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Research Article

An Analysis of Socio-Demographic and Haematologic Profiles of Platelet Donors at a Tertiary Cancer Centre in South India

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A B S T R A C T

Background: Platelets have an active role in haemostasis and are used in patients mainly to stop or prevent life-threatening bleeding. The blood components transfused commonly are packed red blood cells followed by platelets.One of the objectives of the World Health Organization is to promote the availability and safety of blood by targeting blood donors in certain environments.

Objective: To study the socio-demographic, and haematologic profiles including platelet loss and intention to repeat platelet donations

Materials and Methods: This retrospective observational cross-sectional study includes data from 503 plateletpheresis male donors picked in a simple random method. The details such as socio-demographic, anthropometric, vitals, haematologic parameters, and type of apheresis instrument used were collected and analysed. Platelet loss was compared. 109 were first-time donors and 394 were repeat donors.

Results: Haemoglobin in first-time donors was (15.08 g/dl) and in repeat donors was (14.744 g/dl). BMI was 26.360 in repeat donors and 25.501 in first-time donors. Neutrophil/ lymphocyte, lymphocyte/ monocyte, and platelet/ lymphocyte ratios were 2.41 ± 1.19, 4.08 ± 2.16, and 153.98 ± 62.93 respectively. The platelet loss in first-time donors was (75.697 ± 21.809) x 10^3 /µl and in repeat donors, it was (74.444 ± 26.529) x 10^3 /µl; was significantly more with MCS+ (75.249 ± 20.306) x 10^3 /µl (SDP), 148.000 ± 17.776 x 10^3 /µl (DDP) compared to SPECTRA OPTIA 53.667 ± 11.949 x 10^3 /µl (SDP) 94.876 ± 21.067 x 10^3 /µl (DDP) and TRIMA ACCEL 52.285 ± 16.362 x 10^3 /µl (SDP), 103.673 ± 24.736 x 10^3 /µl (DDP). The number of voluntary donors (68.49%) associated with the intention to repeat platelet donation was higher compared to replacement donors (53.91%).

Conclusion: First-time donors can safely undergo plateletpheresis. NLR, PLR, and LMR can be established for the Indian population with the help of a platelet registry.

Keywords: First-Time Platelet Donors, Platelet Loss, Biomarkers, Repeat Intention

Introduction

The need for blood is a concern for the entire medical fraternity and society. Voluntary, non-remunerated blood donors form the cornerstone of a safe and adequate supply of blood transfusion services.[1] However, hospital-based blood centres also depend on the patient's family, relatives, and friends to donate and replenish the blood stocks as well as platelets.

Platelets have an active role in haemostasis and are used in patients primarily to stop or prevent life-threatening bleeding.[2] The blood components transfused commonly are packed red blood cells followed by platelets. Thrombocytopenia or platelet function disorders may result in life-threatening bleeding. Platelet counts < 100 to 150×10^9 /L are defined as thrombocytopenia, while severe thrombocytopenia is platelet counts < 50×10^9 /L. The reasons for thrombocytopenia include increased consumption (bleeding), decreased production (haematological disorders), and immune-mediated destruction of platelets (neonatal alloimmune thrombocytopenia).

The components, such as packed red cells (PRC), fresh frozen plasma (FFP), and platelet concentrates or random donor platelets, are prepared from whole blood. The platelets are also collected by apheresis. Apheresis is an extracorporeal technique using cell separators to collect the desired component and return the rest of the components to the donor. Plateletpheresis is indicated to collect a large number of platelets from a single donor so that the patient is exposed to a few donations. The advantages of fewer donor exposures include minimal alloimmunisation, reduced platelet refractoriness, and reduced transmission of viruses. plateletpheresis has short collection intervals that facilitate more frequent donations, and there is urgency due to a severe shortage of platelets compared to whole blood.

There are fewer side effects associated with plateletpheresis compared to whole blood donations.[2] The limited donor population almost leads to the need to collect even up to three adult doses per donation.[3,4] Whenever bleeding occurs, platelet transfusions are expected to be available immediately. Platelets are included in the WHO (World Health Organisation) list of essential medicines. The requirement for apheresis platelets has increased phenomenally in the last few years.

The present study conducted at a tertiary cancer hospital in Chennai, India, aims to characterise the donor demography, the haematological profiles, including platelet loss, and the intention to repeat platelet donation.

