

Original Article

Assessing blood donation applicant characteristics to optimize the promotion of apheresis

Daisuke Kumazawa, Makiko Sugawa and Kazuo Kawahara

Department of Health Care Management and Planning, Graduate School, Tokyo Medical and Dental University

Abstract

For effectively using blood products from a limited donor population, the promotion of apheresis donation should be emphasized more often. This study assessed the demographic data of apheresis applicants using blood donor data from the Japanese Red Cross Society.

We analyzed blood donor data (253,039 samples) to compare apheresis applicants and subjects who applied for and made whole-blood donations. There were significant differences between both groups, and among apheresis applicants, females were more numerous, as were “public servants” and “blood centers.” In terms of each fixed facility’s characteristics, the rate of applications was the highest for the “Tokai Hokuriku” region.

Due to the differences among facilities, we considered the possibility of facility-specific promotional activities. Such practices are helpful for continuous blood donation for those who may be deferred from donation.

Key Words: Apheresis donation, Blood Donation, Blood Donor Attributes

Introduction

In Japan, blood donations include whole-blood (200 mL and 400 mL) and apheresis donations. For new donors,

the Japanese Red Cross Society is promoting blood donation among young people via LOVE in Action Project¹. The 200-mL blood donation is utilized in such campaigns. In contrast, for repeat donors, efficient blood donation promotion has been attempted by the promotion of 400-mL blood donation and apheresis. Compared with whole-blood donation, apheresis is less burdensome to donors because erythrocytes are returned to the donor’s system. The promotion of apheresis donation is also important to ensure sufficient sources of plasma for plasma derivatives.

According to blood collection standards, there are some requirements for a donor’s body condition¹, especially in the case of whole-blood donation from female donors, even if they meet the weight criteria required for a 200-mL blood donation (at least 40 kg). For 400-mL whole-blood donation, donors must weigh over 50 kg. Unlike whole-blood donation, apheresis donation has a relatively lower body weight requirement, so even if underweight females or those with a low hemoglobin concentration² are unable to donate whole blood, they can continuously perform apheresis donations. Compared with whole-blood collection time (whole-blood donation: 10–15 minutes; apheresis: 40–90 minutes), apheresis collection generally requires a longer time, and donors wishing to donate apheresis can be limited by the amount of spare time they have available before and after donation.

More than 30 years have passed since apheresis and 400-mL whole-blood donations were introduced in 1986. Many 400-mL whole-blood donation promotion campaigns are being conducted^{3, 4}, while apheresis donation is poorly promoted, with the option being typically mentioned only in the blood donation room⁵. In Japan, although the number of donors has decreased in an aging society, the demand for immunoglobulin products is rapidly increasing. Therefore, to ensure an adequate

Corresponding Author: Daisuke Kumazawa
Department of Health Care Management and Planning, Graduate School, Tokyo Medical and Dental University, 1-5-45 Yushima, Bunkyo-ku Tokyo 113-8510, Japan
E-mail: daisukekumazawa@live.jp
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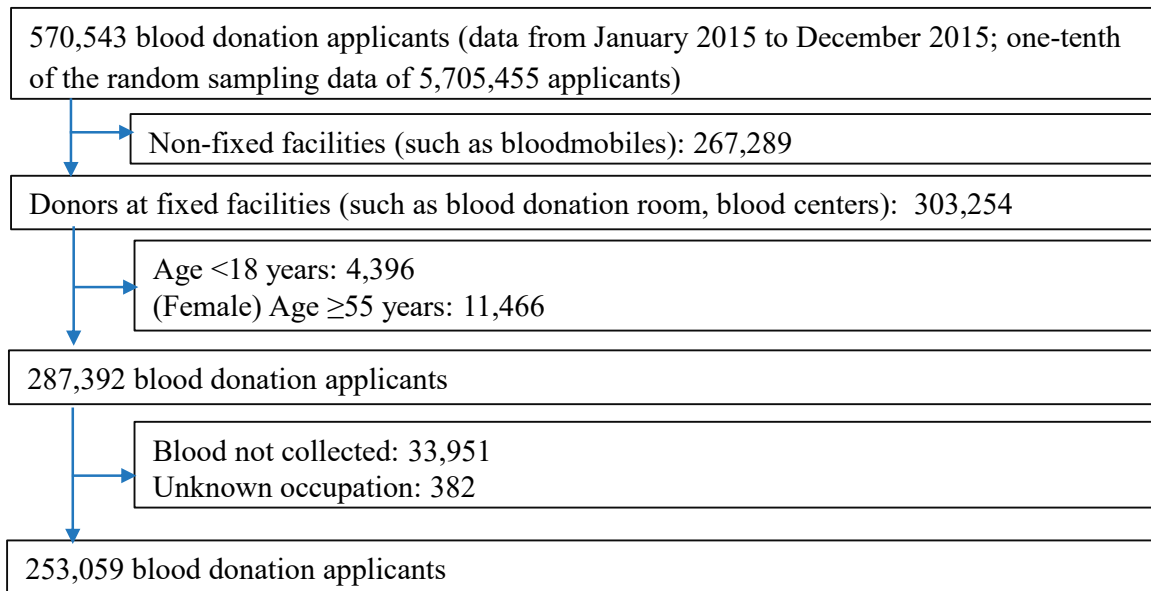


