# Comparison of mean platelet volume in patients with diabetes mellitus, impaired fasting glucose and non-diabetic subjects

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## ABSTRACT

__Introduction:__ Large platelets are more thrombogenic and thus put the patient at a higher risk status. Mean platelet volume (MPV) is a determinant of platelet functionality and increased MPV is associated with increased risk for myocardial infarction, stroke and transient ischaemic attacks. The objective of this study is to compare the MPV in patients with diabetes mellitus (DM), impaired fasting glucose (IFG), and non-diabetic controls.

__Methods:__ This cross-sectional study was conducted at Dow University of Health Sciences, Karachi, Pakistan between the period of September 2006 and May 2007. Sample size of 204 in each group was calculated using power (1-beta) of 90 percent and level of significance (alpha) at five percent. Confirmed patients with DM, IFG and non-diabetic controls were selected and allocated to respective groups. A total of 612 patients were selected and allocated to three groups of 204 patients each, referred to as DM group, IFG group and non-DM group. Fasting blood glucose, platelet counts and MPV were done.

__Results:__ Mean MPV in the DM group was 9.34 fl, in the IFG Group 8.98 fl, and in the non-DM group 8.63 fl. Comparison of MPV values for the three groups showed statistically significant intergroup and intragroup differences, with a p-value of 0.00.

__Conclusion:__ MPV was significantly increased in the IFG group, as compared to the non-DM group, and it increased further when compared to the DM and IFG groups.

Keywords: diabetes mellitus, impaired fasting glucose, mean platelet volume, stroke, thromboembolism

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## INTRODUCTION

Platelets play an important role in the integrity of normal homeostasis, and mean platelet volume (MPV) is the indicator for its function.[1] The large platelets contain more dense granules, are more potent than the smaller platelets, and are hence more thrombogenic. Both the size and number of granules in platelets in circulation are under independent hormonal control and do not change during the life span of the platelet.[2-4] Increase in MPV has been documented in patients with metabolic syndrome, stroke and diabetes mellitus (DM).[5] MPV, a determinant of platelet function, is a newly emerging risk factor for atherothrombosis. Many studies have shown that increased MPV is one of the risk factors for myocardial infarction, cerebral ischaemia and transient ischaemic attacks.[6-10]

Impaired fasting glucose (IFG) is probably a frequent glycaemic disorder in the general population, and is considered as a pre-diabetic state.[11] Altered platelet morphology and function have been reported in patients with DM, and MPV was found to be significantly higher in diabetic patients.[12,13] They are likely to be associated with the pathological processes and increased risk of vascular disease seen in these patients.[13] Larger platelets are haemostatically more active and are a risk factor for developing coronary thrombosis, leading to myocardial infarction. Patients with larger platelets can easily be identified during routine haematological analysis and could possibly benefit from preventive treatment. Thus, MPV is an important, simple, effortless, and cost-effective tool that should be used and explored extensively, especially in countries like Pakistan, for predicting the possibility of impending acute events.[14] A large proportion of persons with type 2 DM suffer from preventable macrovascular complications. There is a need to develop risk factor modification interventions to reduce the impact of long-term complications.[15]

The prevalence of diabetic microvascular complications is higher in people with poor glycaemic control, longer duration of DM, and associated hypertension and obesity.[16] Elevated MPV is associated with a worse outcome for acute ischaemic cerebrovascular events independent of other clinical parameters.[17] There

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is no study about the relationship between MPV, DM and IFG from Pakistan. This study is conducted to compare MPV in diabetic patients, subjects with IFG, and non-diabetic controls.

## METHODS

This cross-sectional study was conducted at the civil hospital associated with Dow University of Health Sciences, Karachi, Pakistan, during the period September 2006 to May 2007. Consecutive patients with DM attending the diabetic clinic were selected by non-parametric sampling and allocated to the DM group. Diagnosis of DM was established using the ADA criteria of fasting blood glucose (FBG) of ≥ 126 mg/dL on two occasions. Near relatives of diabetic patients were encouraged for blood glucose testing and those with values between 110 mg/dL and 126 mg/dL were allocated to the IFG group and those whose values were < 110 mg/dL were taken as normal subjects and allocated to the non-DM group. Subjects having idiopathic thrombocytopenic purpura and iron deficiency anaemia, acute post-streptococcal glomerulonephritis, renal failure, cyanotic congenital heart diseases and myocardial infarction were excluded.[18] Informed consent was taken from all selected subjects.

