

A study of mean platelet volume in obese young adults

Kanmani Karthikkeyan ¹, Vidhya A ², SuganthaPriya S ³, Latha K ⁴, Deepa G ⁵

¹Associate Professor, ²Assistant Professor, ³Postgraduate, ⁴Assistant Professor, ⁵Assistant Professor, Department of Physiology, Stanley Medical College, Chennai -600 001, Tamilnadu.

Abstract

Background: Obesity is defined as an abnormal accumulation of adipose tissue due to increase in number and size of the fat cells or both. It is a major public health problem with increasing risk of developing Hypertension, Type 2 Diabetes mellitus, cardiovascular diseases, Stroke, Cancers, etc. Increased platelet activity with higher mean platelet volume is noted with elevated levels of inflammatory mediators in obesity. **Aim:** To determine the mean platelet volume in obese young adults. **Materials and methods:** Of the 60 participants, 30 were obese and 30 were healthy subjects with normal BMI, in the age group of 18 to 35 years recruited from the Non Communicable Disease Outpatient Department, Chennai. Body Mass Index (BMI), Waist Circumference (WC) and Waist Hip Ratio (WHR) were the obesity indices used to assess the obesity. Mean platelet volume (MPV) was estimated in them. **Results:** The data was analyzed using Statistical Package for Social Sciences (SPSS) version 20. The study groups were with the mean age of 23.87 ± 3.61 , mean BMI of 29.14 ± 2.63 , mean WC of 96.48 ± 5.98 , mean WHR of 0.91 ± 0.23 , mean MPV of 9.58 ± 1.88 . MPV was significantly higher ($p < 0.05$) among the obese individuals. Positive correlation was observed between the mean platelet volume and all the obesity indices and was statistically significant ($p < 0.05$). **Conclusion:** Mean platelet volume was higher among the obese individuals. This shows that the obese individuals are at the risk for cardiovascular complication due to increased platelet activation. Hence early diagnosis and appropriate interventions may prevent adverse cardiac events in obese individuals.

Key words: diabetes, hypertension, mean platelet volume, obesity, stroke

Corresponding Author

Dr. A. Vidhya, Assistant Professor, Department of Physiology, Stanley Medical College, Chennai, Tamilnadu.

Telephone : 9486526012 E-mail : antovidhya@rediffmail.com

Introduction

Obesity is defined as an abnormal growth of adipose tissue due to an enlargement of fat cell size (hypertrophy) or an increase in fat cell number (hyperplasia) or both. Obesity greatly increases the risk of chronic diseases such as Hypertension, Type 2 Diabetes Mellitus, cardiovascular diseases, certain

cancers, depression which lead to mortality and morbidity.^{1,2} Metabolic syndrome includes the group of disorders such as Hypertension, Diabetes, Dyslipidemia, Insulin Resistance, and obesity. Abdominal obesity associated with metabolic syndrome, favors the development of atherosclerosis, which is a potent risk factor for cardiovascular and cerebro vascular diseases.^{3,4}

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Obesity is excessive accumulation of metabolically active adipose tissue, found under the skin, around internal organs, between muscles and in breast tissue. Adipose tissue is an endocrine organ which secretes inflammatory mediators like leptin, interleukin -1, interleukin -6, TNF - α and CRP.⁵ Platelets have receptors for TNF- α and increased levels of TNF- α leads to activation of platelets.

Platelets also have receptors for insulin; it inhibits platelet aggregation and activation in insulin sensitive subjects. Insulin resistance is associated with reduction in anti-aggregation action of insulin.^{6,7} In addition they also produce plasminogen activator inhibitor-1 (PAI-1), that inhibits fibrinolysis, which is the physiological process in the lysis of atherothrombus.⁸

The circulating platelets are disc shaped, which may vary in size and play main role in maintaining the integrity of blood vessels through adequate hemostasis.⁹ Larger platelets contain more granules and are metabolically and enzymatically more active producing more vasoactive and haemostatic substances such as thromboxane A₂, serotonin or adenosine triphosphate (ATP) which promotes aggregation. They also have greater number of adhesion molecules (p-selectin) which increases the thrombus formation, enhancing the prothrombotic potential when they are stimulated.¹⁰

Mean platelet volume (MPV), the most commonly used measure of platelet size, is a potential marker of platelet reactivity.¹¹ MPV is increased in acute myocardial infarction, acute ischemic stroke, preeclampsia and renal artery stenosis. Several studies have demonstrated that there is a close relationship between obesity, metabolic syndrome, body fat, and MPV.^{12, 13} Hence this study was done to assess the mean platelet volume in young obese

adults, so as to prevent the cardiovascular complications at the earliest.

