NLR	$2.9 \pm 1.8$	$2.8 \pm 1.7$	0.939
PLR	$153.0 \pm 63.0$	$118.8 \pm 61.0$	0.003
MPV	$10.4 \pm 0.8$	$10.9 \pm 1.1$	0.32

**Table 2:** Reference values for NLR, PLR and MPV according to gender.

Further analysis showed that, young individuals aged 18 to 50 years had significantly lower NLR ( $p=0.019$ ) and PLR ( $p < 0.05$ ) than older individuals aged 51 to 85 years (Table 3).

Parameters	Age		p-value
	18-50 (years)	51-85 (years)	
NLR	$2.7 \pm 1.5$	$3.1 \pm 2.2$	0.019
PLR	$113.0 \pm 32.0$	$151.0 \pm 49.9$	0
MPV	$10.7 \pm 1.1$	$10.4 \pm 0.9$	0.474

**Table 3:** Reference values of NLR, PLR and MPV according to age.

## Discussion

Studies on NLR, PLR and MPV have grown recently following the discovery of their immense values in prediction and prognosis of many medical conditions. These parameters are potent markers of inflammation which underlies the basic pathologies of various diseases. The easy of availability of these parameters without additional costs to the patients may gradually replace the older markers of inflammation.

Our result revealed that the mean value for NLR in our locality was 2.8. This is higher than the value reported in Non-Hispanic Blacks (2.24) and in Whites (1.76) in a study conducted in the United States [18]. In another study carried out on healthy adults in China, the mean baseline NLR was  $1.5 \pm 0.05$  [19]. Though the sample size for that study was low (30), the value is also lower than what we got in our centre. In Chennai, Shiny et al, reported a NLR of  $1.5 \pm 0.41$  among healthy non- glycaemic individuals [20]. These variations in the values of NLR may be an indication that race and environment have effect on the NLR, therefore the use of arbitrary cut off points for risk stratification will be inherently misleading. This buttresses the need to establish the mean value and reference ranges for this parameter in our environment. We did not note any significant differences in NLR with respect to sex, education, and marital status similar to what was reported in other studies [18-20].

Older individuals between the ages of 51 to 85 years had significantly higher mean NLR of ( $p=0.019$ ) than younger candidates aged 18 to 50 years (Table 3). This may be as a result of increase in inflammatory environment associated with chronic conditions like diabetes, and cardiovascular diseases which are common with increasing age [21].

The mean PLR from this study was  $137 \pm 62$ . Various research works [7,22,23] have used various cut off points for their studies but none to our knowledge actually worked out what the reference range should be in a particular population. The PLR is a largely available and cheap marker, which could be used to highlight patients at high risk for vascular endpoints; as a result, it will be advisable for centers to establish its reference ranges in their environments.

The mean MPV from this study was  $10.6 \pm 0.9$  fl. This is higher than the  $8.9 \pm 1.4$  fl that was recorded in Demirin et al study [24]. In stable conditions, it has been shown that MPV, which is the most accurate measure of the size of platelets, is inversely associated with platelet count [25,26]. The higher MPV in our study may be related to the lower platelet count compared with the Caucasian value. Since MPV is a simple and accurate marker of the functional status of platelets, one can assume that our platelets are more functionally active than that of Caucasian, but this is yet to be proven.

## Conclusion

The reference values for NLR, PLR vary with age and PLR also vary with gender. These variations need to be considered while using these parameters for predictive and prognostic purposes in our environment. Abnormalities in these parameters may be a pointer to a subclinical condition which further investigation will lead to early diagnosis.

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