

A cross-sectional blood study in India: from donation activities of donors to blood bank services

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The present article analyses the causal relationship between perception towards blood donation and expectations towards blood bank services with demographic characteristics such as gender, age, marital status, education and occupation. Factor analysis was initially performed to delineate the latent structure of perception configuring components of blood donation and expectations towards blood bank services followed by multivariate analysis of variance aimed at exploring their relationships with demographics. The study found that only gender had a significant impact on factors such as value and ethics, social bigotry, apprehension and social affinity in building perception towards blood donation. Also, gender had a significant impact on expectations of corporeal aspect of blood bank services. The study throws up the negative psyche such as social bigotry along with other various myths and fear prevailing in the society about blood donation. Therefore, the need of the hour is to target and run a customized awareness campaign based on societal needs and strata for promoting the benefits of blood donation. The government also needs to address the various lacunae in the system and improve the basic infrastructure, so as to make blood donation a more user-friendly exercise.

Keywords: Blood donation, demography, expectation, factor analysis, perception.

THE medical science today is challenged by escalating demand for blood and blood components^{1,2}. Among the many necessities of today's healthcare system is blood transfusion and the ever-expanding requirement of blood components³. India is the world's second most populated country, with 1.2 billion people requiring blood and its components under the healthcare system⁴. One study estimated that most of the deaths in a country like ours occur due to inadequate availability and supply of safe blood and its components⁵. Another study showed that the need of our nation is approximately 9 million units of blood every year⁶. Among the populace, it is the children due to poor nutrition, women during pregnancy and unsafe deliveries, followed by thalassemia patients who

suffer the most⁷. The healthcare system of the country generally meets the overall average international standards with very poor ratings on the availability of blood and its components, mainly since 2000 (ref. 8). Even if one takes into account the total contributions of blood donations (both voluntary and replacement blood donors), the gigantic demand for blood still remains unmet⁹. Despite having a robust framework which includes 2760 authorized blood donation centres run by government, non-government organizations and other cooperative affiliations¹⁰, the motivation to promote blood donation remains a key challenge for policy makers as well as for blood banks¹¹⁻¹³. As a developing country, India has to build a framework for safe blood transfusion system to protect people from transmissible diseases¹⁴. The issue of shortage of blood and its component along with building a resilient system can only be overcome, if majority of our billion people voluntarily donate blood for a social cause^{15,16}. Against this backdrop, the present study analyses motives and willingness of donors towards donating blood voluntarily.

Materials and methods

A cross-sectional survey was conducted during November 2014 to April 2015, which covered the northern and eastern regions of India, viz. Uttar Pradesh, Bihar, Jharkhand and West Bengal. We primarily adopted and re-specified the scale items of volunteer functions inventory (VFI) proposed by Clary *et al.*¹⁷ and service quality model (Servqual) proposed by Parasuraman *et al.*³⁴ as an instrument to assess the perception on blood donation and expectations on blood bank services respectively. The validity and reliability of the scale have been recognized by a host of researchers¹⁸⁻²³; however, the content validity has been re-examined and achieved successfully. At the initial stage, a pilot test of the full questionnaire of 55 items among blood donors was conducted. Finally, a self-administered structured questionnaire was prepared in three parts comprising 40 items based on the inputs from the pilot study. The first part contains questions on socio-demographic characteristics which include gender, age, marital status, education and occupation as an important

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aspect to know the impact of demographic characteristics on each factor²⁴⁻²⁶. The second part consists of 1–21 questions on blood donation perception from the perspective of the donors and the third part contains 22–34 questions corresponding to the view of blood donors on blood bank services. The data were collected using non-probability (purposive) and probability (stratified) sampling²⁷. Both the methods were used because while the purposive method provides the scope to choose the respondents based upon wisdom, the stratification method suitably attempts to make the sample as representative as possible. The data were collected on-line using *Google* forms, primarily through Facebook and field survey at the places where blood donation camps were organized. The questionnaire was both in English and Hindi (national language of India), intending to seek as many responses as possible. The questionnaires were administered to 383 donors at various donation camps, with requests to return them anonymously. Almost 317 finally returned the completely filled questionnaire, giving a response rate of 82.7%. Also, 283 completely filled-in responses were registered on-line. Thus, 600 responses were collected against the total 700 donors approached. Finally, the data were analysed using factor analysis to identify the cardinal factors constituting perception and expectations of blood donation motives and blood bank services respectively. MANOVA (multivariate analysis of variance) was used to study the causal relationship between the aforementioned factors with the demographic profile of the donors. Statistical analysis was performed using the Statistical Package for the Social Sciences (SPSS) software, version 20.00.

Results

Factor analysis on donor perception towards blood donation

To determine the dimensions of perception on blood donation and expectations towards blood bank services, the exploratory factor analysis with principal components was performed. For ascertaining the data, preliminary tests to determine the reliability of factor analysis were included. Here, the reliability statistics registered the Cronbach's alpha of 0.93 in the case of perception on blood donation and 0.76 on expectation towards blood bank services, which is a good sign of consistency. Thus, Bartlett's test of sphericity ($P < 0.001$) in Tables 1 and 2, indicates that the data are appropriate for factor analysis. For exploratory factor analysis, we used principal component analysis with varimax rotation. For a sample size greater than 500, the factor loading of 0.30 is considered significant^{28,29}. As a result, we came up with four factors on perception of donors towards blood donation vis-à-vis four factors on expectations regarding blood bank services.