Aim and objectives

1. To determine the Mean Platelet Volume.
2. To measure the Waist Circumference (WC) and to calculate Body Mass Index (BMI), Waist Hip Ratio (WHR) in the obese adults.
3. To correlate the mean platelet volume with the obesity indices.

Materials and Methods

This is a analytical cross sectional study done after obtaining clearance from the Institutional Ethical committee. 60 subjects in the age group of 18 to 35 years were recruited from Non communicable disease, Outpatient Department, Stanley Medical College and Hospital, Chennai for a period of 6 months. 30 subjects of both gender with BMI > 25, based on recent consensus guidelines for India (Normal weight - BMI 18 - 22.9, Overweight - BMI 23 - 24.9, Obese - BMI > 25)¹⁴ were recruited as obese group.

Obese subjects with the known history of the Diabetes, Hypertension, Coronary artery disease, Neurological disorders, Thyroid dysfunction, chronic medications for any other illness, those with adverse habits such as smoking, tobacco and alcohol abuse, and women with pregnancy and history of PCOS were excluded from the study. 30 apparently healthy subjects, who were age and gender matched and with normal BMI, were the control group.

Written and informed consent were obtained from all the subjects. History was taken and clinical examination was done. The height was measured in meter (m) on barefoot using stadiometer and weight in kilograms by using a standardized weighing machine for all the subjects.

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Body Mass Index was calculated using Quetelet's Index (Weight / Height²). Their Waist Circumference was measured in centimeters at the level of umbilicus or midway between the lower ribcage and pubic symphysis and hip circumference was measured as widest circumference at the level of greater trochanter using inch tape. Then the Waist-Hip Ratio was calculated.

Determination of Mean platelet volume

Under strict aseptic precaution, 2ml of blood sample was collected in EDTA coated tubes from each subject by antecubital venipuncture.

Results

Mean platelet volume was estimated in central laboratory, by using Hematology Sysmex Autoanalyzer, Department of Pathology, Stanley Medical College and Hospital, Chennai.(Reference values of MPV - 7.5 to 12 femtolitres).

Statistical analysis

The data was obtained and analysis was done using software SPSS version 20. Independent Students t- test was used and p value < 0.05 was considered to be statistically significant. Pearson's test was used to find out the correlation between the mean platelet volume and obesity indices.

Table -1 : Demographic characteristic, obesity indices and Mean platelet volume in control and study population

Parameter	Control Group (n=30) (Mean ± S.D)	Study group- Obese(n=30) (Mean ± S.D)	p- value
Age (years)	24.05 ± 3.43	23.87 ± 3.61	0.73
Sex	Males n=12 Females n=18	Males n=17 Females n=13	
SBP (mmHg)	117.8 ± 5.31	125.9 ± 6.39	0.98
DBP (mmHg)	73.16 ± 6.03	80.02 ± 6.51	0.57
Random blood sugar (mg/dl)	102.23 ± 2.17	108.76 ± 1.54	0.84
Height (m)	1.68 ± 0.12	1.74 ± 0.61	0.64
Weight (kg)	60.01 ± 5.64	87.16 ± 6.27	0.08
BMI (kg/m ²)	22.03 ± 1.06	29.14 ± 2.63	0.045*
WC (cm)	76.32 ± 3.35	96.48 ± 5.98	0.038*
WHR	0.82 ± 0.85	0.91 ± 0.23	0.052*
Mean platelet volume(fl)	8.56 ± 1.42	9.58 ± 1.88	0.046*

* p value < 0.05 significant

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Of the total of 60 participants, 30 of them were healthy individuals and 30 were obese. Data are represented as mean \pm standard deviation. Table- 1 depicts the demographic characteristics, obesity indices and mean platelet volume in the control and study group. It shows the mean age for control and obese group were 24.05 and 23.87 years.

Both the groups were age and gender matched. There was a significant difference ($p < 0.05$) in mean values of BMI, WC, WHR between the

control and obese group. There was increase in mean values of MPV among the obese group than the control group which was statistically significant ($p < 0.05$). Correlation between obesity indices and mean platelet volume is given in table 2.

A significant positive correlation was observed between BMI, WC, WHR and MPV values and was statistically significant ($p < 0.05$). Among the obesity indices, BMI had better positive correlation than WC and WHR.

Table -2 : Correlations between Obesity Indices and Mean platelet volume in the study group.

