Xg Blood Group Frequencies in Some Further Populations

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Gene frequency estimates for the two alleles in the Xg blood group system in several populations have been published. Table I summarizes the information available to date. Xg and other blood group frequencies in further populations are reported here.

Table II summarizes the data on four *middle western groups*. The Amish population lives in an area centered near Wells County, Indiana, and is

principally of Swiss extraction. The effective population size is not known, but the level of inbreeding is extremely high. The population appears to deviate from random mating in the small samples so far studied, but the breeding structure is such that we presume this finding to be an artefact.

The Grand Rapids and Bluffton Caucasian populations are each derived from obstetrical series in private general hospitals in their respective locations, and consist of married couples ascertained through confinement of the wife for delivery. The Negro population is comprised of the small number of Negro couples from the two hospital series, pooled, plus some unrelated American Negroes living in Grand Rapids at the time of testing. Most of the families in the Grand Rapids, Bluffton.

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TABLE I
Xg FREQUENCIES PREVIOUSLY REPORTED

Population	Males		Females		Total Persons	$\hat{q} \pm \text{S.E.}$	90% Confidence Interval
	Positive	Negative	Positive	Negative			
Western Caucasians							
Mann, Cahan, Gelb, Fisher, Hamper, Tippet, Sanger, and Race (1962)	95	59	167	21	342	0.3650 ± 0.0258	$0.3134 - 0.3986$
Race and Sanger (1962)	93	51	93	10	247	0.3367 ± 0.0303	$0.2867 - 0.3868$
Sanger, Race, Tippet, Hamper, Gavin, and Cleghorn (1962)	137	82	179	21	419	0.3504 ± 0.0234	$0.3118 - 0.3870$
Gavin, Tippet, Sanger, and Race (1963)	191	88	235	28	542		
Gavin, Tippet, Sanger, and Race (1964)	152	84	193	21	450	0.3359 ± 0.0225	$0.2988 - 0.3730$
Chown, Lewis and Kaita (1964)	194	100	255	39	588	0.3525 ± 0.0194	$0.3206 - 0.3845$
Sardinians							
Siniscalco, Filippi, Latte, Piomelli, Rattazzi, Gavin, Sanger, and Race (1966)	118	38	157	9	322	0.2388 ± 0.0254	$0.1970 - 0.2806$
Negroes							
Gavin <i>et al.</i> (1963)	65	54	80	20	219	0.4505 ± 0.0319	$0.3978 - 0.5030$
Chamarros							
Plato, Cruz, and Kivland (1964)	71	38			109	0.3846 ± 0.0455	$0.2753 - 0.4327$
Indians (Bombay)							
Bhatia (1963)	34	16	43	7	100	0.3480 ± 0.0464	$0.2715 - 0.4245$
Singapore Chinese							
Boon, Noades, Gavin, and Race (1964)	16	19	20	9	64	0.55 ± 0.057	

(Dr. Race and co-workers (Adam, Sheba, Sanger, Race, Tippet, Hamper, Gavin, and Finney, 1963; Sanger and Adam, 1964; R. R. Race personal communication, 1966) have found both alleles to occur in Israeli Jews of Iraqi, Yemenite, Kurdish, and Ashkenazi origin.)

TABLE II
Xg FREQUENCIES IN FOUR MIDWESTERN UNITED STATES GROUPS

Population	Males		Females		Total Persons	$\hat{q} \pm \text{S.E.}$	90% Confidence Interval
	Positive	Negative	Positive	Negative			
Amish	28	13	28	13	82	0.4607 ± 0.0483	$0.3810 - 0.5403$
Caucasians							
Grand Rapids	372	171	474	69	1086	0.3361 ± 0.0141	$0.3128 - 0.3594$
Bluffton	97	51	131	17	296	0.3417 ± 0.0275	$0.2964 - 0.3870$
Pooled	469	222	605	86	1382	0.3373 ± 0.0126	$0.3165 - 0.3581$
Negroes	11	8	19	9	47	0.5200 ± 0.0642	$0.4142 - 0.6258$

and Negro series are the same families as those in which we have observed an apparent interaction between the Xg blood group system and the sex ratio (Dewey, Mann, Wilson, and Jackson, 1965).

We have reported briefly on the Xg frequencies found among a sample of *American Indians* (Bouman, Mann, and Dewey, 1966). Our work with this source is now completed, and the entire body of these data are represented in Table III. All the tribes represented appear to have low frequencies of the negative allele; in view of the small numbers and well-known difficulty of sampling American Indians, it is difficult to make any inferences from these isolated observations.

We have obtained bloods from a number of *populations on Taiwan*. These data are summarized in Tables IV and V.

The Mainland Chinese of Table IV are post-World War II emigrants to the island from Mainland China. They show a lower gene frequency than the Singapore Chinese. The Taiwanese Chinese were on the island before the latest influx, being descendants of eighteenth-century emigrants from Fuchien province on the South eastern coast of China. Their Xg frequency is somewhat higher. The Hakka represent a still earlier invasion of the island, originating in Kwangtung province on the southern coast in the sixteenth and seventeenth centuries.

