Segmenting active blood donors according to their barriers to develop retention programs

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Abstract

Given the lack of a consensus on a catalogue of donation barriers, this study proposes a holistic scale of barriers which was used to segment Spanish active blood donors in order to define specific retention and loyalty strategies. A sample of 26,626 active donors from 14 of the 17 Spanish blood transfusion centers assessed a total of 25 barriers through an online survey. This scale was validated and four barrier categories were defined: Informative, Intrinsic, Time-space and Procedural. Segmentation was performed through k-means clustering. Four active donor clusters were created: (1) “Very Inhibited” (13.2%), who experienced a high number of barriers in all categories; (2) “Uninhibited” (46.9%), which was the largest cluster with fewer barriers; (3) “Apprehensive” (16.9%), whose most prevalent barriers were Informative and Intrinsic in nature, and (4) “Busy” (23.0%), who experienced mainly Time-space and Informative barriers. Afterwards, depending on the size of the cluster, the presence of barriers, and the greater ease or difficulty to act on them, the attractiveness of each cluster was established in order to propose specific marketing actions.

Keywords

blood donation, donation barriers, donor segmentation, retention strategies

Introduction

Most developed countries have implemented a voluntary non-remunerated blood donation system, which is considered the most desirable by the World Health Organization [1]. Consequently, it is a priority for blood transfusion centers (BTC) to increase the number of donors, to retain them and to increase their donation frequency. Although less than 40% of the population is eligible to donate blood, it is estimated that only 5-10% does donate, despite the awareness campaigns launched by the responsible bodies [2,3]. Due to the decrease of the donor pool, which sometimes causes issues to satisfy the existing blood demand, BTC make great efforts to promote donation. To this end, they have two alternatives: retaining active donors and/or recruiting new donors [4]. Although the recruitment of new donors contributes to increasing the size of the donor pool and to replacing donors who, either voluntarily or by obligation, cease to donate [5,6], retaining active donors implies lower costs [7,8], since repeat donors are more familiar with the system.

To optimize donor retention strategies, it is essential that BCT are aware of the factors that intervene in blood donation behavior. Among them, barriers are perhaps those that most affect such behavior, preventing or hindering donation [9]. Although barriers have generally been studied for non-donors and lapsed donors [10,11], they also affect active donors, preventing them from donating more frequently [12].

In the literature, donation barriers of a very diverse nature have been identified, but in a fragmented manner. These barriers are fear [13,14], inconvenience of the donation venue [9,15], lack of time [10,12], physical reactions [16,17], lack of information [18,19] or the absence of a personal request to donate [20,21]. There is no consensus around a general

barrier scale, either common categories. Moreover, conceptually similar barriers have been studied, but different labels have been used for the same barrier [9]. This makes it difficult to compare results or to group barriers according to their category. Furthermore, barriers vary among donors. Therefore, it is necessary to segment them in order to develop differentiated marketing actions [12,22–25].

Hence, the aim of this work is two-fold. Firstly, it is aimed at designing and validating a holistic barrier scale based on the different scales existing in the literature. The second aim is to segment active donors from Spanish BTC using the different categories identified in the previously designed scale as criteria. One of the main practical applications of this work could be to create targeted marketing actions in order to increase donation frequency among the different clusters identified.

Material and methods

The methodological process was based on a survey through an online questionnaire. The population was comprised of active donors (individuals who had donated blood at least once in the last two years) registered in the databases of 14 of the 17 regional BTC, which are the responsible institutions for blood collection in Spain [26]. All active donors in the study population were over 18 years old, both sexes and residents in Spain. BTC sent all their registered active donors an e-mail with the URL of the online platform that hosted the questionnaire. The initial sample had 31,993 active donors. However, due to unfinished questionnaires, the sample was reduced to 26,626 donors (questionnaire completion rate 83.22%).

To measure donation barriers, a scale was designed based on an extensive review of the literature [5,12,14,27–32]. The 14 participating BTC contributed to the content validation of the proposed scale. The scale comprised 25 items, each corresponding to a single barrier. By using dichotomous responses - Yes or No -, an answer to the following question was given: “Please note whether each of the following causes could prevent you from increasing the number of blood donations you make per year.”

