138. *The Frequency of the Rh-Hr Blood Types in Japanese*

By Tanemoto FURUHATA, M. J. A., Masami UETAKE,
and Mitsuo YOKOYAMA^{*)}

Institute of Legal Medicine, Tokyo Medical and Dental University
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The discovery of the Rh blood types by Landsteiner and Wiener in 1940, together with the work of Levine and Stetson in 1939, was undoubtedly the most important event in the blood group field since the discovery of the ABO blood system forty years before.

Recently the Rh-Hr blood system has become a very important element in intragroup blood transfusion reactions,^{4,5)} in hemolytic disease of the newborn^{3,8)} in the clinical field, and in the determination of disputed paternity in Legal Medical work in Japan.

Fisher (1944) suggested that the Rh genotype was constituted by a short strip of closely linked elementary genes, one from each allelomorphic pair C:c, D:d, and E:e, thus giving eight theoretical Rh types by different combinations of the elementary antigens. Wiener⁴⁾ (1943-'45) revised the nomenclature because there is evidence of multiple allelomorphs at a single locus.

Various workers have given us a fairly complete picture of the statistical distribution of Rh-Hr blood types in the peoples of Europe and America. Now we have made a similar study of these frequencies among the Japanese and the results are reported here.

Table I
The Rh gene-complex percentage frequencies
in Japanese and English

Gene-complex	Japanese %	English ^{*)} %
cde	5.94	38.86
Cde	0.00	0.98
cdE	5.43	1.19
cDe	5.43	2.57
CDe	67.12	40.76
CDE	2.33	0.24
cDE	13.75	14.11

^{*)} The frequencies of the gene-complex involving C^w in English are omitted from this table.

^{*)} United Nations Blood Bank, 406 Medical General Laboratory, Tokyo.

Rh gene-complex frequencies were calculated by the "simpler method" of Race,⁶⁾ which is based on Fisher's "maximum likelihood method".⁷⁾

Table I shows the frequency of the Rh gene-complexes in this group as contrast with a similar study made in England (Race, Mourant, Lawler, and Sanger, 1948).

Table II
The Rh genotypes of Japanese and English

Antisera C + C ^w D E c	Observed number	%	Frequency in English (if only four sera are used)	Genetic and antigenic constitu- tion	Expected genotype percentage frequency in Japanese	Expected genotype percentage frequency in English
+ + - -	383	45.0588	18.5073	CDe/CDe CDe/Cde	45.0509 —	16.6097 0.8016
+ + + +	264	31.0588	13.4178	CDe/cDE cDe/cdE cDE/Cde CDE/cde cDE/CDE cDe/CDE cdE/CDE	18.4580 7.2892 — 0.2768 0.6408 0.2530 0.2530	11.5000 0.9685 0.2775 0.1893 0.0687 0.0125 0.0058
- + + +	98*)	11.5294	14.0769	cDE/cde cDE/cDE cDE/cDe cDE/cdE cDe/cdE	1.6355 1.8906 1.4933 1.4933 0.5897	10.9657 1.9906 0.7243 0.3353 0.0610
+ + - +	58	6.8235	34.8899	CDe/cde CDe/cDe CDe/Cde	7.9738 7.2892 —	31.6759 2.0922 0.0505
+ + + -	27	3.1765	0.2101	CDe/CDE Cde/CDE CDE/CDE	3.1278 — 0.0543	0.1985 0.0048 0.0006
- - + +	8	0.9412	0.9376	cdE/cde cdE/cdE	0.6451 0.2949	0.9235 0.0141
- + - +	8*)	0.9412	2.0609	cDe/cde cDe/cDe	0.6451 0.2949	1.9950 0.0659
- - - +	3	0.3529	15.1020	cde/cde	0.3528	15.1020
+ - + +	1	0.1177	0.0234	cdE/Cde CdE/cde CdE/cdE	— — —	0.0234 0.0000 0.0000
+ - - +	0	0.0000	0.7644	Cde/cde	—	0.7644
+ - - -	0	0.0000	0.0097	Cde/Cde	—	0.0097
+ - + -	0	0.0000	0.0000	CdE/Cde CdE/CdE	— —	0.0000 0.0000

*) One out of 98 cases and two out of 8 cases showed D^u factors with anti-human-globulin test (Coombs' test).