Factor 1: The first factor that emerged was produced by the correlation between V1 and V15. Factor 1 accounted for a large proportion (71.2%) of the total variance. Although it included some unrelated variables, we labelled factor 1 of perception of the blood donor as 'values and ethics' factor. In case of expectations regarding blood bank services, the scale items between S1 and S5 are correlated and loading high on the factor 1 labelled as 'unanimity'.

Factor 2: The second factor was composed of the responses to statements V16 and V17, which cite social dogma towards giving blood. These statements correspond to the 'social bigotry' factor. In case of expectation, the responses to statements S6–S8 cite tangibility of blood banks. Thus, these statements correspond to the 'corporeality' factor.

Factor 3: The third factor was formed by V18 and V19, which address fears associated with giving blood. These statements correspond to the 'apprehension' factor. In case of expectation of service, S9–S11 are related to fringe benefits expectation upon giving blood. These statements correspond to the 'perquisite' factor.

Factor 4: The fourth factor was composed of responses to statements V20 and V21. The first variable emphasizes the importance of symbols or advertisements that influence donors to donate blood, while the second variable emphasizes on making new friends³⁰. Thus, we labelled factor 4 as the 'social affinity' factor. In case of expectation over the services of blood banks, S12–S14 reflect on misery while donating blood. Thus, we labelled these variables as the 'agony' factor.

View of donors on blood donation and blood bank services

We studied the relationship between perception on blood donation and expectations towards blood bank services and their interaction with socio-demographic characteristics. For this, the H1 hypothesis was tested using GLM multivariate procedure which allows us to model the values of multiple dependent scale variables based on their relationships to categorical and scale predictors²⁸.

H1 hypothesis

There exists a fair degree of congruence between the perception of donors towards blood donation and expectations towards blood bank services corresponding to demographics which include gender, age, marital status, occupation and education.

Table 1. Results of factor analysis on the view of donors towards blood donation

Construct	Code	Item	Eigen value	Factor loading
Item total (21 items): Bartlett's test of sphericity ($P < 0.001$)				
Values and ethics ^{2,9,22}	V1	Blood donation is an inspiring drive	14.594	0.953
	V2	Personal importance		0.942
	V3	Good habit		0.940
	V4	Feel excelling on donation		0.932
	V5	Benefits added to health		0.910
	V6	Ethical and principal duty		0.863
	V7	Humanness towards beneficiary		0.857
	V8	Friends' belief on importance of blood donation		0.856
	V9	Helping others for social cause		0.854
	V10	Test own intensity		0.853
	V11	Valuable experience		0.834
	V12	Blood donation allows to know oneself		0.824
	V13	People place high value on donating blood		0.823
	V14	Free medical examination enables me to donate blood		0.822
	V15	For peaceful protest that benefits to society		0.775
Social bigotry	V16	Restriction due to casteism	2.726	0.951
	V17	Restriction due to religious issues		0.946
Apprehension (fear) ³⁵	V18	Fear related to HIV/AIDS	1.853	-0.710
	V19	Myth related to diabetes/hypertension		-0.684
Social affinity ^{15,24}	V20	Pleasure to see blood logo	1.096	0.943
	V21	Make new friends		0.929

Table 2. Results of factor analysis on the view of donors towards services at blood banks

Construct	Code	Item	Eigen value	Factor loading
Item total (14 items): Bartlett's test of sphericity ($P < 0.001$)				
Unanimity	S1	Gratitude	4.818	0.868
	S2	Thank you note from blood bank on discharging my social duty		0.792
	S3	Post donation services from blood bank upon my donation		0.686
	S4	Incentives in monetary terms		0.685
	S5	Information on donation history		0.645
Corporeality	S6	Pleasant atmosphere	2.152	0.894
	S7	Staff competency		0.747
	S8	Facilities at the blood bank		0.617
Perquisite	S9	Long opening hours of blood bank	1.571	0.741
	S10	Appreciate in getting gifts (fringe benefits)		0.685
	S11	Compensation after blood donation (fringe benefits)		0.630
Agony	S12	Coming to blood bank takes lot of effort	1.177	0.795
	S13	Spending time on waiting		0.752
	S14	Uncomfortable during form filling		0.525

To test this hypothesis, the demographic profile (Table 3) was first divided into five groups namely gender (male and female), age (18–25 years and 26–35 years), marital status (single and married), education (undergraduate, graduate and postgraduate), and occupation (education/academics, private sector and PSU/Central/State Government). We analysed the differences exhibited by the blood donors regarding their own views toward blood donation and services of blood banks. A specialized form of MANOVA, viz. the Hotelling T^2 test was performed on gender, age and marital status to know the sig-

nificant differences among the groups in perception towards blood donation and expectations towards blood bank services. Likewise, a post hoc test was performed to do a pairwise comparison of the education and occupation groups to know the significant differences in perception towards blood donation and expectations towards blood bank services. Responses of all the dependent variables on the two major dimensions, viz. perception on blood donation and expectations towards blood bank services were measured on five-point Likert rating scale (1 – strongly disagree to 5 – strongly agree).