Before segmentation, it was necessary to determine the different underlying barrier categories in the proposed scale and its multidimensional structure. Based on the study carried out by Debelak and Tran [33], the tetrachoric correlation (TCC) matrix must be used if variables are binary when a principal component analysis (PCA) is carried out. For this reason, based on such input, a PCA was done for the barrier scale, and its results are shown in Table 1. In addition, the reliability or consistency of the global scale, as well as that of each resulting factor, was determined by calculating the coefficient of Kuder-Richardson Formula 20 (KR-20). This coefficient is equivalent to Cronbach’s alpha when variables are binary [34]. Throughout this validation process, the number of final items was still 25.

Based on the findings in Table 1, we could infer the following:

(1) The results of PCA could be considered satisfactory, since they explained 70.01 % of the total variance, thus exceeding the 60.0% threshold indicated by Hair et al. [35].

(2) The correlations between the factors and the different items, expressed through factor loadings, were very significant. According to Hair and colleagues [35], factor loadings of

0.5 or higher are considered significant. All items in the scale had loadings greater than 0.5, excepting one, and 19 out of 25 items' loadings were higher than 0.6.

(3) The proportions of explained variance of each item, expressed by means of communalities (COM), were high given that in every case (with the exception of BARR8 and BARR9) more than half of the variability of the participants' answers was explained. It is asserted that items with COM values of 0.5 or higher are considered to have sufficient explanation [35].

(4) It was a reliable scale. KR-20 values, both at a global level and for each dimension (except one of them), were greater than 0.7, which is an acceptable threshold, as suggested by Nunnally and Berstein [34].

Table 1. Results of the PCA of the barrier scale

Barriers		PCA results				
		COM	**F1**	**F2**	**F3**	**F4**
Informative barriers						
BARR24	Absence of promotional donation campaigns to donate blood (TV, radio, social networks, etc.)	0.740	**0.715**	0.434	0.099	0.177
BARR3	Lack of information about the constant need for blood	0.731	**0.682**	0.473	0.193	0.074
BARR1	Lack of information about the donation process or requisites	0.703	**0.570**	0.574	0.222	-0.006
BARR2	Lack of information about the location or opening times of donation venues	0.712	**0.529**	0.270	0.599	-0.017
BARR26	Absence of a reminder from the center to donate	0.504	**0.502**	0.121	0.471	0.126
Intrinsic barriers						
BARR19	General fear and anxiety of donation	0.912	0.220	**0.926**	0.075	0.035
BARR20	Fear of needles and/or pain	0.913	0.250	**0.919**	0.065	0.045
BARR21	Fear of seeing blood	0.873	0.225	**0.903**	0.058	0.052
BARR7	Lack of willingness, interest and/or motivation to donating blood	0.840	0.397	**0.816**	0.093	0.090
BARR6	Negative experience during a previous blood donation	0.727	0.062	**0.811**	0.170	0.190
BARR23	Negative opinions of friends, relatives, etc., towards blood donation	0.751	0.221	**0.809**	0.154	0.151
BARR5	Cultural, religious or ethical reasons	0.686	0.255	**0.786**	0.047	0.031
BARR17	Suffering physical distress (nausea, vomit, dizziness, etc.)	0.711	-0.174	**0.772**	0.275	0.096

BARR22	Fear of suffering anaemia	0.582	0.010	**0.738**	0.125	0.144
BARR18	Suffering wounds in arms due to use of needles (haematoma, irritation, etc.)	0.664	-0.124	**0.716**	0.194	0.313
BARR8	Mistrust about the possible uses of blood	0.487	0.291	**0.574**	0.140	0.231
Time-space barriers						
BARR12	Inconvenient location of donation venues	0.854	0.123	0.201	**0.885**	0.121
BARR11	Donation venues are located too far away	0.826	0.135	0.179	**0.875**	0.098
BARR10	Schedule incompatibility with donation venues	0.694	-0.015	0.010	**0.814**	0.176
BARR13	Lack of parking space in donation venues	0.557	0.212	0.190	**0.606**	0.329
BARR9	Lack of free time	0.405	-0.103	-0.117	**0.536**	0.307
Procedural barriers						
BARR15	Inconvenience related to having to fill out my personal data at each donation	0.671	0.305	0.010	0.119	**0.751**
BARR16	Duration of blood extraction process longer than half an hour	0.684	-0.007	0.283	0.259	**0.733**
BARR14	Waiting time longer than half an hour	0.673	0.015	0.232	0.401	**0.677**
BARR25	Absence of blood donation incentives (blood tests, gifts, social recognition, tickets to events, etc.).	0.604	0.564	0.237	0.033	**0.478**
Factor's self-value			1.645	11.022	3.445	1.391
Partial percentage of explained variance			11.60	32.95	16.05	9.41
Total percentage of explained variance				70.01		
KR-20 of each factor			0.749	0.890	0.740	0.555
KR-20 global scale				0.884		

