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Individual Characteristics Associated with Blood Donation: A Cross-National Comparison of the German and Swiss Population between 1994 and 2010

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Keywords
Blood donation · Donors · Donor recruitment

Summary
Objective: The aim of this study is to compare individual characteristics associated with blood donation in the German and Swiss population between 1994 and 2010. **Methods:** Population-based survey data from the Eurobarometer 1994 and 2009, the Swiss Health Survey 1997, and the Swiss Blood Donation Survey 2010 were used to compare age-adjusted percentages of German and Swiss adults ever having donated blood (n = 8,746). A multivariate logistic regression was applied to the pooled data to estimate odds ratios (OR). **Results:** Donor rates between 1994 and 2010 increased by 8.6% in Germany (p = 0.0045) and remained stable in Switzerland. The likelihood to report donating increased with age. Gender differences (OR = 2.85; p = 0.0000) and differences between education levels were more pronounced in Switzerland as compared to Germany (OR = 2.56; p = 0.0000 and OR = 2.73; p = 0.0010). Furthermore education differences were more marked in men in both countries (OR = 1.99; p = 0.0000 and OR = 1.68; p = 0.0140). **Conclusion:** The blood establishments should intensify their efforts to motivate women and lower educated people to give blood. Our data suggest that population-based surveys could be a helpful tool to describe donor rates in different countries and to guide future recruitment strategies.

Introduction

Blood transfusions are a critical part of modern medicine. Without red blood cell and platelet concentrate transfusion, organ and stem cell transplantation as well as major surgery and modern trauma management would not be possible. Especially chemotherapy and surgery to treat cancer often lead to the need for blood either due to bleeding or due to low white or red blood cells [1]. Consequently the demand for blood in countries with a developed health care system has been rising during the past decades and is expected to further increase, especially in countries where the demographic change is pronounced. A high proportion of older citizens with health concerns will increase the demand for blood substantially [2, 3].

To secure the demand for blood the blood establishments in developed countries primarily rely on voluntary and non-remunerated blood donors [4]. However, the proportion of the population that is willing to donate differs considerably by country. The highest proportions of donors per thousand inhabitants were found in countries with a high Human Development Index (HDI), which is a composite index of the United Nations including life expectancy, literacy, education, and standards of living [5, 6]. Furthermore, within the European countries an educational development index that was calculated on the literacy rate and the gross enrolment ratio has been demonstrated as a further important correlate of blood supply on the country level [6].

On the individual level several national studies describe sociodemographic characteristics of blood donors including male gender, middle age, and high education [7–16]. The

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Table 1. Frequency distribution and central tendency for variables in the samples of subjects aged 18–45 years by nationality and survey year, N = 8,746[a]

	Germany[b] 1994 (n = 965)		Switzerland[c] 1997 (n = 6,560)		Germany[b] 2009 (n = 484)		Switzerland[c] 2010 (n = 737)	
	mean	SD	mean	SD	mean	SD	mean	SD
Age, years	33.2	7.0	32.5	7.2	33.7	7.6	33.6	7.4
	n	%	n	%	n	%	n	%
Donor status[b]								
Donor	315	32.6	2,853	43.5	198	40.9	296	40.2
Non-donor	650	67.4	3,707	56.5	286	59.1	441	59.8
Gender								
Male	477	49.4	3,071	46.8	215	44.4	415	56.3
Female	488	50.6	3,489	53.2	269	55.6	322	43.7
Education								
Low educated	129	13.3	978	14.9	46	9.5	46	6.2
Medium educated	625	64.8	4,332	66.0	321	66.3	577	78.3
High educated	211	21.9	1,250	19.1	117	24.2	114	15.5

[a]Figures refer to number of subjects and percentage or arithmetic mean and standard deviation (SD) within nationality.
[b]Data source: Eurobarometer 1994 and 2009.
[c]Data source: Swiss Health Survey 1997 and Swiss Blood Donation Survey 2010.

number of studies that show differences in sociodemographic characteristics of blood donors between countries is, however, limited to a single report based on the Eurobarometer survey that was carried out in 1994 [17]. This report showed that the association of blood donor status and gender, age as well as education were quite different in the European countries and were influenced by the organization of the blood establishment. In countries where the Red Cross was responsible for the blood collection, the gender gap was greater and the effect of education was smaller than in countries with a nationally run blood organization or in countries where blood banks collect the majority of the blood [17, 18]. By comparing the donor characteristics across Europe, this report highlighted the role of the organizational basis of the blood supply and described differences in the national donor pool [19].

