Blood Donor Deferral among Students in Northern Japan: Challenges Ahead

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Keywords

Deferral · Students · Blood donors · Japan

Summary

Background: As Japan's aging society needs more blood, young students comprise a progressively smaller portion of the donor pool. To ensure a safe and sustainable blood supply, it is crucial to select suitable donors. This study aims to evaluate donor deferral rates, causes of deferral, and characteristics of deferred Japanese students. **Methods:** Computerized records of blood centers in northern Japan (Miyagi and Fukushima Prefectures) from March 2010 through March 2011 were retrospectively analyzed. **Results:** Among 231,361 individuals visiting during the 12-month period, 24,778 were students. Of these, 19,193 (77%) attempted donation, and 5,585 (23%) were deferred. Low hemoglobin, questionnaire-based interview decisions, and medication were the main reasons for temporary deferral. Age, sex, and blood center location were associated with low hemoglobin; donation history and blood center location were associated with medication-based deferral. The odds ratio among female students deferred for low hemoglobin was 35.48 with a 95% CI of 27.74–45.38. **Conclusions:** These results suggest that continued efforts are needed to motivate deferred potential donors to return, to prevent low hemoglobin especially among females, and to review medical interview decisions, while paying close attention to regional differences.

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Introduction

In developed countries, shortage of blood is increasingly becoming a major concern and a decline in the level of blood donation has been observed [1, 2]. Based on a future demand-supply simulation conducted in 2010, the Blood Service Headquarters of the Japanese Red Cross Society estimated that by 2027, when the demand for blood products peaks, Japan would lack 1,010,000 donors [3]. In Japan, the decrease of donations, especially by people in their teens and twenties, underscores the urgent need to secure an adequate supply of blood products [4]. Students represented 16% of donors in 2001 versus about 10% in 2010, a 6% decrease [4]. Demographic changes in developed countries threaten the adequacy of their blood supplies [5], and there are concerns that temporary deferral may further compound the situation by reducing the probability of future donations, thus leading to a disparity between supply and demand. Hence, addressing the issue of deferral would be part of the solution.

The donor screening process is very critical to protect the safety of the blood supply [6]. Recruitment, selection, and retention of voluntary non-remunerated donors from low-risk populations are the cornerstones of a safe, sustainable, and adequate national blood supply [7]. Screening, however, can lead to either temporary or permanent deferral, resulting in lower donation rates that could further limit the donor pool [8]. Early reports have shown that prospective donors who were temporarily deferred returned less frequently for subsequent donation than those who donated successfully, and this was especially true for first-time donors [9–11]. Furthermore, there is a cost implication for blood collection organizations in all deferrals [12]. In contrast, a successful donor is 29% more

likely than a deferred to return and donates 81% more products over a 4.25-year period [13]. Thus, in order to sustain the blood supply and to reduce deferral-related costs incurred by blood collection organizations, efforts to mitigate deferral and improve the donation experience are needed.

Numerous reports focus on factors related to recruitment difficulties [14–19], and the bulk of research on blood donor deferral targets the general population [10–13, 20–24]. However, little is known about donor deferral among students, including deferral rates, deferred donor characteristics, and reasons for deferral. Yet, students are underrepresented in the donor pool even though in general they are young, in good health, and are potentially long-term donors [18]. Awareness and understanding of patterns of deferral in this specific demographic group has implications for the sustainability and safety of the blood supply in countries undergoing major demographic changes. Students, most of whom are young, hold the key to increasing the size of the donor pool for decades to come, and appropriate management of blood donation-related issues will likely play a tremendous role in the sustainability of blood supply [25]. Thus, the objective of this study is to evaluate donor deferral rates, characteristics, and reasons among students. Epidemiologic evidence provided by this study will help clarify the extent of donor deferral and suggest paths that might be explored to increase donations through scientifically and socially acceptable deferral practice with the ultimate goal to meet the current demographic challenge.

Material and Methods

Donor Screening

Details have been described elsewhere [24]. In summary, since 1999, a nationwide nucleic acid testing (NAT) system has been implemented to screen for HBV, HCV, and HIV. Currently, The Japan Red Cross Blood Service performs NAT in minipools of 20 donors. NAT is conducted at four facilities, the Kanto-Koshinetsu Block Blood Center in Tokyo, the Plasma Fractionation Center in Hokkaido, the Center for NAT and Quarantine in Kyoto, and the Kyushu Block Blood Center in Fukuoka. These four facilities cover all of Japan. With regard to the specimens sent from other blood centers, a 24-hour NAT screening service is provided by these facilities throughout the year, and the results are promptly reported to the respective blood centers. Reactivity testing for HBV uses the LUMIPULSE Presto HBs Ag-N CLEIA and LUMIPULSE Presto HBc Ab-N CLEIA; that for HCV LUMIPULSE Presto Ortho HCV CLEIA, that for HIV LUMIPULSE Presto HIV1/2 CLEIA, and that for HTLV-1 LUMIPULSE Presto HTLV-1 CLEIA (all Fujirebio Inc, Tokyo, Japan).

