R. E. Gaensslen,[1] *Ph.D.; Suzanne C. Bell,*[2] *M.S.; and Henry C. Lee,*[3] *Ph.D.*

Distributions of Genetic Markers in United States Populations: I. Blood Group and Secretor Systems

REFERENCE: Gaensslen, R. E., Bell, S. C., and Lee, H. C., **"Distributions of Genetic Markers in United States Populations: I. Blood Group and Secretor Systems,"** *Journal of Forensic Sciences,* JFSCA, Vol. 32, No. 4, July 1987, pp. 1016-1058.

ABSTRACT: All published and unpublished population frequency data that could be located for U.S. populations are tabulated and presented for the blood group and secretor systems. Results obtained by combining data for comparable racial/ethnic groups are also presented. The results obtained with combined data may give better information on frequencies for the U.S. population at large than is obtainable from studies conducted in restricted geographic areas.

KEYWORDS: forensic sciences, genetic typing, demography, population genetics, genetic markers, genotypic frequencies, phenotypic frequencies, ABO blood group system, Rh blood group system, MN blood group system, MNSs blood group system, Kell blood group system, Duffy blood group system, Kidd blood group system, Lewis blood group system, secretor system

Forensic serology has witnessed extraordinary growth and development in the past 25 years, reflective of the significant advances in immunology and human genetics. Important aspects of this progress have been the unraveling of many human polymorphic genetic marker systems and the discovery of new ones. Workers involved in disputed parentage testing now have a substantial number of genetic marker systems from which to construct routine testing protocols. The choice of systems having relatively high exclusion probabilities, especially the human leukocyte antigens (HLA) system, has enabled calculations of the probability of paternity in nonexclusion cases [*1-3*]. Moreover, a wider range of genetic marker systems than ever before is available to criminalists for the partial individualization of blood and physiological fluid stains [*4-10*]. To interpret and appreciate better the significance of typing results, both parentage and criminalistics applications of genetic marker testing often require knowledge of genotypic and phenotypic frequencies in applicable populations.

Thousands of frequency studies on various genetic marker systems have been carried out on many populations throughout the world, the most complete compilation of them being

Supported in part by Grants 76-NI-99-0107 and 78-NI-AX-0001 from the National Institute of Justice, U.S. Department of Justice, Washington, DC to REG. Various aspects of this work presented in part at the 8th Annual Meeting of the Northeastern Association of Forensic Scientists, Albany, NY, 1982; the 35th Annual Meeting of the American Academy of Forensic Sciences, Cincinnati, OH, 15-19 Feb. 1983; and the International Symposium on Forensic Applications of Electrophoresis, FBI Academy, Quantico, VA, 1984. Received for publication 15 Aug. 1986; accepted for publication 23 Sept. 1986.

[1]Professor and director, Forensic Sciences Program and Laboratories, University of New Haven, West Haven, CT.

[2]Organo-analytical chemist, Los Alamos National Laboratories, Los Alamos, NM.

[3]Chief criminalist and director, Connecticut State Police Forensic Science Laboratory, Meriden, CT.

the extraordinary work by Mourant et al. [*11*]. A number of papers and studies have appeared which compile or analyze or both frequency data for many different genetic marker systems for the populations of entire countries, such as Japan [*12–14*], Ireland [*15*], and England [*16–18*]. Genetic marker frequency data from the many different studies of United States populations, however, have not to our knowledge been thoroughly compiled.

In this and two planned following papers, we summarize all the published and some unpublished population frequency data that could be located for U.S. populations for 22 genetic marker systems, along with the results obtained by combining data from different studies. In this paper, we summarize the sources and methods employed and report data for the classical blood group and secretor systems.

Methods

In connection with the preparation of a lengthy review book [*10*], all population frequency studies of U.S. populations published since 1950 that could be located were collected, in addition to data from papers presented at professional meetings and unpublished studies. The data from a number of additional published and unpublished studies that have since appeared are included in the present work as well.

Within the separate tables, each representing a different genetic marker system, data are tabulated separately for Caucasian, Negro, Hispanic, Chinese, and Asian populations. Each population studied is identified by location (city and state; two-letter abbreviations have been used for the states) and by any description provided by the original author(s). Each row (and in a few cases, several related rows) of each table represents a different study, and a reference is provided. References to population studies are given a "T" (for "Table") prefix in the tables, and are separately compiled at the end of the paper. Data for each phenotype within each system are reported using a *NNN*(%.%) format, where *NNN* represents the number of individuals who possessed the phenotype and %.% represents the percentage rounded to one decimal place.

The total number of people studied is also given, and is not always the sum of the major phenotypes because rare phenotypes were observed. The notes in each table provide data for rarer types, unusual or descriptive features of a population, or explanations about the calculations.

Data from studies of the ABO system in which anti-A_1 was used, that is, the data in Table 3, were used to compute simple ABO frequencies which are included in Table 1. Similarly, data from studies of the MNSs system (Table 8) were used to compute data for the MN system and the computed data included in Table 7.

Where sufficient data were available, two types of calculations were used to combine all the data for a particular racial/ethnic class within a genetic marker system. Some authors provided the actual numbers of individuals possessing the different phenotypes, whereas others expressed the distributions in percentages. We calculated percentage values for the data sets that provided numbers of individuals. For data sets that provided percentages, only the percentages given by the original author(s) are tabulated. As a result, every data set has a set of percentage distributions, but some sets do not have numbers of individuals. The first calculation sums the numbers of individuals for all data sets showing numbers, and a percentage value for each phenotype is computed from the resulting totals. This result is referred to as the "numerical total." The second calculation was carried out on every group of data for a particular racial/ethnic group for which at least two independent percentage distributions were available. In the second calculation, the percentage distributions for each phenotype are weighted according to the number of individuals typed and what is referred to as the "weighted mean of proportions," or "WMP," is computed according to: WMP = $\Sigma np/N$, where n is the number of individuals in a particular data set, p is the corresponding phenotypic proportion, and N is the total number of people in the racial/ethnic group. A

weighted standard deviation of proportions (WSDP) is calculated for each WMP according to $\sqrt{\Sigma\ np^2/N - (\mathrm{WMP})^2}$, where n, p, N, and WMP have the meanings defined above.

All available data were included in the tables for completeness, but in some circumstances a data set was not used in the calculations. These circumstances include cases in which: (a) one study included the data from another study by the same author(s); (b) a data set was incomplete for all phenotypes (as, for example, an Rh study in which anti-e was not employed and Rh_2Rh_2 was indistinguishable from Rh_2rh); and (c) one data set was provided for a group of individuals related to those in another data set, such as mothers and their infant children.

In the Kell, Duffy, and Kidd data, separate calculations were carried out on data from studies in which only one of the antisera was used in testing.

Gene frequencies were calculated for data sets in which there was sufficient information to enable the calculation. Those for the ABO and A_1A_2BO systems were calculated using the maximum likelihood methods of estimation described by Stevens [*19*]. The method applicable to ABO was also used for calculation of Fy^a, Fy^b, and Fy in populations that showed four Duffy types. Rh and MNSs gene frequencies were calculated by the methods described by Mourant et al. [*11*], which give estimates nearly as good as true maximum likelihood methods [*20,21*]. Gene frequencies for two-allele three-phenotype systems (MN, some Kell, Kidd, and Duffy data) were calculated by gene counting. Gene frequencies for two-allele two-phenotype systems (Kell, using only anti-K; Duffy, using only anti-Fy^a; Kidd, using only anti-Jk^a; Secretor) were estimated by the square root method. This method assumes that all K−, Fy(a−), and Jk(a−) people are, respectively, kk, Fy^bFy^b, and Jk^bJk^b homozygotes, and that nonsecretors are *sese*. The square root of the phenotypic distribution of the assumed homozygotes provides an estimate of the frequency of one gene. An estimate of the other is obtained by difference from unity. No gene frequency calculations were attempted for the Lewis system, as the data are for red cell Lewis types [*11*].

A chi-square value was calculated for every data set for which gene frequencies could be meaningfully calculated and for the corresponding numerical totals. Chi-square values were not calculated for data sets in which gene frequencies were estimated by the square root method. It is common practice in human genetic studies to regard data with some concern if χ^2 values corresponding to $P < 0.05$ are obtained. Observed frequencies in such cases are said to represent "significant" deviations from expectation under Hardy Weinberg equilibrium assumptions. Data yielding χ^2 values corresponding to $P < 0.01$ are said to represent "highly significant" deviations. Chi-square values must be interpreted in context, however. In some data sets, there are phenotypic classes with small numbers and small differences between observed and expected values can yield disproportionately large contributions to the chi-square statistic. In the tables where gene frequency data are presented (except in those where gene frequencies were obtained by the square root method, as noted above), data sets having χ^2 values corresponding to $P < 0.05$ or $P < 0.01$ are indicated.

In the Rh system, tabulation and WMP calculations were carried out for seven major phenotypes. Less common phenotypes are reported in the table notes. Phenotypes having C^w or D^u were not included with the corresponding major phenotypes (that is, $Rh_1^wRh_1$ were not included with Rh_1Rh_1, and so forth) but are reported in table notes. For data sets containing sufficient data, frequencies were estimated for all the Rh genes except r^y, and in these cases, all the phenotypes except those having r^y, C^w, or D^u had to be taken into account. In a few data sets, the original authors' gene frequencies are cited. These are indicated in table notes, and in those cases C^w or D^u types may be included within the major Rh phenotypes. In some cases, frequencies of the four major genes were estimated from data for the seven major phenotypes.

Most computations were carried out on a Data General MV 8000 mainframe computer with programs written in FORTRAN.

Results and Discussion

In Tables 1 through 14 are reported the phenotypic distribution and, where applicable, the estimates of gene frequencies for the ABO, A_1A_2BO, Rh, MN, MNSs, Kell, Duffy, Kidd, Lewis, and Secretor systems, respectively. Tables 2, 4, 6, and 9 show the gene frequency estimates for applicable data in Tables 1, 3, 5, and 8, respectively.

In addition to tabulating all the data, phenotypic proportions for all individuals typed as well as a WMP were calculated for each phenotype within each system for each major racial/ethnic group as described under **Methods**. Populations are defined by the size of the effective interbreeding gene pool rather than by geographical boundaries, especially in a country like the United States where mobility is very high. According to this reasoning, which we have discussed elsewhere [*22,23*], it might be useful in certain circumstances to have frequency estimates for larger and presumably better randomized samples of the population at large than would result from local population studies. Computation of WMP for systems in which a number of different studies have been done and in which fairly large numbers of people have been typed provides a possible approach to obtaining such an estimate.

The results suggest that the approach may be a useful one. Although there are no large studies on randomly sampled individuals throughout the United States in every racial/ethic group against which to compare the WMP values, a recent study has been carried out on a completely ascertained, randomly selected, country-wide population of Caucasian and Negro teenagers [*T30*]. Table 15 shows a comparison between WMPs obtained by the method in the present work with the values obtained in the U.S. study. The WMP values used for comparison in Table 15 were obtained from all available data except that the data from the U.S. study was omitted. If the U.S. data are regarded as "expected" and the WMP data as "observed" in a chi-square goodness-of-fit test, only one system shows a significant deviation, the A_1A_2BO set for Negroes. The greatest contribution to the chi-square statistic in this instance is the A_2 class, which is very small. Although only a few of the blood group systems could be compared with the U.S. study, results obtained with those which could indicate that WMP may give a reasonably good estimate of the phenotypic proportions based upon the population data which has been gathered.

Our expectation that the aggregation of appropriate data for a given ethic/racial category for a particular system would yield larger, better randomized data sets for gene frequency calculations was not altogether realized, at least to the extent that in some cases the numerical total values showed noteworthy deviations from expectation. In some cases, the results are understandable because of the small numbers in certain phenotypic classes. In other cases, there were not very many population studies amenable to aggregation. Another factor to be considered is the difficulty of defining ethnic/racial groups which can properly be regarded as belonging to an effective interbreeding gene pool.

In the studies on the ABO system for which gene frequencies were calculated (Table 2), several data sets and the Caucasian and Hispanic totals showed deviations from expectation based on Hardy Weinberg equilibrium assumptions. In every case, however, the greatest contribution to the chi-square statistic results from Group AB, the smallest class. Similarly, in the A_1A_2BO studies (Table 4) data sets showing significant deviations from expectation were accounted for by the AB phenotypes. A number of Rh data sets (Table 6) did not show goodness of fit on the basis of chi-square, which was computed separately for the major types and for all types. MN data (Table 7) including the aggregate totals showed good fit for the most part. Highly significant deviations from expectation are seen in two studies.

Caucasian data sets for MNSs (Table 9) were mostly within expectation. The Negro data sets, however, uniformly showed highly significant deviations from expectation. The largest Hispanic data set showed highly significant deviations, and so did the Hispanic total as a result. Kell (Table 10) three-phenotype data, including the totals, showed good fit through-

TABLE 1—*Phenotypic frequencies of ABO blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent) O	A	B	AB	Note	Reference
			CAUCASIAN				
New York, NY	3 268	1 470(45.0)	1 199(36.7)	425(13.0)	166(5.1)	1,2	*T1*
Minnesota	300	(40.0)	(45.7)	(11.7)	(2.6)	3	*T2*
Iowa City, IA	49 979	22 392(44.8)	21 144(42.3)	4 695(9.4)	1748(3.5)		*T3*
Iowa City and Des Moines, IA	6 313	(45.8)	(41.6)	(9.0)	(3.6)	3	*T4*
Brooklyn, NY							
Leukemia patients							
Jewish	665	226(34.0)	261(39.2)	120(18.0)	58(8.7)		
Non-Jewish	639	291(45.5)	235(36.8)	90(14.1)	23(3.6)		
Blood donors							
Jewish	375	142(37.9)	165(44.0)	46(12.3)	22(5.9)		
Non-Jewish	548	281(51.3)	184(33.6)	62(11.3)	21(3.8)		*T5*
Seattle, WA							
University students	5 657	2 399(42.4)	2 458(43.5)	599(10.6)	201(3.6)		*T6*
St. Louis, MO							
Veteran's Hospital	359	169(47.1)	149(41.5)	29(8.1)	12(3.3)		
Control donors	32 945	14 918(45.3)	13 611(41.3)	3 248(9.9)	1168(3.5)		*T7*
Iowa City, IA							
Control donors	1 261	563(44.6)	512(40.6)	144(11.4)	42(3.3)	2	*T8*
New Haven, CT							
Students	1 000	431(43.1)	422(42.2)	110(11.0)	37(3.7)		*T9*
New York, NY							
Memorial Hospital							
Donors	4 738	2 029(42.8)	1 828(38.6)	636(13.4)	245(5.2)		
Transfused patients	2 332	976(41.9)	932(40.0)	291(12.5)	133(5.7)		
Tumor patients	525	192(36.6)	233(44.4)	70(13.3)	30(5.7)		*T10*
Southeastern GA	333	172(51.7)	136(40.8)	20(6.0)	5(1.5)	2	*T11*
Boston, MA							
Rheumatoid	608	276(45.4)	246(40.5)	55(9.0)	31(5.1)		
Nonrheumatoid	605	281(46.4)	225(37.2)	76(12.6)	23(3.8)	2	*T12*

