International Journal of Medical and Health Sciences

Journal Home Page: http://www.ijmhs.net ISSN:2277-4505

Original article

Changes in Platelet Indices in Obese and Non-Obese Individuals in a Tertiary Healthcare Facility in Uyo, Nigeria

Timothy Amos Ekwere[1*], OlugbemiOluseyiMotilewa[2]

[1]Department of Haematology, [2]Department of Community Health, University of Uyo/University of Uyo Teaching Hospital, Uyo, Nigeria.

ABSTRACT

Background: Obesity is associated with significant cardiovascular and thromboembolic risk largely due to increased platelet reactivity. **Objectives**: To determine the changes in platelet counts and platelet activation using platelet indices (MPV & PDW) in obese and non-obese patients in a tertiary hospital in Uyo, Nigeria.**Methodology**: This was a cross-sectional descriptive study comprising of 191 participants recruited consecutively from the out-patients Departments of University of Uyo Teaching Hospital over a six months period (March-August 2018). Patients were categorised into obese, overweight and normal weight based on their Body Mass Index (BMI). Also, 2.5mls of blood was collected from each patient and same was used to determine full blood count from where the platelet count and platelet indices (MPV & PDW) were obtained. **Results:** There was progressive increase in the mean platelet count of the patients (210.59 ± 51.6, 194.26 ± 49.8, 184.95 ± 51.7 for obese, overweight and normal weight respectively) and this increase was statistically significant (P=0.0208). However, the mean platelet indices (MPV & PDW) was not statistically significant (P=0.351 and 0.933 for MPV and PDW respectively). **Conclusion:** Platelet counts was significantly elevated in obese patients compared with the overweight and normal weight however, the MPV and PDW was not significantly different in the three groups.

KEYWORDS:Obesity, Body mass Index, Platelet indices, Platelet activation.

INTRODUCTION

Globally, obesity has been recognized as an important public health problem that is associated with significant cardiovascular risk and premature mortality [1]. The incidence in many developed countries and more recently in middle and low income countries has been on the increase in the last 2 to 3 decades [2]. Once established, it is often difficult to reverse and may progress through to adulthood [3].

Like other cardiovascular risk factors, obesity is associated with the formation ofatheromatous plaque. This usually begins by second decade of life and tends to progress with increasing age [4]. Chronic low grade inflammatory processes involving adipose tissue contributes to the metabolic disorder in obesity. [5] Various cytokines, in particular Interleukin-6 (IL-6), derived from the adipose tissue alongside other cytokines play a vital role in the pathogenesis of atherosclerosis. [6, 7] In addition, IL-6 promotes platelet production in humans [8].

Association between platelet count and platelet activation have been reported in chronic inflammatory conditions. [7] Elevated Platelet count and platelet activation plays a contributory role in the progression of thromboembolic or cardiovascular disease. It has been implicated in the conversion of atheromatous plaque into a thrombus [9]. Most of the cardiovascular risk factors are able to increase the number of activated platelets in circulation. Activated platelets are generally larger and are metabolically and enzymatically more active than non-activated platelets. [10] Thus, the presence of increased circulating activated platelets preceding a thromboembolic or cardiovascular incident such as myocardial infarction or stroke may be an important factor in the pathogenesis and progression of atherosclerosis [9].

Platelet activation may be assessed by different biomarkers including the assay of 11-dehydrothromboxane B2, a urinary excretion product of thromboxane B2 metabolism, plasma level of

P-selection, β-thromboglobulin and Annexin –V binding [11]. However, the processes involved in the assay of these biomarkers are often cumbersome and quite expensive.

The measurement of platelet indices such as platelet count, mean platelet volume (MPV) and platelet distribution width (PDW) provides an alternative means of assessing platelet activation via the electronic cell counter [12]. The process is fast and cost effective. The PDW measures the degree of variability in platelet size and is more informative than MPV in terms of platelet reactivity and activation. The MPV on the other hand, is a marker of platelet function, an increase MPV is an indicator of larger and more reactive platelets and has been shown to be a good predictor of clinical outcome among survivors of a cardiovascular event such as myocardial infarction [11].

