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Do mean platelet volume and platelet count vary on a daily or gender basis?

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ABSTRACT

Aims: Mean platelet volume (MPV) is a measurement based on platelet morphology. We aimed to investigate whether MPV and platelet count exhibit a daily change in relation to the days and gender.

Methods: Healthy blood donors aged 18–55 years with no history of the disease and/or drug use participated in the study. MPV values and platelet counts were analyzed with respect to the date of the blood test and the gender of the participant based on a 29–day calendar.

Results: A total of 14718 participants (7772 female) were included. The median age of the females and males was similar [38 (range 18–54), and 36 (18–55), p=0.254, respectively]. Median platelet count was 278×10^9/L (range 152–448) in females and 244×10^9/L (range 151–439) in males, with a significant difference (p<0.01). The median MPV was 8.9 (range 5.7–12.2) fL in females and 8.4 (range 5.9–12.8) fL in males (p<0.01). MPV and platelet counts were higher in females on all days of the month compared to males. Decreases in MPV values were observed in both females and males on days 9th, 12th, 20th, and 26th, whereas increases in both occurred on days 5th, 15th, 23rd, and 29th.

Conclusion: We demonstrated that MPV and platelet count exhibited a daily fluctuating in healthy individuals; MPV values and platelet count were overall higher in females. This study may give a different perspective on future studies of MPV and a lead for evaluating daily changes on other blood parameters.

Keywords: Mean platelet volume, platelets, daily changes

INTRODUCTION

Platelets, the smallest blood cells, are responsible for the allowance and maintenance of hemostasis in physiological and pathological conditions. Platelets are anucleate and discoidal, and form the cytoplasmic fragments of megakaryocytes during thrombopoiesis.[1]

Mean platelet volume (MPV) is a measurement based on the volume morphology of platelets that can be easily determined by hematological analyzers. Studies have shown that MPV can provide important information regarding the course and prognosis of numerous diseases,[2] including cardiovascular diseases, neoplasias, respiratory diseases, connective tissue diseases, inflammatory bowel diseases and diabetes mellitus.[3-8]

Although the information that exists concerning changes in MPV in the presence of pathological conditions, there is no clear data to show daily changes in MPV under the physiological conditions in healthy people. In this study, we aimed to investigate whether MPV and platelet counts exhibit a daily change in relation to the days.

METHODS

The study was carried out with the permission of Non-invasive Clinical Researches Ethics Committee of Van Yüzüncü Yıl University Faculty of Medicine (Date: 20.05.2019, Decision No: 329290). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

Participants

The participants in this study consisted of healthy individuals between the ages of 18 and 55 who registered with hospital's blood center and met the criteria for blood donation. We excluded all patients with any type of chronic disease, individuals who had had an infection within the previous month or those with an active infection, and those who had been on medication within the previous month or were currently on medication from the study. Participants were grouped according to their blood draw dates. The monthly cycle was set as 29 days, and each group consisted of participants who registered on the same day of the lunar

month, resulting in 29 groups. These groups were further divided into two separate subgroups, male and female, for a total of 58 groups, each group represented one day of the month. MPV values and platelet counts were then compared on the bases of gender and day of the month.

Haemogram Test

For the whole complete blood count (CBC), 2 ml of blood was drawn into a tube with ethylenediaminetetraacetic acid (EDTA), following which the sample was tested using the Beckman Coulter LH 780 analyzer, an operation lasting approximately 30 minutes. The blood of all the participants was tested on the same device and the whole blood count values were retrospectively analyzed. Cases with platelet count less than 150×10^9/L or exceeding 450×10^9/L were excluded from the study.

Statistical Analysis

Statistical analysis of the data was performed using the IBM SPSS 22 statistical package program. Descriptive statistics are expressed as [median (minimum–maximum)] for variables not exhibiting normal distribution in continuous data, and for categorical variables the frequency is expressed as a percentage (%). Two–way and repeated measures analysis of variance (ANOVA) was used to compare groups and measurement times with respect to these characteristics. The Tukey test was used to identify different groups following the analysis of variance. The level of significance was set at $p<0.05$.

