Frequency of Polymorphic Types of Red Cell Enzymes and Serum Factors in Alaskan Eskimos and Indians

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THE DISTRIBUTION OF types of a genetic polymorphism in a given population is an objective of considerable anthropologic interest. Although the fact that two populations may have similar polymorphic ratios is not evidence of close relationship, it can be concluded that little intermixing could have occurred if these ratios are quite different. In practice, such information is useful in planning searches for genetic linkage, and it may also lead to uncovering unexpected origins of certain families.

For these purposes, the proportions of types of two red cell enzymes—acid phosphatase and phosphoglucomutase—and of two serum factors—haptoglobins and group specific component (Gc)—were determined in four ethnic groups native to Alaska.

METHODS AND RESULTS

Ethnic groups in Alaska cannot be distinguished by physical appearance; differentiation was based therefore on language. Distinct geographic areas are characterized by use of a specific language, with overlap only in limited fringes. For present purposes, ethnic group was determined from hospital records, which listed the patient as Eskimo, Indian, or Aleut, giving the fraction of admixture, birthplace, and birthplace of parents as supplied by the patient. If the person had mixed ancestry or if these records were inconsistent (for example, the birthplace did not correspond with the stated ethnic group), the person was not included. Many Alaskan inhabitants did not know the correct designation of their group. A summary of the geographic areas studied is shown in Table 1.

Most of the samples were collected in heparin from patients at the Alaska Native Medical Center, Anchorage. A few were collected from other sources in ACD solution. Plasma gave results in the determination of group specific component (Gc) and haptoglobin types that were identical with the results using serum, so that one sample of blood could be used for all four determinations.

Gc types were determined by immunoelectrophoresis (Hirschfeld, 1959) using Gc-specific antisera. Haptoglobin types were determined by the method of Allison and ap Rees (1957), except that methemoglobin was added to the serum instead of hemoglobin. The haptoglobin patterns obtained with either

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TABLE 1. ETHNIC GROUPS IN VARIOUS AREAS IN ALASKA

Geographic area	Ethnic group usually reported*	Linguistic group
North of Norton Sound and Brooks Range	Eskimo	Northern Eskimo
Norton Sound	Eskimo	Mixed northern and southern Eskimo
South of Norton Sound	Eskimo	Southern Eskimo
Bristol Bay	Aleut	Southern Eskimo
West of Chignik Bay and Pribilof Islands	Aleut	Aleut
Kenai Peninsula	Aleut	Athabaskan
Interior Valleys	Indian	Athabaskan

*As stated by the patient and listed in hospital records.

TABLE 2. ACID PHOSPHATASE TYPES OF ALASKAN ESKIMOS AND INDIANS

Ethnic group	Number of persons				Gene frequency		Standard error
	Total	A	BA	B	P^a	P^b	
Northern Eskimos	99	35	49	15	0.60	0.40	0.03
Southern Eskimos	155	45	79	31	0.55	0.45	0.03
All Eskimos*	264	83	132	49	0.56	0.44	0.02
Aleuts	43†	11	19	12	0.48	0.51	0.05
Athabaskans	118	55	49	14	0.67	0.33	0.03

*Includes Norton Sound Eskimos.
†One CB type found. See text.

methemoglobin or hemoglobin were identical, but free methemoglobin migrated to the anode more slowly than free hemoglobin. When very little haptoglobin was present, the excess methemoglobin did not interfere with the haptoglobin pattern as did excess hemoglobin.

Acid phosphatase types were determined by a slight modification (Scott, 1966) of the method of Hopkinson, Spencer, and Harris (1964). Phosphoglucomutase types were determined by the method of Spencer, Hopkinson and Harris (1964) with two minor modifications. It was necessary to use ten times the recommended concentration of glucose-6-phosphate dehydrogenase, and the hemolyzates were prepared by adding an equal volume of water to the washed red cells followed by freezing. They were then applied to wicks of thick filter paper (Whatman No. 17) for insertion in the gel.