There has been contrasting reports on the association between platelet count and platelet activation in obese Individuals. While some authors have reported evidence of platelet activation in obese Individuals [13], others found no evidence of platelet activation in obese persons. [14, 15] Activated platelet as measured by the platelet indices are potentially useful markers for the early diagnosis of thromboembolic and/or cardiovascular events. [16] Obesity is a known risk factor for various thromboembolic/ cardiovascular disease. Therefore, this study aims to determine the changes in platelet counts and platelet activation using platelet indices (MPV & PDW) in obese, overweight and normal weight patients in a tertiary hospital in Uyo, Nigeria.

MATERIALS AND METHODS

Study Site.

The study was conducted at University of Uyo Teaching Hospital a tertiary referral hospital in Uyo, a capital city in the Niger Delta region of Nigeria.

Study Population

The participants were apparently healthy individuals who presented for medical check-up or follow-up after full recovery of primary ailment in the General out-patient department of University of Uyo Teaching Hospital. They were recruited consecutively as they come over a period of six months (March-August 2018). The recruitment was based on the body mass index of the participants. A total of 191 participants were recruited into the study of whom 64 were of normal weight, 68 were overweight while 59 were obese.

Study design

A descriptive cross-sectional study design was used to achieve the set objectives.

Analytical Method

2.5mls of venous blood was collected from each participant into a sterile specimen bottle containing ethylene diaminetetracaetic acid (EDTA) as anticoagulant under aseptic condition. Each sample was marked with a unique identification number allocated to each participant. These samples were pooled in batches and used to determine Complete Blood Count (CBC) within 2hours of its collection using "SysmexKX3"1 N Haematology autoanalyzer. The total platelet count, Platelet Distribution width (PDW) and Mean platelet Volume (MPV) were obtained from the CBC results and recorded for each participant.

Also, the weight and height of each participant were obtained using standard scales. From these values the body mass index (BMI) for each participant was determined. The BMI is an estimate of body fat mass. It is determined by dividing a person's weight in kilogram by the square of the height in meters i.e. Weight (Kg)/ H (m^2). Based on the BMI value, the individual is classified as follow:

Under weight: BMI < 18.5, Normal weight: BMI 18.5 – 24.9, Over weight: BMI 25.0 – 29.9, Obesity: BMI > 30.0 [ ].

Data Collection

The test result of platelet indices and BMI for each respondent was collected and recorded in a proforma designed for the study.

Data Analysis

The data was analyzed using SPSS for Windows Version 16.0 (SPSS Inc., Chicago, IL, USA) and presented in simple tables. The Continuous variables were given as Means ± Standard deviation (SD). Pearson Chi – Squared was used to test for association between Categoricalvariables. Anovatest was used to compare means across the three categoriesthe level of significance was set at $p < 0.05$

Ethical Consideration

A signed informed consent was obtained from each participant before their enrolment in the study. Also, ethical approval was obtained from the Ethics and Research Committee of the hospital before the commencement of the study.

RESULTS

A hundred and ninety-one participants were enrolled in the study. Based on their BMI, 64 were normal weight while 59 and 68 were over-weight and obese respectively. 59.7% of the participants were females while 40.3% were males. The mean ages of the normal weight, overweight and obese participantswere 38.95±12.3 years, 41.46± 10.4 years and 42.88±8.0 years respectively. There were twice and thrice as many overweight and obese women as men (61.8% vs 38.2% and 78.0% vs 22.0% respectively). Furthermore, there was statistically significant differences in the mean weight, height and BMI of participantsin the three arms of the study (p=0.001, 0.0031 and 0.0001 respectively). Table 1