Figure 1. Study flowchart

supply of plasma, it is necessary to consider a blood donation system for apheresis donors.

This study aimed to identify characteristics of apheresis donors and focused on blood donation of applicants, their attributes, and each facility's characteristics to improve the efficiency of apheresis donation. This is the first study to assess trends in apheresis donation applicants using blood donation data across the country from the Japanese Red Cross Society. In this study, we compared the attributes of whole-blood and apheresis applicants and assessed how these individual attributes affected apheresis. We also assessed facility characteristics to determine their relationship with the rates of apheresis applicants.

Materials and Methods

The Blood Service Headquarters at The Japanese Red Cross Society provided us data of a cumulative total of 5,705,455 blood donation applicants across Japan between January and December 2015. From this data, we extracted data of 570,543 using a simple random sampling method (one-tenth of the random sampling data). Because most apheresis donors donate blood at fixed facilities such as blood donation rooms and blood centers, we extracted data from these fixed locations. Then, we analyzed applicants who met the criteria for

every type of apheresis donation (males and females over 18 years of age and females under 55 years). In addition, to consider actual blood donor conditions, we focused only on actual donors. Applicants with inadequate data were excluded; in total, 253,059 applicants were included in our analyses. Figure 1 shows the study flow chart.

First, we tested for significant differences in the demographic characteristics of apheresis and whole-blood donation applicants. To compare each group, a chi-squared test was used to compare the percentages for a contingency table, and an independent t-test (two-tailed) was used to compare the means of each group. We also utilized the independence test through a chi-squared analysis to assess differences between male applicants and female applicants.

Next, we used a multivariate logistic regression analysis to assess the individual attributes of applicants by sex; the independent variables were age group, occupation, day of the week, block blood center, and collection facility location. Each attribute was analyzed against the binary dependent variable. To ensure a significant difference, partial regression coefficients (B) were identified, and odds ratios were observed. We defined the applicants as dependent variable (apheresis was "1," and whole blood was "0") and "age group," "occupation," "day of the week," "block blood center," and "facility location"