Pittsburgh, PA							
School population	1 578	609(38.6)	630(39.9)	250(15.8)	89(5.6)		
County fair sample	3 871	1 586(41.0)	1 595(41.2)	489(12.6)	201(5.2)		
Male blood donors	1 959	840(42.9)	742(37.9)	253(12.9)	124(6.3)		*T13*
Salt Lake City, UT							
College age	247	111(44.9)	108(43.7)	23(9.3)	5(2.0)		*T14*
Oakland-Eastern San Francisco Bay Area, CA							
Mothers	4 928	(44.9)	(40.9)	(10.3)	(3.8)		
Newborns	4 928	(45.4)	(39.8)	(11.2)	(3.5)	3,14	*T15*
San Francisco Bay Area, CA							
Caucasians	8 962	4 067(45.4)	3 639(40.6)	958(10.7)	298(3.3)		
"Caucasians of Western European Origin"	5 056	2 361(46.7)	2 033(40.2)	507(10.0)	155(3.1)	2,5	*T16*
New York, NY	500	229(45.8)	171(34.2)	62(12.4)	34(6.8)	2,6	*T17*
Denver, CO	3 648	1 717(47.1)	1 473(40.4)	324(8.9)	134(3.7)		*T18*
Central and Southern WV	1 412	(45.9)	(41.3)	(9.1)	(3.7)	3,7	*T19*
Tecumseh, MI	8 965	3 916(43.7)	3 907(43.6)	811(9.0)	331(3.7)	2	*T20*
Brooklyn, NY							
Kings County Hospital							
Adults	599	265(44.2)	220(36.7)	76(12.7)	38(6.3)		
Newborns	253	114(45.1)	102(40.3)	29(11.5)	8(3.2)		
Patients	68	32(47.1)	28(41.2)	8(11.8)	0		*T21*
Los Angeles, CA	205	79(38.6)	88(42.9)	31(15.1)	7(3.4)	2	*T22*
California and Hawaii	6 004	(48.2)	(35.8)	(12.1)	(4.0)	3	*T23*
Bexar County, TX	200	(54.0)	(34.0)	(8.0)	(4.0)	3	*T24*
Detroit, MI	507	(41.2)	(34.9)	(17.0)	(6.9)	2,3,8	*T25*
Greater Philadelphia, PA including part of NJ	223	103(46.2)	76(34.1)	26(11.7)	18(8.1)	2,9	*T26*
Baltimore, MD							
Postmortem samples	1 095	(44.1)	(39.7)	(11.7)	(4.5)	3	*T26*
Miami/Dade County, FL	366	189(51.6)	111(30.3)	44(12.0)	22(6.0)	10	*T27*
Los Angeles, CA							
Case material	419	190(45.3)	169(40.3)	52(12.4)	8(1.9)	10	*T28*
U.S. national sample	5 735	(44.3)	(42.1)	(10.2)	(3.6)	2,3	*T30*
CA, TX, HI, and Mexico City	914	412(45.1)	371(40.6)	85(9.3)	46(5.0)	2	*T31*
Philadelphia, PA	396	174(43.9)	158(39.9)	48(12.1)	16(4.0)		*T32*

TABLE 1—*(Continued).*

Population	Total	Frequency—Number (Percent) O	A	B	AB	Note	Reference
Los Angeles County, CA							
Case material	516	213(44.8)	211(40.9)	64(12.4)	10(1.9)		*T33*
North Carolina	773	356(46.1)	327(42.3)	70(9.1)	20(2.6)		*T34*
Connecticut							
Case material	382	169(44.2)	161(42.1)	42(11.0)	10(2.6)	2	*T35*
Southeastern MO							
Case material	344	(45.9)	(38.4)	(13.1)	(2.6)	2	*T36*
TOTAL CAUCASIAN							
Numerical total	140 681	62 597(44.5)	58 227(41.4)	14 461(10.3)	5384(3.8)		
WMP		44.7	41.2	10.3	3.8		
WSDP		1.813	1.983	1.519	0.809		
NEGRO							
New York, NY	200	(50.0)	(22.0)	(23.5)	(4.5)	2,3	*T37*
Miami, FL	502	244(48.6)	122(24.3)	117(23.3)	19(3.8)		*T38*
Washington, DC							
Howard University Students							
Series 1	1 188	(53.0)	(27.2)	(17.3)	(2.5)		
Series 2	937	(49.3)	(27.2)	(20.0)	(3.5)	2,3	*T39*
Iowa City and Des Moines, IA	6 722	(49.1)	(26.5)	(20.1)	(4.3)	3	*T4*
St. Louis, MO							
Veteran's Hospital	99	53(53.5)	24(24.2)	19(19.2)	3(3.0)		
Control donors	1 395	713(51.1)	353(25.3)	269(19.3)	60(4.3)		*T7*
Southeastern GA	300	162(54.0)	74(24.7)	58(17.4)	6(2.0)	2	*T11*
Oakland—Eastern San							
Francisco Bay Area, CA							
Mothers	1 453	(49.3)	(26.8)	(19.1)	(4.8)		
Newborns	1 453	(46.6)	(27.2)	(21.4)	(4.3)	3,4	*T15*
San Francisco Bay Area, CA	3 146	1 540(49.0)	870(27.7)	605(19.2)	131(4.2)	2	*T16*
Birmingham, AL							
School children	610	302(49.5)	163(26.7)	122(20.0)	23(3.8)		*T40*

New York, NY	500	242(48.4)	123(24.6)	110(22.0)	18(3.6)	2,6	*T17*
Central and Southern WV	133	(55.0)	(27.0)	(16.0)	(2.0)	3,7	*T19*
Brooklyn, NY							
Kings County Hospital							
Adults	1 150	580(50.4)	271(23.6)	246(21.4)	53(4.6)		
Newborns	2 933	1 441(49.1)	790(26.9)	592(20.2)	110(3.8)		
Patients	628	298(47.5)	171(27.2)	137(21.8)	22(3.5)		*T21*
California and Hawaii	1 025	(47.7)	(25.9)	(21.5)	(5.0)	3	*T23*
Bexar County, TX	200	(55.0)	(21.0)	(19.0)	(5.0)	3	*T24*
Detroit, MI	507	(53.1)	(16.2)	(26.2)	(4.6)	2,3,8	*T25*
Greater Philadelphia, PA including part of NJ	176	82(46.6)	47(26.7)	40(22.7)	7(4.0)	2,9	*T26*
Baltimore, MD							
Postmortem samples	1 289	(46.6)	(27.5)	(22.3)	(3.5)	3	*T27*
Miami/Dade County, FL	346	180(52.0)	75(21.7)	76(22.0)	15(4.3)	10	*T28*
Los Angeles, CA							
Case material	185	87(47.0)	56(30.3)	35(18.9)	7(3.8)	10	*T29*
U.S. national sample	999	(47.5)	(26.8)	(21.2)	(4.5)	2,3	*T30*
CA, TX, HI, and Mexico City	713	359(50.4)	184(25.8)	137(19.2)	33(4.6)	2	*T31*
Philadelphia, PA	1 347	630(46.8)	369(27.4)	297(22.0)	51(3.8)		*T32*
Los Angeles County, CA							
Case material	224	100(44.6)	69(30.8)	45(20.1)	10(4.5)		*T33*
North Carolina	642	322(51.6)	155(24.8)	132(21.2)	33(5.3)		*T34*
Connecticut							
Case material	67	41(61.2)	16(23.9)	8(11.9)	2(3.0)	2	*T35*
Southeastern MO	79	(50.6)	(32.9)	(15.2)	(1.3)	2	*T36*
			TOTAL NEGRO				
Numerical total	14 963	7 376(49.3)	3 932(26.3)	3 045(20.4)	603(4.0)		
WMP		49.3	26.3	20.3	4.1		
WSDP		1.808	1.937	1.551	0.612		
			HISPANIC				
Southern TX							
Mexican surnames	1 597	962(60.2)	452(28.3)	144(9.0)	39(2.4)		*T41*
San Francisco Bay Area, CA							
"Mexicans"	335	186(55.5)	91(27.2)	44(13.1)	14(4.2)	2	*T16*

TABLE 1—*(Continued).*

Population	Total	Frequency—Number (Percent) O	A	B	AB	Note	Reference
Brooklyn, NY							
Kings County Hospital							
Puerto Rican adults	288	161(55.9)	90(31.2)	27(9.4)	10(3.5)		
Puerto Rican newborns	928	533(57.4)	275(29.6)	96(10.3)	24(2.6)		
Puerto Rican patients	248	131(52.8)	78(31.5)	29(11.7)	10(4.0)		*T21*
California and Hawaii	1 596	(56.5)	(30.9)	(10.8)	(1.9)	3,11	*T23*
Bexar County, TX	200	(61.0)	(26.0)	(11.0)	(2.0)	3	*T24*
Miami/Dade County, FL	357	204(57.1)	117(32.8)	29(8.1)	7(2.0)	10	*T28*
Los Angeles, CA							
Case material	215	133(61.9)	60(27.9)	19(8.8)	3(1.4)	10,12	*T29*
CA, TX, HI, and Mexico City	1 212	801(66.1)	278(22.9)	113(9.3)	20(1.7)		*T31*
Los Angeles County, CA							
Case material	310	186(60.0)	88(28.4)	29(9.4)	7(2.3)		*T33*
Connecticut	21	12(57.1)	6(28.6)	3(14.3)	0	2	*T35*
		TOTAL HISPANIC					
Numerical total	5 511	3 309(60.0)	1 535(27.9)	533(9.7)	134(2.4)		
WMP		59.3	28.5	10.0	2.3		
WSDP		3.614	2.883	1.146	0.697		
		CHINESE					
New York, NY							
Blood donors	103	(45.6)	(27.2)	(22.3)	(4.9)	2,3	*T37*
New York, NY	817	(40.4)	(28.6)	(25.9)	(5.5)	3	*T42*
New York, NY	400	172(43.0)	108(27.0)	101(25.3)	19(4.8)	2	*T17*
New York, NY	946	395(41.8)	253(26.7)	240(25.4)	58(6.1)	13	*T43*
		TOTAL CHINESE					
Numerical total	946	395(41.8)	253(26.7)	240(25.4)	58(6.1)		
WMP		41.4	27.6	25.4	5.8		
WSDP		1.214	0.904	0.799	0.374		

			ASIAN				
California and Hawaii	3 053	(32.5)	(37.8)	(21.0)	(8.8)	3	*T23*
CA, TX, HI, and Mexico City	1 342	475(35.4)	446(33.2)	287(21.4)	134(10.0)		*T31*
			TOTAL ASIAN				
Numerical total	1 342	475(35.4)	446(33.2)	287(21.4)	134(10.0)		
WMP		33.4	36.4	21.1	9.2		
WSDP		1.333	2.103	0.178	0.546		

Notes:

1. Six were A_{12}, 1 was A_3, and 1 was A_4.
2. $A_1 - A_2$ subgrouping carried out (see Table 2).
3. Distributions given in percentages; data not used in calculating numerical totals.
4. Mothers and newborns studied; "mothers" percent distribution used in calculating WMP.
5. Includes 5056 "Caucasians of Western European Origin" in next row.
6. Two A_i and 2 A_iB found in Caucasians; 4 A_i, 2 A_iB, and 1 A_3 found in Negroes.
7. In 485 Caucasian A types, 76% were A_1, 24% were A_2; in 34 Negro A types, 82% were A_1, 18% were A_2; in 36 Caucasian AB types, 72% were A_1B, 28% were A_2B; and in 3 Negro AB types, 1 was A_1B and 2 were A_2B.
8. Data of Stolorow and collaborators.
9. Identical twin study; data for one member of each twin pair tabulated and used in calculations.
10. See Shaler, 1978 (Ref *T24*).
11. "Chicano-Amerindian."
12. Primarily Mexican.
13. Includes the data of Wiener, 1969 (Ref *T16*) above; data on the 946 people used for calculations.

TABLE 2—*Gene frequencies for the ABO system in U.S. populations.*

Population	Total Number Typed	Gene Frequency			χ^2	Reference to Population Study
		A	*B*	*O*		
	CAUCASIAN					
New York, NY	3 268	0.2371	0.0950	0.6680		*T1*
Iowa City, IA	49 979	0.2638	0.0667	0.6695		*T3*
Brooklyn, NY						
Leukemia patients						
Jewish	665	0.2779	0.1438	0.5738		
Non-Jewish	639	0.2284	0.0929	0.6133		
Blood donors						
Jewish	375	0.2916	0.0951	0.6133		
Non-Jewish	548	0.2085	0.0787	0.7129		*T5*
Seattle, WA						
University students	5 657	0.2725	0.0735	0.6540	*	*T6*
St. Louis, MO						
Veteran's Hospital	359	0.2571	0.0588	0.6842		
Control donors	32 945	0.2575	0.0694	0.6731		*T7*
Iowa City, IA						
Controls	1 261	0.2517	0.0768	0.6714		*T8*
New Haven, CT						
Students	1 000	0.2648	0.0765	0.6587		*T9*
New York, NY						
Memorial Hospital						
Donors	4 738	0.2497	0.0976	0.6526		
Transfused patients	2 332	0.2622	0.0952	0.6426		
Tumor patients	525	0.2938	0.1003	0.6059		*T10*
Southeastern GA	333	0.2410	0.0383	0.7207		*T11*
Boston, MA						
Rheumatoid	608	0.2640	0.0738	0.6621		
Nonrheumatoid	605	0.2320	0.0855	0.6825		*T12*
Pittsburgh, PA						
School population	1 578	0.2625	0.1411	0.6234		
County fair sample	3 871	0.2677	0.0934	0.6389		
Male blood donors	1 959	0.2519	0.1009	0.6472	**	*T13*
Salt Lake City, UT						
College age	247	0.2645	0.0586	0.6769		*T14*
San Francisco Bay Area, CA						
Caucasians	8 962	0.2512	0.0727	0.6761	*	
"Caucasians of Western						
European Origin"	5 056	0.2471	0.0678	0.6851		*T16*
New York, NY	500	0.2471	0.1012	0.6666	**	*T17*
Denver, CO	3 648	0.2516	0.0648	0.6836		*T18*
Tecumseh, MI	8 965	0.2738	0.0658	0.6604		*T20*
Brooklyn, NY						
Kings County Hospital						
Adults	599	0.2442	0.0996	0.6562		
Newborns	253	0.2488	0.0762	0.6751		
Patients	68	0.2354	0.0613	0.7033		*T21*
Los Angeles, CA	205	0.2694	0.0981	0.6325		*T22*
Greater Philadelphia, PA						
including part of NJ	223	0.2367	0.1029	0.6605	**	*T26*
Miami/Dade County, FL	336	0.2006	0.0939	0.7055	*	*T28*
Los Angeles, CA						
Case material	419	0.2415	0.0748	0.6837	*	*T29*
CA, TX, HI, and Mexico City	914	0.2615	0.0741	0.6644	*	*T31*
Philadelphia, PA	396	0.2515	0.0844	0.6641		*T32*
Los Angeles County, CA						
Case material	516	0.2454	0.0749	0.6796	*	*T33*
North Carolina	773	0.2581	0.0601	0.6818		*T34*

