




Blood donation barriers: How does donor profile affect them?

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Abstract

Donation barriers are a crucial factor to consider in the study of blood donor behavior. Since blood donors do not behave homogeneously, the aim of this work is to analyze how the donor profile (i.e. sociodemographic characteristics and donation behavior) influences the prevalence of blood donation barriers. A total of 5,353 active donors in the Canary Islands (Spain) completed an online survey. Given the general lack of agreement concerning the conceptualization and measurement of donation barriers, an integrative 25-item barrier scale, which is the result of grouping all barriers identified in the literature according to the concept of obstacle which they represent, was designed and validated. The results indicate that individuals between 18 and 35 years of age, with university education and higher income are more likely to be affected by donation barriers. At the same time, individuals who donate once or twice a year, and those with shorter experience as donors, are more prone to experience donation barriers. The present study is useful for blood transfusion centers, because it shows that centers must identify which donation barriers are the most prevalent in their donor pool, as well as which donor groups are the most affected by them. Thus, blood transfusion centers will be able to design appropriate marketing actions to reduce or eliminate those barriers that prevent active donors to donate repetively.

Keywords Blood donation · Barriers · Donor profile · Sociodemographics · Donation behavior

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1 Introduction

For decades, healthcare systems have faced a declining blood donor pool, leading to an imbalance between blood supply and demand (Carter et al., 2011). This is due to factors such as an increase in medical and surgical interventions, an ageing population, stricter donor selection criteria, and the perishable nature of blood (Solomon, 2012; Vavić et al., 2012). As blood cannot be artificially produced (Moussaoui et al., 2016), the stability of any blood donation system depends on the willingness of voluntary donors (Tey et al., 2020).

Blood transfusion centers¹ devote great efforts to promote blood donation among the population by using three complementary strategies: retaining active donors, recruiting new donors, and recovering inactive and deferred donors (Godin et al., 2005). The last two strategies contribute to expanding the donor pool, whereas donor retention aims to maintain a stable, safe blood supply. Furthermore, active donors generally experience less donation-related physical reactions (e.g. dizziness, physical weakness or fainting), and their infectious markers are generally lower (Gemelli et al., 2017). Active donors' donation frequency is higher and, given their high commitment to this social cause, they might act as prescriptors (Martín-Santana & Beerli-Palacio, 2012).

To retain donors, blood transfusion centers must identify which factors stimulate and hamper donation (Rodrigues & Carlos, 2020). Among them, donation barriers and motivations should be considered. A barrier can be described as any obstacle that prevents or hinders donation (e.g. fear of needles, lack of time, medical conditions), whereas a motivation could be any force or source driving to donate (e.g. prosocial reasons, positive emotions, incentives). The interaction between barriers and motivations explains their simultaneous analysis: when barriers prevail over motivations in terms of quantity and/or intensity, individuals decide not to donate, and viceversa (Hupfer et al., 2005). However, the particular interest on analyzing barriers lies with their impact on donation behavior: while multiple motivations have additive effects on the donation decision, a single barrier might completely prevent a donation attempt (Bednall & Bove, 2011). This contributes to the fact that the majority of the population does not donate blood, even though they are willing to do so (Huis in 't Veld et al., 2019). These arguments, along with the the fact that barriers have been studied to a lesser extent than motivations, justify the importance of studying barriers when analyzing blood donor behavior.

However, human behavior is naturally heterogeneous. Therefore, the prevalence of donation barriers is expected to differ among individuals, and it depends on other factors such as donors' sociodemographic characteristics and their donation behavior.

¹ According to Spanish Royal Decree 1088/2005, blood transfusion centers are “health centers where activities are carried out to collect and analyze human blood or their components, regardless of the purpose that they are used for, and to treat, store and distribute them when they are used for transfusion.” Blood transfusion centers are framed in the Spanish public national health system. They are also considered non-profit because their main purpose is “to organize and oversee voluntary social action directed at humanitarian problem-solving” (Mokwa, 1990, p. 43).