The continuance of this work on differences in sociodemographic characteristics of blood donors in times of increasing demand appears to be fruitful to target national interventions and to promote blood donation. Cross-national comparisons of countries with the same organizational basis of the blood supply could show opportunities for the recruitment that were underdeveloped in some countries. A comparison of characteristics associated with blood donation in Germany and Switzerland seems to be an interesting starting point as the Red Cross is responsible either for the collection of all (Switzerland) or for the collection of the majority of all blood donations (Germany) in these countries. Furthermore, both countries have a developed health care system with a high demand for blood, share common culture and to some extent common language, and both are actually facing a significant change in their age structure, which is likely to increase the demand for blood in the next decades. Thus, the aim of this study is to compare individual characteristics associated with blood donation in the German and Swiss population and to describe how these associations have changed over time.

Material and Methods

Study Design, Study Population and Data

The study was designed as secondary analysis of cross-sectional population-based pooled survey data. German data from two cross-sectional waves of the Eurobarometer (EB) survey, a nationally representative study performed in Europe, and the Swiss Health Survey (SHS) and Swiss Blood Donation Survey (SBDS), two nationally representative cross-sectional surveys, were used to compare age-adjusted percentages of German and Swiss adults ever having donated blood. EB-based samples for Germany 1994 and 2009 (n = 965; n = 484) were pooled with the samples of the SHS 1997 and the SBDS 2010 (n = 6,560; n = 737) for Switzerland. The total sample size amounted to n = 8,746.

EB 41.0 (1994) [20] and EB 72.3 (2009) [21] data were obtained from the data archive for the social sciences (GESIS) and can be retrieved and downloaded free of charge using ZACAT (*www.gesis.org/eurobarometer*). SHS data was obtained from the Swiss Federal Statistical Office (BFS). For scientific purposes, SHS data is provided against a small fee. Researchers are required to sign a contract with the BFS pertaining to the use of the data (*www.bfs.admin.ch*). Finally, SBDS data was obtained from the Red Cross Blood Service of Switzerland (*www.blutspende.ch*). Researchers who are interested in the use of SBDS data should contact the corresponding author.

While the EB and SHS cover the population of the respective nationalities aged 15 and older, the SBDS only covers the Swiss population between 18 and 45 years. Hence, only respondents between 18 and 45 years old in each population-based sample could be included in the pooled sample and were used in the analysis. The basic sample design applied in all surveys is a multistage, random probability design. In Germany interviews were conducted face-to-face, in Switzerland computer-assisted tele-

Table 2. Percentage of adults ever having donated blood in Germany and Switzerland, N = 8,746[a]