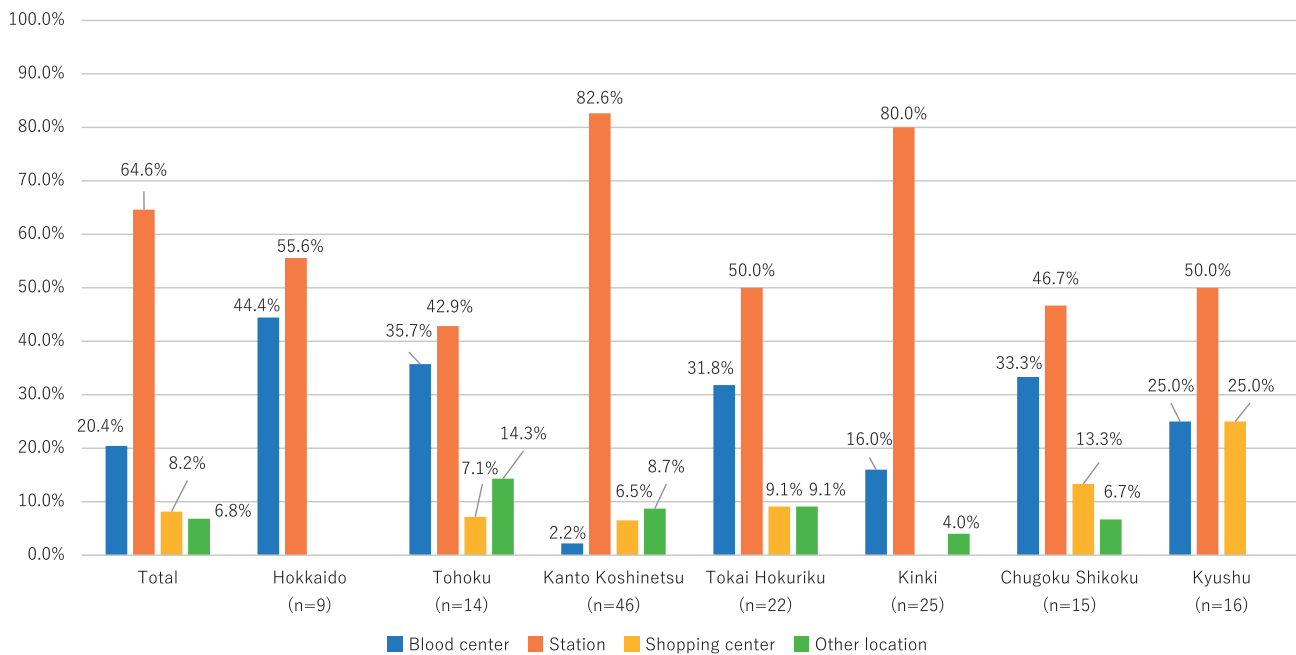


Figure 2. Distribution of fixed facilities' characteristics (n = 147)

as independent variables. The reference groups were set to "40–49" (for "age group"), "company employee" (for "occupation"), "weekday" (for "day of the week"), "Kanto Koshinetsu" (for "block blood center"), and "station" (for "facility location").

Finally, to analyze each fixed facility's characteristics, factors associated with those who applied for apheresis were analyzed by multiple regression analysis with the dependent variable being the log odds ratio of the rate of apheresis applicants (because the rate of apheresis applicants ranged from 0 to 1) using the forced entry method by sex. Independent variables of blood donor attributes were occupation ("public servants," "company employee," "high school students," "university students," "housewives (female only)," "self-employed," and "others"), block blood center region ("Hokkaido," "Tohoku," "Tokai Hokuriku," "Chugoku Shikoku," and "Kyushu"), and facility location ("blood center," "shopping center," and "others"). Unstandardized partial regression coefficients (B) and standardized partial regression coefficients (β) were then calculated to determine a significant difference. In addition, the test statistics were observed. We excluded the variables with high collinearity ("others" from the occupation variable) by collinearity statistics tolerance and by determining the variance inflation factor (VIF). While there were a total of 157 fixed facilities, 9 did not perform apheresis collection and one conducted

apheresis donation only on weekdays; thus, we excluded these 10 facilities, leaving a total of 147 facilities for analysis. Figure 2 shows the distribution of fixed facility characteristics and that of block blood center and location.

Location of a collection facility was defined as follows: blood center, a facility located in the blood collection center of each prefecture; station, a facility located within a five-minute walk from a train station; shopping center, a facility located in a large-scale commercial facility or its vicinity; and others, any collection facility other than those described above.

For statistical analyses, we used IBM Statistical Package for the Social Sciences (SPSS) version 25 (IBM, Armonk, New York, U.S.A.). *P*-values <0.05 were considered statistically significant.

