Accepted Manuscript

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Introduction

According to the World Health Organization, most countries recruit blood donors between 18 and 65 years old for allogeneic transfusion, that is, for transfusion to patients unrelated to the donor. In high-income countries, 75% of blood transfusions are given to people aged 65 years or older[1]. In Japan, the population over 65 years old comprised more than 28%[2], whereas working-age (15 to 64 years old) comprised 59.7% of the population in 2018[3]. The number of young people (under 15 years old) who could be future donors has been decreasing rapidly, comprising just 12% of the 2018 population[3]. The Ministry of Health, Labour and Welfare estimated that annual blood transfusion demand would increase from about 8,500,000 blood component units in 2020 to 9,000,000 in 2027, while the donated blood from which those components are derived would decrease from about 6,500,000 units in 2020 to 6,300,000 units. Therefore, the proportion of young people who donate blood, and the frequency with which they donate, warrant urgent attention. Fukushima is Japan's third largest prefecture by area, but with only 1.5% of the nation's total and working-age population; 29% of Fukushima's population is 65 years old and above[4]. In Japan, a transfused "unit" of red cells, platelets, or plasma is historically based on a 200 mL whole blood donation; this volume can be collected from healthy volunteers as young as 16 years old. Donations of 400 mL are accepted from 17-year-old men and 18-year-old women, according to policies liberalized in 2011. However, anxiety about COVID-19 infection greatly reduced the number of volunteer donors at various places affected by the spread of SARS-CoV-2[5]. The Japanese Red Cross Society was already concerned about maintaining an adequate pool of blood donors. They have been trying to increase organizational participation and familiarity with blood donation, but putting even more effort into donor recruitment has been required in this context[6]. Transfusion demand in a rapidly aging society is thus complicated by various health crises. The aim of this paper is to explore factors influencing young people's motivation to donate blood.

We previously asked university students about motivators and barriers to donating blood and found that the proportion of those "frightened by blood donation" significantly differed between donors and non-donors[7]. According to Lowe and Ferguson, people who receive positively framed messages (e.g., "lives saved") tend to be more confident about blood safety than those who receive negatively framed messages (e.g., "lives lost")[8]. A study conducted in Korea showed that altruism among high school students greatly increased blood donation rates and concluded that such correlates are important to develop a blood donation program[9]. Another study also indicated that altruistic feelings were associated with donors' satisfaction with their treatment and blood donor loyalty after giving blood for the first time[10]. Since our previous study focused on students' negative attitudes toward blood donation, we explored their positive attitudes in the present study to advance previous work. We focused on a questionnaire item which asked one's perceptions of blood donation as "doing good for others" and actual donation behaviors among Japanese high school students. Our specific hypothesis was that the perception of blood donation as "doing good for others" would associate with students' actual donation behavior, and the following analysis plan was to explore factors associated with that perception.

Materials and methods

This was a cross-sectional study implemented by the Fukushima Red Cross Blood Donor Center. The center conducted a questionnaire survey in 2018 at 10 high schools in Fukushima Prefecture. Four

students did not respond to the survey. The questionnaire assessed basic characteristics of students and past blood donation experience, along with 10 items as motivators and 8 items as barriers for blood donation. These motivator and barrier items emerged from our previous study[7], which was also conducted in collaboration with the Fukushima Red Cross Blood Donor Center. The age range of Japanese high schoolers in general is 15 to 18 years old.

From that database, we analyzed: basic student characteristics (which school, year in school, gender); subjective health; ABO blood group and Rh (almost always Rh-positive among Asians); transfusion experience of close friends, family members, neighbors; and familiarity with donor eligibility criteria (Table 1). As for the last knowledge item, we asked, "Do you know any of the criteria under which you are not eligible to donate blood?" and the response options were yes or no.

As the main outcome measurement, the questionnaire asked, "How important do you think the following reason is when you decide whether or not to donate blood, on a 5-point scale ranging from 1 = very important to 5 = not important at all?" Among the motivators, our focus this time was "doing good for others." For statistical analysis, we placed the perception of "doing good for others" into 2 groups. Included in the "important" group are those who answered very important or important (1 and 2), and others (3, 4, and 5) were included in the "not important" group. After confirming this perception associated with students' donation behavior, we investigated its association with other variables.

Survey data were analyzed using SPSS version 25 for Windows. As for factors associated with the perception of "doing good for others" through blood donation, we first performed chi-square tests. Significant items by univariate analysis ($p < 0.05$) were entered into multivariate analysis using binomial regression.

The original survey was conducted by the Fukushima Red Cross Blood Donor Center. It was an anonymous self-administered questionnaire survey conducted in classrooms. Our secondary analysis of the database was approved by the Fukushima Red Cross Blood Donor Center, as guided by Red Cross policy, national law, and the World Medical Association Declaration of Helsinki. Of note, the school names were masked in the databased we received.