As expected, there were several clearly different dimensions in this scale, which we could call "Informative barriers" (F1), "Intrinsic barriers" (F2), "Time-space barriers" (F3) y "Procedural barriers" (F4). The "Informative barriers" category consisted of barriers related to lack of information about the donation process, location and opening times of donation venues or the constant need for blood [18,19]. In addition, it also included the absence of promotional campaigns to donate blood [14,31] and the absence of reminders from the centers to donate [12,13]. "Intrinsic barriers" included barriers related to the internal processes of individuals such as beliefs and perceptions [30,37] or fears associated with donation (e.g. fear of needles, fear of collapsing, etc.) [14,17,31]. "Time-space barriers" were related to the opportunity costs of donating blood in terms of time and space [15,36]. Finally, "Procedural barriers" comprised certain factors of the donation process itself which discourage people from repeating blood donation [12,35,38].

Results

The sociodemographic profile of Spanish active blood donors (see Table 1) was characterized as homogeneous in terms of sex (48.9% male and 51.1% female), older than 45 years old (36.4%) and having university education (51.0%). Most of them were employed (78.8%) and had a monthly income lower than 2,000 euros (53.8%). Regarding their donation behavior, most of them donated only once or twice a year (73.0%) and had been donating for more than 4 years (63.0%).

Table 2. Sample profile

Characteristics	N	%
Sex		
Male	13007	48.9
Female	13619	51.1
Age (years)		
18-25	4237	15.9
26-35	5267	19.8
36-45	7421	27.9
>45	9701	36.4
Education		
No formal education or Primary	3422	12.9
Secondary	9623	36.1
University	13581	51.0
Employed		
Yes	20975	78.8
No	5651	21.2
Total monthly income (euros)		
≤2000	14331	53.8
2001-4000	9610	36.1
>4000	2685	10.1
Donation frequency in 2017		
Once	10585	39.7
Twice	8864	33.3
3 or 4 times	7177	27.0
Experience as a donor (years)		
< 2	4228	15.9
2-4	5616	21.1
5-10	6643	24.9
11-15	3035	11.4
>15	7104	26.7
Total	**26626**	**100.0**

According to the PCA results, Table 3 also shows the descriptive analysis of different barriers influencing Spanish active donors. The most frequent barriers were informative, with frequency values between 30.5% y 40.3%. The most relevant barriers were “Lack of information about the location or opening times of donation venues” (40.3%) and “Absence of a reminder from the center to donate” (36.9%). However, “Time-space barriers” also showed high percentages, e.g. “Schedule incompatibility with donation venues” (45.3%) and “Lack of free time” (38.6%). Amongst “Intrinsic barriers”, the most important ones were “Lack of willingness, interest and/or motivation to donating” (36.1%) and “Fear of needles and/or pain” (30.2%). Lastly, the results particularly highlight “Waiting time longer than half an hour “(25.6%) as the most frequent barrier in the category of “Procedural barriers”.