RESULTS

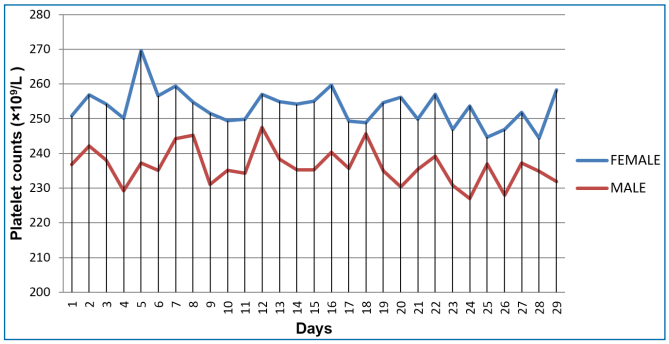
A total of 14718 individuals participated in this study, including 7772 females and 6946 males. The median age of the females was 38 (range 18–54) and that of the males was 36 (range 18–54). There were no significant differences with respect to the total numbers for each gender and age distributions of the participants ($p=0.142$ and $p=0.254$, respectively).

Median platelet count was 278×10^9/L (range 152–448) in females and 244×10^9/L (range 151–439) in males, a statistically significant difference ($p<0.01$). The median MPV was 8.9 (range 5.7–12.2) femtoliters (fL) in females and 8.4 (range 5.9–12.8) fL in males, also statistically significant ($p<0.01$) (Table 1).

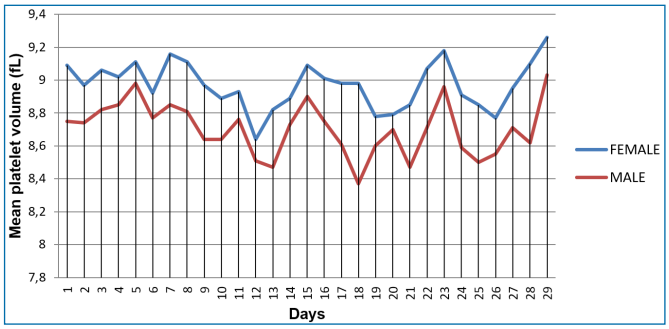
Table 1. Demographic and laboratory characteristics of the participants

Parameters	Female	Male	p–value
Number of participants, n (%)	7772 (52.8%)	6946 (47.2%)	0.142
Age (years)			0.254
Median	38	36	
Range	18–54	18–55	
Platelet counts ($\times10^9$/L)			<0.01
Median	278	244	
Range	152–448	151–439	
Mean platelet volume (fL)			<0.01
Median	8.9	8.4	
Range	5.7–12.2	5.9–12.8	

Additionally, the platelet counts were higher in females on all days of the month compared to males (Graph 1), as was the MPV values (Graph 2). In both females and males, decreases in MPV values were observed on the 9th, 12th, 20th, and 26th days of the month, while increases were observed on the 5th, 15th, 23rd, and 29th days (Table 2).



Graph 1. Distribution of daily platelet counts by gender



Graph 2. Distribution of daily MPV values by gender

Table 2. MPV status by gender and days

Parameters	Female (Mean±SD)	Male (Mean±SD)
Increase in MPV levels (fL)		
Day 5	9.11±1.16	8.98±1.36
Day 15	9.09±1.15	8.90±1.08
Day 23	9.18±1.14	8.96±1.21
Day 29	9.26±1.16	9.03±1.09
Decrease in MPV levels (fL)		
Day 9	8.87±1.23	8.67±1.08
Day 12	8.64±1.19	8.51±1.06
Day 20	8.79±1.12	8.70±1.10
Day 26	8.77±1.21	8.55±1.23