Results

Among those in the Red Cross database, 4506 students from all 10 high schools responded (99.9%). Males comprised 55.2% overall; first-, second-, and third-year students comprised 31.8%, 36.7%, and 31.4%, respectively (Table 1).

Figure 1 illustrates how the number of past blood donations relates to the degree that "doing good for others" is perceived. The "very important" and "important" groups correspond to exactly those survey answers, with the remaining answers aggregated in the "not sure, not important" group. We found that students who donated blood more often tended to cite "doing good for others" as an important motivator: the percentage of those answering "very important" was 37.2% in the no donation group, 54.7% in the single donation group, and 62.0% in the multiple donation group.

By multivariate analysis, as shown in Table 2, two high schools had a significantly lower proportion of students answering that "doing good for others" was important: 67.2% for School 1 and 65.5% for School 5. The probability of answering "doing good for others" as important was significantly higher among females (adjusted odds ratio (AOR)=1.853), those with better subjective health (AOR=2.433), those knowing their blood type (AOR=1.694), and those knowing eligibility criteria of blood donation (AOR=1.633).

Discussion

As hypothesized based on previous studies from Korea[9] and Germany[10], we found that the perception of "doing good for others" was associated with students' past blood donation experiences. Our further analysis of factors associated with the perception might usefully inform donor recruitment efforts.

Encouraging healthy activities is intrinsically good, and has the potential to improve subjective self-assessments of health. Especially for female students, we need to address low hemoglobin while striving to motivate potential donors. In our previous report analyzing data from blood centers in northeastern Japan (Miyagi and Fukushima Prefectures), over 20% of students attempting donation were deferred, mainly for low hemoglobin, with the probability of such a deferral 35 times higher for female students than for male students[11].

In contrast to low hemoglobin as a donation barrier for female students, low motivation seems to be a barrier for male students. Outreach efforts should address this. Hupfer showed that male undergraduates in Canada responded well to moderately self-referencing and agentic donor recruitment messages[12]. A systematic review of motivating factors, by gender, suggests that it could also motivate males if marketing campaigns encouraged current donors to recruit their friends[13].

Our findings that knowledge – of blood type and donor eligibility criteria –associates with the perception of blood donation as "doing good for others" concur with Hong and Loke that enhancement of health education programs related to blood and blood donation for young people is important to increase their awareness[14]. However, a primary limitation to the generalization of our results is that this cross-sectional study cannot infer causality from statistical correlations between perceptions and behavior.

Nevertheless, education is widely perceived as an essential element of effective donor recruitment. Gender and other factors warrant further attention. Currently, we are developing blood donation education programs for elementary and junior high school students as a part of a student-initiated Popularization of Medical knowledge (POMk) Project[15]. Mentors in this program are themselves part of a legacy that includes Fukushima Medical University's response to the 2011 Great East Japan Earthquake, when students were among the hospital volunteers ready to donate blood for emergency transfusions if Red Cross inventories were insufficient or unavailable[16]. Education spans generations. Generation-specific health education aiming to ensure the future of blood donation may also improve the overall health of society.

Disclosure

The authors declare that they have no conflicts of interest pertinent to the work described in this manuscript.

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Table 1 Characteristics of students

Variables	N (%) N=4506
Year in high school	
First	1433 (31.8)
Second	1654 (36.7)
Third	1414 (31.4)
School	
School 1	373 (8.28)
School 2	43 (0.95)
School 3	235 (5.22)
School 4	664 (14.7)
School 5	1189 (26.4)
School 6	57 (1.26)
School 7	455 (10.1)
School 8	1267 (28.1)
School 9	166 (3.68)
School 10	53 (1.18)
Gender	
Male	2489 (55.2)
Female	2005 (44.5)
Subjective health	
Excellent	1205 (26.7)
Good	2696 (60.0)
Not good	409 (9.08)
Poor	94 (2.09)
Knowing ABO blood type	
Yes	4298 (95.4)
No	202 (4.48)
Knowing Rh blood type	
Yes	516 (11.5)
No	3985 (88.4)
Close friends, family members, neighbors ever received blood transfusion	
Yes	246 (5.46)
No	4221 (93.7)
Knowing eligibility criteria of blood donation	
Yes	1960 (43.5)
No	2492 (55.3)

