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Ramadan favors first blood donation, but not frequent donation: Results of 10,145 blood donors from Algeria

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Abstract:

CONTEXT: Frequent blood donors contribute to an important share of blood donations in many countries. In Algeria, frequent donation and its determinants, notably the place of the month of Ramadan, which plays an important role in blood donation in Muslim countries, have not been studied.

METHODS: This was a retrospective cohort study of *n* = 10145 Algerians who donated blood to the blood transfusion post (BTP) of Boufarik between January 2, 2008, and December 31, 2019. Donors were assessed at each donation for general clinical information, demographic information, and dates and times of donation. Donor return, defined as two or more donations to Boufarik BTP, and frequent donation, defined as three or more blood donations to Boufarik BTP, were the outcomes of interest and were analyzed using groups comparison and logistic and Cox regression analyses.

RESULTS: 2.2% of donors were frequent donors and donated 9.6% of all donated blood. The volume of donated blood during Ramadan was twice the monthly volume during the rest of the year, but donation in Ramadan was associated with lower odds of return (odds ratio [OR]: 0.54, 95% confidence interval [CI]: 0.40–0.71) and frequent donation (OR: 0.41, 95% CI: 0.24–0.73). Women were underrepresented (10.9%), but they were more likely to be frequent donors (male vs. female OR: 0.55, 95% CI: 0.31–0.96; hazard ratio: 0.64, 95% CI: 0.41–0.98).

CONCLUSIONS: Reducing the gender gap and promoting return could significantly improve the volume of blood donations in Algeria.

Keywords:

Algeria, blood donation, frequent donation, Ramadan, return behavior, transfusion

Introduction

Hospitals are increasingly dependent on blood donation to sustain their need for blood products. Middle- and low-income countries have a larger demand in blood transfusion, mainly due to a higher rate of pregnancy complications.[1,2] Algeria is no different. With a per 100,000 inhabitants blood supply of <4000 units and a need of more than 3400–3700 blood units, the Algerian health system needs higher volumes of blood donation each year to reach a safe level of blood supply.[3]

The act of donating blood is, mainly, an act of planned behavior.[4] It is strongly modeled by the intention to engage in this behavior.[5] This intention is the result of the effects of individual traits, awareness and social responsibility, health promotion coverage and social influence, and above all,[6] previous blood donation experience.[7] National blood supplies often rely on the charitable donations of a limited number of volunteers, which is often further reduced due to safety insurance criteria.[8] Frequent blood donors are, thus, considered a valuable source of safe blood supply with a low risk of infections transmission and transfusion adverse reactions.[9]

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The contribution of religion to charitable practices in general is well documented.[10] Attitudes to blood donation may vary across religious groups and circumstances.[11] Muslims abstain from food and drinks, including water, from sunrise to sunset during the month of Ramadan. Consequently, the volume of donated blood during this period is expected to decrease in Muslim countries as Mei Ling *et al*. noticed in Malaysia.[12] However, this attitude varies across Muslim societies[13] as Ramadan is also associated with altruistic behavior[14] representing an extra incentive to donate despite the hardship of fasting.

While not many studies profiled frequent blood donors,[15] we do not know of any study that assessed the role of the month of Ramadan in frequent blood donation. Moreover, the attitude toward frequent blood donation and the role of Ramadan in blood donation and frequent donation in Algeria, where the majority of the population is Muslim, have not been investigated. This study is meant to fill this gap in the literature.

Methods

Data source

From January 2, 2008, to December 31, 2019, information on each blood donation to the blood transfusion post (BTP) of Boufarik was collected and registered in an electronic database maintained by the post's head physician. Before each blood donation to Boufarik BTP, donors were interrogated and clinically examined. Only candidates with a normal clinical examination were admitted to blood donation. During the interrogation, candidates were asked if they allow their data to be saved in the electronic registry of the BTP to serve statistics and research on blood donation. Ethical approval was obtained from the department of health care, ethics, and deontology of the Algerian ministry of health on the date of July 1, 2020, with the reference number N38 MSPRH-DGSSRH-DPSEDM-2020.

