

Exhibit P-97

Blood Groups of the Haida Indians¹

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In February and March 1962 the Canadian Arthritis and Rheumatism Society carried out a field survey of the Haida Indians on the Queen Charlotte Islands. Blood grouping studies were performed at this time, the results of which are now reported.

The study was carried out at Skidegate on the south end of the north island and at Old Masset on the north tip of the north island.

The requirements for inclusion in the study were that the individual be over 15 and on the reserve Band list — i.e., those that have remained on the reserve with Indian status.

One hundred and fifty-three individuals were studied in Skidegate and 284 in Old Masset. This gave a completion rate of 88.4% of the Indian population eligible for the study.

Other aspects of the study are to be reported separately (Robinson et al., '63).

METHODS

Blood specimens were collected by venipuncture using vacutainers without anticoagulant. All blood grouping studies and slide latex tests were completed within 24 hours of collection. Other specimens of serum for later studies were separated and frozen within two hours of collection.

Table 1 shows the blood groups studied, the source of antiserum and the types of tests used.

CALCULATION OF GENE FREQUENCIES

Formulae

Given Hardy-Weinberg equilibrium, i.e., random mating equilibrium that all geno-

types are phenotypically distinct and that there are two alleles without dominance the gene frequency formula used for one gene A was:

$$p^{(A)} = \frac{2^n AA + {}^n Aa}{2N} \quad \text{Formula 1}$$

Where $p^{(A)}$ = the gene frequency of A; ${}^n AA$ is the number of persons with phenotype AA and ${}^n Aa$ is the number of persons with phenotype Aa and N is the total number of persons in the sample. The frequency of the other allele a is:

$$p^{(a)} = \frac{2^n aa + {}^n Aa}{2N} \quad \text{Formula 2}$$

Where there is dominance and A is the dominant allele and a the recessive allele then the gene frequency of a is:

$$p^{(a)} = \sqrt{\frac{{}^n aa}{N}} \quad \text{Formula 3}$$

and the gene frequency of A is:

$$p^{(A)} = 1 - \sqrt{\frac{{}^n aa}{N}} \quad \text{Formula 4}$$

This may be modified for any dominant D.

$$p^{(D)} = 1 - \sqrt{\frac{{}^n D}{N}} \quad \text{Formula 5}$$

1. ABO blood groups

Calculations. The gene frequency of O was obtained from formula 3 and for A_1A_2 and B from formula 5.

This is essentially the method used by Corcoran et al. ('59). The phenotype and gene frequencies of the ABO groups are shown in table 2.

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TABLE 1

Anti-sera	Source	Test
anti-D	Canadian Red Cross Blood Transfusion Service	saline tube
anti-D	Ortho Pharmaceutical Corporation	saline tube
anti-C	Ortho Pharmaceutical Corporation	saline tube
anti-E	Ortho Pharmaceutical Corporation	saline tube
anti-c	Canadian Red Cross Blood Transfusion Service	saline tube
anti-c	Ortho Pharmaceutical Corporation	modified tube
anti-e	Ortho Pharmaceutical Corporation	saline tube
anti-Le ^a	Canadian Red Cross Blood Transfusion Service	saline tube
anti-C ^w	Canadian Red Cross Blood Transfusion Service	indirect Coombs
anti-C ^w	Dr. Bruce Chown, Winnipeg	indirect Coombs
anti-M	Ortho Pharmaceutical Corporation	saline slide
anti-N	Ortho Pharmaceutical Corporation	saline slide
anti-S	Dr. Bruce Chown, Winnipeg	indirect Coombs
anti-S	Certified Blood Donor Service, Jamaica, N. Y.	saline tube
anti-s Gr. O only	Canadian Red Cross Blood Transfusion Service	indirect Coombs
anti-K	Canadian Red Cross Blood Transfusion Service	indirect Coombs
anti-K Gr. O and A	Vancouver General Hospital	indirect Coombs
anti-k	Canadian Red Cross Blood Transfusion Service	indirect Coombs
anti-k	Knickerbocker Co., New York	indirect Coombs
anti-P	Canadian Red Cross Blood Transfusion Service	saline tube
anti-P Gr. O only	Vancouver General Hospital	saline tube
anti-Fy ^a	Canadian Red Cross Blood Transfusion Service	indirect Coombs
anti-Fy ^a Gr. O. only	Vancouver General Hospital	indirect Coombs
anti-Kp ^a	Dr. Bruce Chown, Winnipeg	indirect Coombs
anti-A	Canadian Red Cross Blood Transfusion Service	saline tube
anti-B	Canadian Red Cross Blood Transfusion Service	saline tube
anti-A ₁	Ortho Pharmaceutical Corporation	saline slide
anti-A + B	Canadian Red Cross Blood Transfusion Service	tile test
inert AB serum	Canadian Red Cross Blood Transfusion Service	diluent
anti Di ^a	Dr. Miguel Layrisse, Venezuela	indirect Coombs
anti Di ^a	Dr. James F. Mohn, Buffalo, N. Y.	indirect Coombs