From a social marketing perspective, which seeks to foster behavioral changes that benefit both individuals and society (Rodrigues & Carlos, 2020), the variability in how barriers affect donors requires differentiated actions to promote blood donation among the population (Beerli-Palacio & Martín-Santana, 2015; Polonsky et al., 2015). However, it is common that blood transfusion centers design undifferentiated actions, i.e. they target a same message to the audience as a whole (Sundermann et al., 2017; Trenholm, 2017).

For the aforementioned reasons, the purpose of this study is to analyze how the donor profile influences the prevalence of blood donation barriers. However, the lack of consensus on the measurement tools has required the design of a holistic, integrative barrier scale, whose validity and reliability will be demonstrated.

2 Theoretical background

Donation barriers have been widely studied in the literature. The most prominent ones include fear (Zucoloto et al., 2019), inconvenience of donation venues (Schreiber et al., 2006), lack of time (Duboz & Cunéo, 2010), physical reactions (France et al., 2005), lack of information (Kalargirou et al., 2014) and lack of an explicit donation request (Marantidou et al., 2007). Nonetheless, it is common that different studies attribute different denominations to a same concept of barrier (Piersma et al., 2017). For example, inconvenience. While some authors refer to the time- (i.e. operating hours of donation venues) or the space dimension (i.e. location) when addressing inconvenience (e.g. Hupfer et al., 2005; Klinkenberg et al., 2018; Yuan et al., 2011), other authors consider both dimensions together, describing the act of donating as “inconvenient” without discerning the causes (e.g. Schreiber et al., 2006; Shaz et al., 2010). Additionally, when barriers are categorized, both the number and content of the items in each category also vary among studies. For instance, in Polonsky et al.’s (2015) work, the barrier scale was divided into three descriptive categories: “Cultural and societal issues” (e.g. “Cultural reasons prevent me from donating blood,” “My elders do not approve me to donate blood”), “Fear” (e.g. “I am scared of needles”) and “Lack of understanding” (e.g. “I do not know where the donation center is”). In contrast, Zaller et al.’s (2005) scale was divided into two categories: “Individual factors” and “Peer factors.” Besides differing substantially in size (9 vs. 2 items), these categories included a wide variety of different barriers: fear of needles, the need to leave work to go donate, concerns about the ability of the phlebotomist... To summarize, if no previous consensus exists, the comparison of results between studies becomes a complex issue (Martín-Santana et al., 2020).

Therefore, to fill this gap, this study proposes a holistic, integrative donation barrier scale (refer to Online Resource 1). The 25 barriers included in this scale are the result of grouping all barriers identified in the literature on blood donor behavior. They were grouped according to the concept of obstacle which they represent, despite the aforementioned terminology and expression differences.

As previously mentioned, donors do not experience the same barriers. The barrier prevalence depends on their donor profile (i.e. sociodemographic- and donation behavior characteristics). However, most research on donation barriers has

studied these individual variables solely from a descriptive perspective (e.g. Bednall & Bove, 2011; Piersma et al., 2017). Studies that cross-analyze the donor profile with self-reported donation barriers are scarce in literature (e.g. Charbonneau et al., 2016; James et al., 2013).

2.1 The influence of donor profile on donation barriers

Online Resource 2 summarizes the results of the studies in which the prevalence of donation barriers has been analyzed according to the donor profile. These results indicate that sex does influence this prevalence. Women report experiencing donation fears (e.g. of sight of blood, of feeling sick) to a greater extent than men (e.g. Kalargirou et al., 2014; Shaz et al., 2010). Besides, previous negative donation experiences prevent female donors from donating again (Charbonneau et al., 2016; Schreiber et al., 2006), as well as the non-compliance with medical requirements for donation (Charbonneau et al., 2016; Hupfer et al., 2005). At the same time, the most prevalent donation barriers in men are those associated with time and space (Bani et al., 2014; Charbonneau et al., 2016).