MPV: mean platelet volume

DISCUSSION

CBC is a blood test used to evaluate our overall health and detect a wide range of disorders, including anemia, infection and leukemia. Currently, the whole complete blood count is measured using modern hematologic analyzers in clinical laboratories. This yields valuable information regarding platelet count, MPV, platelet distribution width (PDW), and plateletcrit (PCT), which are basic platelet parameters. Recent studies have shown that platelet parameters can both contribute to the diagnosis of a patient and have prognostic value for some pathological conditions.[2,9] However, although routine assessments of these parameters have been presented in numerous studies over the years, their clinical importance is not yet fully understood and their application for diagnosis is still limited.

MPV values typically range from 7.5 to 12.0 fL and can easily be calculated using automatic hematologic analyzers. Under physiological conditions, MPV is considered inversely proportional to platelet count;[10] in such cases, with an increase in platelet count, a decrease in MPV is expected. As an example, in one study on immune thrombocytopenia, thrombopoiesis increased significantly while platelet count remained low and MPV increased.[11]

The volumetric distribution of platelets in peripheral blood is not homogeneous. MPV is correlated with platelet activity, with younger platelets exhibiting greater MPV (>15 fL) and activity.[12] Since large platelets contain more cell granules, express more adhesion molecules, and are more active, a greater risk of developing thrombus has been noted as a result.[13] MPV can thus be used as a marker of platelet activation in the diagnosis of specific diseases.[14]

The vast majority of studies on MPV have investigated its variability in pathological conditions such as cardiovascular diseases, cerebrovascular diseases, respiratory diseases, rheumatic diseases, diabetes mellitus, lymphomas, and carcinoma.[2] Additionally, a number of studies have reported that other factors such as age, gender, race/ethnicity, diet, and genetic factors may affect MPV.[15-18] However, information pertaining to physiological MPV changes is limited.

In the present study, we examined daily changes in MPV values and platelet counts in relation to the days of the month. As far as we know, this is the first study on physiological daily changes of MPV according to the day of the month. We used the lunar calendar, based on the moon's rotation around the earth and consisting of 29–day cyclical periods, to determine the daily changes of the MPV.

Previous reports in the literature on MPV values with gender relationships are inconsistent. In some studies, higher MPV values were reported for females,[19,20] while others observed higher MPV in males.[21] Several studies have reported no significant difference in MPV values for females and males.[22-24] In this study, we found that females had higher MPV values and higher platelet counts than males for all days of the lunar month.

Our study also detected periodic increases and decreases in MPV values for both genders. While increased MPV values were observed on the 5th, 15th, 23rd, and 29th days of the month, the values decreased on the 9th, 12th, 20th, and 26th days. We hypothesize that this variation may have occurred in accordance with the MPV's daily changes rhythm, suggesting that females may be more susceptible to thrombosis than males.

A morphological value that can be measured by routine whole blood count testing, MPV can provide important information regarding the disease course and prognosis in many cases of inflammation. However, it should be remembered that various factors may affect platelet activity, and therefore MPV may change under certain physiological and pathological conditions.

CONCLUSION

In this study, differences in MPV values and platelet counts between the genders were detected in healthy subjects, both parameters being higher in female participants compared with males. We also observed that MPV exhibits a variability that changes daily. We believe that this observation will lead to the adoption of a different perspective from which to proceed in future research on MPV and that it will open the door to the investigation of daily change patterns in various blood parameters. However, further studies are needed in order to make proper use of this aspect of MPV analysis in clinical applications.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of Non-invasive Clinical Researches Ethics Committee of Van Yüzüncü Yıl University Faculty of Medicine (Date: 20.05.2019, Decision No: 329290).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper and that they have approved the final version.

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Ömer Candar was responsible for the accuracy and integrity of this study. Ömer Candar, Ömer Ekinci, Ali Doğan and Senar Ebinç analyzed and interpreted the data, prepared the manuscript, performed the statistical analyses, and were responsible for the final editing.

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