Table 3. Descriptive analysis of barriers

Barriers		Frequencies	
		N	%
Informative barriers			
BARR2	Lack of information about the location or opening times of donation venues	10720	40.3
BARR26	Absence of a reminder from the center to donate	9823	36.9
BARR3	Lack of information about the constant need for blood	9770	36.7
BARR24	Absence of promotional donation campaigns to donate blood (TV, radio, social networks, etc.)	8753	32.9
BARR1	Lack of information about the donation process or requisites	8109	30.5
Intrinsic barriers			
BARR7	Lack of willingness, interest and/or motivation to donating blood	9623	36.1
BARR20	Fear of needles and/or pain	8050	30.2
BARR6	Negative experience during a previous blood donation	7479	28.1
BARR17	Suffering physical distress (nausea, vomit, dizziness, etc.)	7398	27.8
BARR19	General fear and anxiety of donation	7232	27.2
BARR21	Fear of seeing blood	6650	25.0
BARR5	Cultural, religious or ethical reasons	4831	18.1
BARR18	Suffering wounds in arms due to use of needles (haematoma, irritation, etc.)	4217	15.8
BARR8	Mistrust about the possible uses of blood	3491	13.1
BARR22	Fear of suffering anaemia	3289	12.4
BARR23	Negative opinions of friends, relatives, etc., towards blood donation	3102	11.7

Time-space barriers			
BARR10	Schedule incompatibility with donation venues	12064	45.3
BARR9	Lack of free time	10285	38.6
BARR11	Donation venues are located too far away	8043	30.2
BARR13	Lack of parking space in donation venues	6705	25.2
BARR12	Inconvenient location of donation venues	6185	23.2
Procedural barriers			
BARR14	Waiting time longer than half an hour	6823	25.6
BARR15	Inconvenience related to having to fill out my personal data at each donation	4915	18.5
BARR25	Absence of blood donation incentives (blood tests, gifts, social recognition, tickets to events, etc.)	4675	17.5
BARR16	Duration of blood extraction process longer than half an hour	3044	11.4

These results show that BTC must apply strategies and take actions to eliminate these barriers in order to increase donation rates. To this end, firstly it is necessary to segment active donors based on the four barrier categories resulting from the PCA. To do this, four new variables were created, each corresponding to the sum of barriers that respondents selected in each of the proposed categories. For instance, the "Informative barriers" value was the sum of barriers BARR1, BARR2, BARR3, BARR24 and BARR26. Thus, this variable could have values from 0 to 5 (see Table 3, Range column), where 0 meant the respondent did not present any of the suggested barriers, and 5 meant that they presented all of them.

Table 4 shows the descriptive statistics of these four new variables, which were subsequently used to segment active donors. Table 3 also includes the results of the k-means clustering, and shows the centers of each of the four identified clusters. K-means is a non-hierarchical clustering analysis model which consists in portioning the data into a user-specified number of clusters and then iteratively reassigning observations (in this case, active donors) to clusters until some numerical criterion is met. The criterion specifies a goal related to minimizing the distance of observations from one another in a cluster and maximizing the distance between clusters [35].

Table 4. Descriptive statistics for the categories of barriers and cluster centers

Barriers	Descriptive statistics			Cluster centroids*				
	Range	Mean	SD	Cluster 1 Very Inhibited	Cluster 2 Uninhibited	Cluster 3 Apprehensive	Cluster 4 Busy	*F* (*p*)
Informative	0.00-5.00	1.77	1.68	3.71	0.57	2.52	2.57	8882.940 (0.000)
Intrinsic	0.00-11.00	2.45	3.11	8.37	0.40	5.34	1.15	58803.900 (0.000)
Time-space	0.00-5.00	1.63	1.61	3.03	0.69	1.05	3.15	8246.629 (0.000)
Procedural	0.00-4.00	0.73	1.00	1.58	0.30	0.77	1.10	2395.333 (0.000)
Cluster size				**3501 (13.2%)**	**12496 (46.9%)**	**4495 (16.9%)**	**6134 (23.0%)**	

*Cluster centroids are the mean values of the observations (active donors) on the variables (the different barrier categories) in the cluster variate [35].

Cluster 1, labelled “Very Inhibited”, represented 13.2% of donors. It was characterized by a high number of barriers in all categories. Cluster 2, labelled “Uninhibited”, was the largest (46.9%) and the one with the least number of barriers in all categories. In cluster 3, which included 16.9% of donors, Intrinsic barriers prevailed, but also Informational barriers. Therefore, this cluster was labelled as “Apprehensive”. Finally, cluster 4 was the second in size (23.0%) and was characterized by a high number of Time-space barriers, which suggested labelling it as “Busy”.