Basic criteria for whole blood donation are based on age, body weight, blood pressure, and hemoglobin level according to sex. For 200 ml whole blood donations, males and females should weigh not less than 45 kg and 40 kg, respectively. Hemoglobin concentration should be at least 12.5 g/dl for males and 12 g/dl for females. For 400 ml, males and females should weigh at least 50 kg. Hemoglobin concentration should be at least 13 g/dl for males and 12.5 g/dl for females. Pre-donation systolic blood pressure should be at least 90 mm Hg, regardless of gender and donation volume [4]. The hemoglobin cutoff level was revised upward for males in April 2011 from 12.0 g/dl for 200 ml and 12.5 g/dl for 400 ml. At the same time, age-based eligibility criteria were also revised. For 400 ml whole blood donations, the lower limit was shifted from 18 to 17 years old, and the

upper limit for platelet aphaeresis increased from 54 to 69 years, but only for men. For females, the lower age limit of 18 years and the upper limit of 54 years remained. For 200 ml whole blood, the age range goes from 16 to 69 years [3].

Subjects

Prospective donors were investigated from two Red Cross blood centers in the northern region of Japan (Tohoku), serving Miyagi and Fukushima prefectures. The data set was restricted to students 16–24 years old. 16 years is the lower age limit for donation, and 24 years was chosen as an upper limit based on the typical age range of university students at the end of school year in Japan [26].

The Japanese Red Cross manages all allogeneic blood collection, testing, and processing. The period of investigation, March 2010 through March 2011, precedes disaster response efforts related to the Great East Japan Earthquake [27]. Only allogeneic donations, either from mobile or fixed collection sites, were analyzed. The analysis included deferrals resulting from the self-administered questionnaire, interview responses, or medical evaluation. Non-donation because of inability to obtain venous access or vasovagal reaction was not analyzed since these donors were otherwise eligible.

Data Collection

Data from electronic records of the Japanese Red Cross Blood Service were extracted with donor identification removed. Protocols for human subject research conformed to institutional review board guidelines, applicable laws, and the World Medical Association Declaration of Helsinki.

Data Items

Details have been described elsewhere [24].

Statistical Analysis

All analyses were performed using STATA statistical software package, version 8.0 for Windows (STATA Corp., College Station, TX, USA). Donor deferral rates were compared using chi-square or Fisher's exact test as appropriate. We conducted logistic regression to determine factors associated with deferral status. Analyses were performed on each of the three most prevalent reasons for deferral: low hemoglobin, interview, and medication using deferral status (deferred = 1, not deferred = 0) as the dependent variable and all other items entered as independent variables. The following variables were assessed: age (16–17 years, 18–19 years, 20–21 years, 22–23 years, and 24 years), sex, donor history (repeat, first-time), and blood center (Fukushima, Miyagi). From these analyses, we reported odds ratios and their corresponding 95% confidence intervals. A two-sided 5% significance level was used for all statistical inferences.

Results

Among 231,361 individuals visiting blood centers during the 12-month period, 24,778 were students. Of these, 19,193 (77%) attempted donation, and 5,585 (23%) were deferred (table 1). The overall median age was 19 years, ranging from 16 to 24 years. Most prospective donors were females (56%), less than 20 years old (58%), and repeat donors (60%). 70% of all presentations were from Miyagi and 30% from Fukushima. Among the deferred, 5,541 (99%) were deferred for temporary reasons and 44 (1%) for permanent or semi-permanent reasons. Main reasons for temporary deferral were low hemoglobin (47%) and interview decision (36%). Unsafe sex or drug abuse (52%) and histories of blood transfusion or

Table 1. Demographic characteristics of donors (students): successful donation and deferral