Methodology

The data was collected from 503 apheresis platelet donors. The socio-demographic and haematologic parameters were analysed. The demographic characteristics of the platelet apheresis donors, such as age, gender, weight, height, Body Mass Index (BMI), marital status, and distance from the blood centre, were analysed. The category of the donation was voluntary or replacement, and the information regarding haematology parameters, number of previous donations, the time interval of donation, past experience, blood group, BMI, vitals, adverse donor reactions, and intentions for future donation, was recorded. Single-donor (SDP) and double-donor platelet (DDP) donations were also compared. All values in the study were calculated from donors' complete blood count (CBC) analyses. The haematologic profiles of haemoglobin (Hb), total white blood cell (WBC) counts (TC), packed cell volume (PCV), platelets, differential count (DC), mean corpuscular haemoglobin concentration (MCHC), platelets/ lymphocyte ratio (PLR), lymphocytes/ monocyte ratio (LMR), neutrophil/ lymphocyte ratio (NLR), and platelet loss were noted. The frequency of the intention to donate in the future and the intention to donate for emergencies were also noted. The type of apheresis instrument was also recorded. The post-platelet counts were obtained from the apheresis instruments.

Statistical Analysis

The data collection was from donor questionnaires and records, including the instrument parameters. The statistical analysis was done with SPSS version 23. Descriptive statistics were used to analyse the data. An independent sample t test and an ANOVA test were performed. A p value of 0.05 was taken as significant. Pearson's correlation, multiple regression, and chi-square tests were performed. The NLR, LMR, and PLR were calculated by mathematical division of absolute counts obtained by Complete Blood Counts in Coulter.

Results & Discussion

The descriptive statistics were performed for the entire group of 503 donors, the first-time donors (those who have not donated either whole blood or platelets), and repeat donors (those who have donated whole blood or platelets) (Table 1).

Table 1.Comparative Demographic and Haematologic Profiles of the First-Time and Repeat Donors

Donor Parameter	Total Donors (n = 503)	First Time Donors (n = 109)	Repeat Donors (n = 394)
Age (years)	30.13 ± 7.465	28.92 ± 7.926	30.7 ± 7.686
Height (cm)	172 ± 7.211	172.59 ± 6.934	172.24 ± 7.292

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Weight (kg)	77.601 ± 11.835	75.81 ± 11.683	78.096 ± 11.837
BMI (kg/m²)	26.174 ± 3.9569	25.501 ± 3.980	26.36 ± 3.928
Pulse rate (beats/min)	79.32 ± 5.794	79.36 ± 5.383	79.31 ± 5.909
Systolic blood pressure (mmHg)	122.97 ± 8.997	122.587 ± 8.524	123.071 ± 9.130
Diastolic blood pressure (mmHg)	78.04 ± 6.408	78.137 ± 6.085	78.015 ± 6.501
Haemoglobin (gm%)	14.804 ± 1.043	15.018 ± 1.087	14.744 ± 1.025
Total WBC count (cells/cmm)	7.246 ± 1.747	7.239 ± 1.780	7.248 ± 1.740
Platelet count (x 10^3/µl)	279.1 ± 53.510	281.55 ± 51.112	278.42 ± 54.198
Post-procedure platelet count (x 10^3/µl)	205.3 ± 47.030	207.2 ± 45.799	204.77 ± 47.409
Platelet loss (%)	26.742 ± 7.889	27.007 ± 7.345	26.668 ± 8.041
Packed cell volume	43.55 ± 3.128	43.96 ± 3.303	43.441 ± 3.072
Mean corpuscular Hb concentration	34.021 ± 1.375	34.213 ± 1.733	33.968 ± 1.253
Polymorphs (%)	60.72 ± 8.041	59.88 ± 7.623	60.96 ± 8.147
Lymphocytes (%)	28.29 ± 7.421	29.04 ± 7.483	28.08 ± 7.399
Monocytes (%)	7.7 ± 2.338	7.94 ± 2.202	7.7 ± 2.374
Eosinophils (%)	3.1 ± 2.435	3.21 ± 2.687	3.13 ± 2.365
Neutrophil lymphocyte ratio	2.41 ± 1.143	2.28 ± 2.949	2.44 ± 1.190
Lymphocyte monocyte ratio	4.08 ± 2.164	4.1 ± 2.568	4.08 ± 2.043
Platelet lymphocyte ratio	153.983 ± 62.934	151.745 ± 64.135	154.602 ± 62.666

The demographic and haematologic profiles of the first-time and repeat donors were compared by the independent sample t test. Haemoglobin in first-time donors was 15.08 g/dl and significantly higher compared to repeat donors (14.744 g/dl) ($p = 0.02$, $t = 2.357$). The Body Mass Index in repeat donors was 26.360 kg/m^2 and significantly higher compared to first-time donors (25.501 kg/m^2) ($p = 0.047$, $t = 2.012$).