TABLE 2

Phenotype and gene frequencies, A B O groups

Phenotype	Masset	Skidegate
O	206	137
A ₁	70	14
A ₂	1	1
B	7	1
AB	0	0
Total	284	153

Gene frequencies (7)		
	Masset	Skidegate
O	0.852	0.946
A ₁	0.132	0.047
A ₂	0.002	0.003
B	0.012	0.003

2. Rh blood groups

Table 3 gives the results of testing with anti sera to CcDE and e.

All D negative results were checked for D^u.

All C positive Indians were tested with anti-C^w. Of the 82 tested at Skidegate none were positive, and of the 157 tested at Masset, three were positive.

M-N-S groups. The gene frequencies of M and N were obtained by direct gene count (formula 1). The gene frequency of s was obtained by the method of equilibrium (formula 3) and the frequency of S correspondingly by formula 4.

In the Skidegate group no homozygous NS were observed so the frequency of NS is therefore considered zero. These results are given in table 4.

TABLE 3

Phenotype frequencies, Rh blood groups

	Masset	Skidegate
CcDEe	102	47
CCDEe	29	16
ccDEe	46	19
ccDEE	77	51
CcDee	25	16
ccee	2	2
ccDee	1	0
CcDEE	0	1 rechecked
CCDEe	0	1 not rechecked
CcD ^u ee	2	0
Total	284	153

Effect of the use of Anti-s. Anti-s serum was available to test 70 group O Indians at Masset and 68 group O Indians at Skidegate. The following are the type frequencies: The estimates of gene frequencies were obtained by direct gene counts according to formulae 1 and 2.

The gene frequencies of the entire M-N-S system of alleles were estimated by direct gene counts considering the MS unit as a single allele. The phenotype MN, Ss may include two genotypes, MS, Ms and Ms, NS.

TABLE 4

Phenotype and gene frequencies, M-N-S blood groups (testing by S alone)

Phenotype	Masset	Skidegate
M, S-	113	66
M, S+	77	22
MN, S-	59	57
MN, S+	27	3
N, S-	6	5
N, S+	2	0
Total	284	153
<i>Gene frequencies</i>		
M	0.820	0.771
N	0.180	0.229
S	0.208	0.085
Ms	0.631	0.657
MS	0.190	0.115
Ns	0.161	0.229
NS	0.019	0.000

TABLE 5

Phenotype and gene frequencies, MNS blood groups (testing by S and s)

Types	Masset	Skidegate
M, S	6	1
M, Ss	15	12
M, s	32	25
MN, S	1	0
MN, Ss	3	1
MN, s	11	27
N, S	1	0
N, Ss	0	0
N, s	1	2
Total	70	68
<i>Gene frequency</i>		
M	0.864	0.765
N	0.136	0.235
S	0.243	0.110
Ms	0.654	0.658
MS	0.211	0.107
Ns	0.104	0.232
NS	0.032	probably none

Kell system. All of the 153 Indians at Skidegate and 256 Indians at Masset (excluding 25 Group A and 3 Group B) were tested by anti-k. Of importance is the observation that the single K phenotype at Masset and the 9 K phenotypes at Skidegate were heterozygous, (Kk).

