

## The Relationship of Body Mass Index with Platelet Counts and Donation Frequency of Platelet Apheresis Donors

Vücut Kitle İndeksinin Trombosit Aferez Donörlerinin Trombosit Sayıları ve Donasyon Sıklığı ile İlişkisi

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### ABSTRACT

**Aim:** The aim of this study was to investigate the demographic characteristics of platelet apheresis donors during the coronavirus disease 2019 (COVID-19) pandemic, to examine the association of platelet counts with blood groups and body mass index (BMI), and to characterize the effects of BMI on platelet apheresis donation.

**Material and Methods:** In this retrospective study, the demographic characteristics of platelet apheresis donors admitted to our center between January 2020 and January 2021 were examined, and hemogram parameters, previous platelet donation frequencies, and blood groups information were recorded. The relationship between donors' platelet counts, blood groups, and BMI were analyzed.

**Results:** There was no statistically significant relationship between the platelet counts and blood groups. Although platelet counts were higher in Rh positive donors, no statistically significant relationship was found between platelet counts and the Rh group ( $p=0.675$ ). Even though the platelet counts were lower in low-weight donors, there was no statistically significant relationship between platelet count and BMI groups ( $p=0.134$ ). The lower collected platelet counts of the normal group, compared to the obese group, was found to be statistically significant ( $p=0.001$ ). The number of donations for the overweight group being higher than the normal and obese groups was found to be statistically significant ( $p=0.002$ ).

**Conclusion:** Even though the platelet count increases with obesity, it does not have any statistical significance in healthy platelet donors. In conclusion, obesity does not have an inverse relationship with platelet apheresis donation and high BMI should not be considered as a prognostic factor for donation.

**Keywords:** Platelet; apheresis; donors; body mass index.

### ÖZ

**Amaç:** Bu çalışmanın amacı, koronavirüs hastalığı 2019 (coronavirus disease 2019, COVID-19) pandemi döneminde trombosit aferez donörlerinin demografik özelliklerinin araştırılması, trombosit sayılarının kan grupları ve vücut kitle indeksi (VKİ) ile ilişkisinin gözden geçirilmesi ve VKİ'nin trombosit aferez bağış üzerindeki etkisini karakterize etmektir.

**Gereç ve Yöntemler:** Bu geriye dönük çalışmada Ocak 2020 ve Ocak 2021 tarihleri arasında merkezimize başvuran trombosit aferez donörlerinin demografik özellikleri incelendi ve hemogram parametreleri, daha önceki trombosit bağış sıklığı ve kan grubu bilgileri kaydedildi. Bağışçıların trombosit sayıları, kan grupları ve VKİ arasındaki ilişki analiz edildi.

**Bulgular:** Trombosit sayıları ile kan grupları arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır. Trombosit sayıları Rh pozitif bağışçılarda daha yüksek olmakla birlikte trombosit sayıları ile Rh grubu arasında istatistiksel olarak anlamlı bir ilişki bulunmamıştır ( $p=0,675$ ). Düşük kilolu donörlerde trombosit sayıları daha düşük olsa da trombosit sayısı ile VKİ grupları arasında istatistiksel olarak anlamlı bir ilişki yoktu ( $p=0,134$ ). Obez grup ile karşılaştırıldığında, normal kilolu gruptaki daha düşük trombosit torba sayısı istatistiksel olarak anlamlı olarak bulundu ( $p=0,001$ ). Normal kilolu ve obez gruplara göre daha fazla sayıda olan, fazla kilolu gruba yapılan bağış sayısı istatistiksel olarak anlamlı olduğu bulundu ( $p=0,002$ ).

**Sonuç:** Trombosit sayısı obezite ile birlikte artsa da bu durum sağlıklı trombosit donörlerde istatistiksel olarak anlamlılığa sahip değildir. Sonuç olarak, obezitenin trombosit aferez bağış ile ters bir ilişkisi yoktur ve yüksek VKİ bağış için prognostik bir faktör olarak kabul edilmemelidir.

**Anahtar kelimeler:** Trombosit; aferez; donör; vücut kitle indeksi.

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## INTRODUCTION

The increasing demand for platelet transfusions for patients with different medical diagnoses has led to the acceleration in the use of apheresis for platelet concentrates carried out in a dedicated area under the supervision of a transfusion practitioner (1). Platelets play an important role in primary hemostasis and are used in patients for various reasons, primarily to stop or prevent life-threatening bleeding (2).

