参考資料5

Young Blood Donation percentage, by country

No	Country	% of Donations from donors under 18 years old	% of Donations from donors in age group 18 to 24	TOTAL % of Donations from donors under 25 years old
1	Lao People's Democratic Republic	52 00%	37 00%	89.00%
2	Zimbabwe	33 33%	46 84%	80.17%
3	Malawi	13 04%	64 28%	77.32%
4	Botswana	55 00%	22 00%	77.00%
5	Viet Nam	0 00%	72 01%	72.01%
6	Republic of Korea	25 54%	43.75%	69.30%
7	Burkina Faso	5 29%	56 52%	61.81%
8	Guinea	11 00%	48 00%	59.00%
9	Tuvalu	5 26%	52 63%	57.89%
10	Jordan	0.00%	57 17%	57.17%
11	Papua New Guinea	16 17%	40 17%	56.34%
12	Kiribati	0 00%	55 22%	55.22%
13	India	0 00%	52 83%	52.83%
14	Gabon	3 00%	48.45%	51.45%
15	Bhutan	0 46%	48 83%	49.29%
16	Mali	0 01%	48 05%	48.06%
17	Sao Tome and Principe	0.16%	46 75%	46.91%
18	Cambodia	6.21%	40 48%	46.69%
19	Myanmar	13 59%	29 70%	43.29%
20	Poland	0 01%	40 53%	40.55%
21	Mauritania	0 00%	38 74%	38.74%
22	Luxembourg	0 00%	36.00%	36.00%
23	Maldives	0 00%	35 64%	35.64%
24	Vanuatu	0 00%	35 29%	35.29%
25	Ethiopia	11 76%	22 19%	33.95%
26	Estonia	0 00%	32 62%	32.62%
27	Tajikistan	0 00%	31 10%	31.10%
28	Kyrgyzstan	0 00%	30.00%	30.00%
29	Singapore	2.33%	26 57%	28.90%
30	Morocco	0 00%	28 00%	28.00%
31	Micronesia (Federated States of)	2 51%	23 94%	26.45%
32	Iran (Islamic Republic of)	7 56%	18 41%	25.97%
33	Tonga	0 85%	24 96%	25.81%
34	Brunei Darussalam	0 00%	24.75%	24.75%
35	Democratic Republic of the Congo	0 00%	22 00%	22.00%
36	United States of America	8 09%	13 73%	21.82%
37	Bosnia and Herzegovina	0 00%	21 47%	21.47%
38	South Africa	9 08%	12.38%	21.45%
39	New Zealand	6 72%	12 78%	19.50%
40	Uzbekistan	0 00%	18 40%	18.40%
41	Republic of Moldova	0 00%	18 00%	18.00%
42	Japan	1 54%	16.05%	17.59%
43	Seychelles	0 55%	17 03%	17.58%
44	Mauritius	0 64%	16 44%	17.09%
45	Australia	3 39%	12 83%	16.21%
46	Georgia	0 00%	16 16%	16.16%
47	Qatar	0 22%	15 41%	15.64%
48	Austria	0.00%	14 95%	14.95%
49	Ireland	0 00%	14 83%	14.83%
50	Iceland	0.00%	14 17%	14.17%
51	Slovenia	0 00%	14 00%	14.00%
52	Cook Islands	0 93%	12 62%	13.55%
53	Kuwait	0 00%	13 53%	13.53%
54	Belgium	0 00%	12 92%	12.92%
55	Timor-Leste	0.00%	11 11%	11.11%
56	Afghanistan	0 00%	11 11%	11.11%
57	Armenia	0 00%	11.08%	11.08%
58	Finland	0.00%	10 96%	10.96%
59	Bahrain	0 00%	8 90%	8.90%
60	Azerbaijan	0 00%	8 33%	8.33%

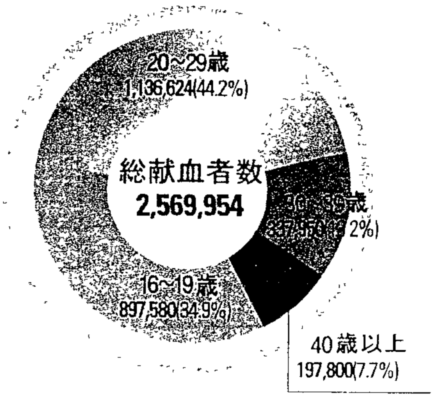
*Source Data reported by countries to WHO Global Database on Blood Safety, 2008 (updated 10 June 2010)