Discussion

Interpretation of gender, age and marital status using Hotelling T² test

Box’s *M* tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups. One should always check for univariate normality of all dependent measures before performing the test. Violation of this assumption, however, has minimal impact if the groups are of approximately equal size, i.e. largest group size ÷ smallest group size <1.5 (ref. 28). In our case, the sample size is 600, which is fairly large and the group ratio is less than 1.5. Thus the data qualify for the MANOVA test and the departure from the homogeneity of variance cannot be completely ruled out²⁸. From Table 4, it can be observed that the significance value of the test is less than 0.05 levels ($F_{\text{gender}} = 81.159, P < 0.05$; $F_{\text{age}} = 6.994, P < 0.05$; $F_{\text{marital status}} = 13.513, P < 0.05$), suggesting that the assumptions of homogeneity of variance across the three groups are not met, and thus the model results are suspect. However, the MANOVA analysis remains robust despite the assumption of homogeneity of variance not being met provided data do not have outliers. Box’s *M* is sensitive to large data files, indicating that when there are a large number of cases, it can detect even small departures from homogeneity^{31,32}. In case of expectations regarding blood bank services, the significance value of the test is more than 0.05 levels ($F_{\text{gender}} = 1.241, P > 0.05$; $F_{\text{age}} = 0.659, P > 0.05$; $F_{\text{marital status}} = 1.542, P > 0.05$), suggesting that the assumptions of homogeneity of variance across the three groups are met.

From Table 5, we can see that a significant gap exists across groups based on gender corresponding to perception building factors which include values and ethics

($F_{\text{value and ethics}} = 8.419, P < 0.05$), social bigotry ($F_{\text{social bigotry}} = 7.742, P < 0.05$), apprehension ($F_{\text{apprehensions}} = 195.952, P < 0.05$) and social affinity ($F_{\text{social affinity}} = 139.655, P < 0.05$). Thus, the effect of values and ethics (mean_{female} = 3.4162) and social affinity (mean_{female} = 2.420) is perceived more on the female than the male counterpart. In case of social bigotry, male domination is more than female, whereas apprehension to donate blood is more in the case of female than male. In addition, the expectations towards blood bank services based on gender across the factors registered significant gap which includes unanimity ($F_{\text{unanimity}} = 1.749, P > 0.05$), perquisite ($F_{\text{perquisite}} = 1.84, P > 0.05$) and agony ($F_{\text{agony}} = 0.072, P > 0.05$). However, no perceptual gap was registered in case of factor corporeality ($F_{\text{corporeality}} = 2.711, P < 0.05$).

A significant gap also exists across groups based on age corresponding to perception building factors which include values and ethics ($F_{\text{value and ethics}} = 2.567, P > 0.05$) and social bigotry ($F_{\text{social bigotry}} = 2.550, P > 0.05$). However, no perceptual gap was registered in case of apprehension ($F_{\text{apprehensions}} = 17.217, P < 0.05$) and social affinity ($F_{\text{social affinity}} = 23.46, P < 0.05$). Thus, the effect of values and ethics on willingness to donate blood diminishes with the aging population. However, the effect of social bigotry becomes more significant in blood donation behaviour with aging people (mean_{18–25 years} = 2.1271; mean_{26–35 years} = 2.2840). In case of expectations towards blood bank services, a significant gap exists across groups based on age corresponding to factors which include unanimity ($F_{\text{unanimity}} = 0.171, P > 0.05$), corporeality ($F_{\text{corporeality}} = 0.235, P > 0.05$), perquisite ($F_{\text{perquisite}} = 0.068, P > 0.05$) and agony ($F_{\text{agony}} = 0.395, P > 0.05$). Thus, the effect of all the factors on expectations towards blood bank services is similar across the age groups.

Furthermore, a significant gap exists based on marital status corresponding to perception building factors which include values and ethics ($F = 1.714, P > 0.05$) and apprehension ($F = 3.133, P > 0.05$). However, there is no perceptual gap found in case of social bigotry ($F = 17.616, P < 0.05$) and social affinity ($F = 30.815, P < 0.05$). Thus, the effect of values and ethics and social affinity increases in married people than those single. However, the effect of social bigotry is more in single than married people, while in the case of apprehension singles people have more fear than married people. In case of expectations towards blood bank services, a significant gap was registered across the groups which include unanimity ($F = 0.650, P > 0.05$), corporeality ($F = 1.658, P > 0.05$), perquisite ($F = 1.035, P > 0.05$) and agony ($F = 0.059, P > 0.05$). Thus, the effect of all the factors on expectations regarding blood bank services is similar for the two marital status groups.

Next, we use the multivariate tests (Table 5) to find the differences between groups for each factor, namely perception on blood donation and expectations towards blood

Table 3. Demographic characteristics of the respondents

		No. of respondents	Percentage of the respondents
Gender	Male	300	50
	Female	300	50
Age (years)	18–25	400	66.60
	26–35	200	33.40
Marital status	Unmarried	450	75
	Married	150	25
Education	Undergraduate	300	50
	Graduate	100	16.70
	Postgraduate and above	200	33.30
Occupation	Education and academics	300	50
	Private sector	200	33.30
	PSU/central/state government	100	16.70

Table 4. Hotelling T^2 tests on perception on blood donation and expectation on blood bank services

