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THE BLOOD GROUP FREQUENCIES IN THE POPULATION OF POLAND

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Abstract. An analysis of the current serological structure of the Polish population was performed. The material submitted for the analysis included more than 355,000 people (men and women) coming from almost all the regions of Poland. The group consisted of hospitalised persons, blood donors, persons applying for driving licence, pregnant women and persons wanting to have the information on their blood group entered into their identity cards. The results encompassed the frequencies of blood groups in the AB0 system and according to the Rh factor. The results were compared with the data of a similar investigation performed forty years earlier. Some regional differences in blood group frequencies in the population of Poland were observed.

Key words: *blood group frequencies, Rh factor, sex and blood groups, pollution of environment and blood group*

Introduction

Studies on the distribution of the AB0 system blood groups in various populations were initiated by the Hirszfelds in 1918 (Hirszfeldowa 1958). The results obtained turned out to be very useful for the fields of science such as:

1. Anthropology, since the frequency of the occurrence of particular genes conditioning the generation of all the blood groups differs within particular races and

the frequencies of the occurrence of A and B blood groups prove some regularities in the geographical distribution (Kelus et al. 1953). Sero-anthropology deals also with the influence of blood groups on the sex of descendants (Socha 1963).

2. Ethnology, due to considerable differences occurring in frequencies of particular blood groups in various ethnic groups (Kelus et al. 1953; Sablińnski 1959; Socha 1966), which may characterise a population equally well as anthropological indices do. Further, some of the studies (Sobolski 1962) seem to indicate a possible link between definite blood groups and pigmentation.

3. Genetics, due to the fact that antigens of the AB0 system, discovered in 1901 by Landsteiner, are genetically conditioned by the three allelomorphic genes lying in the long arm of chromosome 9. Whereas chromosome 1 contains the genes conditioning the occurrence of the erythrocyte Rh antigen and D antigen (Traczyk 1984). All of them are glycoproteids present not only in the cell membrane of erythrocytes, but also (in 80% of the population having Se gene) in all the secretions, excretions and tissues of the organism, except the brain and the vitreous humour of the eye. Group antigens appear already in a few week old embryos and, basically are dependent neither on the intraorganic factors nor on the external environment.

4. Epidemiology, since there is a correlation between certain disease and given blood groups (Charzewski et al. 1965; Korfel, Balding-Korfel 1963; Ziółkiewicz 1965, 1961), which may be important in the regions affected with industrial pollution. In addition, an exceptionally interesting fact was revealed recently. Namely, in some diseases, as, for instance, in marrow leukaemia, weakening of A or B antigen may take place. Some chronic inflammatory and cancer diseases of the large intestine may cause the additional occurence of the B property in A group corpuscles (Seyfriedowa 1990).

Along with cognitive values, studies on the blood group frequencies may also have a practical significance connected with a definite demand for a given blood group in a given territory, for criminology and in paternity tests.

The first study devoted to the distribution of serological groups in the territory of Poland was carried out in 1925 on the basis of over 11 000 tests (Halber, Mydlarski 1925). Subsequent major studies were carried out 20 and 30 years after the pioneer work (Kelus et al. 1953; Sablińnski 1959; Socha 1963, 1966).

Analysing the past in retrospect of the forty years which have passed since the last study covering the enire area of Poland (Kelus et al. 1953), an interesting question arose. The question was whether the percentage structure of blood groups remained unchanged. The attempt to answer this question, and obtaining relevant serological characteristics for this puropse are the objectives of this work.

Materials and methods

Materials for the serological characteristics of Poland were collected as a results of over 355,000 individual blood tests from almost all regions of Poland. This num-

ber covers approximately 1% of the whole population of the country. Data were obtained both from blood donation centres and from hospital laboratories, and thus from blood donors, hospital patients (pregnant women in particular) and from drivers and persons referred by courts of justice to specialist laboratories for medical expertise. This variety of the purposes for blood tests brings the examined group closer to the actual cross-section of society than a group consisting only of patients (influence of blood groups upon the incidence of some diseases) or a group consisting only of persons examined at blood donation centres where the high frequency of 0 group could be taken for granted (Sabliński 1959) as more desirable due to its suitability for use in critical situations as well as due to the fact that individuals with 0 group seem to be more resistant to infections (Charzewski et al. 1965).