All blood transfusion structures in Algeria are governmental. They are either regional blood transfusion centers, blood transfusion centers, BTPs, or blood banks. Boufarik BTP is one of the five blood transfusion structures of the region of Blida.[16] The region of Blida counted nearly 1 million 800 thousand inhabitants in 2015.[17] On average, each year, Boufarik BTP collects 515.5 liters of blood from 1214 blood donations. Patients in Algeria do not have to pay to get blood transfusions. However, when the blood supply reaches a critical level in their region, patients who are in need of nonurgent blood transfusions might be prompted to compensate for them. Compensation is often encouraged rather than required and can be done by family members or friends no matter their blood group. Furthermore, blood donors in Algeria do not get paid for their blood donations. A small snack is usually offered to donors after their blood donation.

Blood transfusion structures regularly collect blood donations during daytime on working days and at night during Ramadan. Mobile transfusion stations, auxiliary to an organizing blood transfusion structure, are occasionally set to ease donation. Other efforts to increase donation include calling donors who previously donated blood to the structure and radio broadcast promotional messages.

The database of Boufarik BTP listed entries from 13355 blood donations collected between January 2, 2008, and December 31, 2019. For the purpose of this study, we have aggregated blood donation entries from the database of Boufarik BTP by unique blood donors using anonymous numerical identifiers. After exclusion of entries with missing values, and participants whom the first or second donation was in 2019 (n = 1693), as they might not have had the chance to donate again, we retained n = 10145 blood donors (full cohort). From the full cohort, we derived the returned cohort, which includes donors who have made at least two donations to Boufarik BTP (n = 722). Donors who did not consent for their data to be entered in the registry are not included in the database.

Variables' measurement

Prior to blood donation, collected information on donors to Boufarik BTP included their demographic data, date and time of the donation, and whether the donation was a compensation. Clinical examination assessed donors' weight, height (only since 2018), general condition, and blood pressure. Before consideration for transfer to a blood bank, donated blood was analyzed for its volume, blood group, red blood cell antigens, and serology of human immunodeficiency viruses, hepatitis B, hepatitis C, and syphilis.

Our input variables of interest included gender, age on first donation, date and time of the first and second donation, weight on the first and second donation, malaise during the first donation, and compensation of the first and second donation. Other input variables of interest deriving from these previously mentioned ones included whether the first or the second donation was given during the month of Ramadan; season of the first and second donation; whether the first and the second donation were given during a similar season; time length between the first and the second donation; and body mass index (BMI) category on first donation [Supplementary Material 1].

The outcome variables of interest were donor return, defined as two or more donations to Boufarik BTP,

and frequent donation, defined as three or more blood donations to Boufarik BTP.

Data analysis

We used R programming language for all data manipulation and analyses tasks.[18] As the height of blood donors was only assessed for 2018 and 2019, BMI could not be calculated for blood donors in other years. Based on the distribution of height in blood donors in 2018–2019 (n = 2981) (mean = 173.7 cm, standard deviation [SD] =7.51 cm), we defined the following BMI categories: not obese: BMI <25 or weight <62.95 kg (in reference to − 2SD, BMI would most likely be <25); obese: BMI >30 or weight >106.85 kg (in reference to + 2SD, BMI would most likely be >30); and borderline (−2SD to + 2SD): Weight between 62.95 and 106.85 kg.

We carried the analysis over four steps. First, we described donors' data and compared groups using Yate's corrected Chi-square test for categorical input variables and using Mann–Whitney U test for continuous input variables. Second, we used logistic regression models to estimate the likelihood of return and frequent donation behavior. ORs and their 95% confidence intervals (CIs) were computed from four fitted models. Model 1 and 2 concerned the full cohort and assessed frequent donation and return, respectively. Model 3 and 4 concerned the returned cohort and assessed frequent donation.

Third, we fitted Cox proportional-hazards models[19] to the returned cohort, with frequent donation (marked by the occurrence of the third donation) as the event of interest and the time between the second and the third donation as the period at risk. We defined the time from the second donation to December 31, 2019, as the follow-up time, with no considerations for the loss to follow-up. We set a full model using the previously mentioned variables, in addition to the year of the first donation. We fitted a simpler Cox regression model to the data of returned blood donors using selected input variables. As there was no concern for overfitting, we did not follow a systematic approach to select input variables. We used the full and simple Cox regression models to compute hazard ratios (HRs) for frequent donation and their 95% CI. Fourth, we evaluated the discriminatory power of the logistic and Cox regression models by generating receiver operator characteristic curves and computing the area under the curve (AUC).[20] For between-groups differences, Cramer's V-test was used to determine the effect size of Chi-square test results, and Cliff's delta was used to determine that of Mann–Whitney U test results.[21]