		Tests of between-subjects effects							
		Mean value	Factors	Type III sum of squares	df	Mean square	F	Significant	Observed power
Perception on blood donation									
(Gender) Box's M test = 817.471; F = 81.159; df_1 = 10; df_2 = 1,709,661; Significant = 0.000									
Gender	Male	3.1004	Value and ethics	14.957	1	14.957	8.419	0.004	0.826
	Female	3.4162							
	Male	2.3267	Social bigotry	10.800	1	10.8	7.742	0.006	0.793
	Female	2.0583							
	Male	1.5417	Apprehension (fear)	243.207	1	243.207	195.952	0.000	1.000
	Female	2.8150							
	Male	1.4617	Social affinity	137.760	1	137.76	139.655	0.000	1.000
	Female	2.4200							
(Age) Box's M test = 70.468; F = 6.994; df_1 = 10; df_2 = 1,351,416; Significant = 0.000									
Age (years)	18–25	3.3324	Value and ethics	4.606	1	4.606	2.567	0.110	0.360
	26–35	3.1547							
	18–25	2.1271	Social bigotry	3.588	1	3.588	2.55	0.111	0.358
	26–35	2.2840							
	18–25	1.9971	Apprehension (fear)	27.577	1	27.577	17.217	0	0.985
	26–35	2.4320							
	18–25	1.7600	Social affinity	27.469	1	27.469	23.46	0	0.998
	26–35	2.1940							
(Marital status) Box's M test = 136.198; F = 13.513; df_1 = 10; df_2 = 1046158; Significant = 0.000									
Marital status	Single	3.2028	Value and Ethics	3.079	1	3.079	1.714	0.191	0.257
	Married	3.3508							
	Single	2.3480	Social bigotry	24.180	1	24.18	17.616	0	0.987
	Married	1.9333							
	Single	2.1067	Apprehension (fear)	5.136	1	5.136	3.133	0.077	0.424
	Married	2.2978							
	Single	1.7520	Social affinity	35.658	1	35.658	30.815	0	1.000
	Married	2.2556							
Expectation on blood bank services									
(Gender) Box's M test = 12.496; F = 1.241; df_1 = 10; df_2 = 1709661; Significant = 0.259									
Gender	Male	3.5827	Unanimity	1.109	1	1.109	1.749	0.187	0.262
	Female	3.6687							
	Male	4.0256	Corporeality	2.711	1	2.711	4.568	0.033	0.569
	Female	4.1600							
	Male	3.5311	Perquisite	1.370	1	1.37	1.84	0.175	0.273
	Female	3.6267							
	Male	3.3167	Agony	0.054	1	0.054	0.072	0.788	0.058
	Female	3.2978							
(Age) Box's M test = 6.642; F = 0.659; df_1 = 10; df_2 = 1351416; Significant = 0.763									
Age (years)	18–25	3.6143	Unanimity	0.109	1	0.109	0.171	0.679	0.070
	26–35	3.6416							
	18–25	4.1057	Corporeality	0.141	1	0.141	0.235	0.628	0.077
	26–35	4.0747							
	18–25	3.5867	Perquisite	0.051	1	0.051	0.068	0.794	0.058
	26–35	3.5680							
	18–25	3.2886	Agony	0.292	1	0.292	0.395	0.530	0.096
	26–35	3.3333							
(Marital status) Box's M test = 15.545; F = 1.542; df_1 = 10; df_2 = 1046158; Significant = 0.117									
Marital status	Single	3.6053	Unanimity	0.413	1	0.413	0.65	0.420	0.127
	Married	3.6596							
	Single	4.0613	Corporeality	0.989	1	0.989	1.658	0.198	0.251
	Married	4.1452							
	Single	3.5511	Perquisite	0.772	1	0.772	1.035	0.309	0.174
	Married	3.6252							
	Single	3.2996	Agony	0.059	1	0.059	0.08	0.778	0.059
	Married	3.3200							

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Table 5. Multivariate tests (Hotelling T^2) on perception on blood donation

Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Gender	Pillai's trace	0.431	112.807	4.000	595.000	0.000	0.431	451.230	1.000
	Wilks' lambda	0.569	112.807	4.000	595.000	0.000	0.431	451.230	1.000
	Hotelling's trace	0.758	112.807	4.000	595.000	0.000	0.431	451.230	1.000
	Roy's largest root	0.758	112.807	4.000	595.000	0.000	0.431	451.230	1.000
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Gender	Value and ethics	14.957	1	14.957	8.419	0.004	0.014	8.419	0.826
	Social bigotry	10.800	1	10.800	7.742	0.006	0.013	7.742	0.793
	Apprehension	243.207	1	243.207	195.952	0.000	0.247	195.952	1.000
	Social affinity	137.760	1	137.760	139.655	0.000	0.189	139.655	1.000
Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Age	Pillai's trace	0.048	7.512	4.000	595.000	0.000	0.048	30.047	0.997
	Wilks' lambda	0.952	7.512	4.000	595.000	0.000	0.048	30.047	0.997
	Hotelling's trace	0.050	7.512	4.000	595.000	0.000	0.048	30.047	0.997
	Roy's largest root	0.050	7.512	4.000	595.000	0.000	0.048	30.047	0.997
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Age	Value and ethics	4.606	1	4.606	2.567	0.110	0.004	2.567	0.360
	Social bigotry	3.588	1	3.588	2.550	0.111	0.004	2.550	0.358
	Apprehension	27.577	1	27.577	17.217	0.000	0.028	17.217	0.985
	Social affinity	27.469	1	27.469	23.460	0.000	0.038	23.460	0.998
Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Marital status	Pillai's trace	0.143	24.769	4.000	595.000	0.000	0.143	99.076	1.000
	Wilks' lambda	0.857	24.769	4.000	595.000	0.000	0.143	99.076	1.000
	Hotelling's trace	0.167	24.769	4.000	595.000	0.000	0.143	99.076	1.000
	Roy's largest root	0.167	24.769	4.000	595.000	0.000	0.143	99.076	1.000
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Marital status	Value and ethics	3.079	1	3.079	1.714	0.191	0.003	1.714	0.257
	Social bigotry	24.180	1	24.180	17.616	0.000	0.029	17.616	0.987
	Apprehension	5.136	1	5.136	3.133	0.077	0.005	3.133	0.424
	Social affinity	35.658	1	35.658	30.815	0.000	0.049	30.815	1.000