Table 5 shows the presence of donation barriers in the four identified clusters, allowing us to observe which were the most inhibiting in each category and cluster. Such presence was related to the percentage of active donors who stated that the proposed barriers could prevent them from increasing the number of donations they make per year. The average presence values of all barriers, both at a global level and in each cluster (see Table 5, Total average row), confirmed the denomination that was assigned to the four clusters. Thus, cluster 1 showed a total average of 66.8%, whereas the total average of cluster 2

was only 7.8%. On the other hand, the other two clusters had values lower than 40.0%, although the incidence of the barrier categories was different.

Table 5. Presence of barriers (%) in each cluster

	Barriers	Global	Cluster 1 Very Inhibited	Cluster 2 Uninhibited	Cluster 3 Apprehensive	Cluster 4 Busy
Informative barriers						
BARR24	Absence of promotional donation campaigns to donate blood (TV, radio, social networks, etc.)	32.9	74.5	9.7	52.6	41.9
BARR3	Lack of information about the constant need for blood	36.7	79.1	10.5	59.8	48.9
BARR1	Lack of information about the donation process or requisites	30.5	75.0	6.3	55.1	36.1
BARR2	Lack of information about the location or opening times of donation venues	40.3	76.4	13.1	47.9	69.4
BARR26	Absence of a reminder from the center to donate	36.9	66.4	17.1	36.1	61.1
Informative barriers average		**35.5**	**74.3**	**11.3**	**50.3**	**51.5**
Intrinsic barriers						
BARR19	General fear and anxiety of donation	27.2	94.9	1.7	74.7	5.5
BARR20	Fear of needles and/or pain	30.2	97.3	2.9	83.4	8.8
BARR21	Fear of seeing blood	25.0	90.7	1.5	66.9	4.6
BARR7	Lack of willingness, interest and/or motivation to donating blood	36.1	95.0	7.1	83.8	26.7
BARR6	Negative experience during a previous blood donation	28.1	86.6	6.0	57.0	18.4
BARR23	Negative opinions of friends, relatives, etc., towards blood donation	11.7	60.7	0.3	18.6	1.7
BARR5	Cultural, religious or ethical reasons	18.1	66.9	1.7	41.8	6.5
BARR17	Suffering physical distress (nausea, vomit, dizziness, etc.)	27.8	81.7	9.8	45.5	20.7
BARR22	Fear of suffering anaemia	12.4	53.9	3.2	17.1	3.7
BARR18	Suffering wounds in arms due to use of needles (haematoma, irritation, etc.)	15.8	60.3	3.7	23.5	9.6
BARR8	Mistrust about the possible uses of blood	13.1	48.5	1.9	22.1	9.2
Intrinsic barriers average		**22.3**	**76.1**	**3.6**	**48.6**	**10.5**
Time-space barriers						
BARR12	Inconvenient location of donation venues	23.2	58.3	2.2	12.1	54.1
BARR11	Donation venues are located too far away	30.2	66.7	6.5	19.7	65.4
BARR10	Schedule incompatibility with donation venues	45.3	69.3	26.1	31.8	80.6

BARR13	Lack of parking space in donation venues	25.2	58.5	6.4	18.9	49.0
BARR9	Lack of free time	38.6	49.9	28.2	22.0	65.6
Time-space barriers average		**32.5**	**60.5**	**13.9**	**20.9**	**62.9**
Procedural barriers						
BARR15	Inconvenience related to having to fill out my personal data at each donation	18.5	31.8	9.5	17.1	30.0
BARR16	Duration of blood extraction process longer than half an hour	11.4	31.2	3.7	10.8	16.4
BARR14	Waiting time longer than half an hour	25.6	54.2	10.9	25.4	39.6
BARR25	Absence of blood donation incentives (blood tests, gifts, social recognition, tickets to events, etc.)	17.5	41.0	5.8	23.7	23.6
Procedural barriers average		**18.3**	**39.6**	**7.5**	**19.3**	**27.4**
TOTAL AVERAGE		**26.3**	**66.8**	**7.8**	**38.7**	**31.9**