Results

Our study analyzed n = 10145 blood donors who have donated blood to Boufarik BTP between January 2, 2008, and December 31, 2019. Within this period, 722 (7.1%) study participants returned at least once to donate to Boufarik BTP, and 222 (2.2%) donated three times or more, and were thus, defined as frequent donors. Overall, frequent donors had a contribution of 9.6% of the pool of donated blood by our study population. Throughout the follow-up time of our study, each frequent donor donated an average of 2.13 l of blood. The median age of the studied donors was 33 years, with an interquartile range (IQR) of 26–41 years, and a majority of male donors (89.1%). The median age differed slightly between genders (32.75, IQR [25.56–39.95] in males; 34.95, IQR [26.45–43.45] in females), but the variation in means of age between genders was statistically significant (P value of the Mann–Whitney U test < 0.001). Most studied donors were blood type O-positive (37%). Malaise events on the 1st donation were too few (0.7% in overall) to allow comparisons. 20.5% of 1st donations were made during Ramadan (a period of 29–30 days each year). Compensated donations represented 9.9% of all donations, while donations in Ramadan represented 16.0% of all donations [Table 1].

Summer and spring were the seasons with the highest number of donations (28.2% and 27.6%, respectively). Summer was also the season with the highest number of first-time donations in overall (30.9%). Frequent donors appeared to be more to have their first donation in spring (29.7%) or winter (26.1%) than summer (20.7%) (P value of the Chi-squared test = 0.037). Nevertheless, because Ramadan coincided with the summers from 2010 to 2017, and partly in 2009 and 2018, we checked the proportion of 1st donation for each season excluding the donations made during the month of Ramadan and found that spring was the most popular season of 1st donation (33% in overall) with no seasonal difference (P value of the Chi-squared test = 0.79) between those who donated once only, twice only, and frequent donors.

In returned donors, the median duration between the 1st and the 2nd donation was 2.1 years in nonfrequent donors' group and 1.2 years in frequent donors' group (P < 0.001). This duration between the 1st and 2nd donation differed significantly between genders (P < 0.001) with a median of 1.9 years in men and 1 year in women.

Effect sizes of Chi-square and Mann–Whitney U tests were small, but they varied. Among the continuous variables, time between the 1st and the 2nd donation had the highest effect size (Cliff's Delta statistic: 0.188, 95% CI: 0.09–0.28). Among the categorical variables, 1st donation in Ramadan and season of the 1st donation had the highest effect sizes [Supplementary Material 2].

In logistic regression models 1 and 2 [Table 2], which concerned the whole study population, age and gender

Table 1: Comparison of blood donor's characteristics in terms of return behavior and frequent donation and *P* values of individually tested variables

Characteristics	Characteristics of the full cohort (whole blood donors' population) (*n*=10,145)					
	Frequent versus nonfrequent			Return versus no return		
	Overall	Nonfrequent	Frequent	Overall	No return	Return
Blood donors (%)	10,145	9923	222	10,145	9423	722
Age (on 1st donation)[a]	32.97 (26.35-41.12)	32.94 (26.34-41.10)	34.65 (27.15-42.27)	32.97 (26.35-41.12)	32.94 (26.34-41.08)	33.54 (26.42-41.83)
Male gender, *n* (%)	9037 (89.1)	8840 (89.1)	197 (88.7)	9037 (89.1)	8377 (88.9)	660 (91.4)
BMI category on 1st donation, *n* (%)						
Not obese (weight <62.95 kg)	1085 (10.7)	1071 (10.8)	14 (6.3)	1085 (10.7)	1031 (10.9)*	54 (7.5)*
Borderline (62.95-106.85 kg)	8527 (84.1)	8331 (84.0)	196 (88.3)	8527 (84.1)	7898 (83.8)*	629 (87.1)*
Obese (weight >106.85 kg)	533 (5.3)	521 (5.3)	12 (5.4)	533 (5.3)	494 (5.2)*	39 (5.4)*
1st donation was in Ramadan (%)	2075 (20.5)	2053 (20.7)***	22 (9.9)***	2075 (20.5)	1972 (20.9)***	103 (14.3)***
1st donation was a compensation (%)	609 (6.0)	599 (6.0)	10 (4.5)	609 (6.0)	573 (6.1)	36 (5.0)
Season of the 1stdonation (%)						
Autumn	2247 (22.1)	2195 (22.1)**	52 (23.4)**	2247 (22.1)	2088 (22.2)*	159 (22.0)*
Spring	2544 (25.1)	2478 (25.0)**	66 (29.7)**	2544 (25.1)	2349 (24.9)*	195 (27.0)*
Summer	3130 (30.9)	3084 (31.1)**	46 (20.7)**	3130 (30.9)	2939 (31.2)*	191 (26.5)*
Winter	2224 (21.9)	2166 (21.8)**	58 (26.1)**	2224 (21.9)	2047 (21.7)*	177 (24.5)*
Time from 1st to 2nd donation (years)[a]	-	-	-	-	-	-