TABLE 2—*(Continued).*

Population	Total Number Typed	Gene Frequency			χ^2	Reference to Population Study
		A	*B*	*O*		
Connecticut						
Case material	382	0.2578	0.0708	0.6714		*T35*
Total Caucasian	140 681	0.2605	0.0721	0.6674	*	
		NEGRO				
Miami, FL	502	0.1523	0.1465	0.7012		*T38*
St. Louis, MO						
Veteran's Hospital	99	0.1474	0.1183	0.7343		
Control donors	1 395	0.1608	0.1257	0.7134		*T7*
Southeastern GA	300	0.1443	0.1135	0.7422		*T11*
San Francisco Bay Area, CA	3 146	0.1744	0.1248	0.7008		*T16*
Birmingham, AL						
School children	610	0.1665	0.1271	0.7063		*T40*
New York, NY	500	0.1569	0.1415	0.7016		*T17*
Brooklyn, NY						
Kings County Hospital						
Adults	1 150	0.1523	0.1396	0.7081		
Newborns	2 933	0.1678	0.1281	0.7042		
Patients	628	0.1648	0.1363	0.6953		*T21*
Greater Philadelphia, PA						
including part of NJ	176	0.1679	0.1443	0.6877		*T26*
Miami/Dade County, FL	346	0.1397	0.1413	0.7190		*T28*
Los Angeles, CA						
Case material	185	0.1884	0.1211	0.6904		*T29*
CA, TX, HI, and Mexico City	713	0.1659	0.1271	0.7072		*T31*
Philadelphia, PA	1 347	0.1710	0.1393	0.6897		*T32*
Los Angeles County, CA						
Case material	224	0.1959	0.1317	0.6723		*T33*
North Carolina	642	0.1586	0.1377	0.7037		*T34*
Connecticut						
Case material	67	0.1445	0.0775	0.7781		*T35*
Total Negro	14 963	0.1654	0.1306	0.7040	*	
		HISPANIC				
Southern TX						
Mexican surnames	962	0.1676	0.0584	0.7735		*T41*
San Francisco Bay Area, CA						
"Mexicans"	335	0.1708	0.0904	0.7389		*T16*
Brooklyn, NY						
Kings County Hospital—Puerto Rican						
Adults	228	0.1915	0.0662	0.7432		
Newborns	928	0.1776	0.0668	0.7566		
Patients	248	0.1962	0.0818	0.7220		*T21*
Miami/Dade County, FL	357	0.1921	0.0518	0.7561		*T28*
Los Angeles, CA						
Case material	215	0.1593	0.0526	0.7881		*T29*
CA, TX, HI, and Mexico City	1 212	0.1315	0.0564	0.8120		*T31*
Los Angeles County, CA						
Case material	310	0.1671	0.0598	0.7731		*T33*
Total Hispanic	5 511	0.1648	0.0624	0.7728	*	
		CHINESE				
New York, NY	400	0.1745	0.1639	0.6616		*T17*
New York, NY	946	0.1808	0.1724	0.6468		*T43*
Total Chinese	946	0.1808	0.1724	0.6468		
		ASIAN				
CA, TX, HI, and Mexico City	1 342	0.2449	0.1705	0.5847	*	*T31*

Notes:

*$\chi^2 > 3.841$.
**$\chi^2 > 6.635$.

TABLE 3—*Phenotypic frequencies of A_1A_2BO blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent) O	A_1	A_2	B	A_1B	A_2B	Note	Reference
				CAUCASIAN					
New York, NY	3 268	1 470(45.0)	948(29.0)	251(7.7)	425(13.0)	132(4.0)	34(1.0)	1	*T1*
Iowa City, IA									
Controls	1 261	563(44.7)	424(33.6)	88(7.0)	144(11.4)	31(2.5)	11(0.9)		*T8*
Southeastern GA	333	172(51.7)	97(29.1)	39(11.7)	20(6.0)	4(1.2)	1(0.3)		*T11*
Boston, MA									
Rheumatoid	608	276(45.4)	183(30.1)	63(10.4)	55(9.0)	25(4.1)	6(1.0)		
Nonrheumatoid	605	281(46.4)	173(28.6)	52(8.6)	76(12.6)	16(2.6)	7(1.2)		*T12*
San Francisco Bay Area, CA									
Caucasians	8 962	4 067(45.4)	2856(31.9)	783(8.7)	958(10.7)	228(2.5)	70(0.8)	3	
"Caucasians of Western European Origin"	5 056	2 361(46.7)	1557(30.8)	476(9.4)	507(10.0)	118(2.3)	37(0.7)		*T16*
New York, NY	500	229(45.8)	134(26.8)	37(7.4)	62(12.4)	29(5.8)	5(1.0)	4	*T17*
Tecumseh, MI	8 965	3 916(43.7)	3048(34.0)	859(9.6)	811(9.0)	234(2.6)	97(1.1)		*T20*
Los Angeles, CA	205	79(38.5)	63(30.7)	25(12.2)	31(15.1)	3(1.5)	4(2.0)		*T22*
Detroit, MI	507	(41.2)	(33.5)	(1.4)	(17.0)	(4.1)	(2.8)	2,5	*T25*
Greater Philadelphia, PA including part of NJ	223	103(46.2)	55(24.7)	21(9.4)	26(11.7)	14(6.3)	4(1.8)	6	*T26*
U.S. national sample	5 735	(44.3)	(35.2)	(6.9)	(10.2)	(2.5)	(1.1)	2	*T30*
CA, TX, HI, and Mexico City	914	412(45.1)	288(31.5)	83(9.1)	85(9.3)	36(3.9)	10(1.1)		*T31*
Connecticut									
Case material	376	169(44.9)	129(34.3)	28(7.4)	42(11.2)	5(1.3)	3(0.8)		*T35*
Southeastern MO	344	(45.9)	(32.0)	(6.4)	(13.1)	(2.0)	(0.6)	2	*T36*
				TOTAL CAUCASIAN					
Numerical total	26 220	11 737(44.8)	8398(32.0)	2329(8.9)	2735(10.4)	757(2.9)	252(1.0)		
WMP		44.6	32.6	8.4	10.5	2.8	1.0		
WSDP		1.216	2.183	1.433	1.597	0.766	0.292		
				NEGRO					
New York, NY	200	(50.0)	(15.0)	(7.0)	(23.5)	(2.5)	(2.0)	2	*T37*
Washington, DC									
Howard University students	937	(49.7)	(20.7)	(6.5)	(20.0)	(2.9)	(0.6)	2	*T39*
Southeastern GA	300	162(48.6)	50(15.0)	24(7.2)	58(17.4)	1(0.3)	5(1.5)		*T11*
San Francisco Bay Area, CA	3 146	1 540(49.0)	603(19.2)	267(8.5)	605(19.2)	84(2.7)	47(1.5)		*T16*
New York. NY	500	242(48.4)	100(20.0)	23(4.6)	110(22.0)	10(2.0)	8(1.6)	7	*T17*

Detroit, MI	507	(53.1)	(16.0)	(0.2)	(26.2)	(2.8)	(1.8)	2,5	*T25*
Greater Philadelphia, PA including part of NJ	176	82(46.6)	41(23.3)	6(3.4)	40(22.7)	6(3.4)	1(0.6)	6	*T26*
U.S. national sample	999	(47.5)	(23.4)	(3.4)	(21.2)	(2.2)	(2.3)	2	*T30*
CA, TX, HI, and Mexico City	713	359(50.4)	147(20.6)	37(5.2)	137(19.2)	20(2.8)	13(1.8)		*T31*
Connecticut Case material	66	41(62.1)	14(21.2)	1(1.5)	8(12.1)	0(0.0)	2(3.0)		*T35*
Southeastern MO	79	(50.6)	(31.7)	(1.3)	(15.2)	(1.3)	(0.0)	2	*T36*
			TOTAL NEGRO						
Numerical total	4 901	2 426(49.5)	955(19.5)	358(7.3)	958(19.5)	121(2.5)	76(1.6)		
WMP		49.5	19.9	6.2	20.3	2.5	1.5		
WSDP		2.013	2.394	2.572	2.120	0.589	0.519		
			HISPANIC						
San Francisco Bay Area, CA	335	186(55.5)	74(22.1)	17(5.1)	44(13.1)	13(3.9)	1(0.3)		*T16*
CA, TX, HI, and Mexico City	1 212	801(66.1)	239(19.7)	39(3.2)	173(14.3)	15(1.2)	5(0.4)		*T31*
Connecticut Case material	21	12(57.1)	4(19.0)	2(9.5)	3(14.3)	0	0		*T35*
			TOTAL HISPANIC						
Numerical total	1 568	999(63.7)	317(20.2)	58(3.7)	160(10.2)	28(1.8)	6(0.4)		
WMP		63.7	20.2	3.7	10.2	1.8	0.4		
WSDP		4.390	0.979	1.019	1.630	1.101	0.065		
			CHINESE						
New York, NY Blood donors	103	(45.6)	(27.2)	(0)	(22.3)	(4.9)	(0)	2	*T37*
New York, NY	817	(40.4)	(28.6)	(0)	(25.9)	(5.5)	(0)	2	*T42*
New York, NY	400	172(43.0)	108(27.0)	0	101(25.2)	19(4.8)	0		*T17*
			TOTAL CHINESE						
Numerical total	400	172(43.0)	108(27.0)	0	101(25.2)	19(4.8)	0		
WMP		41.6	28.0	0	25.4	5.2	0		
WSDP		1.653	0.759	0	0.954	0.351	0		
			ASIAN						
CA, TX, HI, and Mexico City	1 342	475(35.4)	442(32.9)	4(0.3)	287(21.4)	125(9.3)	9(0.7)		*T31*

Notes:

1. Six were A_{12}, 1 was A_3, and 1 was A_4.
2. Distributions given in percentages in original data; not used in calculating numerical totals.
3. Includes the 5056 "Caucasians of Western European Origin" in next row; only data for the 8962 used in calculations.
4. Two A_i and 2 A_iB found in Caucasians.
5. Data of Stolorow and collaborators.
6. Identical twin study; data for one member of each twin pair tabulated and used in calculations.
7. Four A_i, 2 A_iB, and 1 A_3 found in Negroes.

TABLE 4—*Gene frequencies for the A_1A_2BO system in U.S. populations.*

Population	Total Number Typed	Gene Frequency				χ^2	Reference to Population Study
		*A*1	*A*2	*B*	*O*		
		CAUCASIAN					
New York, NY	3 268	0.1819	0.0551	0.0950	0.6681		*T1*
Iowa City, IA							
Controls	1 261	0.2010	0.0509	0.0768	0.6713		*T8*
Southeastern GA	333	0.1653	0.0755	0.0384	0.7208		*T11*
Boston, MA							
Rheumatoid	608	0.1880	0.0725	0.0732	0.6663		
Nonrheumatoid	605	0.1710	0.0612	0.0854	0.6824		*T12*
San Francisco Bay Area, CA							
Caucasians	8 962	0.1903	0.0612	0.0729	0.6757		
"Caucasians of Western European Origin"	5 056	0.1823	0.647	0.0679	0.6851		*T16*
New York, NY	500	0.1793	0.0525	0.1013	0.6670	*	*T17*
Tecumseh, MI	8 965	0.2039	0.0700	0.0658	0.6603		*T20*
Los Angeles, CA	205	0.1778	0.0924	0.0979	0.6319		*T22*
Greater Philadelphia, PA including part of NJ	223	0.1674	0.0688	0.1028	0.6610	*	*T26*
CA, TX, HI, and Mexico City	914	0.1959	0.0655	0.0741	0.6646		*T31*
Connecticut	376	0.1987	0.0537	0.0691	0.6784		*T35*
Total Caucasian	26 220	0.1933	0.0635	0.0742	0.6690		

NEGRO						
Southeastern GA	300	0.0895	0.0553	0.1132	0.7421	*T11*
San Francisco Bay Area, CA	3 146	0.1160	0.0585	0.1248	0.7007	*T16*
New York, NY	500	0.1192	0.0367	0.1393	0.7049	*T17*
Greater Philadelphia, PA including part of NJ	176	0.1442	0.0237	0.1444	0.6877	*T26*
CA, TX, HI, and Mexico City	713	0.1252	0.0410	0.1265	0.7073	*T31*
Total Negro	4 901	0.1170	0.0519	0.1258	0.7054 *	
HISPANIC						
San Francisco Bay Area, CA	335	0.1390	0.0315	0.0905	0.7390	*T16*
CA, TX, HI, and Mexico City	1 212	0.1110	0.0206	0.0564	0.8120	*T31*
Total Hispanic	1 568	0.1167	0.0234	0.0638	0.7961	
CHINESE						
New York, NY	400	0.1745	0	0.1639	0.6616	*T17*
ASIAN						
CA, TX, HI, and Mexico City	1 342	0.2391	0.0063	0.1699	0.5847 **	*T31*

Notes:

*$\chi^2 > 5.991$.
**$\chi^2 > 9.210$.

TABLE 5—*Phenotypic frequencies of Rh blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent)							Note	Reference
		Rh_o	Rh_1rh	Rh_1Rh_1	Rh_2rh	Rh_2Rh_2	Rh_1Rh_2[a]	rh		
CAUCASIAN										
New York, NY	2 390	69(2.9)	798(33.4)	489(20.5)	349(14.6)		330(13.8)	321(13.4)	1,2,3	*T1*
Minnesota	300	(4.7)	(39.6)	(15.3)	(11.0)		(13.7)	(14.7)	1,2,4	*T2*
University of Iowa	2 181	91(4.2)	723(33.2)	382(17.5)	319(14.6)		303(13.9)	338(15.5)	1,5	*T43*
Southeastern GA	331	6(1.8)	112(33.8)	64(19.3)	31(9.4)	13(3.9)	44(13.3)	46(13.9)	6	*T11*
San Francisco Bay Area, CA										
Mothers	4 928	(2.6)	(34.6)	(19.6)	(11.8)	(0)	(13.5)	(13.8)		
Children	4 928	(2.3)	(34.8)	(20.4)	(11.8)	(0)	(12.5)	(13.8)	2,7	*T15*
San Francisco Bay Area, CA										
Caucasians	8 962	206(2.3)	3086(34.4)	1728(19.3)	1033(11.5)	212(2.4)	1189(13.3)	1365(15.2)		
"Caucasians of Western European Origin"	5 056	99(2.0)	1746(34.5)	912(18.0)	594(11.7)	109(2.2)	661(13.1)	853(16.9)	8	*T16*
New York, NY	500	11(2.2)	162(32.4)	111(22.2)	47(9.4)	9(1.8)	80(16.0)	60(12.0)	9	*T17*
South Central WV	1 412	(2.1)	(33.4)	(17.4)	(12.8)	(3.9)	(14.4)	(14.3)	2,10	*T19*
Tecumseh, MI	8 963	188(2.1)	3051(34.0)	1452(16.2)	1124(12.5)	208(2.3)	1124(12.5)	1412(15.8)	11	*T20*
Detroit, MI	505	(2.6)	(32.3)	(13.5)	(9.3)	(2.4)	(13.1)	(23.2)	2,12,13	*T25*
Greater Philadelphia, PA including part of NJ	200	6(3.0)	74(37.0)	38(19.0)	29(14.5)	4(2.0)	26(13.0)	23(11.5)	14	*T26*
Miami/Dade County, FL	370	10(2.7)	138(37.3)	64(17.3)	41(11.1)	12(3.2)	43(11.6)	51(13.8)	15,16	*T28*
Los Angeles, CA										
Case material	256	11(4.4)	80(32.0)	56(22.4)	24(9.6)	14(5.6)	34(13.6)	31(12.4)	15,17	*T29*
U.S. national sample	5 735	(2.4)	(35.4)	(17.6)	(12.1)	(3.1)	(14.2)	(14.1)	18	*T30*
CA, TX, HI, and Mexico City	914	37(4.1)	284(31.1)	150(16.4)	113(12.4)	13(1.4)	122(13.3)	165(18.1)	19	*T31*
Connecticut										
Case material	164	6(3.7)	50(30.5)	27(16.5)	14(8.5)	6(3.7)	35(21.3)	22(13.4)	20	*T35*
TOTAL CAUCASIAN										
Numerical total	22 841	671(2.9)	7760(34.0)	4072(17.8)	2775(12.1)	491(2.1)	3000(13.1)	3513(15.4)		
WMP		2.8	34.2	18.0	12.1	2.1	13.4	15.0		
WSDP		2.372	0.994	1.547	1.000	1.166	0.880	1.420		