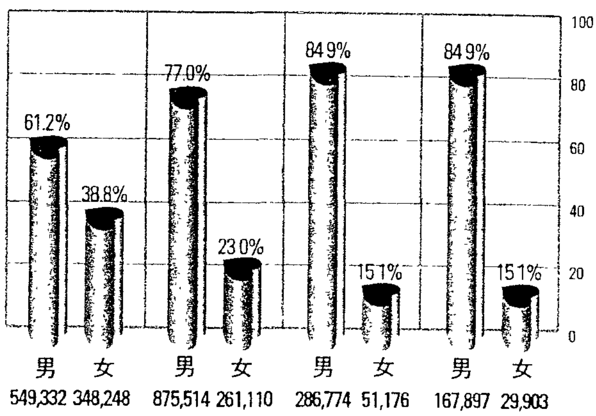
2009年度　韓国における年齢別・職業別献血状況

2009年度　献血事業統計(韓国)より抜粋

■ 年齢別

(単位:人)

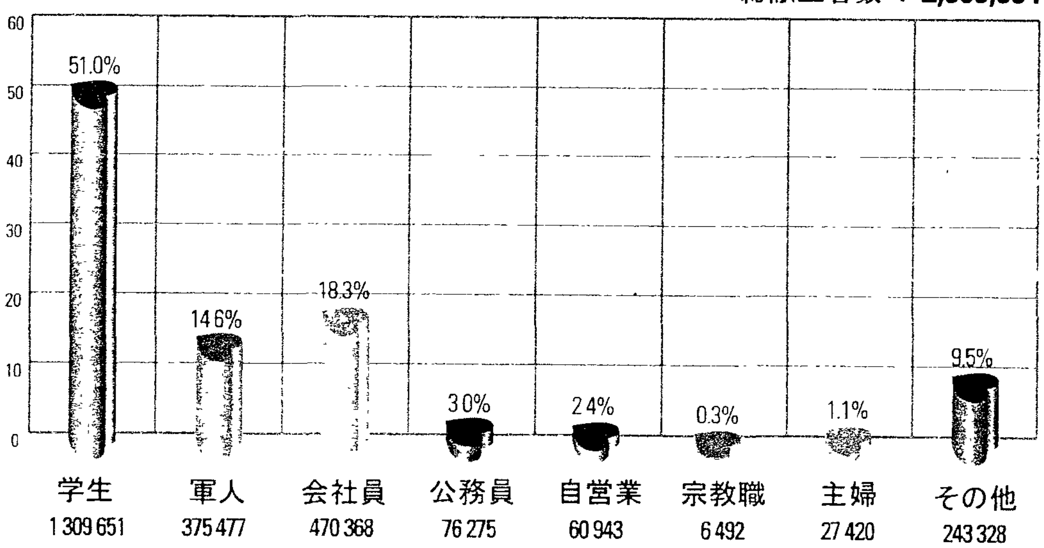




■ 職業別

(単位:人)

総献血者数 : **2,569,954**



The aging population poses a global challenge for blood services

Akif Ali, Marja-Kaisa Auvinen, and Jukka Rautonen

BACKGROUND: The Finnish transfusion registry data suggest some alarming signals and future challenges that are likely to be faced by transfusion services as populations continue to age

STUDY DESIGN AND METHODS: Computerized data collection was performed on all potentially transfused patients in Finland, thus covering ~70% of all blood usage. We simulated the red blood cell (RBC) usage according to the Finnish practice on different age groups but the population demographics from other countries

RESULTS: The Finnish data demonstrate a marked increase in RBC consumption with increasing age among recipients, beginning at around 50 years of age. The 70- to 80-year-olds have an eightfold higher RBC consumption than 20- to 40-year-olds.

CONCLUSIONS: A large part of the variation in RBC use per capita can be explained by the age distribution of the different populations and not by the different national and regional treatment policies and protocols used. If current efforts are not enough to serve the changing population demographic and if increasing demands for blood products cannot be met, there is need to consider unprecedented measures such as reversing certain donor deferrals or even exporting blood from country to country

Since 2002, the Finnish Red Cross Blood Service has had a permanent national database to study transfusion recipients and blood use in Finland. Analysis of this database and of the blood-dependency ratio (the number of donors vs. the number of transfusion recipients) suggests some alarming signals and future challenges that are likely to be faced by transfusion services all over the world as populations continue to age. It is apparent that judging the transfusion practices and success of blood conservation programs in different countries by simply calculating blood usage per capita may be an inadequate or even misleading practice when trying to plan for blood service requirements in aging populations.