Regarding age, younger donors² experience more donation-related fears, principally concerns about the safety of the donation process (Kalargirou et al., 2014). In contrast, older donors highlight medical reasons as a significant donation barrier (Charbonneau et al., 2016; Misje et al., 2008; Schreiber et al., 2006). On the other hand, while both age groups report experiencing time-related barriers, these are different. Older donors experience barriers associated with family responsibilities (Charbonneau et al., 2016), while younger donors report that their sport/leisure activities are incompatible with the blood donation centers' schedules, or that they simply do not have time to donate (Charbonneau et al., 2016; James et al., 2013; Misje et al., 2008). In addition, this general lack of time is complemented by the inconvenience of the donation venues, which has been identified as a major barrier for younger donors (Schreiber et al., 2006).

The association between education and donation barriers has received limited attention. Existing studies attribute medical reasons (Charbonneau et al., 2016) and lack of information on where to donate (James et al., 2013) to less educated donors. Conversely, lack of time (Charbonneau et al., 2016; Shaz et al., 2010) and non-compliance with the donation criteria due to travelling to certain countries (Charbonneau et al., 2016) are associated with donors that have a university education.

Finally, the influence of income level on the prevalence of barriers has also been scarcely studied. The few existing studies indicate that individuals with lower income³ experience a greater lack of information, greater difficulty in accessing donation venues (James et al., 2013), and greater concern about not being physically able to donate (Shaz et al., 2010) than individuals with higher income.

² Following James et al. (2013), the cutpoint to describe a donor as young or old is 40 years-old (i.e. younger donors are less than 40 years-of-age).

³ Following James et al. (2013), an annual income below \$75,000 is considered lower income.

Two conclusions can be drawn from the above-mentioned exposition. Firstly, the existing studies on this topic tend to focus on the same barriers, which fundamentally are those related to fear, lack of time and medical reasons. Many barriers identified in Online Resource 1 have not been considered, and these might be interesting for blood transfusion centers. Secondly, it is evident that the prevalence of certain donation barriers depends on the donor's sociodemographic profile. However, since barriers have been studied under highly different approaches (i.e. terminology, categorizations), it is not possible to propose hypotheses. For this reason, this study establishes the following research question on the relationship between the sociodemographic profile and the prevalence of donation barriers:

Question 1. How does the sociodemographic profile (i.e. sex, age, income and education) influence the prevalence of donation barriers?

As far as donation behavior is concerned, only Beerli-Palacio and Martín-Santana's (2015) research analyzes the relationship between donation frequency and the prevalence of donation barriers. Their results indicate that, compared to occasional- and first-time donors, frequent donors (i.e. individuals who donate at least once a year) experience difficulties in matching their schedules with those of the blood transfusion centers.

Furthermore, the donor experience also affects the prevalence of barriers. As it can be concluded from Online Resource 2, less experienced donors exhibit higher levels of donation-related fears. In contrast, more experienced donors consider lack of time and time-space inconvenience to be the main obstacles to not donating more regularly.

With this in mind, and consistently with the reasoning on the sociodemographic profile, the following research question arises:

Question 2. How does donation behaviour (i.e. donation frequency and donor experience) influence the prevalence of donation barriers?

3 Methodology

3.1 Study population and data gathering

Data were collected through an online survey from March to September, 2018. The study population comprised active donors (individuals who had donated blood at least once in the last two years) registered in the database of the Canary Institute of Hemodonation and Hemotherapy (Spanish initials: ICHH), which is the responsible institution for blood collection, analysis, distribution and storage in the Canary Islands (Spain). The focus on active donors lies with the fact that, contrary to expected, active donors are also affected by donation barriers, which act as obstacles to donate more frequently (Charbonneau et al., 2016). Taking into account that one paramount objective for blood transfusion centers

is achieving the highest number of annual donations from these donors (Martín-Santana et al., 2018), analyzing the donation barriers among active donors is fundamental.