This study was conducted with the approval of the Medical Research Committee of Tokyo Medical and Dental University. (Approval no: M2018-248).

Results

1. Demographic characteristics of blood donation applicants (Tables 1 and 2)

Demographic characteristics of blood donation applicants for those who underwent apheresis compared with those who underwent whole-blood donations were

Table 1. Demographic characteristics of blood donation applicants (by applicants type whole blood/apheresis)

	n	Total	Whole blood applicants		Apheresis applicants		P-value
		253,059	117,361		135,698		
		n	n	(%)	n	(%)	
Sex	Male	181,847	86,500	(73.7)	95,347	(70.3)	<0.01 ^a
	Female	71,212	30,861	(26.3)	40,351	(29.7)	
Age group (years)	18–19	7,614	5,127	(4.4)	2,487	(1.8)	<0.01 ^a
	20–29	46,507	24,588	(21.0)	21,919	(16.2)	
	30–39	53,229	24,160	(20.6)	29,069	(21.4)	
	40–49	78,936	34,806	(29.7)	44,130	(32.5)	
	50–59	50,588	21,603	(18.4)	28,985	(21.4)	
	60–69	16,185	7,077	(6.0)	9,108	(6.7)	
Occupation	Public servants	27,157	10,941	(9.3)	16,216	(12.0)	<0.01 ^a
	Company employee	149,714	70,618	(60.2)	79,096	(58.3)	
	High school students	1,936	1,423	(1.2)	513	(0.4)	
	University students	12,889	7,328	(6.2)	5,561	(4.1)	
	Housewives	13,073	5,930	(5.1)	7,143	(5.3)	
	Self-employed	10,275	5,234	(4.5)	5,041	(3.7)	
	Others	38,015	15,887	(13.5)	22,128	(16.3)	
Day of the week	Weekdays	140,929	63,383	(54.0)	77,546	(57.1)	<0.01 ^a
	Saturday	47,246	21,873	(18.6)	25,373	(18.7)	
	Holiday	64,884	32,105	(27.4)	32,779	(24.2)	
Block blood center	Hokkaido	11,770	6,884	(5.9)	4,886	(3.6)	<0.01 ^a
	Tohoku	14,961	5,838	(5.0)	9,123	(6.7)	
	Kanto Koshinetsu	106,028	51,727	(44.1)	54,301	(40.0)	
	Tokai Hokuriku	31,869	11,905	(10.1)	19,964	(14.7)	
	Kinki	44,833	23,112	(19.7)	21,721	(16.0)	
	Chugoku Shikoku	19,340	7,503	(6.4)	11,837	(8.7)	
	Kyushu	24,258	10,392	(8.9)	13,866	(10.2)	
Location of blood collection facility	Blood center	23,340	7,574	(6.5)	15,766	(11.6)	<0.01 ^a
	Station	189,558	87,356	(74.4)	102,202	(75.3)	
	Shopping center	18,286	9,278	(7.9)	9,008	(6.6)	
	Others	21,875	13,153	(11.2)	8,722	(6.4)	
		Mean (SD)	Mean (SD)		Mean (SD)		
Frequency of blood donations		53.84 (±80.91)	18.84 (±29.75)		84.12 (±97.30)		<0.01 ^b

a. Chi-squared test for cross-table comparison between groups

b. t-test for comparison of mean value between groups

analyzed (Table 1). A chi-squared test was conducted for each categorical variable. In particular, apheresis applicants contained a higher percentage of females and public servants. Based on the location of the facility, apheresis applicants were more likely to be found at "blood centers."

There were significant differences between male and female applicants (Table 2). From these results, we assigned the applicants into male and female groups for the subsequent two analyses, which included logistic and multiple regression analyses.

2. Analysis of individual attributes by logistic regression analysis (Tables 3 and 4)

Because of the difference between male and female blood donation applicants, a logistic regression analysis was conducted according to sex.