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MATERIALS AND METHODS

Data were collected from the Finnish Transfusion Registry ("Optimal Use of Blood"), which was established in 2002. Finnish Red Cross is the only blood supplier in Finland thus providing approximately 400,000 blood components annually to the Finnish hospitals. The data are collected on all potentially transfused patients using computer programs designed for data collection (VOK data extraction system, MediWare Corporation Oy, Helsinki, Finland; and Oulu data extraction system, Oulu, Finland). The validation of data has been described previously.[1] Currently 10 hospital districts provide data to the registry. Altogether these hospital districts transfuse approximately 63% to 70% of blood components produced in Finland. There are no general national transfusion guidelines in Finland. However, the international practice and guidelines are followed and usually implemented to local, hospital instructions. Also, benchmarking activities have been arranged for the participants of the optimal use of blood. The data collected constitute of all 1) patients for whom blood components were ordered (i.e., not necessarily transfused); 2) surgical patients (i.e., all patients visiting operating room; the Nomesco classification of surgical procedures [NCSP], 2003. Chapters A, B, C, D, E, F, G, H, J, K, L, M, N, P, Q, and Y, excluding small and diagnostic procedures in Sections T, U, X, and Z, which are usually used in combination with a code for the main procedure); and 3) patients with hospital visits with any malignant disorder, anemia of any cause, obstetric disorders, fetal or neonatal hemorrhagic and hematologic disorders, and burns and trauma (International Classification of Diseases [ICD-10], main diagnoses C81-C96, D45-D47, D50-D77, O00-O99 8, P50-P61, S00-S99-9, T00-T07, T20-T32, T79-T98, and Z99 9) Patient data are extracted from existing electronic medical registers and blood banking databases (Progesa, MAK-SYSTEM, Paris, France). Computer files provided information on hospital admissions, diagnoses, surgical

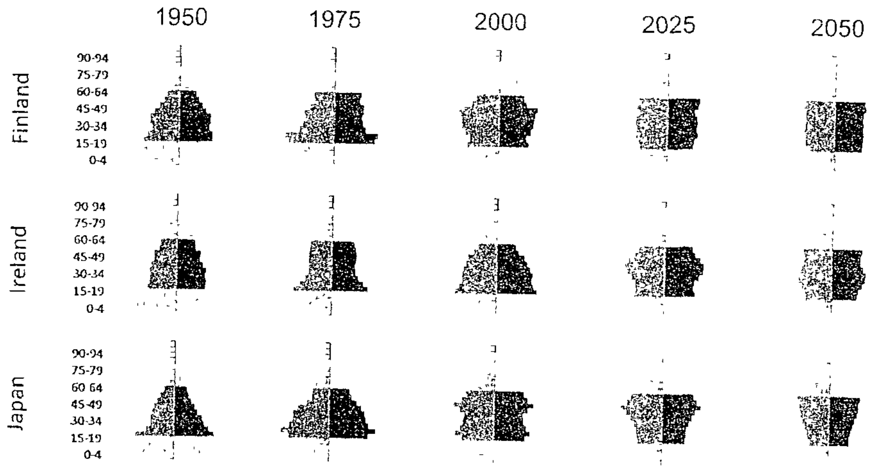

Fig. 1. Examples of population pyramids for Finland, Ireland, and Japan for different age groups based on WHO statistics years 1950 to 2000 and prognosis for 2025 to 2050. The left side of the pyramid indicates the proportion of males and the right side of females in the country.