Blood glucose was tested using Merck Diagnostic kits on a Hitachi automated chemistry analyser. Samples for platelet counts and MPV were collected using sodium citrate as anticoagulant and were done on a Sysmex auto-analyser. Sample size of 204 was calculated for hypothesis testing (two-sided) for proportions using the earlier reported mean values of MPV in diabetic patients and non-diabetic patients as 14.2 fl and 7.1 fl, respectively.[12] The power of test (1-β) was kept at 90% and level of significance (α) at 5%. Mean (± SD) were calculated for age and MPV for all the three groups separately. Difference between the means of age, MPV and gender between the three groups and within the groups were calculated by analysis of variance (ANOVA) using Tukey's honestly significant difference (HSD) test. p-values and 95% confidence intervals (CI) were also calculated. p-value of ≤ 0.05 was taken as significant. Statistical analysis was done by the Statistical Package for Social Sciences version 15.0 (SPSS Inc, Chicago, IL, USA).

## RESULTS

A total of 612 patients fulfilling the selection criteria were selected and allocated to three groups of 204 each, according to their diabetic status. These included 337 (55.1%) males and 275 (44.9%) females. The gender distribution (df = 2; p = 0.67) and mean age (df = 2; p = 0.093) in three groups were similar. The mean FBG in the diabetic group was 163.17 mg/dL, in IFG group

118.39 mg/dL, and in non-diabetic group 95.29 mg/dL. The mean platelet counts in DM, IFG and non-DM groups were 230.42, 200.52 and 210.04, respectively; while the MPV in the three groups were 9.34 fl, 8.98 fl and 8.63 fl, respectively (Table I). The platelet count and MPV were compared among the three groups by ANOVA Tukey's HSD test. The analysis showed that there was no significant difference between the platelet counts of the three groups but significant differences were observed in MPV among all three groups. The difference of MPV among the non-DM and DM groups was highly significant with a p-value of 0.000 and 95% CI of -1.03 and -0.38. The difference between the non-DM and IFG group was also significant with a p-value of 0.03 and 95% CI of -0.67 and -0.02. Difference in MPV was also significant between IFG and DM groups with a p-value of 0.26 and 95% CI of -0.68 and -0.03.

**Table I. Mean age, platelet count and MPV according to diabetic status**

|  | DM | IFG | Non-DM |
| --- | --- | --- | --- |
| Age ± SD (years)[1] | 40.0 ± 10.2 | 40.1 ± 15.0 | 42.3 ± 10.5 |
| Male:female[2] | 117:87 | 112:92 | 108:96 |
| FBG (mg/dL) | 163.17 | 118.39 | 95.29 |
| Platelet count (× 10³) | 230.42 | 200.52 | 210.04 |
| MPV (fl) | 9.34 | 8.98 | 8.63 |

[1] One-way ANOVA, df = 2; p = 0.093
[2] One-way ANOVA, df = 2; p = 0.67

## DISCUSSION

This is the first study from Pakistan to report the increase MPV in diabetic and IFG patients, with respect to non-diabetic patients. In this study, we have shown a significant stepwise increase in MPV from a non-diabetic population to IFG, and then further to a diabetic population, while there is no significant change in platelet counts in the same samples of blood. This is in agreement with other studies that have also reported the increase in MPV in diabetic patients in comparison with healthy controls.[13,19] For reliable estimations of MPV, it is recommended that the sample be collected in sodium citrate instead of ethylenediaminetetraacetic acid (EDTA), and in our study, we used sodium citrate for anticoagulation.` It has been shown that the platelets in diabetic patients are hyperactive.[20] The issue is still unresolved as to whether it is the primary hyperactivity of platelets or secondary hyperactivity of platelets due to the continuous low grade exposure to the damaged microvascular bed. Platelet hyperactivity results in increase in MPV, and vice versa.[4,21]

Increase in MPV is now emerging as an independent risk factor for thromboembolism, stroke and myocardial

infarction.[5,8,9,22] Diabetic patients are known to have higher incidence of stroke and myocardial infarction.[23] Presence of high MPV in these patients is an important finding that could increase the risk of thrombotic complications. It has also been shown that among diabetic patients, those with retinopathy and other complications have higher MPV values than those who do not have this complication.[12] Another important finding in our study was presence of significantly higher MPV in IFG patients as compared to non-diabetic subjects. This shows that patients of IFG are also at an increased risk.[24] Increased MPV has also been documented in gestational diabetes mellitus,[25] congestive cardiac failure[26] and coronary artery ectasia.[27] We conclude that MPV is significantly increased in patients with IFG and DM.