For males (Table 3), "public servants" had significantly higher application rates than did the reference group (odds ratio = 1.30, $p < 0.01$). Regarding regional characteristics, "Tohoku," "Tokai Hokuriku," "Chugoku Shikoku," and "Kyushu" regions had significantly higher apheresis application rates than did the reference group (odds

Table 2. Demographic characteristics of blood donation applicants (by sex)

	n	Total	Male		Female		P-value
		253,059	181,847		71,712		
	n	n	(%)	n	(%)		
Donation type	Whole blood applicants	117,361	86,500	(47.6)	30,861	(43.3)	<0.01 ^a
	Apheresis applicants	135,698	95,347	(52.4)	40,351	(56.7)	
Age group (years)	18–19	7,614	3,436	(2.1)	4,178	(5.9)	<0.01 ^a
	20–29	46,507	24,701	(14.9)	21,806	(30.6)	
	30–39	53,229	36,500	(22.0)	16,729	(23.5)	
	40–49	78,936	58,880	(35.5)	20,056	(28.2)	
	50–59	50,588	42,145	(25.4)	8,443	(11.9)	
Occupation	Public servants	27,157	22,964	(12.6)	4,193	(7.2)	<0.01 ^a
	Company employee	149,714	118,849	(65.4)	30,865	(53.1)	
	High school students	1,936	867	(0.5)	1,069	(1.8)	
	University students	12,889	6,487	(3.6)	6,402	(11.0)	
	Self-employed	10,275	9,208	(5.1)	1,067	(1.8)	
	Others	38,015	23,472	(12.9)	14,543	(25.0)	
Day of the week	Weekdays	140,929	96,876	(53.3)	44,053	(61.9)	<0.01 ^a
	Saturday	47,246	35,150	(19.3)	12,096	(17.0)	
	Holiday	64,884	49,821	(27.4)	15,063	(21.2)	
Block blood center	Hokkaido	11,770	8,091	(4.4)	3,679	(5.2)	<0.01 ^a
	Tohoku	14,961	10,873	(6.0)	4,088	(5.7)	
	Kanto Koshinetsu	106,028	74,400	(40.9)	31,628	(44.4)	
	Tokai Hokuriku	31,869	23,701	(13.0)	8,168	(11.5)	
	Kinki	44,833	31,919	(17.6)	12,914	(18.1)	
	Chugoku Shikoku	19,340	14,524	(8.0)	4,816	(6.8)	
	Kyushu	24,258	18,339	(10.1)	5,919	(8.3)	
Location of blood collection facility	Blood center	23,340	18,457	(10.1)	4,883	(6.9)	<0.01 ^a
	Station	189,558	133,859	(73.6)	55,699	(78.2)	
	Shopping center	18,286	13,268	(7.3)	5,018	(7.0)	
	Others	21,875	16,263	(8.9)	5,612	(7.9)	
		Mean (SD)	Mean (SD)	Mean (SD)			
Frequency of blood donations		53.84 (±80.91)	64.21 (±89.72)	27.38 (±41.64)		<0.01 ^b	

a. Chi-squared test for cross-table comparison between groups

b. t-test for comparison of mean value between groups

ratios were 1.62, 1.51, 1.64, 1.51, respectively, $p < 0.01$). In addition, "blood center" locations were approximately one and a half times more likely to donate apheresis than were the reference group (odds ratio = 1.54, $p < 0.01$). The Nagelkerke R^2 value was 0.064.

For females (Table 4), similar to males, "public servants" and "blood centers" had significantly higher apheresis application rates than did the reference group (odds ratios were 1.36 and 1.44, respectively, $p < 0.01$). However, unlike in males, only in the "Tokai Hokuriku" region, was there significantly more apheresis applicants

compared to the reference group (odds ratio = 1.56, $p < 0.01$). The Nagelkerke R^2 value was 0.074.

3. Multiple regression analysis for fixed facilities (Tables 5 to 7).

Table 5 shows the descriptive statistics of 147 fixed facilities. For each fixed facility's characteristic evaluation, a multiple regression analysis was conducted.