Anti-Kp^a. One hundred twenty-four Indians at Masset (excluding 106 Group O, 49 Group A and 5 Group B) and 135 Indians at Skidegate (excluding 18 Indians Group O) were tested. The phenotypes are given in table 7.

Other blood groups

These are given in table 8.

DISCUSSION

This group of Indians show some interesting differences from the Alaskan Indians reported by Corcoran et al. ('59). The differences are noticeable particularly in regard to the incidence of the "r" gene and the Le^a gene, there being an increased incidence of both genes in the Haida Indian group. A less striking difference is noted in the incidence of the Fy^a gene but here again there is a distinct decrease in the incidence of this gene.

Ro and R^a in Masset suggest African as well as European admixture.

Blood group studies of the Indians of the North Pacific Coast previously reported, in-

TABLE 6

Phenotype and gene frequency, Kell blood groups

Genotype	Masset	Skidegate
KK	0	0
Kk	1	9
kk	283	144
Total	284	153
Using equations 1 and 2 the following is the gene frequency:		
Gene	Masset	Skidegate
K	0.002	0.029

TABLE 7

Phenotypes of Kp blood groups

	Masset	Skidegate
Kp ^a	1	0
Kp ^a -	123	135
Total	124	135

TABLE 8
Phenotypes of other blood groups

Phenotype	Masset	Skidegate
Fy(a+)	279	144
Fy(a-)	5	9
P+	181	89
P-	103	64
Le(a+)	68	35
Le(a-)	216	118
Di(a+)	0	2
Di(a-)	284	151
Totals for each allele group	284	153
<i>Gene frequency</i>		
Fy ^a	0.867	0.758
P	0.252	0.353
Le ^a	0.128	0.122
Di ^a	0.000	0.007

clude those by Ride ('35), Gates and Darby ('34), Hulse, ('55), and Corcoran et al. ('59). The earlier studies have clearly indicated a high incidence of the genes in reference to Group O and the D antigen of the Rh groups. In general this present study of the Haida Indians is in keeping with these previous findings. There are however, some interesting differences from the Alaskan Indians reported by Corcoran et al. ('59). The differences are particularly noticeable in regard to the incidence of the Le^a gene and the Fy^a gene. In the former instance there is an increase incidence in the Haida Group, while in regard to the Fy^a gene there is a distinct decrease in the incidence of this gene. Lewis et al. ('61) have suggested that the occurrence of the Le^a gene indicated an admixture of Caucasian blood. This being the case, the present study would suggest that about a third of the gene pool of the Haida Indians is Caucasian.

In this regard, if the Fy^a gene incidence were one in the native Haida, the present gene incidence would also suggest about a third admixture with the Caucasian Fy^a gene incidence.

The incidence of the gene r if calculated by dominance is only 0.084 in the Masset group and 0.114 in the Skidegate group. If however, one accepts that those grouping ccDEe might be R_rr and that those grouping CcDee might be R_rr and those grouping ccDee be R₀r and that the r gene also occurs in the CcD^eee group why then

the gene calculation for r would be 0.137 for Masset and 0.127 for Skidegate which is again about one third incidence of the gene in the Caucasian population; all assuming the original Haida incidence were zero.

The two individuals that were Di^a positive were a mother and son. They were on the Haida Reserve band list but in actual fact the mother was of the Tsimshian Tribe. This low incidence of Di^a positive is similar to that reported by Corcoran ('59) in the Alaskan Indian group.

SUMMARY

A study of the blood groups of 437 Haida Indians in the Queen Charlotte Island shows their blood group systems to be somewhat similar to those of the Alaskan Indians, however, there is an increased incidence of Rh negative and Lewis positive blood groups suggesting that there has been an appreciable admixture of Caucasian blood.

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