The blood types in order of frequency were O +ve - 35.6%, B +ve - 30.2%, A +ve - 21.9%, AB +ve - 10.7%, and B -ve - 0.8%, O -ve - 0.6%, and A -ve - 0.2%.

The number of procedures leading to a yield of 3 x 10^{11} (single donor platelets) was 389 (77.33%), and the number of procedures leading to a yield of 6 x 10^{11} (double donor platelets/ high yield donations) was 114 (22.66%). The plateletpheresis was performed by Haemonetics MCS+, Spectra Optia, and Trima Accel instruments.

Single donor apheresis platelets accounted for 91.4% in the United States of America in 2015, and the rest were whole blood-derived platelets or random donor platelets. In India, a few studies before 2010 indicated that more than 95% of the platelets used were whole blood-derived platelets and only < 5% were apheresis platelets.[5] There has been a rise in the requirement for apheresis platelets as they are included in chemotherapy protocols and in the treatment of haemato-oncology patients, including Bone Marrow Transplants. It is also used in platelet-refractory patients where human leukocyte antigen-matched or human platelet antigen-matched components are desired.

The recommended age of eligible platelet donors is 18–60 years. 109 (21.7%) of the 503 donors performed donations for the first time, and they donated platelets. The youngest donor was 18 years old, and the oldest was 55 years old. 394 of the 503 (78.3%) were repeat donors; 353 of them donated whole blood earlier; 29 of them donated whole blood and platelets; and 12 of them donated platelets alone. The repeat donors donated at a mean frequency of 5.28 ± 11.220 times and at a mean duration of 13.34 ± 19.46 months. 273 (54.3%) of the donors were voluntary, and 230 (45.7%) were replacement donors. 77.3% of the donors were residents of Chennai, and 22.7% were from places other than Chennai. 61.82% of the donors were married.

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The mean age was 30.13 ± 7.76 years, the median age was 29 years (range18–55 years) and the median BMI was 26.17 (range 16.4–47.3) kg/m^2. This is similar to the average age of 30 ± 7.3 years and average BMI of 28.6 ± 4.9 kg/m^2 reported in a study conducted in Saudi Arabia in platelet donors.[6]

The age distribution has been divided into four groups based on quartiles. The first quartile consists of an age range of 18–24 years (26.4%). The second quartile consists of an age range of 25–29 (25.4%), the third quartile of an age range of 30–35 (23.9%), and the fourth quartile of an age range of 35–55 (24.3%).

Haemoglobin levels were between 12.5 and 17.9, and the median haemoglobin level was 14.7 g/dl. These values are similar to those found in the study conducted in the Department of Haematology, Istanbul Medipol University School of Medicine, Istanbul, Turkey.[7] The median platelet count was 274 x 10^3 /µl with a range of 158–469 (x 10^3 /µl).

The neutrophil/ lymphocyte (NLR), lymphocyte/ monocyte (LMR), and platelet/ lymphocyte (PLR) ratios were 2.41 ± 1.19, 4.08 ± 2.16, and 153.98 ± 62.93 respectively in this group of South Indian males (Table 2). It is ideal to formulate the reference ranges of NLR, LMR, and PLR for normal, healthy individuals according to ethnic origin, age, and gender.[8] There haven't been adequate studies so far to establish these ratios in the Indian population. They are affordable and reliable biomarkers, and they are also used as diagnostic as well as prognostic factors for many diseases.

Table 2.Descriptive Statistics of NLR, PLR, and LMR in Different Age Groups

Age Group Range (%)	NLR		PLR		LMR	
	Mean	Range	Mean	Range	Mean	Range
18–24 (26.44)	2.48 ± 1.504	1–14	162.35 ± 73.650	54.59–551.923	4.06 ± 2.460	1–25
25–29 (25.44)	2.38 ± 1.092	1–8	146.19 ± 62.291	54.816–402.735	4.28 ± 2.512	1–23
30–35 (23.85)	2.35 ± 0.917	1–7	153.53 ± 58.323	68.352–405.713	4.16 ± 1.882	1–14
35–55 (24.25)	2.41 ± 0.928	1–6	153.46 ± 54.363	52.944–356.009	3.83 ± 1.617	2–11

NLR: Neutrophil/lymphocyte ratio, PLR: Platelet/lymphocyte ratio, LMR: Lymphocyte/monocyte ratio

Each donor's blood pressure was measured before the procedure. The systolic blood pressure of the donors ranged from 100 to 140 mmHg with a median of 120 mmHg, while the diastolic blood pressure ranged from 60 to 90 mmHg with a median of 80 mmHg. The pulse rate ranged from 54 to 100 beats per minute with a median of 78 beats per minute.