The determination of the main blood groups and the Rh factor was performed according to the guidelines of the Ministry of Health and Social Care and of the Haematology Institute (Zasady... 1974, Przepisy... 1985) for blood donation centres and hospitals in Poland. Blood samples were drawn by two persons. The analyses were performed independently. In tests for the AB0 system, a series of anti-A, anti-B and anti-AB standard serums and 0, A, B standard corpuscles were used. In the tests for the Rh factor anti-D serum was used. In the case of Rh- factor individuals, an additional analysis was carried out with the application of anti-C and anti-E standard serums. In 63% of studied individuals the test for the anti-gene AB0 system was accompanied with A_1 and A_2 subgroups tests. However, the results obtained may have been influenced by the fact that since 1987 in the determination of the main blood groups A_1 and A_2 antigens, and in the case of the Rh factor test, C, E, and D_4 antigens, have been determined only in blood donors. In consequence, the results obtained, for example, only from sick people's tests may suggest that those subgroups have stopped to occur in Poland.

Further data pertaining to the place of sampling (blood donation centres, hospital laboratories), the composition of the studied group (the sick, the healthy), the scope and period the results refer to are shown in Table 1.

Results

Data from various localities in Poland referring to the frequencies of blood groups in the AB0 system are presented in Table 1. Their differentiation is illustrated in Figure 1. The analysis of these data indicates that in majority of cases the blood group make-up is very similar. Only the data from Wałbrzych and Toruń 2 differ to a higher degree from the serological make-up of other localities calculated on the basis of all considered data. The data for Wałbrzych show the highest percentage of individuals with 0 blood group and the lowest percentage of the remaining groups. In turn, the results obtained in Toruń 2 show the lowest percentage of individuals

Table 1

Frequences (in%) of the blood groups in the AB0 system depending of the region of Poland

Populations	Years of investigation	Remarks*	N	0	A	B	AB
Toruń 1^{DS}	85 – 93	1, 4, 6, 7	16 065	33.56	37.85	19.76	8.83
Grójec^{H}	89 – 93	2, 5	35 236	35.02	37.85	19.58	7.55
Gorzów Wielkopolski^{M}	87 – 91	2, 5	43 812	32.58	39.54	19.78	8.10
Ełk^{DS}	85 – 90	2, 4, 6, 7	16 890	31.00	40.60	18.53	9.87
Bydgoszcz^{DS}	87 – 91	2, 5, 6, 7	12 065	32.58	38.04	19.95	9.43
Świecie^{H}	87 – 91	2, 5, 6, 7	21 166	32.22	40.31	18.51	8.96
Nowe Miasto Lubawskie^{DS}	86 – 90	2, 5, 6, 7	8 917	33.35	38.09	20.24	8.32
Szczecin^{DS}	86 – 90	2, 4, 6, 7	20 743	33.75	37.70	20.26	8.29
Skierniewice^{M}	82 – 86	2, 4, 6, 7	5 884	31.65	38.38	21.22	8.75
Łask^{M}	79 – 87	2, 5, 6, 7	4 262	33.37	38.50	19.71	8.42
Minsk Maz. & Siedlce^{DS}	81 – 85	2, 4, 6, 7	18 462	35.64	38.80	18.16	7.39
Wolsztyn^{M}	80 – 85	2, 5, 6, 7	10 623	34.83	39.28	18.11	7.78
Toruń 2^{M}	81 – 85	2, 5, 6, 7	40 812	29.19	40.38	21.10	9.33
Olsztyn^{DS}	78 – 82	2, 5, 6, 7	19 010	34.17	38.70	19.24	7.89
Milicz^{M}	79	3, 6, 7	24 848	35.77	38.16	18.33	7.74
Chełmża^{M}	75 – 94	2, 4, 6, 7	11 020	33.07	38.63	19.56	8.74
Malbork^{M}	84 – 95	2, 5, 6, 7	18 957	32.51	39.51	19.60	8.38
Wałbrzych^{M}	75 – 94	3, 5, 6	2 196	38.25	36.70	17.81	7.24
Płock^{DS}	90 – 95	3, 5, 6	10 377	33.00	37.87	20.69	8.44
Sztum^{M}	89 – 95	2, 5, 6, 7	14 617	33.99	37.98	19.70	8.33
Min				29.19	36.70	17.81	7.24
Max				38.25	40.60	21.22	9.87
Total			355 962	**33.11**	**38.91**	**19.58**	**8.40**
Poland (Kelus et al. 1953)			40 000	**33.37**	**38.51**	**19.51**	**8.62**
Differences: Poland (1978–1995) – Poland 1953				0.26	0.40	0.07	0.22