Having seen Table 5, we can infer that the “Very Inhibited” cluster showed the greatest affected proportion of any cluster within each barrier, excepting only BARR10. In fact, the average values of the four barrier categories were very high, ranging from 39.6% to 76.1%, unlike the average values of the global sample, ranging from 18.25% to 35.5%. The barriers that affected this cluster the most were Intrinsic barriers and Informative barriers (76.1% and 74.3%, respectively). At the other end of the spectrum, the “Uninhibited” cluster was the least affected by all barrier categories, with average values ranging from 3.6% to 13.9%. Time-space barriers had the greatest influence in this cluster. In the middle of the scale we could find the “Apprehensive” cluster, characterized by a greater prevalence of Intrinsic barriers (48.6%), and the “Busy” cluster, where the most relevant barriers were Time-space barriers (62.9%). However, these two clusters also showed a large percentage of Informative barriers (50.3% “Apprehensive” and 51.5% “Busy”).

From these results, it can be firstly inferred that the “Uninhibited” cluster is the most attractive both for its size and for being the one with fewer barriers. Therefore, it would

be the priority cluster for directing marketing action programs. Secondly, the "Busy" cluster also has some appeal, not only because of its size, but also because its most prevalent barriers – Time-space - can be mitigated in the short term with actions that facilitate donation (i.e., by expanding opening hours of donation venues). Third, the "Apprehensive" cluster has less interest than the previous ones because one of the most prevalent barriers in it, the Intrinsic ones (e.g., fear of needles or of the sight of blood, cultural/ethical reasons,), are more difficult to eliminate. Finally, the "Very Inhibited" cluster is very unattractive, since it is small in size and its high number and range of barriers make it unworthy of devoting efforts and resources to it.

In order to develop differentiated strategies, it is essential to know the profile and donation behavior of each cluster. For this purpose, Tables 6 and 7 show the sociodemographic characteristics and donation behavior of active donors in each cluster, observing statistically significant differences among them. According to the *p-value* of the chi-square (χ^2) statistic, all sociodemographic and donation behavior characteristics were statistically significant (all *p-values* are less than 0.000), thus meaning that there were differences among clusters according to them. However, among all variables analyzed, the "Employed" and the "Total monthly income" variables presented the lowest chi-square values, which means the differences among clusters were less pronounced.

The disproportionate representation of some sociodemographic characteristics compared to the global donor sample allows to establish the sociodemographic profiles of the identified clusters. Thus, comparing the clusters results with the global sample data, the "Very Inhibited" cluster and the "Uninhibited" cluster presented most differences in terms of sociodemographic characteristics (see Table 6). Thus, in the "Very Inhibited"

cluster, a greater presence of women (59.4%) and younger age groups (48.5% between 18-35 years old) was observed, as well as individuals with university education (57.2%) and unemployed individuals (26.8%). The "Uninhibited" cluster presented more men (51.9%), higher age intervals (73.6% older than 35 years old), more donors with primary and secondary education (52.7%), more individuals currently working (80.8%) and slightly higher income levels than the other clusters (48.0% higher than 2,000 euros).

Table 6. Cluster profiles according to sociodemographic characteristics

Characteristics	Global		Cluster 1 Very Inhibited		Cluster 2 Uninhibited		Cluster 3 Apprehensive		Cluster 4 Busy		χ^2 (*p*)
	N	%	N	%	N	%	N	%	N	%	
Sex											
Male	13007	48.9	1412	40.6	6483	51.9	1999	44.5	3105	50.6	184.401
Female	13619	51.1	2081	59.4	6013	48.1	2496	55.5	3029	49.4	(0.000)
Age (years)											
18-25	4237	15.9	937	26.8	1247	10.0	943	21.0	1110	18.1	
26-35	5267	19.8	759	21.7	2048	16.4	1042	23.2	1418	23.1	1246.881
36-45	7421	27.9	829	23.7	3624	29.0	1149	25.6	1819	29.7	(0.000)
>45	9701	36.4	976	27.9	5577	44.6	1361	30.3	1787	29.1	
Education											
No formal education or Primary	3422	12.9	265	7.6	1991	15.9	494	11.0	672	11.0	274.525
Secondary	9623	36.1	1235	35.3	4602	36.8	1624	36.1	2162	35.2	(0.000)
University	13581	51.0	2001	57.2	5903	47.2	2377	52.9	3300	53.8	
Employed											
Yes	20975	78.8	2564	73.2	10093	80.8	3442	76.6	4876	79.5	108.890
No	5651	21.2	937	26.8	2403	19.2	1053	23.4	1258	20.5	(0.000)
Total monthly income (euros)											
≤2000	14331	53.8	1940	55.4	6501	52.0	2531	56.3	3359	54.8	38.523
2001-4000	9610	36.1	1206	34.4	4733	37.9	1536	34.2	2135	34.8	(0.000)
>4000	2685	10.1	355	10.1	1262	10.1	428	9.5	640	10.4	
Total	**26626**	**100.0**	**3501**	**13.2**	**12496**	**46.9**	**4495**	**16.9**	**6134**	**23.0**	