The donors were classified based on BMI, and the parameters such as Hb, PCV, Platelets, total blood volume (TBV), blood volume (BV) processed, adverse donor reactions, and platelet loss are discussed (Table 3). The blood volume of plateletpheresis donors was calculated by Nadler's formula.

There is no significant difference in Hb levels, PCV, blood volume processed, or platelet loss based on BMI. (p = 0.303, p = 0.797, p = 0.186, and p = 0.402, respectively) (Table 3). There is no significant correlation between Hb, PCV, and platelets (p > 0.05) (Table 4). The total blood volume of obese donors is significantly higher than that of normal and overweight donors (p = 0.001). The platelet count in obese donors is significantly higher than in normal and overweight donors. (p = 0.002). The same was opined on by Sadri and Bilgen.[7] There was a significant correlation between platelet count and yield. (p < 0.05) (Table 4). There are numerous studies indicating a correlation between donor platelet counts and yield.[9,10]

The mean platelet loss in the double yield donors was 99.824 ± 24.132 x 10^3 /µl (range 14–232 x 10^3 /µl) approximating 30.299 ± 7.091% and in the single yield donors, it was 67.357 ± 20.892 x 10^3 /µl (range 6–156 x10^3 /µl) approximating 25.369 ± 7.760 %. This differs from another study from North India, where the mean platelet loss observed in the SDP was 35.55 ± 8.53% and in the DDP 37.76 ± 8.65%.[9] In the present study, platelet loss was significantly higher in double-yield donors compared to single-yield donors, as implied by the independent sample t test (p value < 0.001).

Table 3.Parameters Based on BMI

BMI (kg/m^2)	TBV (L)	Platelet (x 10^3 /µl)	Hb (g/dl)	PCV	Platelet Loss (x 10^3 /µl)	Adverse Donor Reactions	BV Processed (ml)
Normal (18.5 to 24.9)	4810.074 ± 452.381	269.72 ± 0.499	14.809 ± 1.071	43.456 ± 3.182	74.688 ± 23.927	N = 3 giddiness	2572.762 ± 472.903

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Overweight (25 to 29.9)	5592 ± 555.761	283.11 ± 0.525	14.854 ± 1.039	43.657 ± 3.178	75.901 ± 25.841	0	2582.183 ± 447.254
Obese (More than 30)	6598.636 ± 776.892	292.03 ± 0.618	14.642 ± 0.978	43.508 ± 2.853	71.337 ± 28.770	0	2473.519 ± 467.582

TBV: Total blood volume, Hb: Haemoglobin, PCV: Packed cell volume, BV: Blood volume

Table 4.Correlation Between Platelet & PCV, Platelet & Hb, Platelet & Yield Based on BMI Groups

BMI (kg/m²)	Karl Pearson Correlation Platelet and PCV	Karl Pearson Correlation Platelet and Hb	Spearman Rank Correlation Platelet and Yield
Normal (18.5 to 24.9)	0.034 weak positive correlation	-0.027 weak negative correlation	0.395 weak positive correlation
Overweight (25 to 29.9)	-0.057 weak negative correlation	-0.124 weak negative correlation	0.376 weak positive correlation
Obese (More than 30)	0.088 weak positive correlation	0.035 weak positive correlation	0.271 weak positive correlation

BMI: Body mass index, PCV: Packed cell volume, Hb: Haemoglobin

The mean platelet loss, as shown by the ANOVA F test, was significantly higher (p value < 0.001) in intermittent flow technology instruments (MCS +) compared to continuous flow technology instruments (Spectra Optia and Trima Accel) for single yield and double yield procedures (Table 5).

The difference in mean platelet loss between first-time donors and repeat donors was not significant. There was also no significant difference in platelet loss in the first-time donors compared to repeat donors for both single- and double-yield platelet donations performed with the continuous flow technology instruments. The platelet loss in first-time donors compared to repeat donors was significantly higher when the procedure was performed on an intermittent flow technology instrument for single-yield platelet donations (Table 5). Double-yield platelet donation procedures were not performed on first-time donors with this instrument.

A Multiple Regression Analysis (MRA) was applied to enumerate the determinants that influence platelet loss. The Ordinary least squares regression model with the stepwise method ($F = 30.189$; $p < 0.000$) indicates the fitness of the model. In the MRA ($R^2 = 0.268$) the blood volume processed, product volume, run time, and BMI have a positive influence, and Total Blood Volume and Platelet count have a negative influence on platelet loss (Table 6). Factors such as age, blood group, Hb, and PCV did not have an impact on platelet loss.

The independent variables considered were age, BMI, HB, PCV, platelet count, TBV, Blood Volume processed, run time, blood group, and product volume.