bank services. Finally power level is assessed. These are the four most commonly used multivariate tests, i.e. Pillai's criterion, Wilk's lambda, Hotelling's trace and Roy's largest root. Each of the four factors of perception on blood donation indicates that gender, age and marital

status have a highly significant difference ($P < 0.05$). Although test between-subject effect indicating that only gender among all the four factors shows significant effect ($P < 0.05$), followed by age ($P_{\text{apprehension}} < 0.05$; $P_{\text{social affinity}} < 0.05$), and marital status ($P_{\text{social bigotry}} < 0.05$; $P_{\text{social affinity}} <$

Table 6. Multivariate tests (Hotelling T^2) on expectation on blood bank services

Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Gender	Pillai's trace	0.012	1.738	4.000	595.000	0.140	0.012	6.951	0.533
	Wilks' lambda	0.988	1.738	4.000	595.000	0.140	0.012	6.951	0.533
	Hotelling's trace	0.012	1.738	4.000	595.000	0.140	0.012	6.951	0.533
	Roy's largest root	0.012	1.738	4.000	595.000	0.140	0.012	6.951	0.533
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Gender	Unanimity	1.109	1	1.109	1.749	0.187	0.003	1.749	0.262
	Corporeality	2.711	1	2.711	4.568	0.033	0.008	4.568	0.569
	Perquisite	1.370	1	1.370	1.840	0.175	0.003	1.840	0.273
	Agony	0.054	1	0.054	0.072	0.788	0.000	0.072	0.058
Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Age	Pillai's Trace	0.003	0.417	4.000	595.000	0.796	0.003	1.668	0.148
	Wilks' Lambda	0.997	0.417	4.000	595.000	0.796	0.003	1.668	0.148
	Hotelling's Trace	0.003	0.417	4.000	595.000	0.796	0.003	1.668	0.148
	Roy's Largest Root	0.003	0.417	4.000	595.000	0.796	0.003	1.668	0.148
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Age	Unanimity	0.513	1	0.513	0.807	0.370	0.001	0.807	0.146
	Corporeality	0.024	1	0.024	0.040	0.842	0.000	0.040	0.055
	Perquisite	0.467	1	0.467	0.626	0.429	0.001	0.626	0.124
	Agony	0.593	1	0.593	0.803	0.371	0.001	0.803	0.145
Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Marital status	Pillai's trace	0.003	0.386	4.000	595.000	0.818	0.003	1.546	0.140
	Wilks' lambda	0.997	0.386	4.000	595.000	0.818	0.003	1.546	0.140
	Hotelling's trace	0.003	0.386	4.000	595.000	0.818	0.003	1.546	0.140
	Roy's largest root	0.003	0.386	4.000	595.000	0.818	0.003	1.546	0.140
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Marital status	Unanimity	0.088	1	0.088	0.139	0.710	0.000	0.139	0.066
	Corporeality	6.173E-05	1	6.173E-05	0.000	0.992	0.000	0.000	0.050
	Perquisite	0.802	1	0.802	1.076	0.300	0.002	1.076	0.179
	Agony	0.001	1	0.001	0.001	0.978	0.000	0.001	0.050

0.05) on the perception of blood donation. However, Table 6 reveals no significant difference among expectation factors corresponding to blood bank services and demographics (including gender, age and marital status), as $P_{\text{value}} > 0.05$ in all the cases. The observed power

for the statistical tests for gender is 1.0, indicating that the sample sizes and effect sizes are sufficient to ensure that the significant differences would be detected if they existed beyond the differences due to sampling error²⁸.

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Table 7. Post hoc tests (MANOVA) on perception of education and occupation on blood donation