Materials and Methods

All blood samples were collected from unselected individuals. No anticoagulant was used and the bloods were allowed to clot before testing with anti-C, anti-D, anti-E and anti-c serum by the capillary tube method^{1,2)} (Wadley Blood Research Institute). Unfortunately anti-d and anti-e sera were unavailable to us at the time. The testing methods used were similar to the standard procedures and techniques of the Wadley Blood Research Institute⁹⁾ and the American Association of Blood Banks.¹⁰⁾

Results

A total of 850 individuals of Japanese race living in the Metropolitan Tokyo area were examined for their Rh-Hr blood types.

Table III

The observed percentage frequencies of the Rh phenotype in Japanese and English

Antisera			Phenotype	Japanese		English
C+C ^w	D	E		Observed number	%	%
+	+	-	CDe, C ^w De	441	51.88	53.40
+	+	+	CDE, C ^w DE	291	34.24	13.63
-	+	+	cDE	98*)	11.53	14.08
-	-	+	cdE	8	0.94	0.94
-	+	-	cDe	8*)	0.94	2.06
-	-	-	cde	3	0.35	15.10
+	-	+	CdE	1	0.12	0.02
+	-	-	Cde	0	0.00	0.77
Total				850	100.00	100.00

*) One out of 98 cases and two out of 8 cases showed D^u factors with Coombs' test. D^u has been classified as D in our study.

In Table II is shown the expected percentage of probable genotypes found in this investigation, while Table III gives the observed phenotype percentage frequencies. For purposes of comparison, the corresponding frequencies of English studies are included.

In Table IV will be found the percentage of gene frequencies

and the calculated homozygous and heterozygous frequencies of each gene pair.

Table IV ⁽¹⁾

The Rh gene percentage frequencies in Japanese and English

Gene	Japanese %	English %	Gene	Japanese %	English %
C	69.45	43.27*)	c	30.55	56.73
D	88.63	58.97	d	11.37	41.03
E	21.51	15.54	e	78.49	84.46

*) The frequency of the C^w gene is included.

Table IV ⁽²⁾

The calculated homozygous and heterozygous frequencies of each gene pair in Japanese

Homozygous or heterozygous of C and c	%	Homozygous or heterozygous of D and d	%	Homozygous or heterozygous of E and e	%
CC	48.23	DD	78.55	EE	4.63
Cc	42.44	Dd	20.16	Ee	33.76
cc	9.33	dd	1.29	ee	61.61

Table V lists the observed number of bloods that reacted with the different antisera that were used.

Table V

The observed percentage frequency of positive and negative reactions given by the anti-Rh sera

Antisera	Positive reaction group			Negative reaction group		
	Japanese		English	Japanese		English
	Number	%	%	Number	%	%
anti-C	703	82.71	67.82	147	17.29	32.18
anti-D	838	98.59	83.16	12	1.41	16.84
anti-E	403	47.41	28.67	447	52.59	71.33
anti-c	440	51.76	81.27	410	48.24	18.73

All specimens which failed to react with anti-D were further tested by the anti-human-globulin technique (Coombs' test). If the cells were agglutinated by anti-human-globulin, they were designated as D^u. No attempt was made to determine the presence of C^w, C^u, c^v or E^u factors.

Summary

As a result of this examination of 850 random bloods, we note some rather pronounced differences in the Rh antigenic structure of Japanese as compared to other races previously studied.

cdE, CDe and CDE gene-complexes are much more common in Japanese than in Europeans, while cde is rarely found in Japan.

Turning to the expected genotype frequencies, we find that CDe/CDe, CDe/cdE and CDe/CDE are more common in Japanese, while CDe/cde, cDE/cde and cde/cde are much rarer.

On the frequencies of the phenotype, it follows also that CDE is much higher and cde incidence is much lower in Japanese than in English.

Again, the gene or antigen frequencies of C, D and E are greater in Japanese than in English, and on the contrary, c, d and e are far less numerous in Japanese than in English.

Lastly, the positive and negative reaction groups to anti-C, anti-D, anti-E and anti-c sera were given; it is obvious from the foregoing work that the positive reactions with anti-C, anti-D and anti-E sera are more numerous, and positive reaction with anti-c is fewer among the Japanese than in the English people.

References

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