Characteristics	Characteristics of the returned cohort (those who have donated at least twice) (*n*=722)		
	Frequent versus nonfrequent		
	Overall	Nonfrequent	Frequent
Blood donors (%)	722	500	222
Age (on 1st donation)[a]	33.54 (26.42-41.83)	32.86 (26.24-41.64)	34.65 (27.15-42.27)
Male gender, *n* (%)	660 (91.4)	463 (92.6)	197 (88.7)
BMI category on 1st donation, *n* (%)			
Not obese (weight <62.95 kg)	54 (7.5)	40 (8.0)	14 (6.3)
Borderline (62.95-106.85 kg)	629 (87.1)	433 (86.6)	196 (88.3)
Obese (weight >106.85 kg)	39 (5.4)	27 (5.4)	12 (5.4)
1st donation was in Ramadan (%)	103 (14.3)	81 (16.2)*	22 (9.9)*
1st donation was a compensation (%)	36 (5.0)	26 (5.2)	10 (4.5)
Season of the 1stdonation (%)			
Autumn	159 (22.0)	107 (21.4)	52 (23.4)
Spring	195 (27.0)	129 (25.8)	66 (29.7)
Summer	191 (26.5)	145 (29.0)	46 (20.7)
Winter	177 (24.5)	119 (23.8)	58 (26.1)
Time from 1st to 2nd donation (years)[a]	1.84 (0.77-3.49)	2.08 (0.97-3.54)***	1.24 (0.51-3.07)***

*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$ indicating the significance of Chi-square and Mann-Whitney U-tests for between groups comparisons, [a]Results presented as median (IQR). %=Column percentages, BMI=Body mass index, IQR=Interquartile range

did not associate with a change of the odds of donation return or frequent donation. Participants in whom the first donation was in Ramadan had lower odds of being a returned (OR: 0.54, 95% CI: 0.40–0.71) or a frequent donor (OR: 0.41, 95% CI: 0.24–0.73). In models 3 and 4 fitted to returned blood donors [Table 2], age also did not associate with a change in the odds of frequent donation. However, women were more likely to be frequent donors (OR male vs. female: 0.55, 95% CI: 0.31–0.96, model 4). Seasonal variation did not associate with significant odds of outcome variable in any of the four models. In term of accuracy of prediction, model 3 scored the highest AUC of 71.3% (95% CI: 67.2–75.5), while model 1, 2, and 4 had AUCs from 57% to 60% (model 1 AUC 60%, 95% CI: 56.6–63.5; model 2 AUC 57.2%, 95% CI: 55.1–59.3; model 4 AUC 60.1%, 95% CI: 55.7–64.5).

The median follow-up time in the Cox proportional hazards models was 3.16 years (IQR: 1.62–5.48) in overall. Follow-up time differed significantly ($P < 0.001$) between nonfrequent donors (4.22 years, IQR: 2.34–5.97) and frequent donors (0.99 years, IQR: 0.48–2.38) [Table 3]. In accordance with the logistic regression analysis, male gender was associated with a lower hazard of frequent donation in comparison to female gender (HR: 0.64, 95% CI: 0.41–0.98, simple model). Donating in Ramadan and the season of donation were not associated with significant HR of frequent donation among returned donors. The models' AUC was 60.2% (95% CI: 55.1–65.3 and 55.3–65.1 for the full model and the simple model, respectively).

Discussion

The present study assessed the association of blood donors' return behavior and frequent donation with basic variables related to demography and the timing of previous donations. Blood donations collected over 12 years from 10,145 individuals were investigated, and data were analyzed in four steps. Only a small proportion (2.2%) of our studied population were frequent donors, which only contributed to a fraction of the pool of donated blood. This is a sign that the blood transfusion system in Algeria relies mostly on occasional donors.