In the male applicants, the facility at the "Tokai Hokuriku" region or "blood center" had a higher rate of apheresis applicants (both P -values = 0.03, the

Table 3. Logistic regression analysis for individual attributes (male)

		n	B	Standard error	Odds ratio	95% Confidence interval for odds ratio	
Age group (years)	18–19	3,436	-1.16 **	0.05	0.31	0.29	0.34
	20–29	24,701	-0.55 **	0.02	0.58	0.56	0.60
	30–39	36,500	-0.15 **	0.01	0.86	0.84	0.88
	40–49	58,880			Ref		
	50–59	42,145	0.09 **	0.01	1.09	1.06	1.12
	60–69	16,185	-0.01	0.02	1.00	0.96	1.03
Occupation	Public servants	22,964	0.26 **	0.02	1.30	1.26	1.34
	Company employee	118,849			Ref		
	High school students	867	-0.29 **	0.10	0.75	0.62	0.90
	University students	6,487	0.02	0.03	1.02	0.96	1.09
	Self-employed	9,208	-0.17 **	0.02	0.84	0.81	0.88
	Others	23,472	0.34 **	0.02	1.41	1.36	1.45
Day of the week	Weekdays	96,876			Ref		
	Saturday	35,150	-0.01	0.01	0.99	0.97	1.02
	Holiday	49,821	-0.10 **	0.01	0.91	0.89	0.93
Block blood center	Hokkaido	8,091	-0.33 **	0.02	0.72	0.69	0.76
	Tohoku	10,873	0.48 **	0.02	1.62	1.55	1.69
	Kanto Koshinetsu	74,400			Ref		
	Tokai Hokuriku	23,701	0.44 **	0.02	1.51	1.46	1.55
	Kinki	31,919	-0.20 **	0.01	0.82	0.79	0.84
	Chugoku Shikoku	14,524	0.49 **	0.02	1.64	1.58	1.70
Location of blood collection facility	Kyushu	18,339	0.29 **	0.02	1.33	1.29	1.38
	Blood center	18,457	0.44 **	0.02	1.54	1.48	1.59
	Station	133,859			Ref		
	Shopping center	13,268	-0.23 **	0.02	0.80	0.77	0.83
	others	16,263	-0.56 **	0.02	0.56	0.54	0.58

Whole blood applicants coded 0, Apheresis applicants coded 1

Ref: reference category; 40–49, Company employee, Weekdays, Kanto Koshinetsu, Station

B, Standard error: partial regression coefficients and its standard error

**: $P < 0.01$, *: $P < 0.05$

Table 4. Logistic regression analysis for individual attributes (female)

		n	B	Standard error	Odds ratio	95% Confidence interval for odds ratio	
Age group (years)	18–19	4,178	-0.92 **	0.05	0.40	0.37	0.44
	20–29	21,806	-0.38 **	0.02	0.69	0.66	0.72
	30–39	16,729	0.02	0.02	1.02	0.98	1.07
	40–49	20,056			Ref		
	50–54	8,443	-0.06 *	0.03	0.94	0.89	0.99
Occupation	Public servants	4,193	0.31 **	0.04	1.36	1.27	1.46
	Company employee	30,865			Ref		
	High school students	1,069	-0.44 **	0.08	0.64	0.55	0.75
	University students	6,402	-0.05	0.03	0.95	0.89	1.01
	Housewives	13,073	-0.28 **	0.02	0.76	0.73	0.79
	Self-employed	1,067	-0.48 **	0.06	0.62	0.54	0.70
Day of the week	Others	14,543	0.06 **	0.02	1.06	1.02	1.11
	Weekdays	44,053			Ref		
	Saturday	12,096	-0.27 **	0.02	0.76	0.73	0.80
	Holiday	15,063	-0.33 **	0.02	0.72	0.69	0.75
Block blood center	Hokkaido	3,679	-1.08 **	0.04	0.34	0.32	0.37
	Tohoku	4,088	0.05	0.04	1.06	0.99	1.13
	Kanto Koshinetsu	31,628			Ref		
	Tokai Hokuriku	8,168	0.48 **	0.03	1.56	1.47	1.64
	Kinki	12,914	-0.15 **	0.02	0.86	0.82	0.90
Location of blood collection facility	Chugoku Shikoku	4,816	-0.13 **	0.03	0.88	0.83	0.94
	Kyushu	5,919	-0.23 **	0.03	0.80	0.75	0.84
	Blood center	4,883	0.39 **	0.03	1.44	1.35	1.54
	Station	55,699			Ref		
	Shopping center	5,018	-0.45 **	0.03	0.64	0.60	0.68
	others	5,612	-0.77 **	0.03	0.45	0.43	0.48