Dependent variables	Groups to be compared		Mean difference between groups (<i>I – J</i>)		<i>P</i> value	95% confidence	
	Education (<i>I</i>)	Education (<i>J</i>)	Mean difference	Standard error	Tukey HSD	Lower bound	Upper bound
Perception on blood donation (education)							
Values and ethics	UG	Graduates	0.2364	0.15480	0.279	-0.1273	0.6002
		PG	0.0161	0.12238	0.990	-0.2714	0.3037
	Graduates	UG	-0.2364	0.15480	0.279	-0.6002	0.1273
		PG	-0.2203	0.16419	0.373	-0.6061	0.1655
	PG	UG	-0.0161	0.12238	0.990	-0.3037	0.2714
		Graduates	0.2203	0.16419	0.373	-0.1655	0.6061
Social bigotry	UG	Graduates	0.2117	0.13702	0.271	-0.1103	0.5336
		PG	-0.0333	0.10833	0.949	-0.2879	0.2212
	Graduates	UG	-0.2117	0.13702	0.271	-0.5336	0.1103
		PG	-0.245	0.14533	0.211	-0.5865	0.0965
	PG	UG	0.0333	0.10833	0.949	-0.2212	0.2879
		Graduates	0.245	0.14533	0.211	-0.0965	0.5865
Apprehension (fear)	UG	Graduates	-0.255	0.14520	0.185	-0.5962	0.0862
		PG	-0.5875	0.11479	0.000	-0.8572	-0.3178
	Graduates	UG	0.255	0.14520	0.185	-0.0862	0.5962
		PG	-0.3325	0.15401	0.079	-0.6943	0.0293
	PG	UG	0.5875	0.11479	0.000	0.3178	0.8572
		Graduates	0.3325	0.15401	0.079	-0.0293	0.6943
Social affinity	UG	Graduates	-0.5467	0.12271	0.000	-0.8350	-0.2584
		PG	-0.6192	0.09701	0.000	-0.8471	-0.3912
	Graduates	UG	0.5467	0.12271	0.000	0.2584	0.8350
		PG	-0.0725	0.13015	0.843	-0.3783	0.2333
	PG	UG	0.6192	0.09701	0.000	0.3912	0.8471
		Graduates	0.0725	0.13015	0.843	-0.2333	0.3783
Perception on blood donation (occupation)							
Values and ethics	Edu/Acad	PS	0.0248	0.12242	0.978	-0.2629	0.3124
		PSU/C/S	0.2191	0.15486	0.334	-0.1447	0.5830
	PS	Edu/Acad	-0.0248	0.12242	0.978	-0.3124	0.2629
		PSU/C/S	0.1943	0.16425	0.464	-0.1916	0.5802
	PSU/C/S	Edu/Acad	-0.2191	0.15486	0.334	-0.5830	0.1447
		PS	-0.1943	0.16425	0.464	-0.5802	0.1916
Social bigotry	Edu/Acad	PS	0.0642	0.10857	0.825	-0.1909	0.3193
		PSU/C/S	0.0167	0.13734	0.992	-0.3060	0.3393
	PS	Edu/Acad	-0.0642	0.10857	0.825	-0.3193	0.1909
		PSU/C/S	-0.0475	0.14567	0.943	-0.3898	0.2948
	PSU/C/S	Edu/Acad	-0.0167	0.13734	0.992	-0.3393	0.3060
		PS	0.0475	0.14567	0.943	-0.2948	0.3898
Apprehension (fear)	Edu/Acad	PS	-0.3925*	0.11498	0.002	-0.6627	-0.1223
		PSU/C/S	-0.6450*	0.14544	0.000	-0.9867	-0.3033
	PS	Edu/Acad	0.3925*	0.11498	0.002	0.1223	0.6627
		PSU/C/S	-0.2525	0.15426	0.231	-0.6149	0.1099
	PSU/C/S	Edu/Acad	0.6450*	0.14544	0.000	0.3033	0.9867
		PS	0.2525	0.15426	0.231	-0.1099	0.6149
Social affinity	Edu/Acad	PS	-0.5342*	0.09688	0.000	-0.7618	-0.3066
		PSU/C/S	-0.7167*	0.12254	0.000	-1.0046	-0.4288
	PS	Edu/Acad	0.5342*	0.09688	0.000	0.3066	0.7618
		PSU/C/S	-0.1825	0.12997	0.339	-0.4879	0.1229
	PSU/C/S	Edu/Acad	0.7167*	0.12254	0.000	0.4288	1.0046
		PS	0.1825	0.12997	0.339	-0.1229	0.4879

UG, Undergraduate; PG, Postgraduate; PS, Private sector; Edu/Acad, Education/academics; PSU/C/S, Public sector undertaking/central/state government.

*Mean difference is significant at the 0.05 level.

Table 8. Post hoc tests (MANOVA) on expectation of education and occupation on blood bank services