NEGRO										
New York, NY	200	(46.5)	(24.5)	(2.0)	(16.0)		(5.0)	(5.5)	1,2	*T37*
Baltimore, MD	580	(43.8)	(25.6)		(15.4)		(6.3)	(7.2)	1,2,21	*T44*
Washington, DC										
Howard University students	937	(44.5)	(24.6)		(17.3)		(5.1)	(7.3)	1,2,22	*T39*
Southeastern GA	304	161(53.0)	58(19.1)	4(1.3)	49(16.3)	4(1.3)	9(3.0)	16(5.3)	23	*T11*
San Francisco Bay Area, CA										
Mothers	1 453	(47.8)	(22.9)	(2.7)	(14.1)	(0)	(3.7)	(6.1)		
Children	1 453	(48.0)	(23.8)	(2.1)	(14.4)	(0)	(3.1)	(5.7)	2,7	*T15*
Birmingham, AL	613	321(52.2)	132(21.5)	2(0.3)	77(12.6)	13(2.1)	18(2.9)	40(6.5)	24	*T40*
San Francisco Bay Area, CA	3 146	1514(48.1)	713(22.7)	69(2.2)	458(14.6)	33(1.0)	108(3.4)	201(6.4)	8	*T16*
New York, NY	500	229(45.8)	104(20.8)	10(2.0)	93(18.6)	1(0.2)	20(4.0)	34(6.8)	25	*T17*
South Central WV	133	(47.0)	(26.0)	(2.0)	(13.0)	(2.0)	(3.0)	(7.0)	2,26	*T19*
Detroit, MI	505	(50.3)	(20.8)	(1.6)	(13.5)	(1.6)	(3.6)	(7.3)	2,12,27	*T25*
Greater Philadelphia, PA										
including part of NJ	173	88(50.9)	48(27.8)	2(1.2)	18(10.4)	4(2.3)	6(3.5)	7(4.1)	14	*T26*
Miami/Dade County, FL	350	179(51.1)	73(20.9)	7(2.0)	48(13.7)	5(1.4)	14(4.0)	22(5.3)	15,28	*T28*
Los Angeles, CA										
Case material	125	63(50.4)	26(20.8)	5(4.0)	12(9.6)	3(2.4)	10(8.0)	6(4.8)	15	*T29*
U.S. national sample	999	(51.6)	(22.7)	(1.7)	(14.8)	(1.2)	(1.9)	(4.7)	2,29	*T30*
CA, TX, HI, and Mexico City	713	283(39.7)	154(21.6)	32(4.5)	94(13.2)	14(2.0)	38(5.3)	61(8.6)	30	*T31*
Connecticut										
Case material	26	9(34.6)	7(26.9)	1(3.8)	3(11.5)	0	3(11.5)	31(11.5)		*T35*
TOTAL NEGRO										
Numerical total	5 950	2847(47.8)	1315(22.1)	132(2.2)	852(14.3)	77(1.3)	226(3.8)	390(6.6)		
WMP		48.4	22.3	2.2	14.3	1.1	3.5	6.3		
WSDP		3.252	1.319	0.918	1.478	0.676	1.038	1.008		
HISPANIC										
San Francisco Bay Area, CA	335	8(2.4)	103(30.7)	81(24.2)	33(9.9)	13(3.9)	59(17.6)	20(6.0)	8	*T16*
Miami/Dade County, FL	364	25(6.9)	124(34.1)	56(15.4)	43(11.8)	9(2.5)	49(13.5)	52(14.3)	15,31	*T28*
Los Angeles, CA										
Case material	117	1(0.9)	33(28.2)	26(22.2)	12(10.3)	7(6.0)	29(24.8)	3(2.7)	15,32,33	*T29*
CA, TX, HI, and Mexico City	1 212	19(1.6)	215(17.7)	324(26.7)	91(7.5)	84(6.9)	316(26.1)	32(2.6)	34	*T31*
Connecticut										
Case material	14	1(7.1)	6(42.9)	1(7.1)	2(14.3)	0	4(28.6)	0		*T35*

TABLE 5—*(Continued).*

Population	Total	Frequency—Number (Percent)							Note	Reference
		Rh_o	Rh_1rh	Rh_1Rh_1	Rh_2rh	Rh_2Rh_2	Rh_1Rh_2[a]	rh		
TOTAL HISPANIC										
Numerical total	2 042	54(2.6)	481(23.6)	488(23.9)	181(8.9)	113(5.5)	457(22.4)	107(5.2)		
WMP		2.6	23.6	23.9	8.9	5.5	22.4	5.2		
WSDP		2.050	7.214	4.448	1.765	1.870	5.157	4.391		
CHINESE										
New York, NY	103	(1.0)	(11.7)	(53.4)	(8.7)		(24.2)	(1.0)	1,2	*T37*
New York, NY	400	1(0.3)	30(7.5)	213(53.2)	6(1.5)	19(4.8)	126(31.5)	0	35	*T17*
New York, NY	946	3(0.3)	70(7.4)	506(53.5)	21(2.2)	42(4.4)	284(30.0)	2(0.2)	36	*T43*
TOTAL CHINESE										
Numerical total	946	3(0.3)	70(7.4)	506(53.5)	21(2.2)	42(4.4)	284(30.0)	2(0.2)		
WMP		0.4	7.8	53.5	2.0	4.0	29.4	0.3		
WSDP		0.203	1.280	0.041	0.661	1.321	1.732	0.235		
ASIAN										
CA, TX, HI, and Mexico City	1 342	23(1.7)	112(8.3)	560(41.7)	46(3.4)	95(7.1)	466(34.7)	2(0.1)	37	*T31*

[a]Includes Rh_1Rh_2, Rh_1rh'', Rh_2rh', Rh_zrh, Rh_zRh_o, and Rh_orh_y.

Notes:

1. Anti-hr″ (anti-e) not used; Rh_2Rh_2 and Rh_2rh indistinguishable.
2. Data not complete for the major phenotypes or given in percentages not used in calculating numerical totals; data collected not using one or more of the five major antisera were not used in calculating WMPs.
3. 22(0.9) were rh′rh, 11(0.5) were rh″rh″, and 1 was Rh_zRh_1.
4. 0.3% were Rh_zRh_1 and 0.7% were rh′rh.
5. 25(1.2) were rh′rh″ (or rh_yrh).
6. One was Rh_zRh_1, 1 was Rh_zRh_2, 7 were rh″rh, and 2 were rh′rh: 3 of the 9 Rh_o had D^u, 2 of the 112 Rh_1rh had C^u, and 1 of the 65 Rh_1Rh_1 had C^w (Rh_1^w).
7. Mothers and their infants (children) studied; "mothers" phenotypic percentages used in calculating the WMPs. 4.3% children and 3.9% mothers among Caucasians and 2.8% children and 2.7% mothers among Negroes reported to be "other" Rh types.

8. 143(1.6) Caucasians, 82(1.6) "Caucasians of Western European Origin," 50(1.6) Negroes, and 18(5.4) Hispanic ("Mexicans") had "other" Rh types. The 8962 Caucasians include the 5056 "Caucasians of Western European Origin" in next row; the data on the 5056 "Caucasians of Western European Origin" was not used in calculating numerical totals nor WMPs.
9. One was Rh_zRh_1, 5 were $Rh_1^wRh_1$, 5 were Rh_1^wrh, 4 were rh′rh, 4 were rh″rh, and 1 was rh_yrh.
10. 0.2% were Rh_zRh_1, 0.3% were Rh_zRh_2, 0.3% were rh′rh, 0.6% were rh″rh, 0.3% were CcD^uee, and 0.1% were ccD^uEe.
11. 5 were Rh_zRh_1, 10(0.1) were Rh_zRh_2, there were one each rh′rh′, rh″rh″, and rh′rh″ (or rh_yrh), 54(0.6) were rh″rh, 38(0.4 were rh′rh, 79(0.9) were $Rh_1^wRh_1$, 37(0.4) were $Rh_1^wRh_2$, 109(1.2) were Rh_1^wrh, 15(0.2) were ccD^uEe, 33(0.4) were CcD^uee, 16(0.2) were ccD^uee, 4(0.04) were CCD^uee, and 1 was ccD^uEE.
12. Data of Stolorow and collaborators.
13. 0.2% were Rh_zRh_1, 0.4% were Rh_zRh_2, 0.2% were Rh_zRh_z, 0.6% were rh′rh′, 1.2% were rh′rh, 1.0% were rh″rh, and 0.2% were CcD^uee.
14. Identical twin study; data for one member of each twin pair tabulated and used in calculations. Among Caucasians, 2 were Rh_zRh_1, 1 was rh′rh, 4 were Rh_1^wrh, 6 were Rh_1Rh_1, C^w+, and 5 were Rh_1Rh_2, C^w+.
15. And see Shaler, 1978 (Ref *T24*).
16. 2 were Rh_zRh_1, 1 was Rh_zRh_2, 3 were rh′rh, 3 were rh″rh, 1 was rh′rh′, and 1 was rh_yrh''.
17. 2 were RzR2, 1 was RzRz, 2 were rh′rh, and 1 was rh″rh.
18. 0.2% were Rh_zRh_1, 0.5% were rh′rh, and 0.4% were rh″rh; Rh_zRh_2 Rh_zrh'' and Rh_2rh_y were included to the Rh_1Rh_2 category, and Rh_o includes those with D^u.
19. 4 were Rh_zRh_1, 3 were Rh_zRh_2, 7 were rh′rh, 5 were rh″rh, 2 were rh″rh″, 6 were CcD^uee, and there were one each of ccD^uEe, ccD^uee, and CCD^uee.
20. There were one each Rh_zRh_1, Rh_zRh_2, rh″rh, and rh′rh″.
21. Anti-hr′ (anti-c) not used; Rh_1Rh_1 and Rh_1rh indistinguishable. 1.4% were rh′rh′.
22. Anti-hr′ (anti-c) not used; Rh_1Rh_1 and Rh_1rh indistinguishable. 1.2% were rh′rh′ or rh′rh.
23. 3 were rh′rh.
24. 1 was Rh_zRh_2, 9 were rh′rh, and 1 was ccD^uee.
25. 5 were rh′rh, 3 were ccD^uee, and 1 was Rh_1^wrh.
26. 1% were rh′rh.
27. 1.2% were rh′rh.
28. 2 were rh′rh.
29. 0.9% were rh′rh and 0.4% were rh″rh; Rh_zRh_z, Rh_zrh'', and Rh_2rh_y were included in the Rh_1Rh_2 category, and Rh_o contains those with D^u.
30. 2 were Rh_zRh_1, 12 were rh′rh, 12 were ccD^uee, 7 were CcD^uee, and 4 were ccD^uEe.
31. 2 were Rh_zRh_1, 1 was Rh_zRh_2, and 3 were rh′rh.
32. Primarily Mexican.
33. 2 were Rh_zRh_2, 1 was Rh_zRh_z, 2 were rh′rh, and 1 was rh″rh.
34. 46 were Rh_zRh_1, 47 were Rh_zRh_2, 28 were R_zR_z, 2 were rh′rh, 2 were rh″rh, 2 were rh″rh″, and 4 were rh_yrh_y.
35. 4 were Rh_zRh_1 and 1 was Rh_zRh_2.
36. 15(1.6) were Rh_zRh_1, 2(0.2) were Rh_zRh_2, and 1(0.1) was rh′rh. Includes the 400 people on the line immediately above; data on the 946 people used for calculations.
37. 14 were Rh_zRh_1, 6 were Rh_zRh_2, 3 were rh′rh, 3 were rh″rh, 1 was $rh'rh_y$, 4 were CCD^uee, 1 was ccD^uee, 2 were CcD^uee, 1 was ccD^uEe, and 3 were CcD^uEe.

TABLE 6—*Gene frequencies for the Rh blood group system in U.S. populations.*

Population	Total	Gene Frequency							Note	Reference to Population Study
		R_o	R_1	R_2	R_z	r	r'	r''		
					CAUCASIAN					
Southeastern GA	327	0.0235	0.4274	0.1428	0.0034	0.3714	0.0080	0.0236		*T11*
San Francisco, CA	8 819	0.0279	0.4383	0.1500	. . .	0.3837	. . .	. . .	1,3	*T16*
New York, NY	489	0.0311	0.4595	0.1382	0.0022	0.3545	0.0116	0.0130		*T17*
Tecumseh, MI	8 669	0.0261	0.4050	0.1498	0.0007	0.4051	0.0054	0.0078	5	*T20*
Greater Philadelphia, PA including part of NJ	218	0.0433	0.4371	0.1505	0.0101	0.3521	0.0070	0.0000	6,7	*T26*
Miami/Dade County, FL	369	0.0365	0.4066	0.1403	0.0065	0.3900	0.0110	0.0090	5	*T28*
Los Angeles, CA Case material	255	0.0522	0.4402	0.1742	0.0000	0.3184	0.0108	0.0043	2	*T29*
CA, TX, HI, and Mexico City	905	0.044	0.382	0.136	0.008	0.408	0.010	0.012	6	*T31*
Connecticut	164	0.0428	0.4221	0.1850	0.0078	0.3339	0.0000	0.0084		*T35*
					TOTAL CAUCASIAN					
Major types	20 042	0.0286	0.4275	0.1532	. . .	0.3908	. . .	. . .	1,3	
All types	11 396	0.0291	0.4080	0.1492	0.0017	0.3974	0.0063	0.0083	5	
					NEGRO					
Southeastern GA	304	0.5337	0.1046	0.1086	0.0000	0.2294	0.0236	0.0000		*T11*
Birmingham, AL	613	0.5110	0.0736	0.1003	0.0000	0.2549	0.0601	0.0000	3,5	*T40*
San Francisco, CA	3 096	0.4887	0.1549	0.1021	. . .	0.2544	. . .	. . .	1	
New York, NY	496	0.4700	0.1300	0.1159	0.0000	0.2639	0.0202	0.0000		*T17*
Greater Philadelphia, PA including part of NJ	173	0.539	0.168	0.092	0.0000	0.201	0.0000	0.0000	1,6	*T26*
Miami/Dade County, FL	350	0.5019	0.1353	0.1029	0.0000	0.2481	0.0118	0.0000		*T28*
Los Angeles, CA Case material	125	0.4964	0.1840	0.1120	. . .	0.2076	. . .	. . .	1,2	*T29*
CA, TX, HI, and Mexico City	690	0.397	0.163	0.114	0.005	0.292	0.029	0.0000	6	*T31*

				TOTAL NEGRO						
Major types	2 777	0.4764	0.1338	0.1063	0.0024	0.2592	0.0219	0.0000	3	
All types	5 812	0.4838	0.1542	0.1055	. . .	0.2565	. . .	. . .	3	
				HISPANIC						
San Francisco, CA	317	0.0469	0.5110	0.1861	. . .	0.2559	. . .	. . .	1	*T16*
Miami/Dade County, FL	364	0.0808	0.3792	0.1496	0.0070	0.3726	0.0108	0.0000		*T28*
Los Angeles, CA										
Case material	116	0.0312	0.4514	0.2306	0.0000	0.2016	0.0572	0.0281		*T29*
CA, TX, HI, and Mexico City	1 212	0.040	0.490	0.235	0.061	0.138	0.005	0.016	4,6,8	*T31*
				TOTAL HISPANIC						
Major types	1 867	0.0475	0.5094	0.2298	. . .	0.2133	. . .	. . .	3	
All types	1 660	0.0499	0.4563	0.2382	0.0275	0.2155	0.0087	0.0039	3,5	
				CHINESE						
New York, NY	946	0.0262	0.7018	0.2051	0.0106	0.0451	0.0112	0.0000	2	*T43*
				ASIAN						
CA, TX, HI, and Mexico City	1 330	0.020	0.631	0.262	0.000	0.062	0.013	0.003	3,5,6,8	*T31*

Notes:

1. Frequencies of R_o, R_1, R_2, and r estimated from the seven major phenotypes.
2. χ^2 major types > 7.815.
3. χ^2 major types > 11.345.
4. χ^2 all types > 14.067.
5. χ^2 all types > 18.475.
6. Gene frequencies are those quoted by original author(s).
7. Frequency of C^w estimated to be 0.035.
8. Frequency of r^y estimated to be 0.015 for Hispanic and 0.009 for Asian.