Whole blood applicants coded 0, Apheresis applicants coded 1

Ref: reference category; 40–49, Company employee, Weekdays, Kanto Koshinetsu, Station

B, Standard error: partial regression coefficients and its standard error

**: $P < 0.01$, *: $P < 0.05$

Table 5. Classification of fixed facilities

	Number of facilities	Male	Female
Total	147	170,375	68,027
Hokkaido	9	7,223	3,273
Tohoku	14	10,873	4,088
Kanto Koshinetsu	46	67,731	29,843
Tokai Hokuriku	22	22,333	7,867
Kinki	25	29,352	12,221
Chugoku Shikoku	15	14,524	4,816
Kyushu	16	18,339	5,919
Blood center	30	18,457	4,883
Station	95	128,140	54,267
Shopping center	12	12,606	4,666
Other location	10	11,172	4,211
		Mean (SD)	
Rate of public servant donors		0.137 (± 0.050)	0.064 (± 0.026)
Rate of company employee donors		0.639 (± 0.068)	0.419 (± 0.068)
Rate of high school student donors		0.004 (± 0.003)	0.014 (± 0.011)
Rate of university student donors		0.031 (± 0.021)	0.074 (± 0.045)
Rate of housewife donors		—	0.203 (± 0.084)
Rate of self-employed donors		0.053 (± 0.021)	0.016 (± 0.010)
Rate of other occupation donors		0.135 (± 0.029)	0.211 (± 0.049)
Log odds ratio of the rate of apheresis applicants (SD)		0.320 (± 0.562)	0.411 (± 0.667)

Table 6. Multiple regression analysis for fixed facilities' characteristics (male)

	B	Standard error	β	t	Tolerance	VIF
(Constant)	0.22	0.22	0.00	1.02	—	—
Rate of public servants	1.31	1.13	0.12	1.16	0.55	1.81
Rate of high school students	-11.93	15.35	-0.07	-0.78	0.77	1.31
Rate of university students	-2.62	2.29	-0.10	-1.14	0.76	1.32
Rate of self-employed	0.29	2.31	0.01	0.13	0.75	1.33
Hokkaido	-0.40	0.21	-0.17	-1.91	0.68	1.47
Tohoku	0.02	0.18	0.01	0.13	0.65	1.53
Tokai Hokuriku	0.32	0.14	0.20*	2.25	0.69	1.46
Kinki	-0.23	0.13	-0.16	-1.75	0.69	1.46
Chugoku Shikoku	0.14	0.17	0.08	0.87	0.69	1.44
Kyushu	0.03	0.18	0.02	0.16	0.58	1.73
Blood center	0.29	0.13	0.21*	2.22	0.61	1.63
Shopping center	-0.28	0.17	-0.14	-1.71	0.84	1.18
Others location	-0.05	0.18	-0.02	-0.29	0.87	1.15

**: $P < 0.01$, *: $P < 0.05$

B, Standard error: unstandardized partial regression coefficients and its standard error

β : standardized partial regression coefficients

t: test statistic

Tolerance, VIF: collinearity statistics

standardized coefficients (β) were 0.20 and 0.21, respectively.) Conversely, there was no significant association between occupation and the rate of apheresis application (adjusted $R^2 = 0.19$) (Table 6).

For females, the facility at "Tokai Hokuriku" region had

a higher rate of apheresis applications (P -value = 0.01, $\beta = 0.22$; adjusted $R^2 = 0.28$) (Table 7).

In the "Tokai Hokuriku" region, it was confirmed that the rate of apheresis applications was higher in both males and females.