* Characteristics of the data: 1 – only males; 2 – separately males and femals; 3 – together males and femals; 4 – Rh factor together with the AB0 system; 5 – Rh factor separately from the AB0 system; 6 – subgroups A_1, A_2; 7 – subgroups A_1B, A_2B; DS – data only from patients of blood donatory station; H – data only from patients of hospitals; M – mixed data.

with 0 blood group and the maximum percentage of A, B, and AB groups. In the two above mentioned places, in relation to other localities, the differences in frequency oscillate from 2.63% (AB group) to 3.90% (A group). The serological make-up of all the individuals examined is also very similar to the prevailing serological

make-up of Poland ascertained by Kelus et al. (1953). The greatest difference (0.40%) was noted in the frequency of the occurrence of A group and the smallest one – (0.07%) of B group. The percentage participation of A and AB subgroups is

Table 2

Frequences of the subgroups A_1, A_2, A_1B, A_2B in Poland

	$A_1 + A_2 = 103\,594$		$A_1B + A_2B = 21\,408$	
	A_1	A_2	A_1B	A_2B
Percent	**84.85**	**15.15**	**81.21**	**18.79**
Min	82.05	11.00	75.73	12.69
Max	89.00	17.95	87.39	24.27
Poland (Kelus et al. 1953)	**88.36**	**11.64**	–	–

presented in Table 2. Compared to the results from 1953 (Kelus et al. 1953) a higher percentage of A_2 subgroup and a lower percentage of A_1subgroup is observed. Serological make-up of the individuals examined in division into sexes is shown in Table 3. Differences in the frequency of occurrence of particular blood groups in both sexes are not great (the greatest one amounts to 0.40% for A group). Distribution of the Rh factor in the studied population and its comparison with the data from 1953 (Kelus et al. 1953) as well as its sexual differentiation are presented in

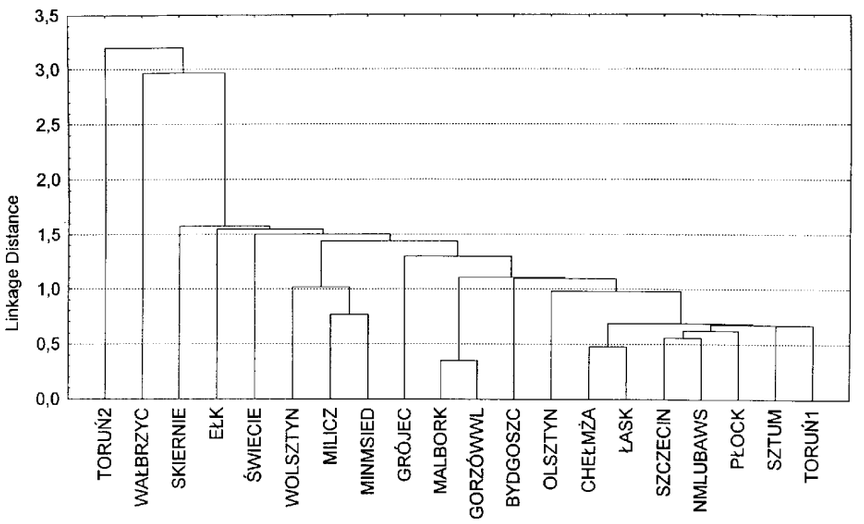

Fig. 1. Tree diagram of euclidian distances between the data from several localities