TABLE 7—*Genotypic and phenotypic frequencies of MN blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent)			Gene Frequency	Note	Reference
		M	MN	N	*M*		
			CAUCASIAN				
New York, NY	3 263	1037(31.8)	1 621(49.7)	603(18.5)	0.5662	1	*T1*
New York, NY	954	287(30.1)	481(50.4)	186(19.5)	0.5529		*T46*
Western Alaska	784	(36.6)	(45.0)	(18.4)		2	*T47*
Minnesota	300	(35.0)	(49.7)	(15.3)		2	*T2*
University of Iowa							
Controls	2 186	587(26.9)	1 208(55.3)	391(17.9)	0.5448	**	*T44*
Southeastern GA	333	86(25.8)	166(49.8)	81(24.3)	0.5075		*T11*
Boston, MA							
Rheumatic	606	200(33.0)	293(48.3)	113(18.6)	0.5718		
Nonrheumatic	600	182(30.3)	305(50.8)	113(18.8)	0.5575		*T12*
New York, NY	332	95(28.6)	159(47.9)	78(23.5)	0.5256		*T48*
Eastern San Francisco Bay Area, CA							
Mothers	4 928	(31.3)	(48.9)	(19.9)			
Children	4 928	(28.4)	(52.4)	(19.2)		2,3	*T15*
New York, NY	900	280(31.1)	429(47.7)	191(21.2)	0.5494		*T49*
San Francisco Bay Area, CA							
Caucasians	8 962	2755(30.7)	4 411(49.2)	1796(20.0)	0.5535		
"Caucasians of Western European Origin"	5 056	1522(30.1)	2 514(49.7)	1020(20.2)	0.5496	4	*T16*
New York, NY	500	158(31.6)	249(49.8)	93(18.6)	0.5650		*T17*
South Central WV	1 051	(29.8)	(51.8)	(18.5)		2	*T19*
Tecumseh, MI	8 447	2546(30.1)	4 191(49.6)	1710(20.2)	0.5495		*T20*
Detroit, MI	461	(37.3)	(49.0)	(14.7)		2,5	*T25*
Philadelphia, PA							
including part of NJ	218	55(25.2)	119(54.6)	44(20.2)	0.5252	6	*T26*
Miami/Dade County, FL	366	108(29.5)	181(49.5)	77(21.0)	0.5423	7	*T28*
CA, HI, TX, and Mexico City	751	241(32.1)	363(48.3)	147(19.6)	0.5626		*T31*
Connecticut							
Case material	361	87(24.1)	192(53.2)	82(22.7)	0.5069		*T35*
Southeastern MO	328	(14.9)	(57.9)	(27.1)		2	*T36*

			TOTAL CAUCASIAN				
Numerical total	28 779	8704(30.2)	14 368(49.9)	5705(19.8)	0.5521		
WMP		30.5	49.8	19.7			
WSDP		2.409	1.920	1.418			
			NEGRO				
New York, NY	580	(24.1)	(49.7)	(26.2)		2	*T37*
Ann Arbor, MI	96	28(29.2)	43(44.8)	25(26.0)	0.5156		*T50*
Baltimore, MD	580	136(23.4)	280(48.3)	164(28.3)	0.4759		*T45*
Washington, DC							
Howard University students	937	(39.7)	(36.0)	(24.3)		2	*T39*
Southeastern GA	300	70(23.3)	153(51.0)	77(25.7)	0.4883		*T11*
New York, NY	204	54(26.5)	101(49.5)	49(24.0)	0.5123		*T48*
Houston, TX	263	60(22.8)	132(50.2)	71(27.0)	0.4791		*T51*
Eastern San Francisco Bay Area, CA							
Mothers	1 453	(24.4)	(50.8)	(24.9)			
Children	1 453	(23.2)	(51.3)	(25.5)		2,3	*T15*
Birmingham, AL	610	154(25.2)	298(48.9)	158(25.9)	0.4967		*T40*
New York, NY	493	120(24.3)	242(49.1)	131(26.6)	0.4888		*T49*
San Francisco Bay Area, CA	3 146	740(23.5)	1 579(50.2)	827(26.3)	0.4862		*T16*
New York, NY	500	119(23.8)	242(48.4)	139(27.8)	0.4800		*T17*
South Central WV	106	(24.0)	(48.0)	(29.0)		2	*T19*
Detroit, MI	485	(22.7)	(51.8)	(25.7)		2,5	*T25*
Philadelphia, PA							
including part of NJ	173	43(24.9)	74(42.8)	56(32.4)	0.4624	6	*T26*
Miami/Dade County, FL	345	81(23.5)	176(51.0)	88(25.5)	0.4899	7	*T28*
CA, HI, TX, and Mexico City	710	212(29.9)	294(41.4)	204(28.7)	0.5056	**	*T31*
Connecticut							
Case material	58	11(19.0)	31(53.4)	16(27.6)	0.4569		*T35*
Southeastern MO	64	(12.5)	(32.8)	(54.7)		2	*T36*
			TOTAL NEGRO				
Numerical total	7 478	1828(24.4)	3 645(48.7)	2005(26.8)	0.4882	*	
WMP		25.6	48.0	26.5			
WSDP		4.705	4.570	2.593			
			HISPANIC				
San Francisco Bay Area, CA	335	126(37.6)	173(51.6)	36(10.7)	0.6343	*	*T16*
Miami/Dade County, FL	359	116(32.3)	167(46.5)	76(21.2)	0.5557	7	*T28*

TABLE 7—*(Continued).*

Population	Total	Frequency—Number (Percent) M	MN	N	Gene Frequency M	Note	Reference
CA, HI, TX, and Mexico City	1 189	593(49.9)	472(39.7)	124(10.4)	0.6972	*	*T31*
Connecticut							
Case material	19	4(21.1)	11(57.9)	4(21.1)	0.5000		*T35*
		TOTAL HISPANIC					
Numerical total	1 902	839(44.1)	823(43.3)	240(12.6)	0.6575		
WMP		44.1	43.3	12.6			
WSDP		7.732	4.945	4.258			
		CHINESE					
New York, NY	103	(38.9)	(43.7)	(17.5)		2	*T37*
New York, NY	400	141(35.2)	201(50.3)	58(14.5)	0.6037	8	*T17*
New York, NY	946	321(33.9)	477(50.4)	148(15.6)	0.5914	9	*T43*
		TOTAL CHINESE					
Numerical total	946	321(33.9)	477(50.4)	148(15.6)	0.5914		
WMP		34.4	49.8	15.8			
WSDP		1.478	2.000	0.552			
		ASIAN					
CA, HI, TX, and Mexico City	1 342	432(32.3)	641(47.8)	267(19.9)	0.5622		*T31*

Notes:

1. Two were MN_2.
2. Data given in percentages; not used to calculate numerical totals.
3. Mothers and their infants (children) studied; "mothers" phenotypic percentages used in calculating WMPs.
4. Included in the 8962 "Caucasians" on line above; data for the 8962 people used for calculations.
5. Data of Stolorow and collaborators.
6. Identical twin study; data for one member of each twin pair tabulated and used for calculations.
7. And see Shaler (1978), Ref *T24*.
8. MN class includes nine MN_2.
9. MN class includes 17 MN_2; includes the 400 reported by Wiener, 1969 (Ref *T16*); data for the 946 people used for calculations.

*$\chi^2 > 3.841$.

TABLE 8—*Phenotypic frequencies of MNSs blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent)									Note	Reference
		MS	MSs	Ms	MNS	MNSs	MNs	NS	NSs	Ns		
CAUCASIAN												
New York, NY	394	88(22.3)		37(9.4)	106(26.9)		87(22.1)	27(6.9)		49(12.4)	1	*T46*
Southeastern GA	333	13(3.9)	39(11.7)	34(10.2)	11(3.3)	76(22.8)	79(23.7)	1(0.3)	21(6.3)	59(17.7)		*T11*
New York, NY	332	12(3.6)	44(13.3)	39(11.7)	7(2.1)	75(22.6)	77(23.2)	4(1.2)	26(7.8)	48(14.5)		*T48*
New York, NY	900	50(5.6)	121(13.4)	109(12.1)	29(3.2)	194(21.6)	206(22.9)	11(1.2)	63(5.9)	127(14.1)		*T49*
San Francisco Bay Area, CA												
Caucasians	8 962	575(6.4)	1327(14.8)	853(9.5)	331(3.7)	1992(22.2)	2088(23.3)	41(0.5)	457(5.1)	1298(14.5)		
"Caucasians of Western European Origin"	5 056	335(6.6)	719(14.2)	468(9.3)	183(3.6)	1144(22.6)	1187(23.5)	24(0.5)	239(4.7)	757(15.0)	2	*T16*
South Central WV	1 051	(6.4)	(13.8)	(9.6)	(3.6)	(24.1)	(24.1)	(0.6)	(4.5)	(13.4)	3	*T19*
Tecumseh, MI	8 447	587(6.9)	1262(14.9)	697(8.3)	278(3.3)	1959(23.2)	1954(23.1)	29(0.3)	423(5.0)	1258(14.9)		*T20*
Detroit, MI	461	(6.3)	(17.6)	(13.4)	(2.4)	(24.3)	(22.3)	(1.7)	(3.0)	(10.0)	3,4	*T25*
Philadelphia, PA including part of NJ	218	13(6.0)	25(11.5)	17(7.8)	14(6.4)	41(18.8)	64(29.4)	2(0.9)	11(5.0)	31(14.2)	5	*T26*
Miami/Dade County, FL	370	28(7.6)	50(13.5)	30(8.1)	19(5.1)	82(22.2)	80(21.6)	3(0.8)	19(5.1)	59(15.9)	6	*T28*
CA, TX, HI, and Mexico City	751	49(6.5)	111(14.8)	81(10.8)	28(3.7)	158(21.0)	177(23.6)	6(0.8)	22(2.9)	119(15.8)		*T31*
Southeastern MO	328	(2.1)	(7.9)	(4.9)	(6.4)	(30.5)	(21.0)	(2.7)	(8.8)	(15.6)	3	*T36*
TOTAL CAUCASIAN												
Numerical total	20 313	1327(6.5)	2979(14.7)	1860(9.2)	717(3.5)	4577(22.5)	4725(23.3)	97(0.5)	1032(5.1)	2999(14.8)		
WMP		6.5	14.6	9.2	3.6	22.8	23.2	0.5	5.1	14.6		
WSDP		0.806	1.126	1.270	0.585	1.236	0.747	0.382	0.795	0.896		

TABLE 8—*(Continued).*

Population	Total	Frequency—Number (Percent)									Note	Reference
		MS	MSs	Ms	MNS	MNSs	MNs	NS	NSs	Ns		
NEGRO												
New York, NY	580	(6.9)		(17.2)		(16.6)	(33.1)		(26.0)	(20.2)	1	*T37*
Ann Arbor, MI	96	10(10.4)		18(18.7)		12(12.5)	31(32.3)		8(8.3)	17(17.7)	1	*T50*
Southeastern GA	304	6(2.0)	22(7.2)	42(13.8)	9(3.0)	31(10.2)	113(37.2)	4(1.3)	15(4.9)	58(19.1)	7	*T11*
New York, NY	206	10(4.9)	16(7.8)	28(13.7)	4(2.0)	33(16.2)	64(31.4)	5(2.5)	10(4.9)	34(16.7)	8	*T48*
Houston, TX	263	0	12(4.6)	48(18.3)	4(1.5)	49(18.6)	79(30.0)	0	15(5.7)	56(21.3)	9	*T51*
New York, NY	493	10(2.0)	32(6.5)	78(15.8)	8(1.6)	71(14.4)	163(33.1)	9(1.8)	23(4.7)	99(20.1)	10	*T49*
San Francisco Bay Area, CA	3 146	57(1.8)	201(6.4)	482(15.3)	98(3.1)	349(11.1)	1132(36.0)	33(1.0)	167(5.3)	627(19.9)		*T16*
South Central WV	106	(2.0)	(6.0)	(16.0)	(4.0)	(10.0)	(34.0)	(1.0)	(4.0)	(24.0)	3	*T19*
Detroit, MI	485	(3.1)	(6.2)	(13.4)	(2.7)	(11.0)	(38.1)	(2.3)	(4.0)	(19.4)	3,4	*T25*
Philadelphia, PA including part of NJ	173	4(2.3)	4(2.3)	35(20.2)	8(4.6)	14(8.1)	51(29.5)	4(2.3)	13(7.5)	38(22.0)	5,11	*T26*
Miami/Dade County, FL	337	7(2.1)	23(6.8)	49(14.5)	11(3.3)	40(11.9)	122(36.2)	6(1.8)	11(3.3)	68(20.2)	6	*T28*
CA, HI, TX, and Mexico City	710	16(2.3)	68(9.6)	128(18.0)	21(3.0)	75(10.6)	198(27.9)	11(1.5)	48(6.8)	145(20.4)		*T31*
Southeastern MO	64	(0.0)	(3.1)	(9.4)	(1.6)	(10.9)	(20.3)	(6.3)	(9.4)	(39.1)	3	*T36*
TOTAL NEGRO												
Numerical total	5 632	110(2.0)	378(6.7)	890(15.8)	163(2.9)	662(11.8)	1922(34.1)	72(1.3)	302(5.4)	1125(20.0)		
WMP		2.0	6.6	15.6	2.9	11.7	34.3	1.4	5.3	20.2		
WSDP		0.772	1.383	1.644	0.625	2.021	3.410	0.732	0.989	2.149		
HISPANIC												
San Francisco Bay Area, CA "Mexican"	335	23(6.9)	62(18.5)	41(12.2)	18(5.4)	77(23.0)	78(23.3)	1(0.3)	12(3.6)	23(6.9)		*T16*
Miami/Dade County, FL	363	24(6.6)	57(15.7)	36(9.9)	12(3.3)	77(21.2)	81(22.3)	2(0.6)	12(3.3)	62(17.1)		*T28*
CA, HI, TX, and Mexico City	1 189	133(11.2)	277(23.3)	183(15.4)	52(4.4)	205(17.2)	215(18.1)	8(0.7)	31(2.6)	85(7.1)		*T31*