	Germany[b]					Switzerland[c]					Δ CH-D[d]	
	1994		2009		Δt_1-t_0[e]	1997		2010		Δt_1-t_0[e]	1997/1994	2010/2009
	%	95% CI	%	95% CI	%	%	95% CI	%	95% CI	%	%	%
Total	30.5	27.3, 34.1	39.1	34.4, 44.0	8.6**	42.2	40.1, 43.6	42.6	37.2, 48.2	0.4	11.6***	3.5
Sex												
Women	28.9	24.3, 34.0	38.2	32.1, 44.7	9.3*	26.3	24.7, 28.0	27.9	21.2, 35.8	1.6	–2.7	–10.3*
Men	32.2	27.6, 37.2	40.0	33.1, 47.3	7.2	58.0	55.9, 60.0	53.7	45.9, 61.3	–4.3	25.8***	13.7*
Age												
18–24 years	24.6	17.8, 33.1	22.8	15.7, 31.8	-1.8	23.9	21.1, 26.9	28.3	16.5, 43.9	4.4	-0.8	5.5
25–31 years	30.9	25.3, 37.2	43.7	24.2, 53.7	12.8*	43.7	41.2, 46.3	34.6	27.1, 43.0	–9.1*	12.8***	–9.1
32–38 years	39.5	33.0, 46.4	38.3	28.8, 48.7	–1.2	47.6	45.3, 50.0	55.1	44.0, 65.7	7.5	8.1*	16.9*
39–45 years	27.1	22.0, 34.3	51.6	42.8, 60.2	24.5***	53.4	50.6, 56.2	52.4	44.1, 60.7	–1.0	26.3***	0.8
Education												
Low education	27.4	19.0, 37.7	34.1	20.9, 50.3	6.7	20.1	17.5, 23.0	6.1	1.9, 17.5	–14.0***	–7.3	–28.0***
Medium education	29.3	25.2, 33.7	37.0	30.7, 43.7	7.7	42.5	40.8, 44.3	44.1	38.1, 50.3	1.6	13.3***	7.2
High education	39.0	31.2, 47.4	54.4	43.4, 65.0	15.4*	63.7	60.7, 66.7	57.2	44.4, 69.0	–6.5	24.8***	2.8

[a]Weighted and age-adjusted data (European Standard Population). [b]Data source: Eurobarometer 1994 and 2009. [c]Data source: Swiss Health Survey 1997 and Swiss Blood Donation Survey 2010. [d]Δ CH-D = Difference (in %) between Switzerland and Germany. [e]Δt_1-t_0 = Difference (in %) between second and first wave of the country-specific surveys.
*p < 0.05; **p < 0.01; ***p < 0.001.

phone interviews were conducted in the appropriate regional language (German, French, or Italian). The characteristics of the pooled sample are shown in table 1.

Dependent Variable and Predictors

Donor status, the dependent variable of this study, was assessed by response to the question 'Have you given blood before?'. Subjects were categorized as donors or non-donors according to whether they reported to have donated blood or not. As mentioned, several demographic characteristics have been associated with blood donation. We therefore assessed gender (female/male), age (years), and education (low, medium, high educated) in the current study. Subjects were assigned to the low-educated category if they had stopped full-time education at ages 13–15 years. The medium-educated category comprises subjects who reported to have stopped full-time education between 16 and 19 years of age and the high-educated category comprises subjects who were 20 years or older at the time they stopped their education. To assess temporal and cross-country effects, two binary predictors were included. Although the four surveys were not conducted in the same year, the two surveys of 1994 and 1997 and those of 2009 and 2010 are reasonably close to consider them as broad approximations of a single point in the mid-1990s and the end of the first decade of the 21st century respectively. Hence the predictor study year takes on the value 0 if the study has either been conducted in 1994 or 1997, and it takes on the value 1 otherwise. Similarly, the predictor country takes on the value 0 if the study has been conducted in Germany, and a value of 1 otherwise. Interaction terms between study year, country, and the sociodemographic characteristics outlined above were included in order to decompose potential cross-country and time-dependent effects of gender and education.

Weighting and Standardization

The original expansion weights of the EB, SHS and SBDS take into account the different sampling strategies which have been used, and they allow to correctly estimate population parameters. However, the age structure between Germany and Switzerland as well as the age structure within each country over time is slightly different. On average, subjects in Germany and Switzerland tend to be older in the study year 2009/2010 as compared to 1994/1997. Similarly, the average Swiss subject is slightly older than the average German subject. In order to take account of these demographic differences, all original expansion weights have been age-adjusted and hence all reported rates were directly standardized to the European Standard Population [22]. The weighted, age-adjusted rates cover the German and Swiss population aged 18–45 years in all survey years.