operations, test results, and blood components as well as on transfusions. For data security reasons, a coding computer program (DWcrypt, Datawell Oy, Espoo, Finland) encrypted patients' personal identification numbers using different passwords for each hospital district. The data were analyzed with the analyzer reporting program (Ecomed, Datawell Oy) and a statistical software package (SPSS, SPSS, Inc., Chicago, IL). The simulation analyses are based on red blood cell (RBC) usage in Finland. Per-capita usage was calculated by dividing the annual RBC use of persons at certain age with the total number of living individuals of the same age. We simulated the RBC usage according to the Finnish practice on different age groups but the population demographics from other countries, which can be presented as population pyramid, that is, distribution of different age groups within a population. Some examples of population pyramids for Finland, Ireland, and Japan are shown in Fig. 1. For the population demographics, the data from Statistics Finland and WHO were used. The data for Finland consist of population statistics on the size and structure of the permanently resident population and related changes, such as births, deaths, marriages, migration, as well as population projections. For the other countries the WHO (United Nations, Department of Economic and Social Affairs, Population Division, http://www.un.org/esa/population/unpop.htm) data consist of world population prospects, population by age groups, medium-fertility assumption based on UN Population Division's quinquennial estimates and projections.

RESULTS

The Finnish data demonstrate a marked increase in RBC consumption with increasing age among recipients, beginning at around 50 years of age. The elderly consistently have a much higher RBC consumption than younger people: 70- to 80-year-olds have an eightfold higher RBC consumption than 20- to 40-year-olds (Fig. 2). Many other countries show similar trends in RBC usage.[2-4]

According to Council of Europe 2004 statistics, the use of RBC products varies considerably among the European Union member states (4-73 per 1000 inhabitants; mean, 37 per 1000 inhabitants).[5] A large part of the variation in RBC use per capita can be explained by the age distribution of the different populations and not by the different national and regional treatment policies and protocols used. Figure 3 shows the simulated RBC usage per capita in selected countries in 1950 to 2050, based on historical and predicted age distribution figures (from the UN Population Division) and the age-distributed variation of blood usage (as RBC units) in Finland between 2002 and 2006. This simulation assumes the same transfusion practices for each country. In Finland, 55% of RBCs are used for patients treated for surgical diagnoses or interventions, whereas 45% are used during conservative treatment periods. For the platelets, the proportions are 32 and 68%, respectively. Of all blood used in Finland, 21% goes for treatment of hematologic malignancies (ICD-10 classes C81-C97), 16% for treatment of cardiac and circulatory system diseases (I00-I99), and 12% for the treatment of tumors (C00-C80 and D00-D48). The population trend during the period 1950 to 2050 predicts an increase in RBC requirements in most countries. Very few countries exhibit a period of decreasing need for simulated RBCs, and since 1990 the simulated RBC use shows increase in all the countries.

We have calculated the blood-dependency ratio in selected countries for the period 1950 to 2050, describing the number of age-noneligible donors that each