Table 1: Demographic and Anthropometric Characteristics of the Participants

Characteristics	Normal weight n=64 (%)	Overweight n=68 (%)	Obese n=59 (%)	Total n=191 (%)	Statistical indices
Age (years) Mean (SD)	38.95 (12.3)	41.46 (10.4)	42.88 (8.0)	41.06 (10.5)	Ftest=2.26 P value=0.1072

Sex F M	26 (40.6) 38 (59.4)	42 (61.8) 26 (38.2)	46 (78.0) 13 (22.0)	114 (59.7) 77 (40.3)	Chi2=17.9795 P value<0.0001
Weight (Kg) Mean (SD)	60.78 (7.5) †‡	71.01 (6.9)‡	84.75 (9.3)	71.83 (12.5)	Ftest=141.25 P value<0.0001
Height (cm)	164.13 (7.9) †‡	160.73 (7.4)‡	159.(7.4)	161.54 (7.8)	Ftest=5.95 P value=0.0031
BMI Mean (SD)	22.44 (1.6) †‡	27.4 (1.5)‡	33.2 (3.0)	27.53 (4.8)	Ftest= 394.13 P value<0.0001

† P value less than 0.05 when compared to overweight

‡ P value less than 0.05 when compared to Obese

A progressive increase in the mean platelet count was observed in the three arms of the study and this increase was statistically significant. (p=0.0208). On the other hand, the mean platelet indices (MPV & PDW) in the three arms of the study were not statistically significant. (p=0.351 & 0.933 respectively) Table 2

Table 2: The Mean Platelet Count and Platelet Indices of obese, overweight and normal weight Participants

Characteristics	Normal weight (n=64)	Overweight (n=68)	Obese (n=59)	Total (n=191)	Statistical indices
PLT Mean (SD)	184.95 (51.7)‡	194.26 (49.8)	210.59 (51.6)	196.19 (51.8)	Ftest=3.95 p value=0.0208
MPV Mean (SD)	9.49 (0.8)	9.55 (0.8)	9.33 (0.9)	9.46 (0.8)	Ftest =1.05 p value=0.351
PDW Mean (SD)	16.1 (0.5)	16.08 (0.4)	16.11 (0.4)	16.09 (0.4)	Ftest=0.07 p value=0.933

KEYS: PLT: Platelet count; MPV: Mean Platelet Volume; PDW: Platelet Distribution Width.

‡: p value less than 0.05 when compared to Obese

The BMI differs significantly across the three groups p= 0.0001. However, the platelet count and the platelet indices were not significantly different across the three groups, though a progressive increase in the mean platelet count was observed across the three groups. Table 3.

Table 3: Mean BMI and Platelet indices of obese, overweight and normal weight male Participants

Characteristics	Normal weight (n=38)	Overweight (n=26)	Obese (n=13)	Total (n=77)	Statistical indices
BMI	22.39 (1.6)†‡	26.99 (1.5)‡	31.63 (1.2)	35.5 (3.8)	Ftest =200.02 P value<0.0001
PLT	178.39 (50.7)	188.12 (47.9)	207.77 (41.9)	184.95 (48.9)	Ftest=1.81 P value=0.1704
MPV	9.47 (0.9)	9.47 (0.8)	9.45 (0.8)	9.46 (0.8)	Ftest=0.00 P value=0.9985
PDW	16.23 (0.4	16.19 (0.4)	16.09 (0.3)	16.19 (0.4)	Ftest= 0.51 P value=0.6019

† P value less than 0.05 when compared to overweight

‡ P value less than 0.05 when compared to Obese

There was a near equal representation of the overweight and obese female Individuals. Similar to the male subjects, the BMI differs significantly across the three groups but, platelet count and platelet indices did not show any significant difference across the groups. However, a progressive increase in the mean platelet count was also observed across the three groups. Table 4.