Contrary to age, which, as in Germain *et al*.,[6] did not associate with commitment to blood donation in first-time donors, a significant gap in return and frequent

Table 2: Odds ratios of the logistic regression analysis for frequent donation and return among all blood donors and returned donors

Variable	Units	OR (95% CI)			
		Model 1: *n*=10145 frequent versus nonfrequent	Model 2: *n*=10145 return versus no return	Model 3: *n*=722 frequent versus nonfrequent	Model 4: *n*=722 frequent versus nonfrequent
Age (on 1st donation)	Years	1 (0.99-1.02)	1 (0.99-1.01)	1.01 (0.99-1.02)	1.01 (0.99-1.02)
Gender	Female	Reference	Reference	Reference	Reference
	Male	0.89 (0.58-1.36)	1.28 (0.98-1.68)	0.64 (0.35-1.16)	0.55 (0.31-0.96)*
BMI category on 1st donation	Not obese	Reference	Reference	Reference	Reference
	Borderline	1.86 (1.07-3.23)*	1.51 (1.13-2.02)**	1.46 (0.72-2.95)	1.46 (0.75-2.81)
	Obese	1.65 (0.75-3.62)	1.41 (0.92-2.17)	2.59 (0.93-7.21)	1.31 (0.51-3.38)
1st donation was in Ramadan	No	Reference	Reference	Reference	Reference
	Yes	0.41 (0.24-0.73)**	0.54 (0.40-0.71)***	0.74 (0.40-1.40)	0.74 (0.41-1.34)
2nd donation was in Ramadan	No			Reference	
	Yes			0.97 (0.55-1.74)	
Season of the 1st donation	Autumn	Reference	Reference	Reference	Reference
	Spring	1.12 (0.77-1.62)	1.07 (0.86-1.33)	0.84 (0.51-1.37)	1.06 (0.67-1.67)
	Summer	0.84 (0.54-1.33)	1.03 (0.80-1.32)	0.64 (0.38-1.09)	0.73 (0.44-1.21)
	Winter	1.1 (0.75-1.60)	1.1 (0.88-1.37)	0.78 (0.47-1.30)	1.02 (0.64-1.63)
Season of the 2nd donation	Autumn			Reference	
	Spring			0.95 (0.60-1.50)	
	Summer			0.73 (0.44-1.22)	
	Winter			0.61 (0.36-1.04)	
1st donation was a compensation	No	Reference	Reference	Reference	Reference
	Yes	0.67 (0.35-1.28)	0.77 (0.54-1.09)	0.46 (0.20-1.04)	0.74 (0.35-1.59)
2nd donation was a compensation	No			Reference	
	Yes			0.67 (0.21-2.18)	
Time from 1st to 2nd donation	Years			1.02 (0.93-1.13)	
Years of 2nd donation	Years			0.78 (0.73-0.83)***	

*$P \leq 0.05$, **$P \leq 0.01$, ***$P \leq 0.001$ indicating the significance of Chi-square and Mann-Whitney U-tests for between groups comparisons. OR=Odds ratio, CI=Confidence interval, BMI=Body mass index

Table 3: Hazard ratios of the Cox regression analysis for frequent donation among returned donors, from their second to their third donation (event) or to December 31, 2019 (censored)

Variable	Units	HRs (95% CI)	
		Full model	Simple model
Age (on 1st donation)	Years	1 (0.99-1.02)	1.01 (0.99-1.02)
Gender	Male (versus female)	0.69 (0.44-1.08)	0.64 (0.41-0.98)*
BMI category on 1st donation (versus nonobese)	Borderline	1.35 (0.76-2.39)	1.37 (0.78-2.40)
	Obese	2.3 (1.00-5.31)*	1.6 (0.72-3.54)
1st donation was in Ramadan	Yes (versus no)	0.78 (0.47-1.31)	0.77 (0.46-1.28)
2nd donation was in Ramadan	Yes (versus no)	0.85 (0.54-1.34)	
Season of the 1st donation (versus autumn)	Spring	0.89 (0.60-1.30)	0.98 (0.68-1.42)
	Summer	0.75 (0.49-1.15)	0.76 (0.50-1.16)
	Winter	0.83 (0.55-1.23)	0.96 (0.65-1.41)
Season of the 2nd donation (versus autumn)	Spring	0.92 (0.65-1.32)	
	Summer	0.81 (0.55-1.19)	
	Winter	0.66 (0.43-1.00)	
1st donation was a compensation	Yes (versus no)	0.48 (0.25-0.94)*	0.61 (0.32-1.16)
2nd donation was a compensation	Yes (versus no)	0.81 (0.34-1.93)	
Time from 1st to 2nd donation (years)	Years	0.99 (0.90-1.08)	
Year of 2nd donation	Year	0.88 (0.83-0.93)**	