In all three methods using starch gel, a water-cooled horizontal tray was used, and the samples were added after the gel had cooled but before it had set completely (10 to 15 minutes after pouring). Clearer patterns were thus obtained, apparently as a result of more intimate contact of the paper inserts with the gel.

The results are summarized in Tables 2–5.

DISCUSSION

Northern and southern Eskimos are related culturally and linguistically, but they are widely separated geographically and only intermix in a small area on

TABLE 3. PHOSPHOGLUCOMUTASE TYPES OF ALASKAN ESKIMOS AND INDIANS

Ethnic group	Number of persons				Gene frequency		Standard error
	Total	1-1	2-1	2-2	PGM^1	PGM^2	
Northern Eskimos	108	71	34	3	0.81	0.19	0.03
Southern Eskimos	175	128	38	9	0.84	0.16	0.02
All Eskimos*	299	208	77	14	0.82	0.18	0.02
Aleuts	53	41	9	3	0.86	0.14	0.03
Athabaskans	127	102	23	2	0.89	0.11	0.02

*Includes Norton Sound Eskimos.

TABLE 4. HAPTOGLOBIN TYPES OF ALASKAN ESKIMOS AND INDIANS

Ethnic group	Number of persons				Gene frequency		Standard error
	Total	1-1	2-1	2-2	Hp^1	Hp^2	
Northern Eskimos	104	13	40	51	0.32	0.68	0.03
Southern Eskimos	109	11	49	49	0.33	0.67	0.03
All Eskimos*	220	26	91	103	0.32	0.68	0.02
Aleuts	64	18	33	13	0.54	0.46	0.04
Athabaskans	104	13	50	41	0.37	0.63	0.03

*Includes Norton Sound Eskimos.

TABLE 5. GC TYPES OF ALASKAN ESKIMOS AND INDIANS

Ethnic group	Number of persons				Gene frequency		Standard error
	Total	1-1	2-1	2-2	Gc^1	Gc^2	
Northern Eskimos	103	50	42	11	0.69	0.31	0.03
Southern Eskimos	111	58	40	13	0.70	0.30	0.03
All Eskimos	214	108	82	24	0.70	0.30	0.02
Aleuts	61	29	25	7	0.68	0.32	0.04
Athabaskans	108	77	29	2	0.85	0.15	0.02

Norton Sound. At present, they cannot be distinguished on the basis of any known genetic polymorphism. Aleuts are quite different linguistically, although they resemble southern Eskimos culturally. The degree of Caucasian admixture in Aleuts is uncertain, due to early contacts with Russians. Most of these "Russians" were in fact Siberians.

Haptoglobin types of Alaskan Eskimos and Athabaskan Indians were previously determined by Blumberg, Allison, and Garry (1959), and our results are closely in agreement with theirs. The gene frequency reported by Persson (1962) in Greenland Eskimos is similar. The high frequency of Hp^1 in Aleuts distinguishes them from the other groups studied ($P < 0.01$).

The P^c gene of erythrocyte acid phosphatase appears to be a Caucasian gene. It has not been found in Orientals and only rarely in Negroes (Giblett and Scott, 1965). We found no evidence of it in Eskimos or Indians. One Aleut was found with type CB. This man stated that he believed that he was full Aleut, but he could not be positive that he had not had a Russian ancestor. Athabaskan Indians have a high frequency of the P^a gene of acid phosphatase,

but the proportion is also higher in Eskimos and Aleuts than in other populations (Hopkinson, Spencer, and Harris, 1964; Giblett and Scott, 1965).

Phosphoglucomutase types were quite similar in Eskimos, Aleuts, and Indians, although the proportion of PGM^1 gene is higher than in a British population (Spencer, Hopkinson, and Harris, 1964). The frequency of the Gc^1 gene is approximately the same in Eskimos and Aleuts as in Europeans (Hirschfeld, Jonsson, and Rasmuson, 1960) but is higher in Athabaskans ($P < 0.001$).

SUMMARY

The characteristic distributions of types of red cell acid phosphatase, red cell phosphoglucomutase, haptoglobins, and Gc factor were determined in Alaskan ethnic groups of Aleuts, Athabaskan Indians, and northern and southern Eskimos.

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