					TOTAL HISPANIC							
Numerical total	1 887	180(9.5)	396(21.0)	260(13.8)	82(4.3)	359(19.0)	374(19.8)	11(0.6)	55(2.9)	170(9.0)		
WMP		9.5	21.0	13.8	4.3	19.0	19.8	0.6	2.9	9.0		
WSDP		2.151	3.135	2.220	0.629	2.389	2.287	0.140	0.410	3.940		
					CHINESE							
New York, NY	103	(3.9)		(35.0)	(5.8)		(37.9)	(1.0)		(16.5)	1	*T37*
					ASIAN							
CA, HI, TX, and Mexico City	1 342	8(0.6)	79(5.9)	347(25.9)	8(0.6)	80(6.0)	553(41.2)	3(0.2)	30(2.2)	234(17.4)		*T31*

Notes:

1. Anti-s not used in testing. MS is indistinguishable from MSs, MNS indistinguishable from MNSs, and NS indistinguishable from NSs. Data not used in calculations.
2. Included in the 8962 Caucasians above; data for the 8962 people used for calculations.
3. Data given in percentages; not used in calculating numerical totals.
4. Data of Stolorow and collaborators.
5. Identical twin study; data on one member of each twin pair tabulated and used for calculations.
6. And see Shaler, 1978 (Ref *T24*).
7. Four were S-s-.
8. 1 was MS-s-U-; 1 was MNS-s-U-.
9. Anti-M and anti-M_1 used; M and M_1 combined in tabular data and calculations.
10. 2 were Mu, 1 was MNu, and 4 were Nu.
11. 1 was MNS^u and 1 was NS^u.

TABLE 9—*Haplotype frequencies for the MNSs system in U.S. populations.*

Population	Total Number Typed	Haplotype Frequency				χ^2	Reference to Population Study
		MS	*Ms*	*NS*	*Ns*		
			CAUCASIAN				
Southeastern GA	333	0.1965	0.3110	0.0828	0.4097		*T11*
New York, NY	332	0.1872	0.3384	0.1004	0.3740		*T48*
New York, NY	900	0.2137	0.3357	0.0907	0.3598		*T49*
San Francisco Bay Area, CA							
Caucasians	8 962	0.2473	0.3062	0.0691	0.3774		*T16*
"Caucasians of Western European Origin"	5 056	0.2483	0.3013	0.0668	0.3836		*T16*
Tecumseh, MI	8 447	0.2600	0.2894	0.0615	0.3890		*T20*
Philadelphia, PA including part of NJ	218	0.2333	0.2919	0.0763	0.3984	*	*T26*
Miami/Dade County, FL	370	0.2610	0.2754	0.0781	0.3854		*T28*
CA, HI, TX, and Mexico City	751	0.2473	0.3153	0.0570	0.3805	*	*T31*
Total Caucasian	20 313	0.2490	0.3011	0.0677	0.3821		
			NEGRO				
Southeastern GA	300	0.1096	0.3787	0.0671	0.4446	**	*T11*
New York, NY	204	0.1495	0.3627	0.0882	0.3995	**	*T48*
New York, NY	493	0.1046	0.3842	0.0779	0.4332	**	*T49*
San Francisco Bay Area, CA	3 146	0.1001	0.3861	0.0736	0.4402	**	*T16*
Philadelphia, PA including part of NJ	171	0.0690	0.3959	0.1152	0.4198	**	*T26*
Miami/Dade County, FL	337	0.1149	0.3762	0.0661	0.4428	**	*T28*
CA, TX, HI, and Mexico City	710	0.1185	0.3872	0.0836	0.4107	**	*T31*
Total Negro	5 624	0.1037	0.3855	0.4338	0.0769	**	
			HISPANIC				
San Francisco Bay Area, CA "Mexicans"	335	0.2752	0.3591	0.0756	0.2901		*T16*
Miami/Dade County, FL	363	0.2544	0.3021	0.0514	0.3921		*T28*
CA, TX, HI, and Mexico City	1 189	0.3196	0.3776	0.0584	0.2444	**	*T31*
Total Hispanic	1 887	0.3006	0.3584	0.0587	0.2823	**	
			ASIAN				
CA, TX, HI, and Mexico City	1 342	0.0579	0.5043	0.0267	0.4111	*	*T31*

Notes:

*$\chi^2 > 11.070$.
**$\chi^2 > 15.086$.

TABLE 10—*Genotypic and phenotypic frequencies of Kell blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent) KK	Kk	kk	Gene Frequency *K*	Note	Reference
		CAUCASIAN					
Boston, MA	210	21(10.0)		189(90.0)	0.0513	1	*T52*
Minnesota	300	(11.0)		(89.0)	0.0566	1,2	*T2*
Boston, MA	1 925	(0.3)	(9.5)	(90.2)		2	*T55*
Southeastern GA	333	28(8.4)		305(91.6)	0.0429	1	*T11*
San Francisco Bay Area, CA							
Mothers	4 928	(8.3)		(91.7)	0.0424		
Children	4 928	(8.6)		(91.4)	0.0440	1,2,3	*T15*
NC and VA							
Mongoloids	585	44(7.5)		541(92.5)	0.0382		
Controls	585	36(6.2)		549(93.8)	0.0315		
Donors	253	19(7.5)		234(92.5)	0.0382	1	*T53*
San Francisco Bay Area, CA							
Caucasians	8 962	768(8.6)		8 194(91.4)	0.0440	1	
"Caucasians of Western European Origin"	5 056	452(8.9)		4 604(91.1)	0.0455	1,4	*T16*
New York, NY	500	42(8.4)		458(91.6)	0.0429	1	*T17*
South Central WV	1 412	(0.4)	(8.1)	(91.4)		2	*T19*
Tecumseh, MI	8 442	6(0.1)	594(7.0)	7 842(92.9)	0.0359		*T20*
Philadelphia, PA including part of NJ	222	9(4.1)		213(95.9)	0.0207	1,5	*T26*
CA, TX, HI, and Mexico City	911	3(0.1)	84(7.2)	824(90.5)	0.0494		*T31*
		TOTAL CAUCASIAN					
Two phenotype (K+, K−):							
Numerical total	11 650	967(8.3)		10 683(91.7)	0.0424		
WMP		8.3		91.7			
WSDP		0.793		0.791			
Three phenotype:							
Numerical total	9 353	9(0.1)	678(7.2)	8 666(92.7)	0.0372		
WMP		0.2	7.7	92.1			
WSDP		0.129	0.984	1.100			

TABLE 10—*(Continued).*

Population	Total	Frequency—Number (Percent) KK	Kk	kk	Gene Frequency *K*	Note	Reference
			NEGRO				
New York, NY	200		(3.5)	(96.5)	0.0177	1,2	*T37*
New York, NY	126		(1.6)	(98.4)	0.0080	1,2	*T54*
Southeastern GA	303		3(1.0)	300(99.0)	0.0050	1	*T11*
San Francisco Bay Area, CA							
Mothers	1 453		(1.6)	(98.4)	0.0080		
Children	1 453		(2.1)	(97.9)	0.0106	1,2,3	*T15*
San Francisco Bay Area, CA	3 146		52(1.7)	3 094(98.3)	0.0085	1	*T16*
New York, NY	500		5(1.0)	495(99.0)	0.0050	1	*T17*
South Central WV	133	(0)	(1.0)	(99.0)		2	*T19*
Philadelphia, PA							
including part of NJ	176		3(1.7)	173(98.3)	0.0085	1,5	*T26*
CA, TX, HI, and Mexico City	713	0(0)	19(2.7)	694(97.3)	0.0133		*T31*
			TOTAL NEGRO				
Two phenotype (K+, K−):							
Numerical total	4 251		65(1.5)	4 186(98.5)	0.0075		
WMP			1.6	98.4			
WSDP			0.417	0.419			
Three phenotype:							
Numerical total	713	0(0)	19(2.7)	694(97.3)	0.0133		
WMP		0.0	2.4	97.6			
WSDP		0.000	0.606	0.606			
			HISPANIC				
San Francisco Bay Area, CA							
"Mexican"	335		14(4.2)	321(95.8)	0.0212	1	*T16*
CA, TX, HI, and Mexico City	1 212	0(0)	23(1.9)	1 189(98.1)	0.0095		*T31*
			CHINESE				
New York, NY	103		(0)	(100.0)	0.0000	1,2	*T37*

New York, NY	160		0(0)	160(100.0)	0.0000	1	*T42*
New York, NY	946		2(0.2)	944(99.8)	0.0010	1	*T43*
			TOTAL CHINESE				
Two phenotype (K+, K−):							
Numerical total	1 106		2(0.2)	1 104(99.8)	0.0010		
WMP			0.2	99.8			
WSDP			0.087	0.088			
			ASIAN				
CA, TX, HI, and Mexico City	1 342	0(0)	3(0.2)	1 339(99.8)	0.0011		*T31*

Notes:

1. Tests done with anti-K; KK and Kk indistinguishable.
2. Distributions given in percentages; data not used in calculating numerical totals.
3. Mothers and their newborns (children) studied; "mothers" percent distribution used in calculating WMPs.
4. The 5056 "Caucasians of Western European Origin" are included in the 8962 Caucasians; data for the 8962 Caucasians used in calculating numerical totals and WMPs.
5. Identical twin study; data for one member of each twin pair tabulated and used in calculations.

TABLE 11—*Genotypic and phenotypic frequencies of Duffy blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent) Fy(a+b−)	Fy(a+b+)	Fy(a−b+)	Fy(a−b−)	Gene Frequencies Fy^a	Fy^b	*Fy*	Note	Reference
CAUCASIAN										
Minnesota	100	68(68.0)		32(32.0)		0.4343	0.5657	. . .	1	*T2*
Southeastern GA	333	221(66.4)		112(33.6)		0.4203	0.5797	. . .	1	*T11*
San Francisco Bay Area, CA										
Mothers	4 928	(66.5)		(33.4)		0.4221	0.5779	. . .		
Children	4 928	(65.9)		(34.1)		0.4160	0.5840	. . .	1,2,3	*T15*
San Francisco Bay Area, CA										
Caucasians	8 962	6 007(67.0)		2955(33.0)		0.4255	0.5745	, . .		
"Caucasians of Western European Origin"	5 056	3 405(67.4)		1651(32.6)		0.4286	0.5714	. . .	1,4	*T16*
South Central WV	1 016	(15.4)	(46.2)	(38.3)					2	*T19*
Tecumseh, MI	8 946	6 009(67.2)		2937(32.8)		0.4273	0.5727	. . .	1	*T20*
Philadelphia, PA including part of NJ	223	49(22.0)	91(40.8)	81(36.3)	2(0.9)	0.3887	0.5201	0.0912	5	*T26*
CA, TX, HI, and Mexico City	913	201(22.0)	408(44.7)	291(31.9)	13(1.4)	0.4100	0.5001	0.0900	*	*T31*
TOTAL CAUCASIAN										
Two Phenotype [Fy(a+), (a−)]:										
Numerical total	18 341	12 305(67.1)		6036(32.9)		0.4263	0.5737	. . .		
WMP		67.0		33.0						
WSDP		0.265		0.234						
All phenotype:										
Numerical total	1 136	250(22.0)	499(43.9)	372(32.7)	15(1.3)	0.4508	0.5039	0.0903	*	
WMP		18.9	45.0	35.4	0.7					
WSDP		3.298	1.595	3.055	0.677					
NEGRO										
New York, NY	125	11(8.8)	2(1.6)	27(21.6)	85(68.0)	0.0534	0.1235	0.8231		*T56*
Southeastern GA	304	27(8.9)		277(91.1)					1	*T11*
San Francisco Bay Area, CA										
Mothers	1 453	(17.4)		(82.6)						
Children	1 453	(17.1)		(82.9)					1,2,3	*T15*

New York, NY	179	19(10.6)	9(5.0)	43(24.0)	108(60.3)	0.0809	0.1564	0.7627	*	*T57*
San Francisco Bay Area, CA	3 146	564(17.9)		2582(82.1)					1	*T16*
Detroit, MI	404	85(21.0)		319(79.0)					1	*T58*
South Central WV	103	(17.0)	(5.0)	(78.0)	(0.0)				2	*T19*
Philadelphia, PA including part of NJ	176	22(12.5)	5(2.8)	30(17.0)	119(67.6)	0.0796	0.1046	0.8158		*T26*
CA, TX, HI, and Mexico City	713	117(16.4)	33(4.6)	149(20.9)	414(58.1)	0.1108	0.1363	0.7529	**	*T31*
				TOTAL NEGRO						
Two phenotype [Fy(a+), (a−)]:										
Numerical total	3 854	676(17.5)		3178(82.5)						
WMP		17.5		82.5						
WSDP		2.306		2.306						
All phenotype:										
Numerical total	1 193	169(14.2)	49(4.1)	249(20.9)	726(60.9)	0.0955	0.1332	0.7713	**	
WMP		14.2	4.1	20.9	60.9				6	
WSDP		2.886	1.088	1.925	4.097					
				HISPANIC						
San Francisco Bay Area, CA	335	268(80.0)		67(20.0)					1	*T16*
CA, TX, HI, and Mexico City	1 212	493(40.7)	517(42.7)	182(15.0)	20(1.7)	0.5697	0.3363	0.0937	7,**	*T31*
				ASIAN						
CA, TX, HI, and Mexico City	1 342	1 093(81.4)	232(17.3)	15(1.1)	2(0.1)	0.8763	0.0955	0.0281		*T31*

Notes:

1. Tests with anti-Fy^a only; Fy(a+b−) indistinguishable from Fy(a+b+) and Fy(a−b+) indistinguishable from Fy(a−b−).
2. Distributions given in percentages; not used in calculation of numerical totals.
3. Mothers and newborns (children) studied; "mothers" phenotypic distributions used in calculation of WMPs.
4. The 5056 "Caucasians of Western European Origin" are included in the 8962 Caucasians; data for the 8962 Caucasians used in calculation of WMPs.
5. Identical twin study; data for one member of each twin pair tabulated and used in calculations.
6. South Central WV data excluded from the calculations.
7. "Mexican."

*$\chi^2 > 3.841$.
**$\chi^2 > 6.635$.