Many authors have reported that apheresis is a safer procedure due to its less frequent side effects compared to whole blood donations, and collecting platelets also prove advantageous in that up to three adult doses of platelets can be given per donation (3). Platelet apheresis is expensive and a huge financial burden to procure (4). In addition, the significant decrease in the number of donors during the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) pandemic in 2020 led to the disruption of supply from regional blood centers, and the platelet supply in the hospitals' blood banks reached critically low levels.

Obesity definition and grading are evaluated based on body mass index (BMI) by the weight/height ( $\text{kg}/\text{m}^2$ ) formula. In the obesity guideline by the Turkish Endocrinology Association, the obesity classification recommended by the World Health Organization (5) is defined as underweight, BMI <18.5; normal, BMI: 18.5-24.9; overweight, BMI: 25-29.9, and obese, BMI  $\geq 30$  (obesity is also subdivided into categories as class 1, BMI: 30-34.9; class 2, BMI: 35-39.9; and class 3, BMI:  $\geq 40$ ).

Lifestyle changes such as high-calorie foods and increased inactivity due to the SARS-CoV-2 pandemic are responsible for the development of obesity, one of the major global health problems. It has also been documented in publications that obesity is characterized by the presence of a prothrombotic condition resulting from the combination of increased thrombin production (6), platelet hyperactivity, and decreased fibrinolysis (7), so the increased platelet reactivity is considered to play a role among the different events that accelerate the risk of atherothrombosis.

During the pandemic period, our hospital continued to actively prepare platelet apheresis from active platelet donors. The present study aimed to investigate the demographic characteristics of platelet apheresis donors and to review the relationship of platelet counts with BMI. Therefore, the main objective of the present study was to characterize the effect of BMI on platelet apheresis donation.

## MATERIAL AND METHODS

In the present retrospective study, the platelet apheresis donors were selected among the platelet apheresis donors from January 2020 to January 2021 in line with the standard operation procedure (SOP). A total of 1198 participants were outpatients of the clinic aged between 18 and 65 years.

The body height of the participants was measured on a flat surface without shoes. Bodyweight, BMI, fat percentage, fat mass, and fat-free mass of the patients were determined through a bio-impedance device [Tanita-BC418]. Patients were excluded from the study if they had any disease other than regulated hypertension, chronic inflammatory

process, hematological disorders, infectious disease, ischemic heart disease, and history of corticosteroid use, alcohol use, and smoking. Demographic features, family history, chronic diseases, and hematological parameters (hemoglobin and platelet) were obtained. All values in the study were calculated from patients' complete blood count (CBC) analysis. A routine electronic CBC device was used (XN-CBC, Sysmex, Bornbarch 1, 22848 Norderstedt, Germany) for this purpose.

Platelet aphereses were collected using Terumo or Beckman Coulter Haemonetics. The demographic characteristics of the platelet apheresis donors (weight, height, BMI) were calculated, and the information regarding hemogram parameters, previous platelet donation frequency, blood group, and viral serology were recorded.

In this study, patients were divided into three groups according to BMI; the underweight and normal group (BMI <24.9), the overweight group (BMI: 25-29.9), and the obese group (BMI  $\geq 30$ ), and then these groups were compared. The relationship between the donors' platelet counts, blood groups, and BMI values was analyzed.

The study was approved by the Non-Interventional Clinical Researches Ethics Committee of İstanbul Medipol University (decision date: 01.04.2021 and number: 401).

### Statistical Analysis

NCSS 2007 (Number Cruncher Statistical System, Kaysville, Utah, USA) program was used for statistical analysis. While evaluating the data, descriptive statistical methods (mean, standard deviation, median, interquartile range, minimum, maximum, frequency, and percentage) were used, as well as the Shapiro-Wilk test to assess data distribution. The Kruskal-Wallis test (post hoc Dunn) was used for the comparison of three or more groups, and the Mann-Whitney U test was used for two-group comparisons that did not exhibit a normal distribution. Pearson or Fisher's exact chi-square tests were used to identify the relationship among qualitative data. Significance was evaluated at a level of  $p < 0.05$ .

## RESULTS

Of the 1198 donors enrolled in the study, 55 (4.5%) were female and 1134 (95.5%) were male. The age of the patients in relation to their gender was not statistically significant ( $p=0.355$ ). There was a statistically significant difference between males and females of heights ( $p=0.001$ ). The weight of the males was greater than that of the females ( $p=0.001$ ). Also, the BMI of the males was greater than that of the females and the difference was found to be statistically significant ( $p=0.001$ , Table 1).