All respondents were older than 18 years-old, both sexes, and lived in the Canary Islands. ICHH sent their registered donors an e-mail with the URL that hosted the online survey. After removing 90 unfinished questionnaires, the final sample comprised 5,353 respondents.

3.2 Measurement instruments

Besides questions about the sample profile (sex, age, education, total monthly income, donation frequency and donor experience), the online survey included a donation barrier scale. This scale comprised 25 dichotomous (Yes/No) items adapted from previous studies (see Online Resource 1). Each item corresponded to a barrier, and the following question was asked: “Please note whether each of the following causes might reduce the number of donations you make per year.”

3.3 Scale validation

A principal component analysis (PCA) was used to validate the barrier scale (see Table 1). Given that items were dichotomous, the tetrachoric correlation matrix was used as input (Debelak & Tran, 2013). Scale reliability was calculated using the KR-20 coefficient (Nunnally & Bernstein, 1994).

The results in Table 1 show that:

- No barrier items were removed after the validation process.
- The PCA might be considered satisfactory, because 68.65% of the total variance was explained, thus exceeding the 60% threshold established by Hair et al. (2014).
- Factor loadings were very significant, as most of them exceeded 0.5 (Hair et al., 2014).
- Communalities were higher than 0.5 (excepting BARR8), therefore explaining more than half of the variability of the respondents’ answers (Hair et al., 2014).
- The scale was reliable, since KR-20 values (global and for each dimension, except D4) were above or close to 0.7 (Nunnally & Bernstein, 1994).

The PCA results show that there were several underlying dimensions in the proposed scale. These dimensions were labelled as “Informative barriers” (D1), “Intrinsic barriers” (D2), “Time–space barriers” (D3) and “Procedural barriers” (D4). Informative barriers included those barriers related to a lack of awareness about the donation process, location and operating times of donation venues, as well as the never-ending need for blood. Additionally, this dimension included the absence of promotional campaigns and reminders from the centers to donate again. Intrinsic barriers consisted of barriers related to the internal processes of individuals (i.e.

Table 1 PCA results

Barrier dimensions	COMM	D1	D2	D3	D4
Informative barriers					
BARR23	0.714	0.759	0.279	0.096	0.225
BARR3	0.689	0.733	0.357	0.151	0.042
BARR25	0.541	0.654	0.072	0.287	0.162
BARR2	0.683	0.627	0.182	0.505	-0.034
BARR1	0.661	0.571	0.569	0.105	-0.009
Intrinsic barriers					
BARR18	0.902	0.160	0.934	0.052	0.025
BARR19	0.886	0.179	0.922	0.055	0.031
BARR20	0.860	0.151	0.913	0.051	0.025
BARR22	0.749	0.221	0.823	0.094	0.116
BARR5	0.720	0.104	0.808	0.132	0.197
BARR6	0.798	0.384	0.801	0.037	0.082
BARR21	0.639	0.038	0.777	0.117	0.142
BARR4	0.654	0.240	0.771	0.017	0.044
BARR16	0.667	-0.136	0.753	0.274	0.080
BARR17	0.636	-0.066	0.702	0.217	0.302
BARR7	0.490	0.314	0.589	0.061	0.201
Time–space barriers					
BARR9	0.738	0.032	-0.005	0.854	0.091
BARR11	0.807	0.178	0.214	0.844	0.134
BARR10	0.786	0.214	0.176	0.839	0.077
BARR8	0.415	-0.096	-0.148	0.584	0.208
BARR12	0.501	0.213	0.152	0.580	0.311
Procedural barriers					
BARR14	0.705	0.263	-0.019	0.031	0.796
BARR15	0.676	-0.029	0.280	0.314	0.706
BARR13	0.673	0.015	0.217	0.409	0.677
BARR24	0.574	0.500	0.260	0.002	0.506
Eigenvalue		1.925	10.261	3.500	1.477
Partial explained variance (%)		12.72	32.07	14.58	9.28
Total explained variance (%)	68.65				
KR-20 (dimension)		0.729	0.887	0.725	0.556
Global KR-20	0.870				

Significant at $p \leq 0.05$

beliefs, perceptions) and donation fears (e.g. needles). Time–space barriers were related to the inconvenience of donation. Lastly, procedural barriers included aspects of the process itself which could discourage donation repetition.