	Total ^a (n = 24,778)	Donated (n = 19,193 (77%))	Deferred (n = 5,585 (23%))
Median age (min, max), years ^{b, c}	19 (16, 24)	19 (16, 24)	19 (16, 24)
Age groups, n (%)			
16–17 years	5,550 (22)	4,144 (75)	1,406 (25)
18–19 years	8,985 (36)	6,837 (76)	2,148 (24)
20–21 years	6,557 (27)	5,149 (79)	1,408 (21)
22–23 years	3,080 (12)	2,535 (82)	545 (18)
24 years	606 (3)	528 (87)	78 (13)
Sex, n (%) ^b			
Female	13,987 (56)	9,577 (68)	4,410 (32)
Male	10,791 (44)	9,616 (89)	1,175 (11)
Blood center, n (%) ^b			
Miyagi	17,333 (70)	12,930 (75)	4,403 (25)
Fukushima	7,445 (30)	6,263 (84)	1,182 (16)
Donor status, n (%) ^b			
Repeat	14,759 (60)	12,072 (82)	2,687 (18)
First-time	10,019 (40)	7,121 (71)	2,898 (29)
^a Total donors at presentation.			
^b p < 0.001, chi-square test used.			
^c p for trend < 0.001.			

Table 2. Deferral reasons: temporary and permanent/semi-permanent

	Deferral reasons, n (%)
<i>Temporary</i>	
Low hemoglobin	2,595 (47)
Interview	2,024 (36)
Medication	586 (11)
Blood pressure	229 (4)
Pre-donation test	107 (2)
Subtotal	5,541 (100)
<i>Permanent/semi-permanent</i>	
Unsafe sex or drug abuse*	23 (52)
Transfusion or transplant history	18 (41)
Stay in Europe**	3 (7)
Subtotal	44 (100)
<i>Total</i>	5,585
*Semi-permanent: deferred donor can return after 6 months if deemed suitable.	
**Bovine spongiform encephalopathy (BSE)-related.	

transplantation (41%) were the main reasons for permanent/semi-permanent deferrals (table 2).

The overall proportion of deferral was higher among those in the age group of 16–17 years (25%), females (32% vs 11%, $p < 0.0001$), and first-time donors (29% vs 18%, $p < 0.0001$). Between blood centers, Miyagi registered a higher deferral proportion (25%) (table 1).

Regarding factors associated with low hemoglobin deferral, multivariate logistic regression analysis showed that those 20–21 years old (OR 1.23, 95% CI 3.53–4.07), females (OR 35.48, 95% CI 27.74–45.38), and donors from Miyagi (OR

1.34, 95% CI 1.21–1.49) had higher relative odds of deferral (table 3).

The results of factors associated with deferral due to interview decisions are presented in table 3. We found that females (OR 1.15, 95% CI 1.04–1.26), first-time donors (OR 3.27, 95% CI 2.95–3.63), and donors from Miyagi (OR 2.92, 95% CI 2.58–3.31) had higher relative odds of deferral, whereas those older than 19 years old had lower relative odds of deferral.

Regarding factors associated with deferral due to medication, results indicated that first-time donors (OR 3.35, 95% CI 2.76–4.05) and donors from Miyagi (OR 1.43, 95% CI 1.18–1.73) had higher relative odds of deferral (table 3).

Discussion

Nearly one in four student donors are deferred at two blood centers in northern Japan. This is higher compared to our previously reported overall deferral rate of 14% at the same location [24]. Low hemoglobin emerged as the major contributor to the higher deferral proportion, particularly for female donors for whom there was a very strong association. First-time donation attempts were associated with deferral due to interview decisions and medication. Donation attempts at Miyagi blood center were associated with a higher deferral for three reasons: low hemoglobin, medical interview, and medication. Addressing these negative experiences would be a very important step in retaining these young donors.

Results indicated that being 20–21 years old, being females, and being from Miyagi were associated with deferral due to low

Table 3. Factors associated with deferral due to low hemoglobin, interview decision, and medication