Table 4: Mean BMI and Platelet indices of obese, overweight and Normal weight Female Participants

characteristics	Normal weight (n=26)	Overweight (n=42)	Obese (n= 46)	Total (n=114)	Statistical indices
BMI	22.51 (1.7)	27.64 (1.4)	33.65 (3.2)	28.89 (5.0)	Ftest=190.28 P value<0.0001
PLT	194.54 (52.7)	201.17 (50.3)	211.39 (54.5)	203.78 (52.5)	Ftest=0.94 P value=0.3952
MPV	9.53 (0.8)	9.60 (0.8)	9.30 (0.9)	9.46 (0.8)	Ftest=1.43 P value=0.2448
PDW	15.90 (0.5)	16.01 (0.4)	16.11 (0.4)	16.03 (0.4)	Ftest=2.27 P value=0.1080

† P value less than 0.05 when compared to overweight

‡ P value less than 0.05 when compared to Obese

DISCUSSION

Various parameters have been developed for early detection of cardiovascular risk related complications. [17] Elevated platelet being a determinant of cardiovascular complication, is one of such parameters. [16]

Our result showed that the mean platelet count in obese individuals was significantly higher than those of overweight and normal weight. Our finding agrees with the study by Helou et.al [18] who reported a positive association between obesity and increase leucocyte and platelet counts. However, it contrast with findings from other studies [19, 20, 21]. Atherosclerotic Risk Community study (ARIC) reported no significant correlation between obesity and platelet counts despite demonstrating positive correlation between leucocyte and platelet count. [19]

Jamshidi et.al, [20] reported a higher platelet counts in obese and overweight Individuals, however, this was not significantly different when compared with platelet count of the controls. Furthermore, Charles et.al [21], reported an association between obesity and platelet counts in females but no association was observed in males. Similar observation was reported by Samocha-Bonet et.al. [22] These two later studies contrast with finding from our study which showed that the increase in platelet counts with BMI was not statistically significant in both gender. Perhaps the relatively small sample population used in this study may have accounted for this observed differences.

Obesity being a chronic inflammatory process is associated with production of cytokines. As earlier noted above IL-6 produced from macrophages of adipose tissue promotes Megakaryocytopoiesis in humans in addition to other pro-thrombotic effects it exerts on platelets, vascular endothelium smooth muscle proliferation and macrophage lipid accumulation. [8] This perhaps, explain the high platelet count observed among the overweight and obese Individuals relative to the controls.

Platelet activation represents a central process in thrombus formation. [11] Platelet indices (MPV & PDW) provides an alternative means of determining platelet activation. [12] Increase in level of platelet indices is a potential risk for atherothombosis. Coban et.al [23], reported a significantly higher MPV levels in obese Individuals than in non-obese. Furman-Niedziejko et.al, [24] reported a positive correlation between MPV and waist circumference in Individuals with metabolic syndrome and abdominal obesity and this was significantly higher than in patients without this abnormalities. Similarly, Arslan et.al, [25] showed that the mean MPV was significantly higher in obese adolescents than their healthy counterparts.

However in this study, the mean MPV and PDW in obese and overweight Individuals were not significantly different from those of normal weight individuals. This perhaps implies that MPV and PDW are not related to the degree of obesity and thus plateletsthough elevated are not activated. Our finding agrees with studies from authors who found no evidence of platelet activation in obese Individuals. However, in these studies, [26. 27] biomarkers of platelet activation rather than platelet indices were used to determine evidence of platelet activation. Licata et.al, [26] measured 11- dehydro-thromboxane-β2 excreted in urine to demonstrate platelet activation in obese

and non-obese Individuals and found no significant difference in the urine level of this biomarker. Similarly, De Pergola et.al, [27] measured the plasma level of soluble P-selectin as determinant of platelet activation and found no significant difference in the plasma level of this biomarker in the Individuals and controls.

CONCLUSION

This study has shown that platelet count was significantly elevated in obese patients compared to overweight and normal weight patients. However, the MPV and PDW was not significantly different in the three groups, thus implying that there was no evidence of platelet activation in the obese patients.

Competing interest: The authors declare that they have no competing interests.

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*Corresponding author: DrTimothy Amos Ekwere
E-Mail:timothyekwere@yahoo.com