Table 2 Sample profile

Characteristics	N	%
Sex		
Male	2,640	49.3
Female	2,713	50.7
Age (years)		
18–25	782	14.6
26–35	1,243	23.2
36–45	1,613	30.1
46–55	1,350	25.2
> 55	365	6.8
Education		
No formal education or Primary	705	13.2
Secondary	2,092	39.1
University	2,556	47.7
Total monthly income (EUR)		
≤1,000	1,204	22.5
1,001–2,000	2,412	45.1
2,001–4,000	1,392	26.0
> 4,000	343	6.4
Donation frequency (per year)		
One	2,062	38.5
Twice	2,044	38.2
Three or four times	1,247	23.3
Donor experience (years)		
≤4	1,998	37.3
5–10	1,636	30.6
> 10	1,719	32.1
TOTAL	5,353	100.0

4 Results

4.1 Sample profile

Table 2 shows the sample profile, which was characterized by individuals older than 36 years-old (62.1%), with secondary (39.1%) or university (47.7%) education, and a monthly income between 1,000 and 2,000 euros (45.1%). In terms of sex, the sample was almost homogeneous (49.3% men vs. 50.7% women). Most respondents usually donated once (38.5%) or twice (38.2%) a year. Finally, most respondents were active donors for less than 10 years (67.9%).

Table 3 Descriptive statistics of barrier dimensions

Barrier dimensions	Min	Max	Mean	SD	Mean (%)	Q1 (%)	Q2 (%)	Q3 (%)
Informative barriers	0.00	5.00	2.03	1.69	40.53	0.00	40.00	60.00
Intrinsic barriers	0.00	11.00	2.48	3.09	22.51	0.00	9.09	36.36
Time–space barriers	0.00	5.00	1.82	1.64	36.41	0.00	40.00	60.00
Procedural barriers	0.00	4.00	0.99	1.10	24.69	0.00	25.00	50.00

4.2 Descriptive analysis

To analyze the relationship between the donor profile and the prevalence of barriers, four variables were created starting from the dimensions of the PCA. Each of these new variables corresponded to the sum of responses given by the respondents to the dichotomous items included in each dimension. Affirmative responses were assigned a numerical value of one, and negative responses were assigned a value of zero.

Table 3 shows the descriptive statistics of these new variables. Since each variable included a different number of items (between 4 and 11 barriers), the prevalence percentage⁴ of each variable was calculated for each respondent. Following these calculations, means and quartiles were extracted, showing that the most prevalent barriers were informative barriers ($M=40.53\%$), followed by the time–space barriers ($M=36.41\%$).

4.3 Donor profile and the prevalence of donation barriers

To explore how the donor profile affects the prevalence of donation barriers, *t*-tests or one-way ANOVA analyses were carried out, as well as the Cohen's *d* statistic or Tukey's test, depending on the case (see Tables 4 and 5).

Table 4 shows the relationships between the sociodemographic profile (i.e. sex, age, education and income) and the prevalence of the four barrier dimensions (i.e. informative, intrinsic, time–space and procedural). The results indicate that sex affected all dimensions, except time–space barriers. Women had a higher prevalence of both informative and intrinsic barriers; and men had a higher prevalence of procedural barriers. However, the impact of these effects could not be considered significant because the values of the Cohen's *d* statistic were not close to 0.8.

Differences in means across all four barrier dimensions depending on age indicated a decreasing relationship, which means that the older the individual, the lower the prevalence of barriers. The Tukey's statistic indicated that the main differences were found between the 18–35 year-old donor groups (1 and 2) and the other groups (3, 4 and 5).