*$P \leq 0.05$, **$P \leq 0.001$, n=722, Event of interest: Frequent donation, Number of events=222. BMI=Body mass index, HRs=Hazard ratios, CI=Confidence interval

donation was noted between genders. These results oppose Tucker who found that frequent donors were more likely to be male and older compared to occasional donors.[22] Furthermore, we noticed an inclination toward an increased likelihood of repeated donation in high BMIs. Overall, there was little seasonal difference in the outcomes, but donating in Ramadan seemed to play an important role in determining return and frequent donation.

As opposed to the findings from Malaysia,[12] Boufarik BTP seemed to have a surge of activity during Ramadan with a volume of donated blood twice the monthly volume during the rest of the year. However, we found that those who made their first donation in Ramadan had lower odds of expressing a return behavior or becoming frequent donors, suggesting that donating in special occasions might not be compatible with long-term donation.

In this Algerian population of blood donors, as in many other countries,[23,24] women were underrepresented. However, contrary to studies conducted elsewere,[22,25,26] the odds of frequent donation in our study participants were favoring women. Furthermore, contrary to Bani *et al*., the interval between two successive donations was shorter in Algerian female blood donors. Considering these results, in the Algerian context, reducing the gender gap in donation might improve donors' retainment and effectively increases the number of frequent donors.[23] Based on a study from Iran, Kasraian[27] suggested low body weight and anemia as possible explanations of the gender gap in donation. Although there was a significant difference between frequent and nonfrequent returned blood donors in term of the time-length to return for a second blood donation, as opposed to Ownby *et al*.[28] who found that the likelihood of a third donation decreased with longer time between the first and the second donation, our analyses did not find an association between the time from the first to the second donation and frequent donation.

Considering the scarcity of electronic health registers in Algeria, we consider the data on which we based our study to be rather unique, and in that sense, valuable. We do not know of any other study that attempted to assess the determinants of frequent donation and the role of Ramadan in blood donation in Algeria. Nevertheless, frequent donation could be better profiled by investigating blood donors' sociodemographic characteristics. Socioeconomic status, level of education, accessibility of blood transfusion centers, marital status, and having children were all suggested as factors linked with variation in donation and frequent donation.[29,30] Furthermore, the role of promotion, mobile transfusion stations, and other means that ease blood donation should be included in the analysis as they might be a source of bias.

Conclusions

Frequent donors represent a noteworthy source of blood supply. The month of Ramadan associated with higher volumes of donated blood but lower odds of return and frequent donation in Algeria. Algerian women of all age groups were underrepresented but seemed to be particularly inclined toward frequent donation. Reducing the gender gap and promoting return could significantly improve the volume of blood donations in Algeria.

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Conflicts of interest
There are no conflicts of interest.

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Supplementary material 1: Considered covariates

Covariates	Unit/categories	Full cohort (*n*=10,145)	Returned cohort (*n*=722)
Age	Years	+	+
Sex	Male, female	+	+
Body mass index	Nonobese, borderline, obese	+	+
Blood type	A positive, B positive, AB positive, O positive, negative	+	+
1st donation was a compensation	Yes, no	+	+
2nd donation was a compensation	Yes, no	–	+
1st donation was in Ramadan	Yes, no	+	+
2nd donation was in Ramadan	Yes, no	–	+
Malaise during the 1st donation	Yes, no	+	+
Malaise during the 2nd donation	Yes, no	–	+
Season of the 1st donation	Yes, no	+	+
Season of the 2nd donation	Yes, no	–	+
The 1st and the 2nd donation were made during a similar season	Yes, no	–	+
Time between the 1st to the 2nd donation	Years	–	+

Supplementary material 2: Mann-Whitney U and Cliff's delta tests for group comparison of the continuous input variables in terms of return and frequent donation, in the whole donors' population and in the returned donors' subpopulation

Variable	*P* value of the Mann U-test	Cliff delta score
Age-frequent	0.2515	–0.0449
Age-return	0.5011	–0.015
Age-frequent 2	0.3713	–0.0417
Duration from 1st to 2nd donation in years-frequent 2	<0.001	0.188

Frequent 2, group comparison within the returned donors' subpopulation