Table 3

Frequencies of the blood groups in the AB0 system depending on the sex of Poland

Group	n		0	A	B	AB
Male	176 161	n	58 088	68 425	34 603	15 045
		%	32.,97	38.84	19.65	8.54
Female	142 380	n	46 625	55 881	27 990	11 884
		%	32.74	39.25	19.66	8.35
Male + female	318 541	n	104 713	124 306	62 593	26 929
		%	32.87	39.02	19.65	8.45
Differences (male – female) in %			0.23	–0.41	–0.01	0.19

Table 4

Frequencies of the Rh factors in Poland in the years 1978–1995 depending on the sex

Group	N	Rh^+		Rh^-	
		n	%	n	%
Male	176 161	141 927	80.57	34 234	19.43
Female	142 380	113 448	79.68	28 932	20.32
Male + female	318 541	255 375	80.17	63 166	19.83
Differences (male – female) in %			0.89		–0.89
Total	353 766	284 186	80.33	69 580	19.67
Poland (Kelus et al. 1953)	10 000	8 313	83.13	1 687	16.87
Differences Poland (1978–1995) – Poland 1953			–3.20		3.20

Table 5

Frequencies of the blood groups in the AB0 system depending on the Rh factor in Polish men in the years 1978–1995

Group	N	Rh^+		Rh^-	
		n	%	n	%
0	21 995	18 097	82.28	3 898	17.72
A	25 225	20 595	81.65	4 630	18.35
B	13 267	10767	81.16	2 500	18.84
AB	5 530	4 479	80.99	1 051	19.01
Together	66 017	53 938	81.70	12 079	18.30

Table 6

Frequencies of the blood groups in the AB0 system depending on the Rh factor in Polish women in the years 1978–1995

Group	N	Rh^+		Rh^-	
		n	%	n	%
0	10 025	8 136	81.16	1 889	18.84
A	12 187	9 748	79.99	2 439	20.01
B	5 953	4 767	80.08	1 186	19.92
AB	2 453	2 015	82.14	438	17.86
Together	30 618	24 666	80.56	5 952	19.44

Table 4. Sexual dimorphism is not great. Similarly, the difference between the frequency of this factor calculated for the entire examined population and the frequency calculated for particular sexes of the studied individuals (a group smaller by circa 35,000) is not great. The percentages of Rh factors in relation to the distribution of

Table 7

Frequencies of the blood groups in the AB0 system depending on the Rh factor in Polish men and women in the years 1978–1995

Group	N	Rh^+		Rh^-	
		n	%	n	%
0	38 129	31 281	82.04	6 848	17.96
A	44 450	36 236	81.52	8 214	18.48
B	22 992	18 625	81.01	4 367	18.99
AB	9 623	7 812	81.18	1 811	18.82
Together	115 194	93 954	81.56	21 240	18.44

AB0 groups in men (Tab. 5) and women (Tab. 6) and in individuals of both sexes together (Tab. 7) are slightly different. This applies also to the frequencies of Rh^+ and Rh^- factors in relation to the main blood groups in men and women. These differences (excess and deficiency) tested with c^2 test are, however, statistically insignificant. Compared to the data from 1953 the difference of only 3% has been found.

Discussion

In the case of such a numerous and differentiated population sample influences of artificial, unintended selections disappear – for instance; temporary selection occurring when the research is restricted exclusively to blood donors, or conversely

– only to hospital patients. In a population so big as the one used in our studies, comparison of the frequency of the occurrence of given blood groups in various localities, but, for instance, only from blood donation centres, with the corresponding frequency calculated for the whole population examined did not differ when the compared data were obtained from the centres operating in hospitals (Tab. 1). This was probably due to the fact that hospital groups were not composed exclusively of patients but included also persons referred to for the blood tests necessary to obtain driving licence and blood donors. As a result these groups were always representing a cross-section of society and not particular population groups.

In consequence, our population sample is a good indicator of the haematological differentiation of society and it may be used in anthropological comparative studies. In spite of the lapse of 40 years since the studies conducted by Kelus et al. (1953), no negative selection (suggested by Charzewski et al. (1965)) of individuals with A group has been observed. We think that it was caused by the lack of isolation, especially that in the period between those studies great population movements took place (the war and migrations). It also seems that due to the improvement in health care this selective influence which in the past could have selected individuals with A group, is less important at present, even in relatively isolated groups. However, examples of Toruń and Wałbrzych may constitute the first signals of environmental impact upon the appearance of differences in the frequencies of occurrence of blood groups with a given antigen.