TABLE 12—*Genotypic and phenotypic frequencies of Kidd blood groups in U.S. populations.*

Population	Total	Frequency—Number (Percent)			Gene Frequencies		Note	Reference
		Jk(a+b−)	Jk(a+b+)	Jk(a−b+)	Jk^a	Jk^b		
			CAUCASIAN					
Boston, MA	189	146(77.2)		43(22.8)	0.5230	0.4770	1	*T52*
New York, NY	726	557(76.7)		169(23.3)	0.5175	0.4825	1	*T59*
Southeastern GA	333	92(27.6)	173(52.0)	68(20.4)	0.5360	0.4640		*T11*
South Central WV	1016	(77.4)		(22.6)	0.5246	0.4754	2	*T19*
Philadelphia, PA including part of NJ	177	48(27.1)	84(47.5)	45(25.4)	0.5085	0.4915	3	*T26*
CA, TX, HI, and Mexico City	514	144(28.0)	244(47.5)	126(24.5)	0.5175	0.4825		*T31*
			TOTAL CAUCASIAN					
Two phenotype [Jk(a+), Jk(a−)]:								
Numerical total	915	703(76.8)		212(23.2)	0.5187	0.4813		
WMP		77.1		22.9				
WSDP		0.325		0.320				
All phenotype:								
Numerical total	1024	284(27.7)	501(48.9)	239(23.3)	0.5220	0.4780		
WMP		27.7	48.9	23.3				
WSDP		0.330	2.101	2.053				
			NEGRO					
New York, NY	305	283(92.8)		22(7.2)	0.7314	0.2686	1	*T59*
Southeastern GA	303	166(54.6)	118(38.8)	19(6.3)	0.7401	0.2566		*T11*
New York, NY	67	38(56.7)	23(34.3)	6(9.0)	0.7388	0.2612		*T57*
South Central WV	103	(86.0)		(14.0)	0.6258	0.3742	1,2	*T19*

Philadelphia, PA								
including part of NJ	119	68(57.1)	39(32.8)	12(10.1)	0.7353	0.2647	3	*T26*
CA, TX, HI, and Mexico City	697	303(43.5)	353(50.6)	41(5.9)	0.6879	0.3121	**	*T31*
			TOTAL NEGRO					
Two phenotype [Jk(a+), Jk(a−)]:								
Numerical total	305	283(92.8)		22(7.2)	0.7314	0.2686		
WMP		91.1		8.9				
WSDP		2.949		2.948				
All phenotype								
Numerical total	1186	575(48.5)	533(44.9)	78(6.6)	0.7095	0.2905	**	
WMP		48.5	44.9	6.6				
WSDP		6.022	7.038	1.364				
			HISPANIC					
CA, TX, HI, and Mexico City	1143	288(25.2)	649(56.8)	206(18.0)	0.5359	0.4641	4,**	*T31*
			CHINESE					
New York, NY	103	54(52.4)		49(47.6)			1	*T59*
			ASIAN					
CA, TX, HI, and Mexico City	1340	262(19.6)	767(57.2)	311(23.2)	0.4817	0.5183	**	*T31*

Notes:

1. Tests with anti-Jk^a only; Jk(a+b−) indistinguishable from Jk(a+b+).
2. Distributions given in percentages, not used in calculation of numerical totals.
3. Identical twin study; data for one member of each twin pair tabulated and used in calculations.
4. "Mexican."

*$\chi^2 > 3.841$.
**$\chi^2 > 6.635$.

TABLE 13—*Phenotypic frequencies of red cell Lewis groups in U.S. populations.*

Population	Total	Frequency—Number (Percent) Le(a+b−)	Le(a−b+)	Le(a−b−)	Note	Reference
		CAUCASIAN				
New York, NY	460	(22.8)	(71.5)	(5.7)	1	*T37*
Boston, MA	1194	307(25.7)	666(55.8)	221(18.5)		*T12*
South Central WV	1412	(25.9)	(74.1)		2	*T19*
Southeastern PA, southern NJ and DE	935	(20.1)	(70.2)	(9.7)	1	*T60*
Connecticut	228	46(20.2)	149(65.4)	32(14.5)		*T35*
		TOTAL CAUCASIAN				
Numerical total	1422	353(24.8)	815(57.3)	254(17.9)		
WMP		22.9	63.9	13.2		
WSDP		2.56	7.122	5.033		
		NEGRO				
New York, NY	211	(23.2)	(54.5)	(22.3)	1	*T61*
New York, NY	236	44(11.1)	138(34.8)	54(13.6)		*T62*
South Central WV	133	(20.0)	(80.0)		2	*T19*
Southeastern PA, southern NJ and DE	883	(19.6)	(51.9)	(28.5)	1	*T60*
Connecticut	45	4(8.9)	28(62.2)	13(28.9)		*T35*
		TOTAL NEGRO				
Numerical total	281	48(17.1)	166(59.1)	67(23.8)		
WMP		19.6	53.8	26.6		
WSDP		2.429	2.909	2.775		
		CHINESE				
New York, NY	85	(23.5)	(70.6)	(5.9)	1	*T37*

Notes:

1. Distributions given in percentages; data not used in calculation of numerical totals.
2. Only anti-Le^a used in testing; Le(a−b+) and Le(a−b−) indistinguishable; data not used in calculation of WMPs.

out. Duffy (Table 11) all-phenotype data for total Caucasians and total Negroes did not show good fit. Only a few different studies had sufficient data to contribute to these totals, and some of them exhibited significant or highly significant deviations from expectations. In the Kidd system (Table 12), all Caucasian and most Negro data showed good fit. The Negro all-phenotype total deviates from expectation because of the highly significant deviations in the largest data set contributing to it. The single data sets for Hispanic and Asians showed highly significant deviations as well.

Some but not all of the deviations can be accounted for by inordinately large contributions from small phenotypic classes to the chi-square statistic. Other factors contributing to deviations in the totals values probably include the limited number of data sets available, and the difficulty in deciding which subpopulations belong to the same effective gene pool.

The limited comparisons of WMPs with phenotypic proportions obtained in a fairly large, full ascertained U.S. population sample suggest that these values are relatively representative of the larger population, at least where a sufficiently large data base exists. There may be some value in the combined population gene frequency estimates for parentage probability

TABLE 14—*Genotypic and phenotypic frequencies of secretor-nonsecretor groups in U.S. populations.*

Population	Total	Frequency—Number (Percent)		Gene Frequencies		Note	Reference
		Secretors	Nonsecretors	*Se*	*se*		
			CAUCASIAN				
Iowa City, IA	1 261	971(77.0)	290(23.0)	0.5204	0.4796		*T8*
New Haven, CT							
Yale University students	1 000	773(77.3)	227(22.7)	0.5235	0.4765		*T9*
Boston, MA	1 194	857(71.8)	337(28.2)	0.4687	0.5313		*T12*
Tecumseh, MI	8 664	6461(74.6)	2203(25.4)	0.4957	0.5043		*T20*
Los Angeles, CA	205	141(68.8)	64(31.2)	0.4413	0.5587		*T22*
U.S. national sample	5 735	(77.6)	(22.4)	0.5267	0.4733	1	*T30*
Los Angeles, CA	38	28(73.7)	10(26.3)	0.4870	0.5130		*T33*
			TOTAL CAUCASIAN				
Numerical total	12 362	9231(74.7)	3131(25.3)	0.4967	0.5033		
WMP		75.6	24.4				
WSDP		1.890	1.889				
			NEGRO				
U.S. national sample	999	(74.2)	(25.8)	0.4921	0.5079	1	*T30*
Los Angeles, CA	18	14(77.8)	4(22.2)	0.5286	0.4714		*T33*

Note:

1. Distributions given in percentages; not used in calculation of numerical totals.

TABLE 15—*Comparison of WMP and U.S. phenotypic frequency values[a] for the ABO, A_1A_2BO, Rh, and Secretor systems.*

		Proportion, %			
		Caucasian		Negro	
System	Phenotype	U.S.	WMP	U.S.	WMP
ABO	O	44.3	44.7	47.5	49.4
	A	42.1	41.1	26.8	26.2
	B	10.2	10.3	21.2	21.3
	AB	3.6	3.8	4.5	4.1
		$\chi^2 = 0.0395$		$\chi^2 = 0.1632$	
A_1A_2BO	O	44.3	44.7	47.5	49.8
	A_1	35.2	32.1	23.4	19.4
	A_2	6.9	8.7	3.4	6.6
	B	10.2	10.6	21.2	20.2
	A_1B	2.5	2.8	2.2	2.5
	A_2B	1.1	1.0	2.3	1.4
		$\chi^2 = 0.8070$		$\chi^2 = 4.247$	
Rh	R_0	2.4	2.8	51.6	48.0
	R_1r	35.4	34.0	22.7	22.2
	R_1R_1	17.6	18.0	1.7	2.3
	R_2r	12.1	12.1	14.8	14.2
	R_2R_2	3.1	1.9	1.2	1.1
	R_1R_2	14.2	13.3	1.9	3.8
	rr	14.1	15.2	4.7	6.5
		$\chi^2 = 0.7385$		$\chi^2 = 3.0960$	
Secretor					
Secretors		77.6	74.7		
Nonsecretors		22.4	25.3		
		$\chi^2 = 0.4838$			

[a]Ref *T30*.

calculations as well. It has been shown that differences in the gene frequency values employed in the calculations can have significant effects on the outcomes [*24,25*].

Acknowledgments

We thank the following for kindly sharing the results of their unpublished population studies for inclusion in the data presented: W. C. Stuver of the Miami/Dade County Metro Police Department Crime Laboratory, Gary Siglar of the Los Angeles Police Department Crime Laboratory, Dr. C. S. Tumosa of the Philadelphia Police Department Crime Laboratory, Barry A. J. Fischer of the Los Angeles County Sheriff's Department Criminalistics Laboratory, and Dr. R. C. Briner of the Southeast Missouri Regional Crime Laboratory.

In addition, we thank Holly Hammond, now of the Houston Police Department Crime Laboratory, and Matthew Abbott, now of the Maryland State Police Laboratory, for their assistance in modifying programs and management of the extensive data files.

Special Acknowledgments

We take particular pleasure in thanking Dr. Peter Shenkin, Department of Mathematics, John Jay College of Criminal Justice of the City University of New York, and Dr. James Uebelacker, Department of Mathematics, University of New Haven, for their many helpful discussions and suggestions.

References

[1] Gaensslen, R. E. and Camp, F. R., "Forensic Serology: Parentage Testing," in *Forensic Sciences*, Vol. 2, C. H. Wecht, Ed., Matthew Bender, New York, 1986, Chap. 30, (originally as F. R. Camp and R. E. Gaensslen, "Forensic Serology: Paternity Testing (and Transfusion Reactions)," same book title, 1981).

[2] Silver, H., Ed., *Probability of Inclusion in Paternity Testing*, American Association of Blood Banks, Arlington, VA, 1982.

[3] Walker, R. H., Ed., *Inclusion Probabilities in Parentage Testing*, American Association of Blood Banks, Arlington, VA, 1983.

[4] Culliford, B. J., *The Examination and Typing of Bloodstains in the Crime Laboratory*, U.S. Government Printing Office, Washington, DC, 1971.

[5] Metropolitan Police Forensic Science Laboratory, *Biology Methods Manual*, Commissioner of Police of the Metropolis, London, 1978.

[6] Gaensslen, R. E. and Camp, F. R., "Forensic Serology: Analysis of Bloodstains and Body Fluid Stains," in *Forensic Sciences*, Vol. 2, C. H. Wecht, Ed., Matthew Bender, New York, 1984, Chap. 29.

[7] Lee, H. C., "Identification and Grouping of Bloodstains," in *Forensic Science Handbook*, R. Saferstein, Ed., Prentice Hall, Englewood Cliffs, NJ, 1982, pp. 267-337.

[8] Sensabaugh, G. F., "Isozymes in Forensic Science," in *Isozymes. Current Topics in Biological and Medical Research*, Vol. 6, M. C. Rattazzi, J. G. Scandalios, and G. S. Whitt, Eds., Alan R. Liss, New York, 1982, pp. 247-282.

[9] Sensabaugh, G. F., "The Utilization of Polymorphic Enzymes in Forensic Science," in *Isozymes. Current Topics in Biological and Medical Research*, Vol. 11, M. C. Rattazzi, J. G. Scandalios, and G. S. Whitt, Eds., Alan R. Liss, New York, 1983, pp. 137-154.

[10] Gaensslen, R. E., *Sourcebook in Forensic Serology, Immunology and Biochemistry*, U.S. Government Printing Office, Washington, DC, 1983.

[11] Mourant, A. E., Kopeć, A. C., and Domaniewska-Sobczak, K., *The Distribution of the Human Blood Groups and Other Polymorphisms*, Oxford University Press, London, 1976.

[12] Ferrell, R. E., Ueda, N., Satoh, C., Tanis, R. J., Neel, J. V., Hamilton, H. B., Inamizu, T., and Baba, K., "The Frequency in Japanese of Genetic Variants of 22 Proteins. I. Albumin, Ceruloplasmin, Haptoglobin and Transferrin," *Annals of Human Genetics*, Vol. 40, 1977, pp. 407-418.

[13] Ueda, N., Satoh, C., Tanis, R. J., Ferrell, R. E., Kishimoto, S., Neel, J. V., Hamilton, H. B., and Baba, K., "The Frequency in Japanese of Genetic Variants of 22 Proteins. II. Carbonic Anhydrase I and II, Lactate Dehydrogenase, Malate Dehydrogenase, Nucleoside Phosphorylase, Triose Phosphate Isomerase, Haemoglobin A and Haemoglobin A_2," *Annals of Human Genetics*, Vol. 41, 1977, pp. 43-52.

[14] Satoh, C., Ferrell, R. E., Tanis, R. J., Ueda, N., Kishimoto, S., Neel, J. V., Hamilton, H. B., and Baba, K., "The Frequency in Japanese of Genetic Variants of 22 Proteins. III. Phosphoglucomutase-1, Phosphoglucomutase-2, 6-Phosphogluconate Dehydrogenase, Adenylate Kinase and Adenosine Deaminase," *Annals of Human Genetics*, Vol. 41, 1977, pp. 169-183.

[15] Walter, H. and Palsson, J., "The Incidence of Some Genetic Markers in Ireland," in *Genetic Variation in Britain*, D. F. Roberts and E. Sunderland, Eds., Taylor and Francis, London, 1973, pp. 161-170.

[16] Stedman, R., "Human Population Frequencies in Twelve Blood Grouping Systems," *Journal of the Forensic Science Society*, Vol. 12, 1972, pp. 379-413.

[17] Stedman, R., "Blood Group Frequencies of Immigrant and Indigenous Populations from South East England," *Journal of the Forensic Science Society*, Vol. 25, No. 2, March/April 1985, pp. 95-134.

[18] Rothwell, T. J., "The Frequency of Occurrence of Various Human Blood Groups in the United Kingdom, with Observations on Their Regional Variation," *Journal of the Forensic Science Society*, Vol. 25, No. 2, March/April 1985, pp. 135-144.

[19] Stevens, W. L., "Estimation of Blood-Group Gene Frequencies," *Annals of Eugenics*, Vol. 8, 1938, pp. 362-375.