Finally, regarding donation behavior, statistically significant differences were also observed among clusters. Comparing the clusters results with the global sample data, results also indicated that the "Very Inhibited" cluster and the "Uninhibited" cluster presented most differences. Thus, the "Uninhibited" cluster was the one with donors who

had the highest frequency of donations in 2017 (64.1% donated 2-4 times), whereas the "Busy" cluster and "Very Inhibited" cluster had the lowest frequencies (46.5% and 42.7%, respectively, donated only once). Regarding donor experience, most differences were observed between the "Very Inhibited" cluster and the "Uninhibited" cluster. The former included the least experienced donors (44.8% had been donors for less than 5 years), and the latter included the most experienced donors (44.0% had a donor history of more than 10 years).

Table 7. Cluster profiles according to donation behavior

Characteristics	Global		Cluster 1 Very Inhibited		Cluster 2 Uninhibited		Cluster 3 Apprehensive		Cluster 4 Busy		X^2 (p)
	N	%	N	%	N	%	N	%	N	%	
Donation frequency in 2017											
Once	10585	39.7	1496	42.7	4478	35.8	1758	39.1	2853	46.5	284.304 (0.000)
Twice	8864	33.3	1157	33.0	4265	34.1	1429	31.8	2013	32.8	
3 or 4 times	7177	27.0	848	24.2	3753	30.0	1308	29.1	1268	20.7	
Experience as a donor (years)											
< 2	4228	15.9	758	21.7	1574	12.6	859	19.1	1037	16.9	497.658 (0.000)
2-4	5616	21.1	807	23.1	2357	18.9	1062	23.6	1390	22.7	
5-10	6643	24.9	853	24.4	3067	24.5	1130	25.1	1593	26.0	
11-15	3035	11.4	330	9.4	1547	12.4	464	10.3	694	11.3	
>15	7104	26.7	753	21.5	3951	31.6	980	21.8	1420	23.1	
Total	**26626**	**100.0**	**3501**	**13.2**	**12496**	**46.9**	**4495**	**16.9**	**6134**	**23.0**	

Discussion and conclusions

The first aim of this work was to design and validate a donation barrier scale, taking into account a wide range of different barriers. The results of the study conclude that there are four barrier categories: "Informative barriers", "Intrinsic barriers", "Time-space barriers" and "Procedural barriers". This classification is similar to some barrier typologies that have been previously identified in the literature. For example, "Informative barriers" are quite close to the "No information" categories detected in the work of Martín-Santana and Beerli-Palacio [23] and the "Lack of knowledge" category found in Bednall and

Bove's meta-analysis [9]. Having said that, the classification proposed in the present study includes other barriers that are also relevant for BTC, e.g. the absence of promotional campaigns and the absence of reminders from the centers to donate. On the other hand, "Intrinsic barriers" comprise the majority of the items that Schreiber and others [15] included in the "Physical factors" and "Fear" categories, as well as the barriers that Bednall and Bove [9] grouped under the "Fear" and "Personal values" denominations in their meta-analysis. As for "Time-space barriers", although the inconvenience related to donation has already been analyzed by many authors [9,10,14,38], none of them have considered the time and space dimensions jointly. In the same way, "Procedural barriers" complement the "Lengthy process" category devised by Schreiber and others [15], since it incorporates other barriers such as waiting times, the obligation to fill in a health questionnaire at each donation and the absence of donation incentives. For these reasons, we can conclude that the scale designed and validated in this study provides a more integrative option for analyzing donation barriers.