Dependent variables	Groups to be compared		Mean difference between groups ($I - J$)		P value	95% confidence	
	Education (I)	Education (J)	Mean difference	Standard error	Tukey HSD	Lower bound	Upper bound
Expectation on blood bank services (education)							
Unanimity	UG	Graduates	-0.0120	0.09220	0.991	-0.2286	0.2046
		PG	-0.0650	0.07289	0.646	-0.2363	0.1063
	Graduates	UG	0.0120	0.09220	0.991	-0.2046	0.2286
		PG	-0.0530	0.09780	0.851	-0.2828	0.1768
	PG	UG	0.0650	0.07289	0.646	-0.1063	0.2363
		Graduates	0.0530	0.09780	0.851	-0.1768	0.2828
Corporeality	UG	Graduates	0.0200	0.08916	0.973	-0.1895	0.2295
		PG	-0.0083	0.07048	0.992	-0.1739	0.1573
	Graduates	UG	-0.0200	0.08916	0.973	-0.2295	0.1895
		PG	-0.0283	0.09456	0.952	-0.2505	0.1939
	PG	UG	0.0083	0.07048	0.992	-0.1573	0.1739
		Graduates	0.0283	0.09456	0.952	-0.1939	0.2505
Perquisite	UG	Graduates	-0.1344	0.09985	0.370	-0.3691	0.1002
		PG	-0.0928	0.07894	0.468	-0.2783	0.0927
	Graduates	UG	0.1344	0.09985	0.370	-0.1002	0.3691
		PG	0.0417	0.10591	0.918	-0.2072	0.2905
	PG	UG	0.0928	0.07894	0.468	-0.0927	0.2783
		Graduates	-0.0417	0.10591	0.918	-0.2905	0.2072
Agony	UG	Graduates	-0.0244	0.09880	0.967	-0.2566	0.2077
		PG	-0.0728	0.07811	0.620	-0.2563	0.1108
	Graduates	UG	0.0244	0.09880	0.967	-0.2077	0.2566
		PG	-0.0483	0.10480	0.889	-0.2946	0.1979
	PG	UG	0.0728	0.07811	0.620	-0.1108	0.2563
		Graduates	0.0483	0.10480	0.889	-0.1979	0.2946
Expectation on blood bank services (occupation)							
Unanimity	Edu/Acad	PS	-0.0450	0.07289	0.811	-0.2163	0.1263
		PSU/C/S	-0.0520	0.09220	0.839	-0.2686	0.1646
	PS	Edu/Acad	0.0450	0.07289	0.811	-0.1263	0.2163
		PSU/C/S	-0.0070	0.09780	0.997	-0.2368	0.2228
	PSU/C/S	Edu/Acad	0.0520	0.09220	0.839	-0.1646	0.2686
		PS	0.0070	0.09780	0.997	-0.2228	0.2368
Corporeality	Edu/Acad	PS	-0.0167	0.07048	0.970	-0.1823	0.1489
		PSU/C/S	0.0367	0.08916	0.911	-0.1728	0.2462
	PS	Edu/Acad	0.0167	0.07048	0.970	-0.1489	0.1823
		PSU/C/S	0.0533	0.09456	0.839	-0.1689	0.2755
	PSU/C/S	Edu/Acad	-0.0367	0.08916	0.911	-0.2462	0.1728
		PS	-0.0533	0.09456	0.839	-0.2755	0.1689
Perquisite	Edu/Acad	PS	-0.1244	0.07894	0.257	-0.3099	0.0610
		PSU/C/S	-0.0711	0.09985	0.756	-0.3057	0.1635
	PS	Edu/Acad	0.1244	0.07894	0.257	-0.0610	0.3099
		PSU/C/S	0.0533	0.10591	0.870	-0.1955	0.3022
	PSU/C/S	Edu/Acad	0.0711	0.09985	0.756	-0.1635	0.3057
		PS	-0.0533	0.10591	0.870	-0.3022	0.1955
Agony	Edu/Acad	PS	-0.0628	0.07811	0.701	-0.2463	0.1208
		PSU/C/S	-0.0444	0.09880	0.895	-0.2766	0.1877
	PS	Edu/Acad	0.0628	0.07811	0.701	-0.1208	0.2463
		PSU/C/S	0.0183	0.10480	0.983	-0.2279	0.2646
	PSU/C/S	Edu/Acad	0.0444	0.09880	0.895	-0.1877	0.2766
		PS	-0.0183	0.10480	0.983	-0.2646	0.2279

Interpretation of education and occupation using MANOVA test

MANOVA test was performed to study the relationship between different levels of education and occupation on the perception of blood donors or the general populace,

and expectations towards blood bank services. From Tables 7 and 8, the significance of the results of MANOVA is subsequently tested using Tukey HSD post hoc pairwise comparison. In case of perception of blood donation on education profile, a significant difference is observed between undergraduates (UGs) and postgraduates (PGs);

Table 9. Multivariate tests (post hoc test) on perception on blood donation

Multivariate tests									
Effect	Value	<i>F</i>	Hypothesis <i>df</i>	Error <i>df</i>	Significant	Partial eta squared	Non-central parameter	Observed power	
Education	Pillai's trace	0.105	8.262	8.000	1190.000	0.000	0.053	66.099	1.000
	Wilks' lambda	0.897	8.335	8.000	1188.000	0.000	0.053	66.683	1.000
	Hotelling's trace	0.113	8.408	8.000	1186.000	0.000	0.054	67.265	1.000
	Roy's largest root	0.092	13.667	4.000	595.000	0.000	0.084	54.669	1.000
Tests of between-subjects effects									
Source	Type III sum of squares	<i>df</i>	Mean square	<i>F</i>	Significant	Partial eta squared	Non-central parameter	Observed power	
Education	Value and ethics	4.147	2	2.074	1.137	0.322	0.004	2.274	0.251
	Social bigotry	53.454	2	26.727	23.667	0.000	0.073	47.334	1.000
	Apprehension	41.452	2	20.726	13.108	0.000	0.042	26.216	0.997
	Social affinity	4.352	2	2.176	1.545	0.214	0.005	3.091	0.329
Multivariate tests									
Effect	Value	<i>F</i>	Hypothesis <i>df</i>	Error <i>df</i>	Significant	Partial eta squared	Non-central parameter	Observed power	
Occupation	Pillai's trace	0.088	6.865	8.000	1190.000	0.000	0.044	54.920	1.000
	Wilks' lambda	0.912	6.989	8.000	1188.000	0.000	0.045	55.911	1.000
	Hotelling's trace	0.096	7.112	8.000	1186.000	0.000	0.046	56.899	1.000
	Roy's largest root	0.092	13.641	4.000	595.000	0.000	0.084	54.562	1.000
Tests of between-subjects effects									
Source	Type III sum of squares	<i>df</i>	Mean square	<i>F</i>	Significant	Partial eta squared	Non-central parameter	Observed power	
Occupation	Value and ethics	3.721	2	1.860	1.019	0.361	0.003	2.039	0.228
	Social bigotry	55.324	2	27.662	24.563	0.000	0.076	49.126	1.000
	Apprehension	38.332	2	19.166	12.081	0.000	0.039	24.163	0.995
	Social affinity	0.501	2	0.250	.177	0.838	0.001	0.354	0.077