Table 7. Multiple regression analysis for fixed facilities' characteristics (female)

	B	Standard error	β	t	Tolerance	VIF
(Constant)	0.80	0.31	0.00	2.61	—	—
Rate of public servants	0.67	2.16	0.03	0.31	0.69	1.45
Rate of high school students	-7.52	5.31	-0.12	-1.42	0.64	1.57
Rate of university students	-0.17	1.43	-0.01	-0.12	0.54	1.86
Rate of housewives	-0.16	0.71	-0.02	-0.23	0.61	1.63
Rate of self-employed	-9.81	4.70	-0.16*	-2.09	0.89	1.12
Hokkaido	-1.06	0.22	-0.38**	-4.85	0.79	1.26
Tohoku	-0.40	0.19	-0.18*	-2.09	0.68	1.47
Tokai Hokuriku	0.41	0.16	0.22**	2.62	0.71	1.41
Kinki	-0.26	0.15	-0.15	-1.77	0.72	1.39
Chugoku Shikoku	-0.25	0.18	-0.11	-1.36	0.71	1.41
Kyushu	-0.35	0.18	-0.16*	-2.00	0.73	1.38
Blood center	0.31	0.16	0.19	1.93	0.51	1.95
Shopping center	-0.28	0.19	-0.11	-1.46	0.81	1.24
Others location	-0.23	0.20	-0.09	-1.13	0.86	1.17

** $P < 0.01$, * $P < 0.05$

B, Standard error: unstandardized partial regression coefficients and its standard error

β : standardized partial regression coefficients

t: test statistic

Tolerance, VIF: collinearity statistics

Discussion

In this study, we confirmed there that there exist differences in the demographics of apheresis applicants in terms of age, occupation, and region. In particular, apheresis applicants accounted for a higher percentage of females and public servants. Multivariate analysis of blood donor attributes revealed regional differences for blood donation implementation at "Tokai Hokuriku"; apheresis donation tended to be preferred by both males and females. From this fact, as a regional factor, demand for apheresis donation in "Tokai Hokuriku" was easily satisfied compared to other regions.

In addition, we observed that apheresis applicant rate was higher at "blood centers." Although many fixed facilities are located in or around train stations or shopping centers, these facilities mainly promote apheresis donation¹. Even if they are relatively difficult to access, the facts that apheresis donation is preferred and predominately conducted in blood centers are meaningful. Some of the fixed facilities that were primarily installed for apheresis donation have shifted to whole-blood donation⁵. Ensuring convenience is crucial for optimal promotion of blood donation.

In this study, the adjusted R^2 values from multiple regression analyses of the rates of apheresis applications were

low, so further analysis of other factors not assessed in this study is necessary to promote optimal apheresis donation for each facility. Furthermore, one of the limitations of this study was that the rate of apheresis applications among younger age groups might be relatively low compared to other age groups because of their small numbers.

The wide-area blood management system was launched in 2012 to help fulfill blood demands within each block blood center (there are seven block blood centers from Hokkaido to Kyushu). While we mentioned above that the "Tokai Hokuriku" region was easily supplied compared with other regions, the supply and demand for blood products are managed within each of the seven regional blocks. However, due to the higher demand for plasma, each blood collection facility has to secure apheresis donations.

Owing to the differences among facilities, we considered the possibility of facility-specific promotional activities. For instance, there are some practices to facilitate apheresis donation, such that donors' blood can be utilized in cases where donors do not meet the criteria for 400-mL blood donation². Females are relatively mismatched for 400 mL of blood donation compared to males. Therefore, such practices are helpful for continuous blood donation for those who were deferred from

donation. Also, the blood donation reservation system seems to affect rates of apheresis donation⁶, so promotion of this system plays an integral role in maintaining stable blood supplies and ensuring efficient blood collection to meet demands for specific blood products⁷⁻¹⁰.

Finally, this study suggested that the promotion of apheresis is better to target females, especially those who are underweight or those with a low hemoglobin concentration. Even if they are often unable to donate whole blood, they could continuously perform apheresis donations.

Conflict of Interest

The authors have no potential conflicts of interest to disclose.

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