	N (%)		Odds ratio ^a	95% CI
	no	yes		
<i>Low hemoglobin</i>	22,183 (90)	2,595 (10)		
Age, years				
16–17	5,004 (90)	546 (10)	1.00	
18–19	8,048 (90)	937 (10)	1.06	0.94–1.19
20–21	5,783 (88)	774 (12)	1.23	1.09–1.40
22–23	2,781 (90)	299 (10)	1.14	0.96–1.34
24	567 (94)	39 (6)	0.97	0.68–1.39
Gender				
Male	10,725 (99)	66 (1)	1.00	
Female	11,458 (82)	2,529 (18)	35.48	27.74–45.38
Donor history				
First-time	9,064 (90)	955 (10)	1.00	
Repeat	13,119 (89)	1,640 (11)	1.09	0.99–1.19
Blood center				
Fukushima	6,869 (92)	576 (8)	1.00	
Miyagi	15,314 (88)	2,019 (12)	1.34	1.21–1.49
<i>Interview decision</i>	22,754 (92)	2,024 (8)		
Age, years				
16–17	4,970 (90)	580 (10)	1.00	
18–19	8,123 (90)	862 (10)	1.04	0.93–1.17
20–21	6,134 (94)	423 (6)	0.84	0.73–0.97
22–23	2,943 (96)	137 (4)	0.65	0.53–0.79
24	584 (96)	22 (4)	0.55	0.35–0.86
Gender				
Male	9,997 (93)	794 (7)	1.00	
Female	12,757 (91)	1,230 (9)	1.15	1.04–1.26
Donor history				
First-time	14,087 (95)	672 (5)	1.00	
Repeat	8,667 (97)	1,352 (13)	3.27	2.95–3.63
Blood center				
Fukushima	7,124 (96)	321 (4)	1.00	
Miyagi	15,630 (90)	1,703 (10)	2.92	2.58–3.31
<i>Medication</i>	24,192 (98)	586 (2)		
Age, years				
16–17	5,373 (97)	177 (3)	1.00	
18–19	8,772 (98)	213 (2)	0.88	0.72–1.09
20–21	6,441 (98)	116 (2)	0.86	0.67–1.11
22–23	3,015 (98)	65 (2)	1.20	0.88–1.64
24	591 (98)	15 (2)	1.50	0.86–2.60
Gender				
Male	10,545 (98)	246 (2)	1.00	
Female	13,647 (98)	340 (2)	1.08	0.91–1.27
Donor history				
First-time	14,568 (99)	191 (1)	1.00	
Repeat	9,624 (96)	395 (4)	3.35	2.76–4.05
Blood center				
Fukushima	7,295 (98)	150 (2)	1.00	
Miyagi	16,897 (97)	436 (3)	1.43	1.18–1.73

^aResults of multivariate logistic regression analysis entering deferral status (deferred = 1, not deferred = 0) as the dependent variable and all items listed in the table as independent variables.

hemoglobin level. More importantly, females were deferred almost 35 times more than males. This is consistent with previous studies that identified low hemoglobin as being the leading cause of donor deferral especially among females [28, 29]. It is well established that premenopausal females have lower iron stores than males and are prone to anemia for several reasons including menstrual and gestational iron loss. This issue is pertinent to male donors in Japan, too, because their minimum hemoglobin threshold has increased. A slight increase in deferral due to low hemoglobin was reported only among men in a recent study [30]. In addition, blood donation itself is also a contributing factor of iron deficiency, and studies have reported that regular donors can deplete their iron levels, which could possibly lead to iron deficiency and anemia. Efforts should therefore be undertaken to minimize anemia by taking appropriate actions and as suggested by Newman [31], it is imperative to ensure that iron stores are replaced by providing a short-term iron supplementation. Educational campaigns should raise awareness regarding the problem of iron loss with blood donation and appropriate measures for iron replacement following blood donation, as blood donation was included in high school's education guidelines in 2009.

Our findings also indicate that Miyagi Blood Center was associated with higher relative odds of deferral for our three main outcomes of interest. Reasons for this finding are not apparent. Any explanation for these associations must be speculative. There are fewer epidemiologic studies with relevant results regarding between-center differences in donor deferral. Some studies have suggested that, for instance, methodological, demographic or technical differences might contribute for some variations observed between centers [32, 33]. We were not able to explore these paths. Thus, further consideration is warranted to investigate regional differences.

First-time donors were more frequently deferred than repeat donors, especially because of interview decisions and

medication; this corroborates previous studies [8, 22]. Although young first-time donors have the potential to increase the donor pool, temporary deferral may discourage them from returning for subsequent donation. Therefore, it is crucial to provide clear explanations about deferral reasons and motivate them to return soon after the expiration of their deferral. Additionally, in order to avoid unnecessary deferrals, recruitments campaigns should also emphasize information regarding eligibility criteria [34].

As a first attempt to characterize epidemiologic features of deferral among students, some caveats need to be considered in the interpretation of these findings. First, data collected were restricted to blood centers in one region. Consequently, these findings may not be generalizable to students from other regions, as suggested by our observed differences between two centers. Thus, it would be enlightening to conduct multi-regional and multi-center studies to confirm the current findings. Second, several reasons were merged under the label 'medical interview', and this limits our ability to comment. Thus, further studies are needed to provide more detailed information. Nevertheless, irrespective of these considerations, we believe that our findings are worthy of comparison with future investigations.

In conclusion, demographic differences should be taken into account by policy-makers and blood banking professionals when devising targeted strategies to limit deferral among students. In light of current and ongoing demographic shifts, it is hoped that further research will provide more evidence onto this understudied, yet important demographic group.

Disclosure Statement

The authors declare that they have no conflict of interest.

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