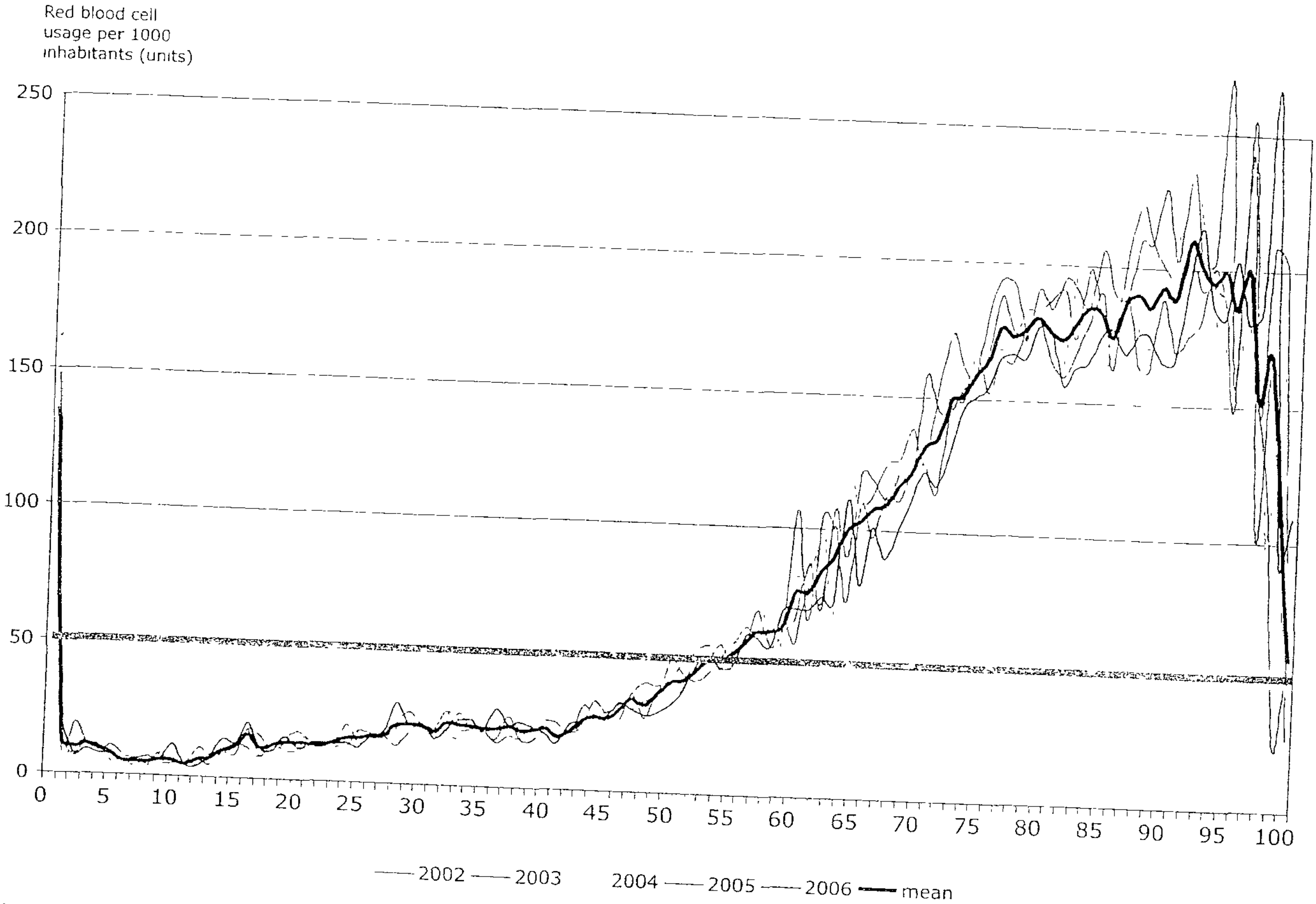

Fig. 2. RBC usage per capita by age in Finland 2002 to 2006. Current annual RBC usage in Finland is 50 units per 1000 inhabitants.

age-eligible donor needs to support in addition to him/herself (Fig. 4). Most countries had a local maximum during the 1960s and 1970s and a subsequent decline until the 1990s.

In conclusion, the increasing proportion of elderly people in most countries will result in a major increase in the demand for RBC products globally, unless treatment modalities can be improved and, consequently, the dependence on RBC transfusions decreased. One might argue that future elderly populations will be healthier than their current counterparts. However, the Finnish data have not shown a decrease in the transfusion needs of elderly people. For the prevalence of the diseases treated with transfusions, we compared WHO data on mortality and morbidity (http://www.who.int/whosis/whostat/2009/en/index.html). For cardiovascular diseases, which is the second largest diagnostic group among transfused patients in Finland, the countries selected for the simulation analyses have similar age-standardized mortality rates. Two exceptions are Russia and Poland, where the mortality rates for cardiovascular diseases are three- and twofold compared with Finland (Table 1). The age-standardized mortality rate for injuries is 64 per 100,000 population in Finland, thus higher than most of the countries analyzed in this study. However, the causes for death due to injury in Finland are more often connected to toxicity or suicidal behavior than traffic accidents or other such injuries where transfusions would be necessary.[6]

The observed difference of 42% between the lowest (Ireland, 41 RBC units/1000 population) and highest (Japan, 58 RBC units/1000 population) country in this simulation is fully explained by the different national population pyramid. It is clear that although the national data on RBC use are a useful indicator, they are not sufficient to compare transfusion practice among countries. The problem posed by the projected increased demand on blood services due to the aging population is exacerbated by the concomitant decrease in the size and proportion of the population eligible to donate blood in developed countries. Globally, the proportion of people aged more than 65 years in the population is projected to increase from 7.7% in 2010 to 16.5% in 2050,[7] with the highest increases expected in Eastern Europe and developed countries.