The mountain tribes are the aboriginal inhabitants of Taiwan. The Tayal tribe, which we have studied most extensively, live in extremely rugged mountains in the northern interior, south of Taipei. The other tribes which we have sampled largely

TABLE III
Xg FREQUENCIES IN AMERICAN INDIANS

Tribe	Males		Females		Total Persons	$\hat{q} \pm \text{S.E.}$	90% Confidence Interval
	Positive	Negative	Positive	Negative			
Navajo	107	27	163	11	308	0.2266 ± 0.0252	$0.1850 - 0.2682$
Cheyenne	5	0	23	1	29	0.1527 ± 0.0999	$0.000 - 0.3176$
Zuni	39	4	14	0	57	0.0884 ± 0.0420	$0.0190 - 0.1577$
Miscellaneous (14 other tribes and hybrids represented)						0.21 ± 0.08	

TABLE IV
Xg FREQUENCIES IN POPULATIONS ON TAIWAN

Population	Males		Females		Total Persons	$\hat{q} \pm \text{S.E.}$	90% Confidence Interval
	Positive	Negative	Positive	Negative			
Mainland Chinese	97	64	8	2	171	0.4010 ± 0.0379	$0.3387 - 0.4633$
Taiwanese Chinese	33	33	88	24	178	0.4747 ± 0.0558	$0.3829 - 0.5664$
Hakka	40	32	48	16	136	0.4744 ± 0.0397	$0.4090 - 0.5398$
Mountain tribes:							
Tayal	26	45	58	35	164	0.6203 ± 0.0333	$0.5653 - 0.6752$
Non-Tayal	0	1	8	6	15	0.67 ± 0.10	

TABLE V
ABO, MN, Fy^a, AND Rh(D) FREQUENCIES OF TAIWAN AND OTHER POPULATIONS

Population	p(I ^A)	q(I ^B)	r(I ^O)	p(Fy ^a)	p(M)	q(N)	p(Rh D)
(Present material: figures in parentheses are the numbers of bloods typed in each system)							
Tayal	0.16	0.11	0.73 (160)	0.75 (99)	0.77	0.23 (99)	—
Non-Tayal Mountain Tribes	0.11	0.19	0.71 (15)	—	—	—	1.00 (15)
Taiwanese Chinese	0.17	0.17	0.65 (175)	1.00 (86)	0.61	0.39 (86)	1.00 (175)
Hakka	0.20	0.10	0.70 (136)	—	—	—	1.00 (136)
Mainland Chinese	0.18	0.17	0.65 (169)	—	—	—	1.00 (171)
(from Mourant, 1954)							
'China proper'	> 0.20	< 0.20	0.60	0.90	0.59	0.41	0.97
Aboriginal Malays	0.12	0.20	0.68	0.70	0.72-0.80	0.20-0.28	1.00

inhabit other mountainous areas. Local traditions have it that the Tayal and non-Tayal tribes have maintained rather strict isolation from each other for centuries, due to a mutual penchant for exoclinous headhunting. The Tayals were decimated by the Japanese armies early in World War II, in retaliation for indulging this habit on a Japanese garrison, producing a marked population-size bottleneck and perhaps some shift in gene frequencies.

The ABO frequencies of these tribes were studied by Japanese workers before the war. Mourant (1954), citing Boyd (1939), says that the Tayals and some others lie well within the Chinese range of frequencies, while others more nearly resemble the Annamites or other Malaysian populations. This is not surprising, since both groups of mountain tribes are believed to derive from Malaysian emigration as early as 900 A.D. Physically, they are compact, muscular people, perhaps a little heavier, and more prognathic, than is typical of the other populations on Taiwan. Also, their skin colour is rather uniformly a dark, opaque, greyish-brown, quite distinct from the 'sun-tanned' hue of the Chinese.

Red cells of all males were tested for G6PD deficiency, and none were found to be deficient. There is endemic malaria on Taiwan, but it is not found in the high country inhabited by these tribes.

Table V gives our results for other blood group systems on Taiwan populations and the number of bloods upon which each estimate is based. Also given are Mourant's general figures for Chinese and Malaysians.

We have studied a small sample from one further population, *Arabs from the Island of Bahrain* in the Persian Gulf. The numbers observed were 20 males (11 positive and 9 negative) and 25 females (14 positive and 11 negative). The estimate obtained from these data is $\bar{q} = 0.592 \pm 0.062$.

Discussion

The method of Haldane (1963) provides a test of consistency between the sexes of the estimate of the gene frequency. In every case except for one this test failed to show any disturbance. The one exception was the Tayal, in whom there was also a deficiency of MN phenotypes, reaching a level of significance between 5 and 2%. We presume that both these anomalies reflect the recent cataclysm in this population's history. Retyping failed to reveal any significant frequency of technical errors, and specimen deterioration seems unlikely, since the bloods from Taiwan generally made the 8000 mile journey to the laboratory within 24 hours. Analysis of the parents treated here as triplet observations, and of all Caucasians pooled, likewise revealed no deviations from expectation.

So far no population studied has lacked an appreciable frequency of either allele, the nearest to an exception being the Zuni Indians. In this respect Xg is reminiscent of the MN system. Professor Morton has presented evidence for heterosis maintaining the MN polymorphism, and both heterosis and incompatibility have been argued for as the explanation of the ABO polymorphism in man.

Further studies of Xg frequencies are being planned by ourselves and others.

Summary

The frequency of the blood types in the Xg system has now been studied in a number of populations. The published frequency data are summarized. Intergroup differences exist, but in all populations so far studied both alleles are found with relatively high frequencies.

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