Statistical Analysis

We used STATA 11.2 for all statistical analyses. A multivariate logistic regression was applied to the pooled data to assess temporal, cross-country and sociodemographic associations. We report odds ratios (OR) and their corresponding 95% confidence intervals (95% CI) and p values. To incorporate information on the appropriate weights and sampling units for correct variance estimation, all statistical analyses were carried out using STATA's command for complex surveys (svy prefix). Statistical significance was established at $p \leq 0.05$.

Results

In Germany the percentage of respondents donating at least once increased by a substantial 8.6% (p = 0.0045) from 30.5% in 1994 to 39.1% in 2009 (table 2). Increases between 1994 and 2009 were found statistically significant in the highest education group (+15.4%; p = 0.0274), in women (+9.3%; p = 0.0236), and in respondents in the age groups 25–31 years

Table 3. Logistic regression analysis of factors associated with donor status, subjects aged 18–45 years (main effects), N = 8,746[a]

Variable	OR	95% CI	p value
Study period			
1994/1997	1.00 (reference)		
2009/2010	1.03	0.85, 1.24	0.7770
Country			
Germany	1.00 (reference)		
Switzerland	1.61	1.36, 1.91	0.0000
Sex			
Women	1.00 (reference)		
Men	3.24	2.90, 3.63	0.0000
Education			
Low education	1.00 (reference)		
Medium education	2.62	2.18, 3.13	0.0000
High education	4.16	3.37, 5.13	0.0000
Age			
18–24 years	1.00 (reference)		
25–31 years	2.00	1.66, 2.40	0.0000
32–38 years	2.57	2.14, 3.08	0.0000
39–45 years	3.16	2.61, 3.81	0.0000

[a]Weighted and age-adjusted data (European Standard Population).
[b]Data source: Eurobarometer 1994 and 2009.
[c]Data source: Swiss Health Survey 1997 and Swiss Blood Donation Survey 2010.

Table 4. Logistic regression analysis of factors associated with donor status, subjects aged 18–45 years (main and interaction effects), N = 8,746 [a]

	OR	95% CI	p value
Variable (main effects)			
Study period			
1994/1997	1.00 (reference)		
2009/2010	1.12	0.58, 2.15	0.7400
Country			
Germany	1.00 (reference)		
Switzerland	0.46	0.28, 0.76	0.0020
Sex			
Women	1.00 (reference)		
Men	0.80	0.52, 1.23	0.3090
Education			
Low education	1.00 (reference)		
Medium education	0.79	0.48, 1.32	0.3700
High education	1.27	0.70, 2.29	0.4300
Age			
18–24 years	1.00 (reference)		
25–31 years	1.99	1.64, 2.40	0.0000
32–38 years	2.55	2.12, 3.08	0.0000
39–45 years	3.11	2.56, 3.77	0.0000
Variable (interaction effects)			
Study period × country	0.57	0.39, 0.84	0.0040
Study period × education			
Medium education	1.53	0.81, 2.91	0.1930
High education	1.78	0.85, 3.74	0.1290
Study period × sex	0.79	0.54, 1.15	0.2220
Country × education			
Medium education	2.56	1.53, 4.28	0.0000
High education	2.73	1.51, 4.92	0.0010
Country × sex	2.85	2.06, 3.95	0.0000
Sex × Education			
Medium education	1.99	1.40, 2.81	0.0000
High education	1.68	1.11, 2.53	0.0140

[a]Weighted and age-adjusted data (European Standard Population).
[b]Data source: Eurobarometer 1994 and 2009.
[c]Data source: Swiss Health Survey 1997 and Swiss Blood Donation Survey 2010.

(+12.8%; p = 0.0299) and 39–45 years (+24.5%; p = 0.0000). In contrast, the overall donor rate in Switzerland remained constant between 1997 (42.2%) and 2010 (42.6%), and decreases of donor rates were found in the age group 25–31 years (–9.1%; p = 0.0351) and in the group with low education (–14.0%; p = 0.0002).