The blood-dependency ratio, describing the number of noneligible donors that each eligible donor needs to support in addition to him- or herself, shows that in most

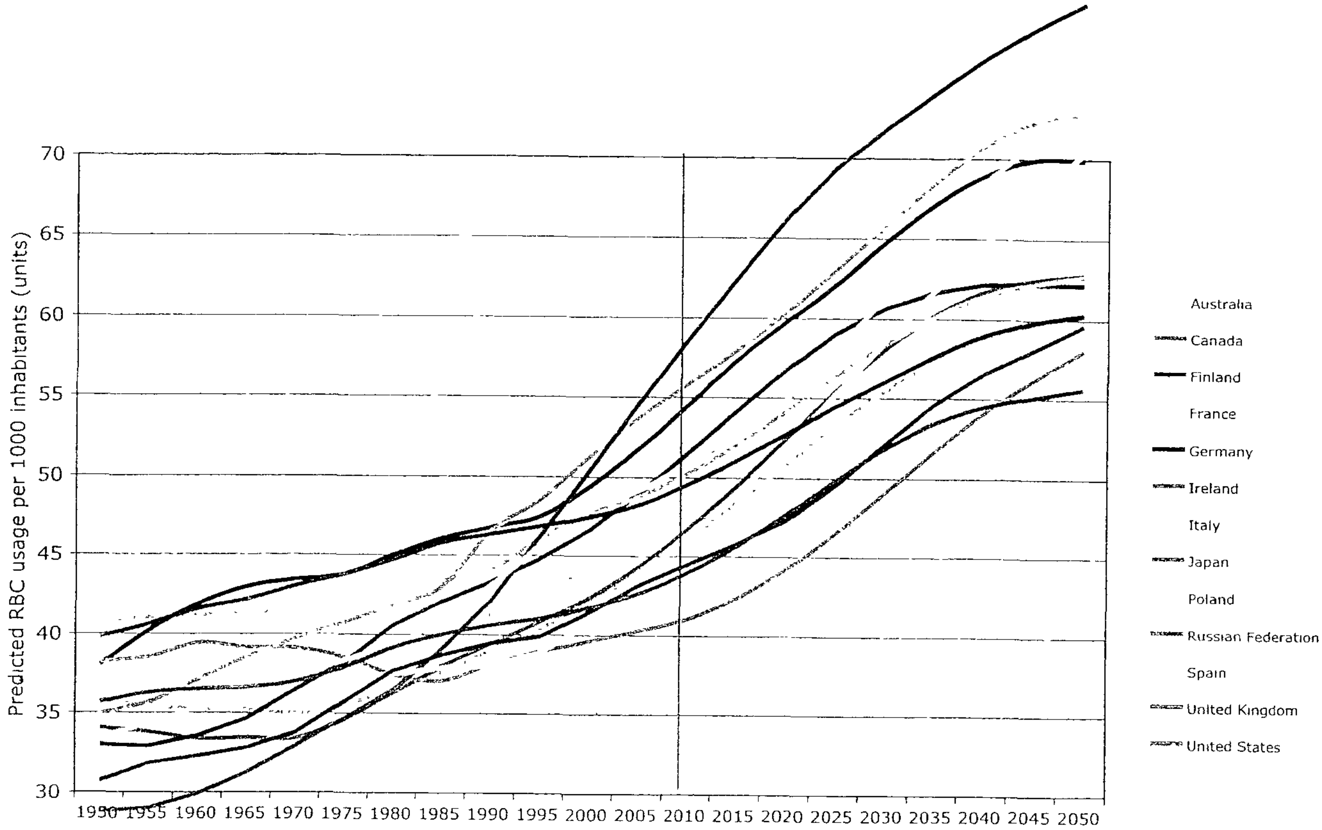

Fig. 3. Simulation of clinical use of RBC units per 1000 population (based on age-distributed variation in blood usage [as RBC units] in Finland between 2002 and 2006).