⁴ For instance, in the informative barriers dimension, if the respondent selected two items (from a total of 5), the prevalence of such barriers was 40.0%.

Table 4 Prevalence of barrier dimensions according to the donor's sociodemographic profile

Sociodemographic variables		Informative barriers		Intrinsic barriers		Time-space barriers		Procedural barriers	
		M	SD	M	SD	M	SD	M	SD
Sex									
Male	1.94	1.68	2.16	2.91	1.80	1.63	1.03	1.11	
Female	2.12	1.69	2.78	3.23	1.84	1.65	0.94	1.10	
<i>t(p)</i>	3.884 (0.000)		7.375 (0.000)		1.049 (0.294)		2.986 (0.003)		
<i>Cohen's d (r)</i>	0.107 (0.0553)		0.202 (0.100)		0.024 (0.012)		0.081 (0.041)		
Age									
(1) 18–25	2.38	1.59	3.24	3.33	1.93	1.57	1.14	1.13	
(2) 26–35	2.20	1.67	2.66	3.08	1.93	1.60	1.02	1.10	
(3) 36–45	1.93	1.67	2.38	3.07	1.86	1.67	0.99	1.12	
(4) 46–55	1.82	1.73	2.07	2.95	1.70	1.68	0.90	1.09	
(5) > 55	1.86	1.72	2.12	2.94	1.51	1.60	0.89	1.06	
<i>F(p)</i>	19.438 (0.000)		20.780 (0.000)		7.332 (0.000)		7.145 (0.000)		
<i>Tukey</i>	1–3		1–2		1–4		1–3		
	1–4		1–3		1–5		1–4		
	1–5		1–4		2–4		1–5		
	2–3		1–5		2–5		2–4		
	2–4		2–4		3–5				
	2–5		2–5						
			3–4						
Education									
(1) No formal education or Primary	1.85	1.76	1.96	2.83	1.53	1.51	0.96	1.09	
(2) Secondary	2.04	1.67	2.45	3.09	1.76	1.62	0.98	1.09	
(3) University	2.06	1.68	2.64	3.16	1.95	1.68	1.00	1.12	
<i>F(p)</i>	4.331 (0.013)		13.864 (0.000)		20.173 (0.000)		0.589 (0.555)		

Table 4 (continued)

Sociodemographic variables	Informative barriers		Intrinsic barriers		Time-space barriers		Procedural barriers	
	M	SD	M	SD	M	SD	M	SD
<i>Tukey</i>	1-2		1-2		1-3		--	
	2-3		1-3		2-3			
Income								
(1) ≤ 1,000	2.14	1.71	2.65	3.14	1.77	1.61	1.06	1.12
(2) 1,001–2,000	2.05	1.69	2.48	3.07	1.78	1.62	0.95	1.09
(3) 2,001–4,000	1.92	1.67	2.39	3.10	1.89	1.69	1.00	1.10
(4) > 4,000	1.93	1.69	2.17	3.04	2.01	1.72	0.98	1.15
<i>F(p)</i>	3.915 (0.008)		2.679 (0.045)		3.308 (0.019)		2.710 (0.044)	
<i>Tukey</i>	1-3		--		--		1-2	
Global sample	2.03	1.69	2.48	3.09	1.82	1.64	0.99	1.10

The results of Tukey's test only show the pairs of groups where differences are observed

Significant at $p \leq 0.05$

Table 5 Prevalence of barrier dimensions according to the donor's donation behaviour