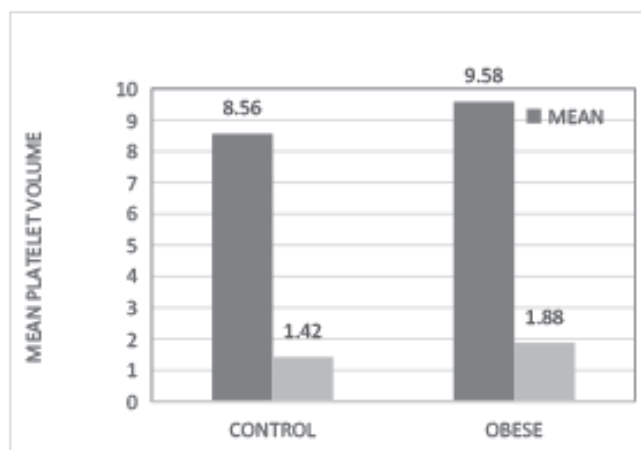
Obesity indices	Correlation co- efficient (r- value, p- value)
BMI	r = 0.64, p=0.021*
WC	r = 0.79, p=0.034*
WHR	r = 0.85, p=0.05*

* p value < 0.05 significant, BMI- Body mass index, WC – Waist circumference, WHR- Waist Hip Circumference.

The mean values of MPV are compared between the control and obese group and is shown in figure 1. The mean platelet volume of the control group and obese group were

8.56 \pm 1.42 and 9.58 \pm 1.88. The mean platelet volume was found to be higher among the study group and was statistically significant ($p < 0.05$).

Figure1 : Comparison of Mean platelet volume among the control group and study group



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Discussion

In our study, 60 subjects were recruited among which 30 were obese and 30 were healthy adults of normal weight. Obesity indices WC were measured, BMI, WHR were calculated and Mean platelet volume were measured. Our study was done in younger age group of 18-35 years with mean of 23.87 years and it showed platelet activation, which is indicated by higher MPV values. Only obese individuals without any co morbidities were recruited to show that obesity is an independent risk factor for platelet activation. Most of the studies had shown the association between mean platelet volume and obesity indices in obese individuals with the mean age of 50 years (18-72 years).¹⁵ Aiyden et al demonstrated the elevated levels of MPV in obese adolescents in the age group of 6-15 years.¹⁶

Our present study showed, the mean platelet volume was higher among the obese group and was statistically significant which was similar to Cohen et al study, who evidenced the elevated levels of MPV among the obese but other studies showed different results.¹⁷ Study by Sansanayudh et al demonstrated that increased MPV is associated with female gender, diabetes, metabolic syndrome, serum triglyceride, hypertension, but not related to BMI.¹⁸ However few studies have shown the lack of association between obesity and MPV.¹⁹

The probable cause for higher values of MPV noted in obese group could be the adipose tissues, which have increased sensitivity to adrenergic stimulation and causes the release of free fatty acids into circulation, altering the lipid metabolism, glucose metabolism, and leading to hyperinsulinemia. Since the platelets have insulin receptors, the insulin stimulates the production of larger platelets during the process of megakaryocytopoiesis in the bone marrow.²⁰ Platelet size is mainly determined in the bone marrow during megakaryocytopoiesis, and subsequently does not substantially change.

Another reason could be the platelets are largely activated by inflammatory triggers. MPV is partially regulated by thrombopoietin. The growth factors and cytokines play important role in the production of larger and more reactive platelets in the bone marrow. Study by Batenelli et al had proposed the role of elevated levels of cytokines like IL-1, IL-3, IL-6, and nitric oxide influencing megakaryocytopoiesis.²¹ Few studies have evidenced increased platelet reactivity in conditions such as obesity, endothelial dysfunction, myocardial and cerebral ischaemia, which is also associated with increased levels of cytokines and inflammatory mediators. Increased oxidative stress could be another contributory factor for platelet activation.^{22,23}

We observed a positive correlation between BMI and MPV and that BMI had better correlation than WC, WHR which was in favour of study by Cohen et al. However few studies have evidenced that the Waist circumference showed positive correlation with mean platelet volume than BMI.²⁴

Our study mainly focused on early identification of elevated MPV in young obese adults. Since obesity is a reversible condition, the reduction in mean platelet volume is noted with weight loss.²⁵ Early interventions like life style modification, health education, increasing physical activity, weight loss measures can reverse mean platelet volume to normal thereby reducing the morbidity and mortality.

Conclusion

This study revealed an elevated mean platelet volume in obese young individuals and positive correlation was observed between the obesity indices and MPV. Mean platelet volume is a simple and easy method of assessing the platelet activation, which could be included as a routine investigation in all obese individuals. Since they are at high risk of cardiovascular diseases, regular

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follow up of these individuals is necessary to prevent morbidities in the future.

Limitations

Our present study was conducted in small sample size; it could be done in larger population in future. The levels of inflammatory markers like leptin, insulin, IL-6, CRP could be included and correlated with MPV in future studies.

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Conflict of interest Nil

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