Since the number of female donors is low, the following study statistics were obtained solely from the male participants. The median age was 35 (range, 18-65) years, and the median BMI was 26.3 (range, 20.4-41.5)  $\text{kg}/\text{m}^2$ . Hemoglobin levels were between 12.1 and 18.8, and the median hemoglobin level was 15.2 g/dl. The median platelet count was 245 with a range of 170-493 ( $\times 10^3$ ). The number of collected platelet bags varied from 1 to 3, and the median bag count was 2. The number of donations to our hospital ranged from 0 to 18. Each patient's blood pressure was measured before the procedure. The systolic blood pressure of the patients ranged from 110 to 160 with

a median of 123, while diastolic blood pressure ranged from 10 to 110 with a median of 79 mmHg (Table 2). The blood types of donors from in order of frequency were 45.1% (n=512) A positive, 22.3% (n=253) O positive, 12.1% (n=137) B positive, 11.2% (n=127) AB positive, 5.8% (n=66) A negative, 2.4% (n=27) O negative, 0.6% (n=7) B negative, and 0.4% (n=5) AB negative. The collection procedure for 35.1% (n=398) of the donors was performed in the Haemonectics machine, while the procedure for 64.9% (n=736) of the donors was performed in the Terumo machine. 23.9% (n=271) of the donors had previously

been platelet donors in our hospital, while 76.1% (n=863) applied for donation for the first time. Of the donors, 0.4% (n=4) were HBS antigen positive, 0.3% (n=3) were anti-HCV positive and 0.1% (n=1) was syphilis positive, thus their platelet aphereses were destroyed. The donors' platelet value of 54.3% (n=616) was less than 250, while the platelet value of 45.7% (n=518) of the donors was 250 and above. Even though platelet counts were higher in Rh positive donors, no statistically significant relationship was found between the platelet count and the Rh group (p=0.675, Table 3).

**Table 1.** Comparison of the donors by gender

	Female (n=55)		Male (n=1134)		P
	Mean±SD	Median (IQR) [min-max]	Mean±SD	Median (IQR) [min-max]	
Age (years)	33.9±8.5	34 (16) [20-52]	35.4±9.3	35 (13) [18-65]	0.355
Weight (kg)	67.3±11.7	65 (16) [50-99]	83.5±12.4	83 (15) [54-130]	<b>0.001</b>
Height (cm)	163.6±6.7	163 (8) [151-185]	175.9±6.8	176 (10) [150-195]	<b>0.001</b>
BMI (kg/m <sup>2</sup> )	25.4±4.4	24.1 (6.2) [19.7-41.2]	26.8±3.7	26.3 (4.9) [20.4-41.5]	<b>0.001</b>

SD: standard deviation, IQR: interquartile range, BMI: body mass index

No statistically significant relationship was found between the BMI group of the donors and the platelet count of  $<250 \times 10^3$  and  $\geq 250 \times 10^3$ . Even though the platelet counts were observed to be lower in low-weight donors, there was no statistically significant difference between platelet count and BMI groups (p=0.134, Table 4). However, high platelet counts in overweight and obese patients, although not statistically significant in the present study, are believed to be associated with platelet count and obesity. The platelet value of the first-time donor group was  $249.88 \pm 48.06$ , which was higher than that of the previous donor group  $243.55 \pm 44.12$ , and was found to be statistically significantly different (p=0.043).

The number of platelet bags collected showed a statistically significant difference by the BMI groups (p=0.001). The lower collected platelet counts of the normal group, compared to the obese group, was found to be statistically significant. The number of donations showed a statistically significant difference by the BMI groups (p=0.002). The number of donations for the overweight group was higher than the normal and obese groups, and found to be statistically significant (Table 5).