Donation behaviour variables	Informative barriers		Intrinsic barriers		Time-space barriers		Procedural barriers	
	M	SD	M	SD	M	SD	M	SD
Frequency								
(1) Once	2.14	1.67	2.50	3.00	1.97	1.65	0.99	1.12
(2) Twice	1.97	1.68	2.43	3.12	1.82	1.64	0.99	1.11
(3) 3 or 4 times	1.94	1.72	2.52	3.20	1.58	1.62	0.99	1.08
<i>F(p)</i>	7.332 (0.001)		0.424 (0.645)		21.929 (0.000)		0.000 (1.000)	
<i>Tukey</i>	1-2 1-3		--		1-2 1-3 2-3		--	
Experience								
(1) ≤ 4	2.25	1.67	2.79	3.14	1.84	1.63	1.04	1.13
(2) 5-10	1.97	1.71	2.41	3.09	1.81	1.62	0.97	1.07
(3) > 10	1.82	1.66	2.18	3.01	1.81	1.68	0.95	1.10
<i>F(p)</i>	31.344 (0.000)		18.402 (0.000)		0.175 (0.839)		3.430 (0.032)	
<i>Tukey</i>	1-2 1-3 2-3		1-2 1-2		--		1-3	
Global sample	2.03	1.69	2.48	3.09	1.82	1.64	0.99	1.10

The results of Tukey's test only show the pairs of groups where differences are observed

Significant at $p \leq 0.05$

Education affected the prevalence of three barrier dimensions: informative barriers, intrinsic barriers and time–space barriers. This relationship was direct and positive, that is, the higher the education, the higher the prevalence of barriers. According to the values of the Tukey’s statistic, the main differences were found between donors with no education or with primary education, and donors with secondary and university education, with the former group having lower prevalence values.

Finally, income affected the prevalence of all barrier dimensions. This relationship was inversely proportional for both informative and intrinsic barriers, which means that the higher the income, the lower the prevalence of such barriers. In the case of time–space barriers, the effect was direct, i.e. their prevalence increased with income. Lastly, the relationship between income and procedural barriers, although statistically significant, did not show a clear trend. The Tukey’s statistic shows that the differences, although minor, were among donors perceiving less than 1,000 euros compared to the other groups.

Table 5 shows how donation behavior (namely donation frequency and donor experience) influences the prevalence of the four barrier dimensions. The results indicate an inverse relationship between both informative and time–space barriers with donation frequency. The Tukey’s statistic shows that the main differences occurred between the donors who donated once a year compared to the other two groups, with the former having a greater prevalence of informative and time–space barriers.

The data indicate that donor experience influenced all barrier dimensions, except time–space barriers. There was an inverse relationship in the three cases, i.e. the greater the experience, the lower the prevalence. Here again, the main differences were found among less experienced donors.

5 Discussion

In order to meet the demand for blood, blood transfusion centers rely on donor retention strategies. One of the advantages of retention is that it involves significant cost savings for centers, because retaining a current donor is substantially more cost-efficient than recruiting a new donor (Gemelli et al., 2017). To ensure that marketing efforts achieve their objectives, blood transfusion centers must analyze their donor pools, in order to know which the most prominent donation barriers are. At the same time, to adequately know who to target the designed marketing actions, centers must be aware of the most salient characteristics (both sociodemographic and donation-related) of their pools (Glynn et al., 2002).

A barrier scale was designed and validated to assist centers in such donor management. This scale itself constitutes, from a theoretical perspective, the first contribution of the present study, as it arises as a possible solution to the absence of an agreed catalogue of blood donation barriers. The designed 25-item scale is the result of grouping all barriers identified in the existing blood donor behavior literature under a same naming, according to their shared meaning. As the scale includes barriers of diverse typology, it is possible to analyze its subyacent dimensionality. In this way, barrier items could be grouped in common categories, as previous authors

have attempted (e.g. Polonsky et al., 2015; Zaller et al., 2005). Therefore, the scale, holistic and integrative in nature, constitutes a useful measurement tool for blood transfusion centers to identify which individual barriers or barrier typologies affect their donors the most.

This scale was used to analyze the prevalence of donation barriers in a sample of active blood donors in the Canary Islands (Spain). The most prevalent barriers were, firstly, informative barriers and, secondly, time–space barriers. The low prevalence of intrinsic barriers among active donors is due to the fact that these donors are familiar with the donation process and equipment, which significantly reduces fear and, consequently, the occurrence of adverse reactions.