## REFERENCES

1. Jakubowski JA, Thompson CB, Vaillancourt R, Valeri CR, Deykin D. Arachidonic acid metabolism by platelets of differing size. Br J Haematol 1983; 53:503-11.
2. Chamberlain KG, Tong M, Chiu E, Penington DG. The relationship of human platelet density to platelet age: platelet population labeling by monoamine oxidase inhibition. Blood 1989; 73:1218-25.
3. Pereira J, Cretney C, Aster RH. Variation of class I HLA antigen expression among platelet density cohorts: a possible index of platelet age? Blood 1988; 71:516-9.
4. Martin J. The relationship between megakaryocyte ploidy and platelet volume. Blood Cells 1989; 15: 108-21.
5. Tavil Y, Sen N, Yazici HU, et al. Mean platelet volume in patients with metabolic syndrome and its relationship with coronary artery disease. Thromb Res 2007; 120:245-50.
6. Khandekar MM, Khurana AS, Deshmukh SD, et al. Platelet volume indices in patients with coronary artery disease and acute myocardial infarction: an Indian scenario. J Clin Pathol 2006; 59:146-9.
7. Kiliçli-Camur N, Demirtunç R, Konuralp C, Eskiser A, Başaran Y. Could mean platelet volume be a predictive marker for acute myocardial infarction? Med Sci Monit 2005; 11:CR387-92.
8. Nadar SK, Lip GY, Blann AD. Platelet morphology, soluble P selectin and platelet P-selectin in acute ischaemic stroke. The West Birmingham Stroke Project. Thromb Haemost 2004; 92:1342-8.
9. McCabe DJ, Harrison P, Sidhu PS, Brown MM, Machin SJ. Circulating reticulated platelets in the early and late phases after ischaemic stroke and transient ischaemic attack. Br J Haematol 2004; 126:861-9.
10. O'Malley T, Langhorne P, Elton RA, Stewart C. Platelet size in stroke patients. Stroke 1995; 26:995-9.
11. Bock G, Dalla Man C, Campioni M, et al. Pathogenesis of pre-diabetes: mechanisms of fasting and postprandial hyperglycemia in people with impaired fasting glucose and/or impaired glucose tolerance. Diabetes 2006; 55:3536-49.
12. Papanas N, Symeonidis G, Maltezos E, et al. Mean platelet volume in patients with type 2 diabetes mellitus. Platelets 2004; 15:475-8.
13. Hekimsoy Z, Payzin B, Ornek T, Kandoğan G. Mean platelet volume in Type 2 diabetic patients. J Diabetes Complications 2004; 18:173-6.
14. Sharpe PC, Trinick T. Mean platelet volume in diabetes mellitus. Q J Med 1993; 86:739-42.
15. Khuwaja AK, Rafique G, White F, Azam SI. Macrovascular complications and their associated factors among persons with type 2 diabetes in Karachi, Pakistan--a multi-center study. J Pak Med Assoc 2004; 54:60-6.
16. Shera AS, Jawad F, Maqsood A, et al. Prevalence of chronic complications and associated factors in type 2 diabetes. J Pak Med Assoc 2004; 54:54-9.
17. Lalouschek W, Lang W, Müllner M; Vienna Stroke Study Group. Current strategies of secondary prevention after a cerebrovascular event: the Vienna stroke registry. Stroke 2001; 32:2860-6.
18. Kim KY, Kim KE, Kim KH. Mean platelet volume in the normal state and in various clinical disorders. Yonsei Med J 1986; 27:219-26.
19. Brown AS, Hong Y, de Belder A, et al. Megakaryocyte ploidy and platelet changes in human diabetes and atherosclerosis. Arterioscler Thromb Vasc Biol 1997; 17:802-7.
20. van der Planken MG, Vertessen FJ, Vertommen J, et al. Platelet prothrombinase activity, a final pathway platelet procoagulant activity, is overexpressed in type 1 diabetes: no relationship with mean platelet volume or background retinopathy. Clin Appl Thromb Hemost 2000; 6:65-8.
21. Bath PM, Butterworth RJ. Platelet size: measurement, physiology and vascular disease. Blood Coagul Fibrinolysis 1996; 7:157-61.
22. Boos CJ, Lip GY. Assessment of mean platelet volume in coronary artery disease - what does it mean? Thromb Res 2007; 120:11-3.
23. Abid AR, Mallick NH, Shahbaz A, Tarin SA. In-hospital outcome of acute myocardial infarction (st segment elevation type) in diabetics and non-diabetics. J Coll Physicians Surg Pak 2005; 15:524-7.
24. Coban E, Bostan F, Ozdogan M. The mean platelet volume in subjects with impaired fasting glucose. Platelets 2006; 17:67-9.
25. Bozkurt N, Yilmaz E, Biri A, Taner Z, Himmetoğlu O. The mean platelet volume in gestational diabetes. J Thromb Thrombolysis 2006; 22:51-4.
26. Chung I, Choudhury A, Lip GY. Platelet activation in acute, decompensated congestive heart failure. Thromb Res 2007; 120:709-13.
27. Bitigen A, Tanalp AC, Elonu OH, Karavelioglu Y, Ozdemir N. Mean platelet volume in patients with isolated coronary artery ectasia. J Thromb Thrombolysis 2007; 24:99-103.