Contrary to what was expected, the results of this study have verified that active donors face important barriers that prevent them from donating more frequently. Therefore, it is necessary to eliminate these barriers in order to increase their number of donations per year. This is especially so because the retention of active donors presents important advantages over both the recovery of inactive donors and the recruitment of new donors, which are mainly lower costs for BTC due to their lower incidence of contagious diseases, their generalized tendency to donate more frequently and their higher level of commitment to blood donation, so they may also act as advocates [13,15,24].

Given the BTC' scarcity of economic resources, their management should be oriented towards developing differentiated programs aimed at the highest investment-return donor clusters, which will be those including donors with fewer barriers or whose barriers are easier to eliminate. For this reason, this study, applying the different categories of barriers as criteria, has identified four clusters of active donors which require differentiated marketing strategies in order to eliminate these barriers: (1) "Uninhibited" donors, who present very few barriers; (2) "Busy" donors, whose most prevalent barriers are Time-space and Informative; (3) "Apprehensive" donors, whose barriers are mostly Intrinsic and Informative, and (4) "Very Inhibited" donors, who experience a high number of barriers in all categories.

Taking into account the characteristics of the four clusters, the present study suggests a series of practical applications that BTC can use in programs to promote donation and retain active donors. First and foremost, the results indicate that BTC must establish differentiated marketing strategies, prioritizing firstly the "Uninhibited" cluster, then the "Busy" and "Apprehensive" clusters, and lastly the "Very Inhibited" cluster. With respect to the specific marketing actions to be implemented, direct marketing would be the most effective communication action for both the "Uninhibited" and the "Busy" clusters. To that end, telephone calls or messages could be used to remind donors that they can give blood again after the inter-donation period, given that both clusters present a slight predominance of male donors who, following Charbonneau and colleagues' [14] results, tend to forget when they can re-donate more frequently than female donors. In the particular case of the "Uninhibited" cluster, the success in using direct communication channels may be greater than in the other clusters because these donors have the greatest commitment to blood donation in terms of annual donation frequency in 2017. Therefore,

it is expected that, in the “Uninhibited” cluster, the rate of negative responses to a telephone call or a direct message will be lower. In the case of the “Busy” cluster, since the most relevant barriers in it are related to lack of time and time incompatibility, which is consistent with the predominance donors of older ages (≥36 years old), with university education, who are currently working and had an annual donation frequency of only one donation in 2017, BTC should consider extending donation times, as well as increasing the frequency of visits for blood donation mobile units.

In the “Apprehensive” cluster, advertising campaigns would be more advisable, and should aim to change beliefs and attitudes towards blood donation, given that the most prevalent barrier categories among “Apprehensive” donors are Informative and Intrinsic barriers. The prevalence of Intrinsic barriers in this cluster is consistent with the predominance of female donors, who have been frequently reported as individuals especially affected by this barrier typology [14,17]. However, and given that the "Apprehensive" cluster did not show an exaggerated prevalence of any age interval and that almost 90.0% of donors had, at least, university studies, it is surprising that Informative barriers were the most prevalent barrier category, taking into account that most developed countries have access to information and ICT. That is why BTCs should strive to design advertising campaigns. With regard to social marketing campaigns, they should be carried out across a significant period of time in order to achieve the intended changes in belief systems and attitudes.

Lastly, since the “Very Inhibited” cluster consists of younger subjects, it would be advisable to use social media with factual messages or testimonials (e.g. “Blood is perishable”, “There is a constant need for blood at hospitals”), instead of messages

appealing to action (e.g. “Donate blood”, “Come give blood at…”). Additionally, in order to educate teenagers, who will be future donors, it would also be advisable to implement informative and awareness actions on the importance of blood donation at educational centers, especially high schools. For that, virtual reality (VR) and augmented reality (AR) technologies could be integrated in the design of campaigns and educational materials aimed at diminishing intrinsic barriers among the young.

This work has some limitations. The first one is basically related to the study population - Spanish active donors. For this reason, it would be advisable to replicate this work in other geographical contexts. Additionally, the methodological procedure followed could be a second limitation, as it is possible that the answers obtained came more or less exclusively from donors which were more committed to blood donation. Finally, the differentiated marketing actions proposed in this work are just proposals based solely on the results of the cluster analysis. In order to verify their effectiveness and suitability, it would be ideal for BTCs to apply some of them.

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