Moreover, the former substantial difference of the overall donor rates between Switzerland and Germany in the 1997/1994 timeframe (+11.6%; p = 0.0000) eroded to statistically insignificant 3.5% in 2009/2010 (p > 0.05). In a first logistic regression model, we assessed the main associations of the predictor variables in the pooled sample (table 3). The model showed no secular increase or decrease in donor rates between the 1994 and 2010 study period, OR = 1.03 (95% CI 0.85, 1.24; p = 0.7770). Generally, the OR of reporting donation in Switzerland were 1.61 times higher (95% CI 1.36, 1.91; p = 0.0000). In all waves the likelihood to report donating was higher for men (OR 3.24; 95% CI 2.90, 3.63; p = 0.0000). The OR of reporting donation was 2.62 times higher for respondents with medium education (95% CI 2.18, 3.13; p = 0.0000) and 4.16 times higher for those with high education relative to the group with low education (95% CI 3.37, 5.13; p = 0.0000). The likelihood to report donating also increased with age. The OR to report donating were 2.00 (95% CI 1.66, 2.40; p = 0.0000), 2.57 (95% CI 2.14, 3.08; p = 0.0000) and 3.16 (95% CI 2.61, 3.81; p = 0.0000) times higher in the respective older age groups as compared to the reference group of 18- to 24-year-old respondents.

Our second logistic regression model included interaction terms in order to decompose potential cross-country and time-dependent effects of gender and education (table 4). Consistent with the initial regression model, the likelihood to report donating increased with age and the OR were of similar magnitude (OR = 1.99; OR = 2.55; OR = 3.11 all p values = 0.0000). In contrast, neither of the main effects of education nor gender was significantly associated with reporting blood donation. Also consistent with the previous model, we found no general time trend in the propensity to report donating. However, the OR of donating in Switzerland decreased by an additional factor of 0.57 in the second survey wave (95% CI 0.39, 0.84; p = 0.0040).

In both countries the interaction between sex and education increased the likelihood of donating for men with higher

education status. For men with medium and high education the OR of donating increased by an additional factor of 1.99 and 1.68, respectively (95% CI 1.40, 2.81; p = 0.0000 and 95% CI 1.11, 2.53; p = 0.0140, respectively). Furthermore, the impact of education on the likelihood to report donating was found to be much more pronounced in Switzerland than in Germany (OR = 2.56; 95% CI 1.53, 4.28; p = 0.0000 and OR = 2.73; 95% CI 1.51, 4.92; p = 0.0000 for medium and high education, respectively). Finally, the OR of reporting donation in Switzerland were an additional 2.85 times higher for men than for women (95% CI 2.06, 3.95; p = 0.0000). The effects of education and sex did not differ between study periods.

Discussion

Germany and Switzerland are geographically and culturally close countries, and the Red Cross is responsible for the collection of the majority of the blood donations. Despite this closeness, marked country-specific differences exist between sociodemographic factors associated with self-reported blood donation as well as with regard to the composition and dynamics of the donor rate. On the country level the likelihood to report donating was much more pronounced for Swiss men. In 1997 and 2010 donor rates for Swiss men amounted to 58.0% and 53.7%, respectively, whereas the corresponding rates for Germany were 32.2% and 40.0%. A likely explanation for the comparably high rate among male donors in Switzerland is the fact that blood drives regularly take place during the mandatory military service. Therefore many Swiss men are at least once in their lifetime confronted with the decision to donate or not to donate blood. At the same time the difference between Swiss and German male donor rates was decreasing from 25.8% (p = 0.0000) in the first survey waves to 13.7% (p = 0.0109) in the second survey waves. This convergence between male donor rates may partly be attributable to a temporary stop of blood drives in the Swiss military which led to a decrease of male donor rates in Switzerland. On the other hand, Germany seemed to be more effective in recruiting new blood donors which eventually led to an increase in donor rates and a convergence between German and Swiss male donor rates. The relative difference in the importance of blood drives during the military service between Germany and Switzerland can be further exemplified by comparing the share of units of erythrocyte concentrates originated from military personnel in relation to the total units of erythrocyte concentrates produced. In Germany, the share of erythrocyte concentrates originated from military personnel amounts to 1%. In Switzerland, the Red Cross Blood Service of Zurich which is the second largest blood agency with regard to the volume of blood products produced reports that the share of erythrocyte concentrates originated from military personnel amounts to 3%.