None
(N=3640)
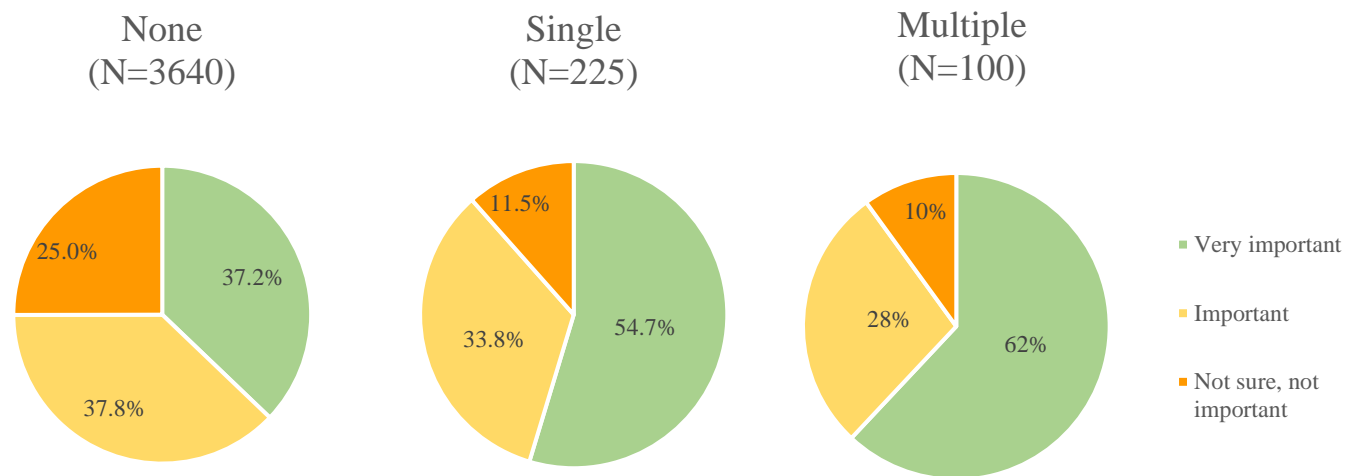
Single
(N=225)

Multiple
(N=100)

Figure 1

Number of past blood donations correlates with perception of blood donation as "doing good for others"

Table 2 Comparison of variables between those who think "doing good for others" is important, or not, when deciding whether or to donate blood

Variables	Doing good for others N(%)		Univariate[a]	Multivariate[b]		
	Important (N=3028)	Not important (N=949)	P value	AOR	(95% CI)	P value
Year in high school						
First	981 (75.2)	323 (24.8)	0.014	1.088	(0.896, 1.321)	0.397
Second	1178 (78.6)	321 (21.4)		1.171	(0.961, 1.427)	0.117
Third	868 (74.0)	305 (26.0)		Reference		
School						
School 1	232 (67.2)	113 (32.8)	<0.01	0.335	(0.136, 0.823)	0.017
School 2	34 (87.2)	5 (12.8)		1.115	(0.286, 4.349)	0.875
School 3	187 (85.8)	31 (14.2)		0.695	(0,268, 1.804)	0.455
School 4	433 (76.5)	133 (23.5)		0.416	(0.171, 1.013)	0.053
School 5	675 (65.5)	356 (34.5)		0.280	(0.116, 0.673)	<0.01
School 6	45 (84.9)	8 (15.1)		0.689	(0.216, 2.196)	0.529
School 7	356 (82.8)	74 (17.2)		0.577	(0.233, 1.427)	0.234
School 8	891 (81.2)	206 (18.8)		0.519	(0.215, 1.253)	0.145
School 9	132 (88.6)	17 (11.4)		1.041	(0.374, 2.892)	0.939
School 10	43 (87.8)	6 (12.2)		Reference		
Gender						
Males	1553 (70.3)	656 (29.7)	<0.01	Reference		
Females	1469 (83.4)	292 (16.6)		1.853	(1.566, 2.194)	<0.01
Subjective health						
Excellent	853 (79.1)	225 (20.9)	<0.01	2.433	(1.464, 4.043)	<0.01
Good	1815 (76.5)	558 (23.5)		1.93	(1.178, 3.163)	<0.01
Fair	241 (67.7)	115 (32.3)		1.288	(0.753, 2.204)	0.355
Poor	46 (59.7)	31 (40.3)		Reference		
Knowing ABO blood type						
Yes	2912 (76.6)	892 (23.4)	<0.01	1.694	(1.191, 2.410)	<0.01
No	114 (66.7)	57 (33.3)		Reference		
Knowing Rh blood type						
Yes	387 (83.0)	79 (17.0)	<0.01	1.216	(0.927, 1.596)	0.158
No	2640 (75.2)	870 (24.8)		Reference		
Close friends/family members/neighbors ever received blood transfusion						

Yes	186 (82.7)	39 (17.3)	0.018	1.321	(0.911, 1.917)	0.142
No	2818 (75.7)	903 (24.3)		Reference		
Knowing eligibility criteria of blood donation						
Yes	1474 (83.0)	301 (17.0)	<0.01	1.633	(1.381, 1.931)	<0.01
No	1528 (70.7)	633 (29.3)		Reference		

a. Chi-square test was used.

b. Binominal logistic regression was used to calculate odds ratios of answering "doing good for others" as important by entering variables that were significant in the univariate analysis. AOR=Adjusted odds ratio, 95% CI = 95% Confidence interval.