## DISCUSSION

The results of the present study showed that, although the platelet count was high in obese patients, no significant difference was found between BMI and platelet count in the comparison of the platelet donor subgroups; however,

**Table 2.** Clinical characteristics of the study group

	Mean±SD	Median (IQR) [min-max]
Hemoglobin (g/dl)	15.4±1.0	15.2 (1.3) [12.1-18.8]
Hematocrit (%)	44.2±17.8	45 (2.3) [35-40.7]
MCV (fl)	83.2±31.9	81.9 (4.3) [57.4-85.7]
Platelet ( $\times 10^3$ )	248.4±47.2	245 (61) [170-493]
Number of platelet bag	2.3±0.7	2 (1) [1-3]
Number of donation	0.6±1.6	0 (0) [0-18]
SBP (mmHg)	124.8±7.5	123 (2) [110-160]
DBP (mmHg)	78.8±8.9	79 (2.4) [10-110]

SD: standard deviation, IQR: interquartile range, BMI: body mass index, MCV: mean corpuscular volume, SBP: systolic blood pressure, DBP: diastolic blood pressure

**Table 3.** Relationship between platelet and blood groups

Blood Groups	Platelet<250	Platelet≥250	p
Rh Negative	55 (8.9%)	50 (9.7%)	0.675
Rh Positive	561 (91.1%)	468 (90.3%)	

**Table 4.** Relationship between platelet and body mass index

BMI Groups	Platelet<250	Platelet≥250	p
Normal	209 (33.9%)	150 (29.0%)	
Overweight	295 (47.9%)	256 (49.4%)	0.134
Obese	112 (18.2%)	112 (21.6%)	

**Table 5.** Comparison of the groups by body mass index

	Normal Weight (n=359)		Overweight (n=551)		Obese (n=224)		P
	Mean±SD	Median (IQR) [min-max]	Mean±SD	Median (IQR) [min-max]	Mean±SD	Median (IQR) [min-max]	
Number of platelet bag	2.2±0.7	2 (1) [1-3]	2.3±0.7	2 (1) [1-3]	2.4±0.7	2 (1) [1-3]	<b>0.001</b>
Number of donation	0.4±1.0	0 (0) [0-7]	0.8±1.9	0 (1) [0-18]	0.5±1.2	0 (0) [0-9]	<b>0.002</b>

SD: standard deviation, IQR: interquartile range

although the high platelet counts in overweight and obese patients were not statistically significant in the present study, it is believed that platelet count and obesity are related.

The relationship between increased platelet count and platelet activation is unclear. Platelet count and activation are associated with essential thrombocytosis (8) with chronic inflammation, and inflammatory bowel diseases (9). In the present study, even though the platelet counts were lower in underweight donors, this was not found to be statistically significant.

In the present study, the most common blood type was A Rh positive (45.1%) followed by O Rh positive (22.3%). The blood group distribution of apheresis donors is substantially similar to the blood group distribution rates in Turkey (10).

Fantuzzi et al. (11) reported that the increase in adipose tissue in obesity triggers inflammation, while a study conducted by Farhangi et al. (12) showed that the platelet count increases with inflammation. In the present study, the platelet count was higher in obese patients with high BMI compared to underweight ones, but this was not found to be statistically significant. However, the number of platelet bags collected by the BMI group shows a statistically significant difference. The lower collected platelet count of the normal group, compared to the overweight and obese group, was found to be statistically significant.

In a study by Kutluturk et al. (13), the platelet count was found to be significantly higher in obese individuals than in non-obese individuals, and this was established as the finding that evaluates the relationship between platelet count and cardiovascular disease metabolic risk factors in obesity. Also in the present study, the lowest platelet count was found in underweight donors.

Eren et al. (14) showed that BMI is higher in the Rh positive group, supporting that Rh immunization may be indirectly related to body mass index and platelet count. In the present study, platelet counts were observed to be higher in Rh positive donors, but no statistically significant difference was found.

In the present study, males donated more platelets than females. Doğu et al. (15) reported that more males donated platelet apheresis than females, and Guo et al. (16) reported that the proportion of males was five times higher than females in a study conducted in 5 centers in China. The authors of the present study believe that this lower donor rate in females is due to the low hemoglobin values of females due to menstruation, pregnancy, breastfeeding periods, and thin vascular structures.

## CONCLUSIONS

Due to the increase in the number of overweight and obese platelet donors compared to normal weight and underweight donors, the number of platelet bags collected is statistically significantly higher. Even though the platelet count increases with obesity, it does not have any statistical significance in healthy platelet donors. There is no statistical relationship between blood group, Rh group, and BMI. In conclusion, obesity does not have an inverse relationship with platelet apheresis donation and it is not suitable to count high BMI as a prognostic factor for donation.

**Ethics Committee Approval:** The study was approved by the Non-Interventional Clinical Researches Ethics Committee of İstanbul Medipol University (01.04.2021, 401)

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