None of the donors in this study complained of symptoms suggestive of thrombocytopenia. Significant clinical thrombocytopenia was observed in very few donors who experienced a 10–20% decrease in platelets.[11]

The blood group distribution is O > B > A > AB. It is similar to studies conducted by Patidar and Dhiman, Das et al. and Reddy and Sudha.[12–14]

The past history of the donors indicated that 0.5% of them experienced giddiness and 1% experienced fainting. 3 of the 503 donors (0.6%) experienced adverse reactions such as giddiness. These reactions were observed for the first time in normal BMI donors. The adverse reaction rates reported in other studies ranged from 0.68% to 16% in plateletpheresis donors.[15,16] The adverse reaction rates reported in the Indian population ranged from 4.36 to 18%.[2,17] Adverse experiences with double phlebotomy were reported in 23 donors (4.57%).

311 (61.8%) of the donors had the intention to repeat platelet donations (1 month - 0.6%; 2 months - 3.6%; 3 months - 32.3%; 6 months - 20.5%; 12 months - 4.8%). Repeat blood donations are economical for the blood bank.[18] 31.8% (99 among 311) of the intended repeat donors are willing to donate in emergencies as well. 66 out of 503 (13.12%) donors intended to donate for emergencies alone. The number of first-time donors who intend to repeat platelet donation is 67 among 109 (61.5%). The intention to donate based on age groups was 18–24 years - 24.76%, 25–29 years - 25.08%, 30–35 - 26.05%, and 35–55 - 24.12%, respectively.

The number of voluntary donors (68.49%) with the intention to repeat platelet donation was significantly higher compared to replacement donors (53.91%) (Pearson chi-square = 11.252, p value = 0.001) (Table 7). There is a strong association between voluntary donors and the intention to repeat platelet donations ($p < 0.001$).

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Table 5.Platelet Loss in First-Time and Repeat Donors With Respect to Apheresis Instruments Used for Single and Double Yield

Item	Platelet Loss ($x 10^3$ /µl)	Platelet loss MCS+ ($x 10^3$ /µl)		Platelet Loss Spectra Optia ($x 10^3$ /µl)		Platelet Loss Trima Accel ($x 10^3$ /µl)	
		SDP	DDP	SDP	DDP	SDP	DDP
First-time donors	75.697 ± 21.809	79.728 ± 19.901	N = 0	53.052 ± 6.818	94.555 ± 12.104	49.833 ± 3.188	102.40 ± 8.961
Repeat donors	74.444 ± 26.529	73.497 ± 20.248	N = 3 1.48 ± 0.385	53.802 ± 12.836	94.928 ± 22.251	52.793 ± 17.937	103.829 ± 26.079
p value	0.614 not significant	0.029 significant	-	0.721 not significant	0.941 not significant	0.414 not significant	0.806 not significant

SDP: Single-donor platelet, DDP: Double-donor platelet

Table 6.Multiple Regression Analysis – Significant Factors Influencing Platelet Loss

Model	Unstandardised Coefficient		T	Sig.
	B	Std Error		
Intercept/ constant	16.723	3.721	4.494	0.000
BV processed	0.003	0.001	3.329	0.001
TBV	-0.003	0.001	-4.566	0.000
Product volume	0.028	0.005	5.247	0.000
Platelets	-0.027	0.006	-4.367	0.000
Run time	0.165	0.046	3.590	0.000
BMI	0.366	0.140	2.621	0.009

Dependent variable: Platelet loss

Table 7.Association Between Donor Type and Intention to Repeat Platelet Donation – Chi-Square Test

Category of Donors	Intention to Repeat Platelet Donation		Total	Inference
	No	Yes		
Voluntary	86	187	273	Pearson chi-square = 11.252 p value = 0.001
Replacement	106	124	230	
Total	192	311	503	

Conclusion

The WHO aims to provide safe and sufficient blood to patients by mobilising donors in particular populations. The characteristics of first-time and repeat donors, such as age, platelets, Total WBC counts, Differential counts, platelet loss, adverse reactions, and vitals, were similar. First-time donors can safely donate platelets by apheresis.

The donor's characteristics and intention to repeat donation are important criteria for donor recruitment and retention and for planning and organising the transfusion requirements of a hospital. Repeat voluntary, non-remunerated apheresis platelet donations shall be promoted.

A national registry should be maintained for donor parameters. These parameters will help establish the socio-demographic profiles of donors according to the region. This will also help establish the NLR, LMR, and PLR reference ranges for the Indian population. These simple and inexpensive tests can add value to the diagnosis and prognosis of certain diseases, including cancer.

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