This study also contributes to statistically show how the donor profile influences the prevalence of the different barrier dimensions. Additionally, this study expands the knowledge on the influence of less studied variables such as education, income level and donation frequency (refer to Online Resource 1).

In consonance with previous literature, women experience more internal barriers (Hupfer et al., 2005; Schreiber et al., 2006), while men are more externally deterred. At the same time, the youngest donors (18–35 years-old) are the most inhibited in general. Results show that barriers decrease as age increases (Charbonneau et al., 2016), which is most likely related to donor experience. Higher education and income lead to higher donation barriers, especially those related to the time factor. Variables related to donation behavior also affect the prevalence of barriers: donors who make less donations per year are the least informed and have the most time–space restrictions, and those who have donated blood the longest are those who experience the fewest barriers. Therefore, this research shows that the donors most affected by blood donation barriers are young adults (18–35 years-old), with university studies and a higher income level, who generally donate once or twice a year and who have less than four years of donor experience. Blood transfusion centers should design social marketing actions aimed at these donors to eliminate, or at least reduce, the barriers that most affect them (Barkworth et al., 2002). Ultimately, these donors would be able to stay in the system longer, as well as to increase the number of donations they make per year. Additionally, given that the population is progressively aging, it is critical that donor pools have enough young active donors to ensure the long-term maintenance of the donation system (Misje et al., 2008; Yuan et al., 2011).

Thus, as practical implications, this study recommends blood transfusion centers to focus preferably on informative and procedural barriers, as their extrinsic nature facilitates interventions on them (Boenigk et al., 2011). Given the profile of the most affected donors, as well as the possibilities offered by technological advances (Trenholm, 2017), developing active, two-way communication on social networks or implementing direct marketing actions (e.g. e-mailing or instant-messaging) would allow centers to more effectively deliver the desired information on, for example, upcoming collection campaigns. As far as procedural barriers are concerned, although certain aspects of the donation process are regulated to ensure the safety of both donors and recipients, measures to reduce these barriers do exist. For example, by automating the pre-donation health questionnaire, so that donors only need to update specific items; or by offering the possibility of filling the questionnaire in online before a donation. A complete and updated

donor database is essential to achieve this, as well as enhancing the use of customer relationship management (CRM) systems to improve donor communication and campaign coordination. On the other hand, if waiting times cannot be reduced for economic reasons, the wait could be made more bearable by offering distractions such as reading material, visual projections, etc. Finally, regarding time–space barriers, although some of them are intrinsic to the individual, blood transfusion centers could facilitate donation by organizing mobile collections in workplaces. In fact, in their study, Schreiber et al. (2006) found that 46.0% of respondents considered the workplace to be the most convenient place to donate. Furthermore, carrying out the process in a familiar environment, away from the healthcare environment, could possibly minimize the aversion to donating, thus minimizing some intrinsic barriers.

The main limitation of this study refers to the studied population, which are active donors living in the Canary Islands (Spain). It would be interesting to replicate the study in other Spanish regions, or even in other countries, for comparative purposes. Furthermore, as a future line of research, the authors propose to replicate the study in geographical contexts where the donation system is not voluntary (e.g. remunerated, replacement), because in Spain, the only legal donation modality is the voluntary one.

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Data availability The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy restrictions.

Code availability Not applicable.

Declarations

Ethics approval This study was exempted from the requirement for approval by the responsible ethics committee due to its nature (participants were not patients, and their participation was voluntary and anonymous).

Consent to participate The participation in the study was voluntary. Therefore, respondents' willingness to complete the questionnaire indicated their consent to participate.

Consent for publication The questionnaire was completely anonymous. Therefore, there is no identifiable information requiring consent for publication.

Conflicts of interest All authors declare that they have no conflicts of interests.

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