As it is evident from Table 1, with two exceptions our general data do not differ essentially from those obtained by Kelus et al. (1953). The exceptions are the groups of Toruń 2 and Wałbrzych (Fig. 1). In the Wałbrzych group, the considerably higher percentage of individuals with 0 group may be an unspecific phenomenon related to the fact that a high percentage of results came from serological centres co-operating with mine rescue services.

Migration movements might be another possible explanation of the distinct character of blood group frequencies in the area of Wałbrzych. After World War II a new generation of the miners who had emigrated to France in the inter-war period came back to these territories. If, however, in that group of people a certain influence of marriages between these two blood groups were to be evident, a certain increase in the frequencies of the occurrence of both 0 and A group and a considerable drop in the frequencies of B and AB groups should be expected. However, the changes in these two last blood groups are not great, while the increase of frequency in the case of 0 group occurrence is significant. This may be related to the preference of blood donors with this blood group in mine rescue work, or to higher incidence of the digestive tract ulcer in this area.

In Table 1 and in Figure 1 our attention is drawn by a completely different frequency of blood groups obtained from the data seemingly collected from the same source. Both of these groups are made up of individuals tested in hospital. In

spite of the fact, frequencies of the occurrence of given blood groups in Toruń 1 are similar to the average for the whole country, while those in Toruń 2 are distinctly different. A thorough comparison of these groups indicates, however, that in the group from Toruń 2 the data refer to the people from the Toruń province, while the subjects from the group of Toruń 1 are conscripts coming from all regions of Poland (soldiers). A similar model of frequency changes in the occurrence of blood groups in ill people in Toruń 2 was described by Charzewski et al. (1965). In that study in a general hospital group ill people were separated from blood donors. Whether that enormous increase of A group frequency in the Toruń province was caused by an imbalance in the proportion of blood donors, drivers and persons wanting the information on their blood group entered in their identity cards to patients, remains a problem for further studies. This thesis may be confirmed by the 1992 report on the demographic situation in Poland (Report... 1992) according to which the Toruń province has the second highest infant mortality rate in Poland. It has also the fourth highest incidence of the breathing system diseases and fifth highest incidence of cancer. As it is known, individuals with A group are especially exposed to the increased risk of cancer and breathing system diseases (Kherumian, Moullec 1957).

Since the comparison of given blood group frequencies in men and women was made using the samples of the size differing only by about 8% and considering the large size of the sample, we can conclude that we have not proved any selective influence of blood groups upon the survival rate of individuals of either of the sexes. This may be due to health care.

Discussing the fact that nowadays, in comparison with the period in Kelus et al. (1953) conducted their studies, the A_1 subgroup frequency is lower and the A_2 subgroup has increased we should not forget that it could be brought about by an unspecific factor, related to the fact that in haemotherapy A antigen compatibility is not important if there are no irregular A_1 allo-antibodies and as a result since 1978 A_1 and A_2 antigens have been determined in principle only in blood donors.

As it was shown in Table 5, in the Polish population Rh^+ factor is four times more frequent than Rh^- factor. This concerns both women and men. Since the time of the study of Kelus et al. (1953) a dropping tendency in the Rh^+ factor frequency and the rise in Rh^- factor frequency has been noted. As the number of Rh^- female individuals has increased a little, we think that this rise may result from the fact that in maternity wards (where they have their blood tested) women with serological incompatibility are hospitalised, and the majority of other women in childbirth come to hospital with blood tests results already confirmed. However, this may also be due to the fact of a higher survival rate of children born from mothers suffering from Rh incompatibility during their pregnancy. In this case, however, one should expect a rise of Rh frequency in similar proportions in men and in women.

Conclusions

1. Distribution of blood group frequencies in the studied population of Poland does not show significant differences compared to the data from 1953.

2. In our study we did not observe any relationship between a given sex and a blood group and Rh factor.

3. An increasing tendency in the frequency of Rh^- individuals was observed as well as a tendency towards the change of the distribution of blood group frequencies in the inhabitants of two highly polluted towns in Poland. If this phenomenon is indeed related to the environmental pollution it should be confirmed in the studies of other towns in Silesia.

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