$P < 0.05$) corresponding to apprehension factor; and graduates and UGs ($P < 0.05$) for social affinity. Moreover, in the case of occupation, the difference for apprehension (fear) factor was found statistically significant between education/academics and PSU/central/state government ($P < 0.05$); private sector and education/academics ($P < 0.05$). Also, the mean score of social affinity factor was statistically significant between education/academics and PSU/central/state government ($P < 0.05$); private sector and education/academics ($P < 0.05$). However, no significant difference was observed in education and occupation groups towards expectations regarding blood bank services. This result contradicts the findings for perception on blood donation²⁸.

Tables 9 and 10 show the four most commonly used multivariate tests. We can see that all four tests of each of perception on blood donation, indicate a statistically significant difference across the three pairs of education and occupation. In addition to the multivariate tests, univariate tests between subject effects for each dependent factor indicate that apprehension ($P < 0.05$) and

social bigotry ($P < 0.05$) have a significant effect on education and occupation category of perception on blood donation. Also, the effect of expectation building is insignificant corresponding to education and occupation. Hence, from the analysis, it can be inferred that the effect of negative factor 'apprehension (fear)' and positive factor 'social affinity' is considerable on education and occupation among blood donors.

Conclusions

The study specifically focused on the prevailing gap between burgeoning demand and shrinking supplies of blood in India. Despite numerous attempts by the government and other agencies to mitigate the gap, the desirable results are still awaited. Against this backdrop, the present study analysed two strong perspectives, viz. perception of donors on blood donation and their expectations regarding blood bank services. Moreover, the effect of demographics on the perceptions and expectations

Table 10. Multivariate tests (post hoc test) on expectation on blood bank services

Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Education	Pillai's trace	0.007	0.521	8.000	1190.000	0.841	0.003	4.172	0.246
	Wilks' lambda	0.993	0.521	8.000	1188.000	0.841	0.003	4.168	0.246
	Hotelling's trace	0.007	0.521	8.000	1186.000	0.842	0.003	4.164	0.246
	Roy's largest root	0.006	0.880	4.000	595.000	0.475	0.006	3.522	0.281
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Education	Unanimity	0.523	2	0.262	0.411	0.663	0.001	0.822	0.117
	Corporeality	0.054	2	0.027	0.045	0.956	0.000	0.090	0.057
	Perquisite	1.822	2	0.911	1.223	0.295	0.004	2.447	0.267
	Agony	0.637	2	0.319	0.431	0.650	0.001	0.862	0.120
Multivariate tests									
	Effect	Value	F	Hypothesis df	Error df	Significant	Partial eta squared	Non-central parameter	Observed power
Occupation	Pillai's trace	0.007	0.497	8.000	1190.000	0.859	0.003	3.975	0.235
	Wilks' lambda	0.993	0.496	8.000	1188.000	0.859	0.003	3.972	0.235
	Hotelling's trace	0.007	0.496	8.000	1186.000	0.860	0.003	3.969	0.234
	Roy's largest root	0.006	0.870	4.000	595.000	0.481	0.006	3.482	0.278
Tests of between-subjects effects									
	Source	Type III sum of squares	df	Mean square	F	Significant	Partial eta squared	Non-central parameter	Observed power
Occupation	Unanimity	0.339	2	0.170	0.266	0.766	0.001	0.533	0.092
	Corporeality	0.190	2	0.095	0.159	0.853	0.001	0.317	0.075
	Perquisite	1.896	2	0.948	1.273	0.281	0.004	2.546	0.277
	Agony	0.504	2	0.252	0.341	0.711	0.001	0.681	0.105

was examined. The study showed significant impact of gender on perception building factors with respect to willingness towards blood donation, viz. value and ethics, social bigotry, apprehension and social affinity. Gender also has a significant impact on expectations regarding blood bank services. The study also highlighted the negative psyche such as social bigotry along with various other myths and fear prevalent in the society about blood donation. The growing dogmatism built around religious beliefs and the prevailing caste system seem to prohibit educated youth towards blood donation. While analysing the expectations towards blood bank services, we found that blood banks should pay special attention to 'perquisite', 'unanimity' and 'corporeality' to enhance the satisfaction of blood donors, their retention and building long-term relationships with them. These findings are significant as they provide the necessary inputs and insights for an Indian blood bank policy to launch an extensive awareness programme regarding donor information, education, motivation, recruitment and retention to ensure adequate availability of safe blood³³. The findings would

also help in addressing the various lacunae in the blood bank services to make blood donation a more user-friendly exercise.

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