While we can observe a trend of converging male donor rates, female donor rates between Germany and Switzerland were diverging. In the 1994/1997 survey waves 28.9% of German and 26.3% of Swiss women reported donating. In the second wave of surveys the female donor rate in Germany amounted to 38.2% while it remained relatively constant in Switzerland (27.9%). The difference between Swiss and German female donor rates increased from (–2.7%; p = 0.3103) to (–10.3%; p = 0.0384). As a consequence of the convergence of male and the divergence of female donor rates, the former substantial difference of the overall donor rates between Switzerland and Germany eroded to statistically insignificant 3.5% in 2009/2010 (p = 0.3453). We can only speculate about the driving forces behind the increasing donor rates in Germany. Partly, the increase may be attributable to monetary incentives for blood donors in Germany. In principle both countries rely on voluntary non-remunerated blood donors. Nevertheless, some blood transfusion services in Germany pay compensation of between 10 and 30 EUR per whole blood donation. Given that potential donors consider these compensations at least partially as incentives and given that the proportion of blood establishments which pay such compensations has increased over time, these blood establishments may have been more successful in recruiting new donors and hence may have facilitated the increase of donor rates in Germany. However, we have no reliable data to substantiate this hypothesis. Alternatively, the increase of donor rates may equally well be due to intensified recruitment efforts of the blood establishments, an increased sense of altruism, a raised awareness for the need for blood, an earlier onset of demographic change, or a more pronounced demographic change in Germany.

On the individual level, the OR of reporting donation in Switzerland were an additional 2.85 times higher for men than for women. Again, this may be attributable to the country-specific and gender-specific difference in the opportunity structure to give blood during the military service.

In both countries the OR for men with medium and high education was higher than the OR for women with corresponding education status (increase by a factor of 1.99 vs. 1.68), and the likelihood to report donating for subjects with medium and higher education was even more pronounced in Switzerland (increase by a factor of 2.56 and 2.73). Again, the reasons for these differences remain unclear.

However, our results identified specific strata of the population who are more or less likely to give blood. Blood establishments in both countries could benefit from intensifying recruitment efforts for those strata with comparatively low donor rates. In both countries, recruitment of subjects with low education could be intensified. Intensifying the recruitment of female donors may be particularly considered in Switzerland since the Swiss female donor rate is far lower than the respective rate in Germany. Finally, the comparatively high male donor rate in Switzerland suggests that large public and

private corporate bodies with institutionalized blood drives are of special importance. The continuous management and recruitment of bodies like the military, the police, universities, schools, or big corporations may therefore be especially rewarding and should be considered in Germany and Switzerland as well.

This study has several limitations. First, we rely on self-reported donor status. Subjects may be inclined to report donating because giving blood is considered to be socially desirable [23]. However, we do not have any reason to assume that this social desirability bias is likely to vary between German and Swiss respondents. Second, we note that the four population studies differ by study design and survey mode. The precision of the survey estimates therefore may differ between country and study period. Third, our analysis was somewhat limited by the data available in all surveys and therefore may by confounded by missing variable bias. Further sociodemographic characteristics like income or marital status may have increased the variance of our model.

The aim of this study is to compare individual characteristics associated with blood donation in the German and Swiss population between 1994 and 2010. The results showed that donor rates between 1994 and 2010 increased in Germany and remained stable in Switzerland. The likelihood to report donating was higher for men and increased with age and educational level in both countries. Gender differences and differences between educational levels, however, were more pronounced in Switzerland than in Germany.

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Disclosure Statement

The authors declare that they have no conflict of interest.

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