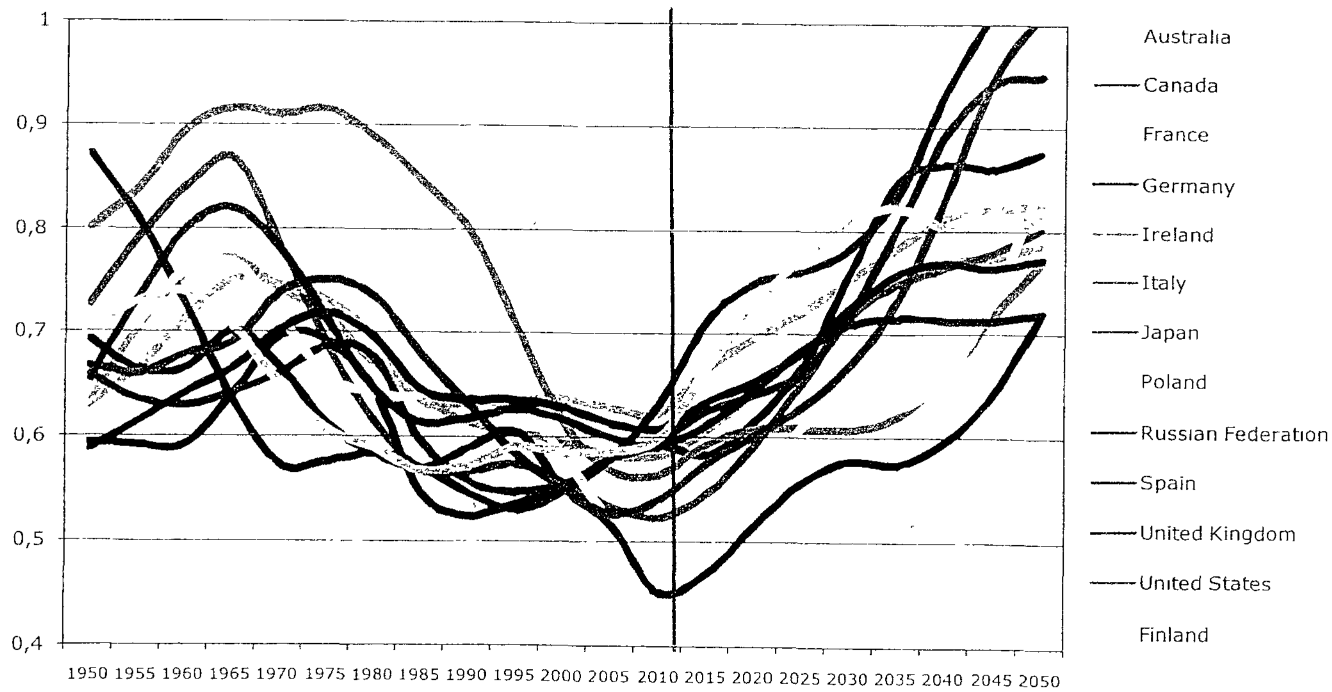

Fig. 4. Blood-dependency ratio in selected countries 1950 to 2050: ratio of age-eligible (18-65 years) to age-noneligible blood donors in the population.

TABLE 1. Age-standardized mortality rate for different causes per 100,000 population year 2004

Location	Cancer	Cardiovascular diseases	Injuries	Noncommunicable diseases
Canada	135	131	33	374
United States of America	133	179	50	450
Finland	113	185	64	405
France	154	123	45	387
Germany	135	199	28	429
Ireland	155	190	30	459
Italy	132	155	29	372
Poland	177	314	54	583
Russian Federation	142	645	218	904
Spain	131	131	30	379
United Kingdom	147	175	26	441
Australia	126	136	32	355
Japan	120	103	39	284

countries a local maximum was exceeded during the 1960s and 1970s and a subsequent decline until the 1990s This suggests that the recruitment of donors has been easier from year to year than during a period of constant ratio. For the future, these projections show an increasing trend for the blood-dependency ratio, suggesting that it will be more difficult to recruit blood donors, exacerbated by the fact that recruitment levels have been relatively good in recent years Although recruitment of blood donors may appear to have been relatively easy and high in recent years, historically this has not been the case and it is unlikely to be so in the future, as most local blood services will attest. The eligible donor population is limited and radical actions to address this, such as extending the age limits for donation, may have to become a reality in some countries. Already in the United Kingdom, Australia, and some US states, the upper age limit of 70 years for not accepting blood from existing donors has been removed. Also extension of the younger age limit to 17 years has been implemented in some donor centers in Denmark, the United Kingdom, and the United States.

If current efforts to maintain effective national blood services are not enough to serve the changing population demographic and if increasing demands for blood products cannot be met, we may need to consider unprecedented measures. It may include reversing certain donor deferrals, such as previous transfusions or living in certain countries, or even exporting blood from country to country, to meet what is now an established and imperative health care need.

CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest relevant to the manuscript submitted to **TRANSFUSION**.

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