[20] Fisher, R. A., "The Fitting of Gene Frequencies to Data on Rhesus Reactions," *Annals of Eugenics,* Vol. 13, 1947, pp. 150-155.
[21] Boyd, W. C., "Shortened Maximum Likelihood Estimation of Rh Gene Frequencies," *American Journal of Human Genetics,* Vol. 6, No. 3, 1954, pp. 303-318.
[22] Gaensslen, R. E., Lee, H. C., Ehart, S., Abbott, M., and Hammond, H., "Use and Interpretation of Phenotypic Frequencies for Genetic Markers in Populations in Forensic Serology," in *Proceedings of the International Symposium on the Forensic Applications of Electrophoresis,* FBI Academy, Quantico, VA, 1984.
[23] Gaensslen, R. E., "When Blood is Their Argument: Use and Interpretation of Population Genetic Marker Frequency Data in Forensic Serology," *FBI Crime Laboratory Digest,* Vol. 12, No. 4, Oct. 1985, pp. 75-81.
[24] Aiken, M., "Some Fallacies in the Computation of Paternity Probabilities," *American Journal of Human Genetics,* Vol. 36, 1984, pp. 904-915.
[25] Reading, P. L. and Reisner, E. G., "The Effect of Differences in Gene Frequency on Probability of Paternity," *Journal of Forensic Sciences,* Vol. 30, No. 4, Oct. 1985, pp. 1130-1139.

Table References

[T1] Wiener, A. S. and Gordon, E. B., "Répartition des Facteurs de Groupes Sanguines dans une Population de New York City, avec une Étude Spéciale des Agglutinogènes rares," *Revue d'Hematologie,* Vol. 6, 1951, pp. 45-50.
[T2] Matson, G. A., Koch, E. A., and Levine, P., "A Study of the Hereditary Blood Factors Among the Chippewa Indians of Minnesota," *American Journal of Physical Anthropology,* Vol. 12(N.S.), 1954, pp. 413-426.
[T3] Buckwalter, J. A. and Knowler, L. A., "Blood Donor Controls for Blood Group Disease Researches," *American Journal of Human Genetics,* Vol. 10, 1958, pp. 165-174.
[T4] Buckwalter, J. A., Tidrick, R. T., Knowler, L. A., Wohlwend, E. B., Colter, D. C., et al., "The Iowa Blood Type Disease Research Project," *Journal of the Iowa State Medical Society,* Vol. 48, 1958, pp. 76-81.
[T5] Macmahon, B. and Folusiak, J. C., "Leukemia and ABO Blood Group," *American Journal of Human Genetics,* Vol. 10, 1958, pp. 287-293.
[T6] Van Arsdel, P. P. and Motulsky, A. G., "Blood Groups and Secretion of Blood Group Substances. Comparison of Allergic with Nonallergic Persons in a Pacific Northwest College Population," *Journal of Allergy,* Vol. 30, 1959, pp. 460-463.
[T7] Sievers, M. L., "Hereditary Aspects of Gastric Secretory Function. Race and ABO Blood Groups in Relationship to Acid and Pepsin Production," *American Journal of Medicine,* Vol. 27, 1959, pp. 246-255.
[T8] Newman, E., Naifeh, G. S., Auer, J. E., and Buckwalter, J. A., "Secretion of ABH Antigens in Peptic Ulceration and Gastric Carcinoma," *British Medical Journal,* Vol. 1, 1961, pp. 92-94.
[T9] Niederman, J. C., Gilbert, E. C., and Spiro, H. M., "The Relationship Between Blood Pepsin Level, ABO Blood Group and Secretor Status," *Annals of Internal Medicine,* Vol. 56, 1962, pp. 564-569.
[T10] Osborne, R. H. and DeGeorge, F. V., "The ABO Blood Groups in Parotid and Submaxillary Gland Tumors," *American Journal of Human Genetics,* Vol. 14, 1962, pp. 199-209.
[T11] Cooper, A. J., Blumberg, B. S., Workman, P. L., and McDonough, J. R., "Biochemical Polymorphic Traits in a U.S. White and Negro Population," *American Journal of Human Genetics,* Vol. 15, 1963, pp. 420-428.
[T12] Dublin, T. D., Bernanke, A. D., Pitt, E. L., Massell, B. F., Allen, F. H., et al., "Red Blood Cell Groups and ABH Secretor System as Genetic Indicators of Susceptibility to Rheumatoid Fever and Rheumatic Heart Disease," *British Medical Journal,* Vol. 2, 1964, pp. 775-779.
[T13] Kaplan, S., Li, C. C., Wald, N., and Borges, W., "ABO Frequencies in Mongols," *Annals of Human Genetics,* Vol. 27, 1964, pp. 405-412.
[T14] Mayeda, K., "Study of Tolerance to the ABO Blood Group Antigens," *Vox Sanguinis,* Vol. 11, 1966, pp. 33-37.
[T15] Reed, T. E., "Research on Blood Groups and Selection from the Child Health Development Studies, Oakland, California. I. Infant Birth Measurements," *American Journal of Human Genetics,* Vol. 19, 1967, pp. 732-746.
[T16] Reed, T. E., "Distribution and Tests of Independence of Seven Blood Group Systems in a Large Multiracial Sample from California," *American Journal of Human Genetics,* Vol. 20, 1968, pp. 142-150.
[T17] Wiener, A. S., "Problems and Pitfalls in Blood Grouping Tests for Non-parentage. I. Distribution of the Blood Groups," *American Journal of Clinical Pathology,* Vol. 51, 1969, pp. 9-14.

[*T18*] Charney, M., "ABO Blood Groups and Asthma—A Suspected Correlation," Thesis, University of Colorado, cited by A. E. Mourant, A. C. Kopeć and K. Domaniewska-Sobczak, *The Distribution of the Human Blood Groups and Other Polymorphisms*, Oxford University Press, Oxford, 1976.

[*T19*] Juberg, R. C., "Blood-Group Gene Frequencies in West Virginia," *American Journal of Human Genetics*, Vol. 22, 1970, pp. 96–99.

[*T20*] Schreffler, D. C., Sing, C. F., Neel, J. V., Gershowitz, H., and Napier, J. A., "Studies on Genetic Selection in a Completely Ascertained Caucasian Population. I. Frequencies, Age and Sex Effects, and Phenotype Associations for 12 Blood Group Systems," *American Journal of Human Genetics*, Vol. 23, 1971, pp. 150–163.

[*T21*] Robinson, M. C., Tolchin, D., and Halpern, C., "Enteric Bacterial Agents and the ABO Blood Groups," *American Journal of Human Genetics*, Vol. 23, 1971, pp. 135–145.

[*T22*] Sturgeon, P., McQuiston, D., and VanCamp, S., "Quantitative Studies on Salivary Blood Group Substances. I. Methodology and Physiological Variables. II. Normal Values," *Vox Sanguinis*, Vol. 24, 1973, pp. 97–113 and 114–125.

[*T23*] Grunbaum, B. W., Selvin, S., Pace, N., and Black, D. M., "Frequency Distribution and Discrimination Probability of Twelve Protein Genetic Variants in Human Blood as Functions of Race, Sex and Age," *Journal of Forensic Sciences*, Vol. 23, No. 3, July 1978, pp. 577–587.

[*T24*] Ganaway, R. L. and Lux, P., "AB, PGM, EAP and Hp Distribution in Three Ethnic Groups in Bexar County, Texas," *Forensic Serology News*, Vol. 4, No. 1, 1978.

[*T25*] Shaler, R. C., *Forensic Implications of Genetic Population Data Collected in Different Geographical Regions*, Final Report, Contract J-LEAA-025-73 for Law Enforcement Assistance Administration, Eastern Technical Division, Aerospace Corporation, Report ATR-79(7910)-1, 1978.

[*T26*] Pakstis, A. J., Polesky, H. F., Scarr, S., and Katz, S. H., "Gene Frequency Estimates for Samples of Black and White Twins from the Philadelphia Metropolitan Area," *Human Genetics*, Vol. 43, 1978, pp. 159–177.

[*T27*] Profili, M. and Hurley, R., "ABO Blood Group Distributions in the Baltimore, Maryland Metropolitan Area," *Forensic Serology News*, Vol. 5, No. 1, 1979.

[*T28*] Stuver, W. C., Unpublished Personal Communication, 1979.

[*T29*] Siglar, G., Unpublished Personal Communication, 1979.

[*T30*] United States National Center for Health Statistics, *Selected Genetic Markers of Blood and Secretions for Youths, 12–17 Years of Age. United States*, U.S. Department of Health, Education and Welfare, Public Health Service, Office of Health Research, Statistics and Technology, National Center for Health Statistics, Hyattsville, MD, DHEW Publication (PHS)80-1664, 1980.

[*T31*] Grunbaum, B. W., Selvin, S., Myhre, B. A., and Pace, N., "Distribution of Gene Frequencies and Discrimination Probabilities for 22 Human Blood Genetic Systems in Four Racial Groups," *Journal of Forensic Sciences*, Vol. 25, No. 2, April 1980, pp. 428–444.

[*T32*] Tumosa, C. S., Unpublished Personal Communication, 1981.

[*T33*] Fischer, B., Unpublished Personal Communication, 1982.

[*T34*] Nelson, M. S., "A Computer-Assisted Population Frequency Study of 14 Polymorphic Blood Group Systems in North Carolina," *Journal of Forensic Sciences*, Vol. 29, No. 3, July 1984, pp. 762–773.

[*T35*] Lee, H. C., Gaensslen, R. E., Pagliaro, E. M., and Lord, C., Unpublished, 1984.

[*T36*] Briner, R. C. and Compas, T., Unpublished Personal Communication, 1985.

[*T37*] Miller, E. B., Rosenfield, R. E., and Vogel, P., "On the Incidence of Some of the New Blood Agglutinogens in Chinese and Negroes," *American Journal of Physical Anthropology*, Vol. 9(NS), 1951, pp. 115–126.

[*T38*] Butts, D. C. A., "Blood Groups of the Bush Negroes of Surinam," *Documenta de Medicina Geographica et Tropica*, Vol. 7, 1955, pp. 43–49, cited by A. E. Mourant, A. C. Kopeć, and K. Domaniewska-Sobczak, *The Distribution of the Human Blood Groups and Other Polymorphisms*, Oxford University Press, Oxford, 1976.

[*T39*] Moore, R. E., "Distribution of Blood Factors, ABO, Rh, MN and Rh in a Group of American Negroes," *American Journal of Physical Anthropology*, Vol. 13(NS), 1955, pp. 121–128.

[*T40*] Casey, A. E., Phillips, C., Hale, K., Kynerd, B. R., and Downey, E., "ABO, MN and Rh Blood Groups Among North Alabama Negroes," *Alabama Journal of Medical Sciences*, Vol. 5, 1968, pp. 209–212.

[*T41*] King, J. W., Berthier, M. G., and Farinacci, C. J., "Frequency of Blood Antigens in a Texas Population having Mexican Surnames," *American Journal of Clinical Pathology*, Vol. 25, 1955, pp. 755–760.

[*T42*] Sussman, L., "Blood Groups in Chinese of New York Area. Studies with A-B-O, M-N, Rh-Hr, Kell and P Groups," *American Journal of Clinical Pathology*, Vol. 26, 1956, pp. 471–476.

[*T43*] Wiener, A. S., "Blood Groups of Chinese in New York City: Application to Problems of Disputed Parentage," *Journal of Forensic Sciences*, Vol. 19, No. 4, Oct. 1974, pp. 735–743.

[*T44*] Buckwalter, J. A., Neifeh, G. S., and Auer, J. E., "Rheumatoid Fever and the Blood Groups," *British Medical Journal,* Vol. 2, 1962, pp. 1023-1027.

[*T45*] Glass, B. and Li, C. C., "The Dynamics of Racial Intermixture—An Analysis Based on the American Negro," *American Journal of Human Genetics,* Vol. 5, 1953, pp. 1-20.

[*T46*] Wiener, A. S., DiDiego, N., and Sokol, S., "Studies on the Heredity of the Human Blood Groups. I. The M-N Types," *Acta Geneticae Medicae Gemellologiae,* Vol. 2, 1953, pp. 391-397.

[*T47*] Pauls, F. P., Victors, B. B., and Dodson, M. W., "Distribution of Blood Groups among the Eskimoes, Indians and Whites of Western Alaska," *American Journal of Human Genetics,* Vol. 5, 1953, pp. 252-256.

[*T48*] Issitt, P. D., Haber, J. M., and Allen, F. H., "Anti-Tm, an Antibody Defining a New Antigenic Determinant within the MN Blood-Group System," *Vox Sanguinis,* Vol. 10, 1965, pp. 742-743.

[*T49*] Issitt, P. D., Haber, J. M., and Allen, F. H., "Sj, a New Antigen in the MN System, and Further Studies on Tm," *Vox Sanguinis,* Vol. 15, 1968, pp. 1-14.

[*T50*] Neel, J. V. and Hanig, M. M., "The Inheritance and Frequency of the MNS Factors in the American Negro," *Genetics,* Vol. 36, 1951, pp. 84-92.

[*T51*] Francis, B. J. and Hatcher, D. E., "MN Blood Types. The S-s-U+ and the M_1 Phenotypes," *Vox Sanguinis,* Vol. 11, 1966, pp. 213-216.

[*T52*] Allen, F. H., Diamond, L. K., and Niedziela, "A New Blood-Group Antigen," *Nature,* Vol. 167, 1951, p. 482.

[*T53*] Goodman, H. O. and Thomas, J. J., "Kell Types in Down's Syndrome," *Annals of Human Genetics,* Vol. 31, 1968, pp. 369-372.

[*T54*] Race, R. R. and Sanger, R., (1955), cited by A. E. Mourant, A. C. Kopeć, and K. Domaniewska-Sobczak, *The Distribution of the Human Blood Groups and Other Polymorphisms,* Oxford University Press, Oxford, 1976.

[*T55*] Allen, F. H. and Lewis, S. J., "Kp^a (Penney), a New Antigen in the Kell Blood Group System," *Vox Sanguinis,* Vol. 2, 1957, pp. 81-87.

[*T56*] Sanger, R., Race, R. R., and Jack, J., "The Duffy Blood Groups of New York Negroes: the Phenotype Fy(a−b−)," *British Journal of Haematology,* Vol. 1, 1955, pp. 370-374.

[*T57*] Race, R. R. and Sanger, R., *Blood Groups in Man,* 5th ed., Blackwell Scientific Publications, Oxford & Edinburgh, 1968.

[*T58*] Gershowitz, H., 1968, cited by T. E. Reed, 1968 (Ref *T16*).

[*T59*] Rosenfield, R. E., Vogel, P., Gibbel, N., Ohno, G., and Haber, G., "Anti-Jk^a: Three New Examples of the Isoantibody. Frequency of the Factor in Caucasians, Negroes and Chinese in New York City," *American Journal of Clinical Pathology,* Vol. 23, 1953, pp. 1222-1225.

[*T60*] Molthan, L., "Lewis Phenotypes of American Caucasians, American Negroes and Their Children," *Vox Sanguinis,* Vol. 39, No. 6, Dec. 1980, pp. 327-330.

[*T61*] Miller, E. B., Rosenfield, R. E., Vogel, P., and Haber, R., "The Lewis Blood Factors in American Negroes," *American Journal of Physical Anthropology,* Vol. 12(NS), 1954, pp. 427-443.

[*T62*] Ceppellini, R., Dunn, L. C., and Innella, F., "Immunogenetica II. Analisi genetica formale dei carrateri Lewis con particolare riguardo alla natura epistatica della specificita serologica Le^b," *Folia Hereditaria et Pathologica,* Vol. 8, 1959, pp. 261-296.

Address requests for reprints or additional information to
R. E. Gaensslen, Ph.D.
University of New Haven
300 Orange Ave.
West Haven, CT 06516